Gender and Regional Variations in the Quality of Care and the Health Outcomes after an Acute Myocardial Infarction

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by

Carol E. Wideman Ringer

A Thesis

Submitted to the School of Graduate Studies

in partial fulfillment

for the degree of

DOCTOR OF PHILOSOPHY

Department of Community Health Sciences
The University of Manitoba
Winnipeg, Manitoba, Canada

THE UNIVERSITY OF MANITOBA

FACULTY OF GRADUATE STUDIES

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Defended: June 10, 2005

Approved: June 10, 2005

Dedicated to

the memory of my parents,

George and Elizabeth Diefenbacher Wideman

and to my best friend and husband,

David,

and our sons,

Justin and Giles

"Love surpasses all things"

ABSTRACT

This study focused on the three-year period after the acute myocardial infarction (AMI) with the intent to identify the gender and geographical differences in the post-AMI period.

The study used a retrospective, longitudinal design to identify the differences in the quality of care and outcomes in the post acute myocardial infarct (AMI) period for three cohorts of AMI patients from 1996–1999. The major quality of care variables included access to cardiac procedures and post-AMI drug prescriptions at the time of the index AMI and within 30 days and 90 days after the AMI. Other quality of care variables and pre-morbid conditions were included based on the Population Health conceptual framework used to guide the study.

Data for each of the three cohorts was extracted for two years pre-AMI and three years post-AMI. The specific health outcomes were mortality and readmission for specific illness after the index AMI.

Results indicated that gender variations were minimal in the quality of care variables and there were no gender differences in the health outcomes. Regional variations were evident in both the quality of care and health outcomes. The individuals in the Central/North and South regions were less likely overall to use the recommended prescriptions and were less likely to access cardiac procedures at the time of the index AMI. Regional variations in the cardiac procedures and use of cardiac medications,

however, did not relate to a difference in the health outcomes within one and three years after the AMI.

What remains to be identified is the gender and regional variation in the quality of life that people with an AMI have during the post-AMI period.

ACKNOWLEDGMENTS

The completion of this dissertation would not have been possible had it not been for the support, encouragement, and mentoring I received by a significant number of family members and colleagues.

For my first advisor, Dr. K. Young, I extend my most sincere thanks for directing and guiding me through a difficult initial step in the proposal development. For Dr. J. Sawatzky, who focused my thinking on the significance and the contribution that conceptual frameworks can make to a dissertation and the importance of identifying the contribution that nurses make to this health issue, I express my thanks. For Dr. V. Menec, who was willing to take on the responsibility as advisor, and who most graciously and wisely guided the long and torturous path that this dissertation took, I give my most sincere thanks. To my copy editor, Helga Dyck, I give my thanks for the fine work, which has resulted in a document of which I am truly proud.

Justin and Giles, our sons, I thank you for your encouragement during the times in our life when the dissertation seemed a most selfish thing to do when you had major life-altering events happening to you. To Melissa, our new daughter-in-law, thanks for supporting Giles so that I could focus on the completion of the dissertation and for your encouragement in this process.

For my long-suffering, wise, and most loving, supportive husband, David, I can only say thanks every day. Had it not been for your insistence that the life events experienced during this process could not be allowed to prevent the completion of this dissertation, I would not have completed it. I give you my thanks.

Although no longer present, I thank my parents, who valued education even though life events allowed them to complete only a Grade VI education. They demonstrated how life long learning can enhance living. I thank them for instilling a love of learning, for their insistence that all eight children never turn back once a task had been started, and who told us that whatever we chose to do we were expected to do it well.

Carol E. Wideman Ringer
August 2005

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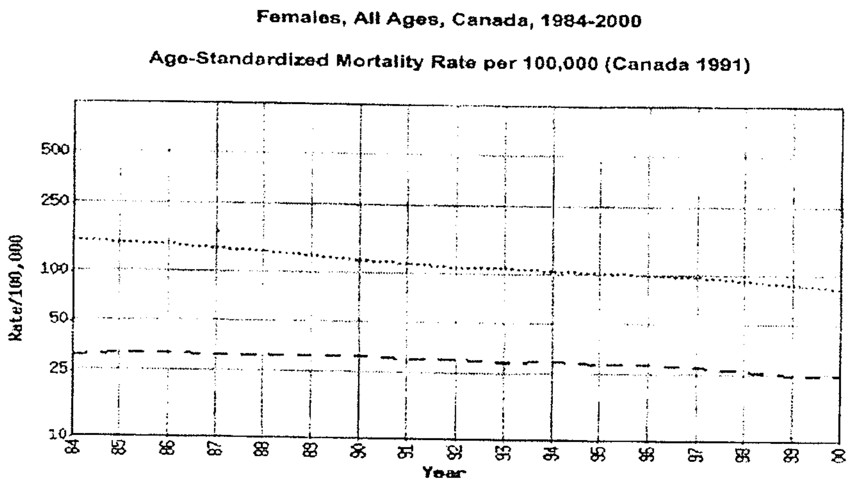
CHAPTER 1

INTRODUCTION

Coronary heart disease (CHD) is the leading cause of death in industrialized countries (Wenger, 2003). Cardiovascular disease (CVD), including heart disease and stroke, is the leading cause of death for over one third of Canadians. It not only affects the elderly but also it is the leading cause of premature death for those under the age of 75 years (Heart and Stroke Foundation of Canada, 2003). The extent of the disease in women has only been recognized in the last several decades. Because women develop clinically apparent CHD about ten years later than men do, CHD has not received as much attention in women. It is not, however, only a disease of older women. Even in premenopausal women, the mortality from CHD is almost equal to deaths related to cancer (Statistics Canada, 2000). In contrast to popular women's beliefs, ischemic heart disease is responsible for more deaths in women then breast cancer (Figure 1.0).



		1984	1985	1986	1987	1988	1989	1990	1991	1992
Breast Cancer	— —	30.73	31.80	32.02	31.32	31.36	31.24	31.30	30.07	30.42
Ischemic Heart Disease	········	151.63	144.51	142.90	134.75	130.40	123.33	117.51	114.22	108.00

		1993	1994	1995	1996	1997	1998	1999	2000
Breast Cancer	— —	29.37	29.96	28.68	28.92	27.72	26.36	25.15	24.97
Ischemic Heart Disease	········	108.20	105.12	102.61	99.51	97.91	92.06	88.13	83.64

Figure 1.0
Comparison of Breast Cancer and Ischemic Heart Disease for Women, Canada, 1984–2000.

The economic and societal impact of this disease is significant. Information about the death rates and the extent of illness after an acute myocardial infarction (AMI) in women is limited. There is some indication that regional variation exists in the treatment of AMI and the utilization of cardiac procedures and consequently there are different health outcomes for men and women (Rodrigues, Simpson, Hugues, & Pilote, 2002). There is, however, no information as to whether or not there are gender differences as well as regional variation. There is a specific paucity of information about gender and regional differences in the quality of care and the subsequent health outcomes after an acute myocardial infarct. It is important, therefore, to describe the disease trajectory after an AMI for both men and women in order to focus health policy decisions, to guide practice, and to foster research on improving the outcomes for both men and women after an AMI.

Background Information

In Canada, cardiovascular disease is the leading cause of death, accounting for 33% of all deaths based on the 2002 data (Figure 1.1).

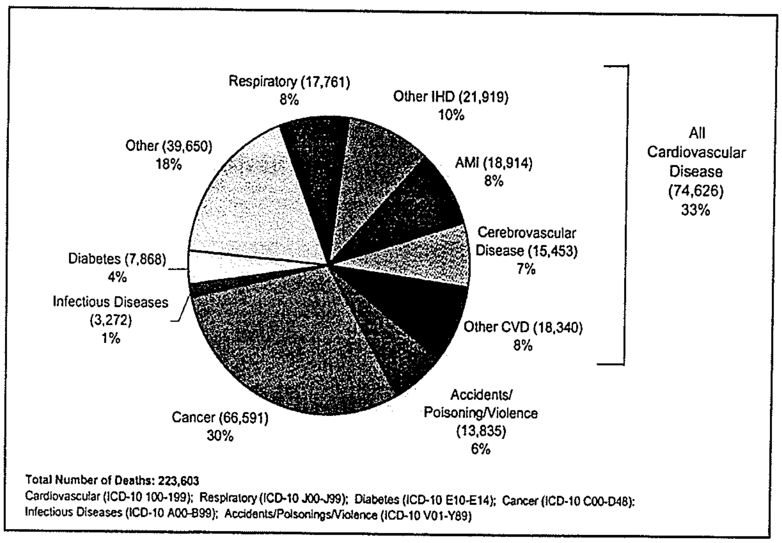


Figure 1.1
Leading Causes of Death, Number, and Percentage of Deaths, Canada, 2002.

Cardiovascular disease (CVD) is a term that encompasses many distinct diseases. The term cardiovascular disease according to the International Statistical Classification of Diseases (ICD-9) includes all diseases of the circulatory system, including acute myocardial infarction (AMI), ischemic heart disease, valvular heart disease, peripheral heart disease, arrhythmias, high blood pressure, and stroke. (Heart and Stroke Foundation of Canada, 2003). The statistical and epidemiological data often use CVD as the disease category, thus including all the various diseases of the heart including stroke. Although all of the relevant existing data will be reviewed in this study, the focus will be specifically on acute myocardial infarction (AMI).

Gender Differences

Although for many years CVD has been recognized as a major health illness for men, the extent to which women also suffer from heart disease has only recently become apparent. The incidence and prevalence of CVD in women after menopause appears to be comparable to that of men in the later years (Figure 1.2).

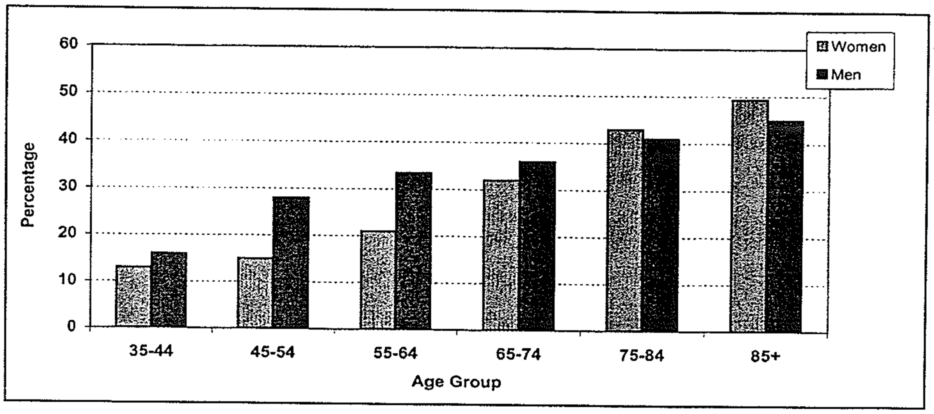


Figure 1.2
Percentage of Total Deaths due to Cardiovascular Diseases by Age and Sex, Canada, 1997.

In the 1997 data, 35 % of all male deaths (39,767) and 38% of all female deaths (39,197) in Canada were due to CVD (Statistics Canada, 1997). Deaths from AMI accounted for 22% of all CVD deaths in women in 2002 (Figure 1.3).

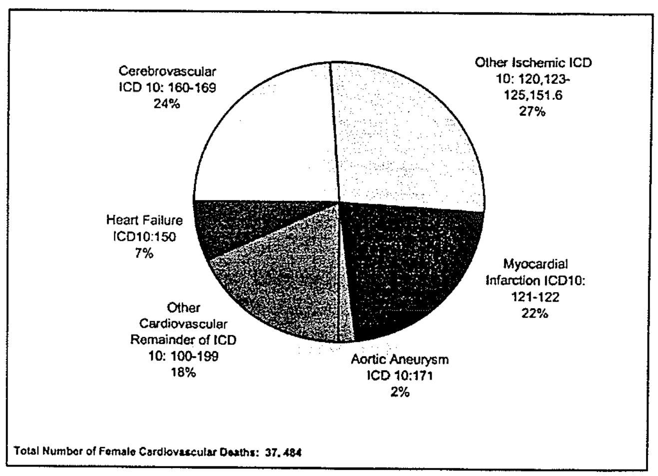


Figure 1.3
Cardiovascular Disease Deaths, Percentage by Subgroup, Canada, Females, 2002.

In men, there were 7% more deaths attributable to AMI in the 2002 data, as compared to women in the same period (Figure 1.4).

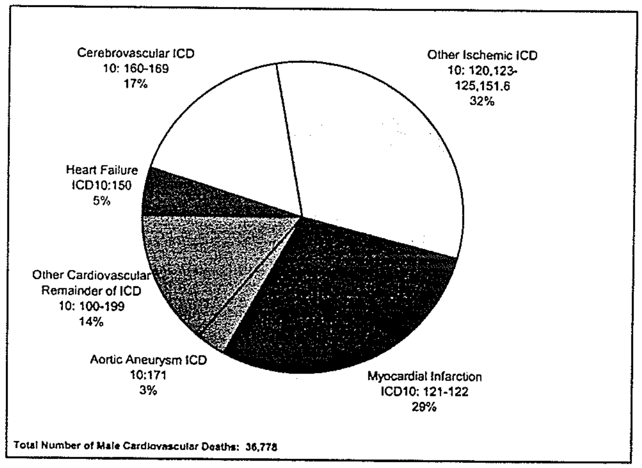
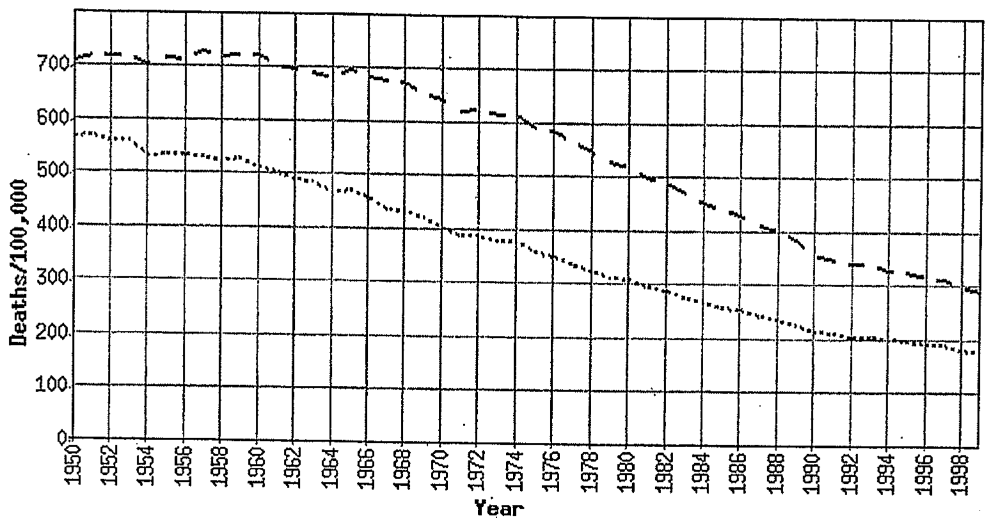


Figure 1.4
Cardiovascular Disease Deaths, Percentage by Subgroup, Canada, Males, 2002.

Between 1993 and 1999, the latest year for which Statistics Canada has data, the age standardized mortality rates for all diseases of the heart, for both sexes, has declined from 193/100,000 population to 173/100,000. Since the mid-sixties, the age-standardized mortality rate for both sexes, for all cardiovascular disease has been steadily declining (Figure 1.5).

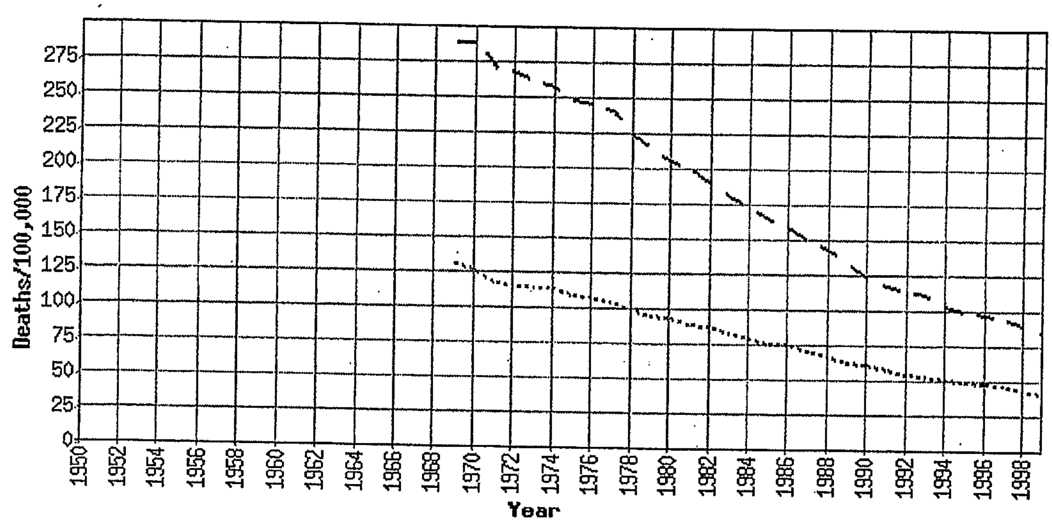


Key: Male – Female …

Figure 1.5
Mortality Over Time: Age-Standardized Death Rate for Cardiovascular Diseases, Canada 1950–1999.

The rate had decreased by more than 50% between 1965 and 1999 for both men and women. The mortality attributable to CVD, for men fell from 698/100,000, in 1965, to 291/100,000 in 1999 and from 472/100,000 to 175/100,000 for women in the same period.

Deaths attributable to AMI also decreased significantly over the last 20 years. In the early 1970s, the mortality for men with an AMI was 288/100,000 and for women 127/100,000; however, by the late 1990s the rate had fallen to 85/100,000 for men and 41/100,000 for women (Figure 1.6).



Key: Male – Female ....

Figure 1.6
Mortality Over Time: Age-Standardized Death Rate for AMI. Canada, 1950–1999

Some of the reasons for the decrease in the mortality, over the past several decades, may be related to the increased clinical and research interest. Gender differences were beginning to be recognized within the clinical milieu. In the eighties and the nineties, substantive research was completed that described risk factors, symptomology, and described the acute phase of an AMI in women (Mosca, Manson, Sutherland, Langer, Manolio, & Barrett-Connor, 1997; Murdough & O'Rourke, 1988). In this same period, clinical practice changed to a more gender-based approach in the treatment of an AMI (Ayanian & Epstein, 1991). Basic research also elucidated the importance of a rapid clinical response with appropriate medications after an AMI. In particular, the use of thrombolytic agents, statins, and beta-blockers was identified as improving the outcomes after an AMI (Garg & Yusuf, 1995; The Beta-Blocker Pooling Project Research Group, 1988; Scandinavian Simvastatin Survival Study Group, 1994).

As in men, the number of deaths related to heart disease in women increases with age. The age distribution of deaths attributable to cardiovascular disease however, varies significantly between men and women. In men, there is a significant increase in the number of deaths related to an AMI in the 35–44 year period (6.0%) as compared to the earlier age cohort of 34 years and younger (0.6%), and it continues to rise until the age of 65 years at which point it begins to decline. In contrast, the deaths attributable to AMI in women increase at a rate of approximately 2% in each of the decades after the age of 30 years until the age of 80 years at which point there is a decline in the percentage of deaths (Table 1.0).

Table 1.0

Number and Percent of Deaths due to Cardiovascular Diseases by Sex, Canada, 1997.

TABLE 1.0

Age	All Deaths	All CVD[1]		IHD[2]		AMI[3]		CBVD[4]	
		Number	Percent of All Deaths	Number	Percent of All Deaths	Number	Percent of All Deaths	Number	Percent of All Deaths
Women									
<35	2982	150	5.0	13	0.9	9	0.3	37	1.2
35-44	2416	314	12.9	101	4.2	59	2.4	112	4.6
45-54	4563	712	15.6	325	7.1	208	4.6	198	4.3
55-64	8111	1708	21.1	903	11.1	518	6.4	345	4.3
65-74	18040	5711	31.7	3155	17.5	1791	10.0	1100	6.1
75-84	31989	13531	42.3	7030	22	3713	11.6	3185	10.0
85+	35567	17488	49.2	8172	23	3171	8.9	4398	12.4
All Ages	103668	39614	38.2	19699	19	9469	9.1	9375	9.0
Men									
<35	5947	226	3.8	50	1.0	33	0.6	38	0.6
35-44	4361	702	16.1	447	10.2	261	6.0	92	2.1
45-54	7384	2113	28.6	1439	19.5	895	12.1	241	3.3
55-64	13466	4419	32.8	3050	22.6	1808	13.4	503	3.7
65-74	27560	9999	36.3	6380	23.1	3473	12.6	1428	5.2
75-84	33915	13846	40.8	8094	23.9	4197	12.4	2585	7.6
85+	19338	8529	44.1	4362	22.6	1821	9.4	1786	9.2
All Ages	111971	39834	35.6	23822	21.3	12488	11.2	6673	5.9

Table does not include cases with a missing age.

1. All CVD = All Cardiovascular diseases (ICD code 9th revision 390-459)
2. IHD = Ischemic heart disease (ICD-9 410-414)
3. AMI = Acute myocardial infarction (heart attack): (ICD-9 410), AMI is a sub-category of IHD
4. CBVD = (ICD-9 430-438)

This finding has been consistent in a number of studies and it has been suggested that the difference is related to the reduction in the estrogen hormone in menopause (Gohlke-Barwolf, 2000; Lerner & Kannel, 1986; Limacher, 1996). Specifically, AMI deaths in men between the ages 35 to 74 years are three to four times higher than for women in the same age groups (Table 1.0). However, the deaths related to AMI among women are almost four times greater in the immediate postmenopausal period (i.e., 45–54 years) than in the previous age cohort (i.e., 35–44 years), indicating a particular vulnerability to death related to AMI in this post menopause period. A number of researchers have found that the occurrence of menopause in women appears to increase the risk of CVD as a separate risk factor from the lifestyle and familial risk factors common to both genders (Gohlke-Barwolf, 2000; Lerner et al., 1986). The recognition that there are differences between men and women in the mortality rates related to cardiovascular diseases and most significantly, AMI has resulted in a significant increase in research into these differences. However, there are still significant gaps in knowledge about the post-AMI trajectory for both men and women.

Statement of the Problem

Just as there are differences between the sexes in the percentage of deaths attributable to cardiovascular diseases at specific ages, one can assume that there may be differences in the illness period of the disease. Although there are some studies describing the illness period, these studies have not identified the gender and geographical differences in the quality of care and the subsequent health outcomes. To understand the potential inequalities, the quality of care between men and women, and the impact of regional location, population-based studies are most useful.

The intent of this study is to describe this important part of the illness trajectory, to identify care and treatments changes that should be made to direct policy and, ideally, to decrease the percentage of total deaths attributable to AMI in both men and women. Although the survival rates after AMI are increasing due to improvements in technology and pharmacological agents, it is estimated that there will still be 5,000 to 9,000 annual deaths due to AMI among women and 7,000 to 12,000 annual deaths among men between 1994 and 2016 (Figure 1.7). Therefore, CVD and specifically AMI continue to be an important health threat to men and women. This disease does not only affect an individual's health but the consequences of the disease also have a significant impact on society, as described in the following section.

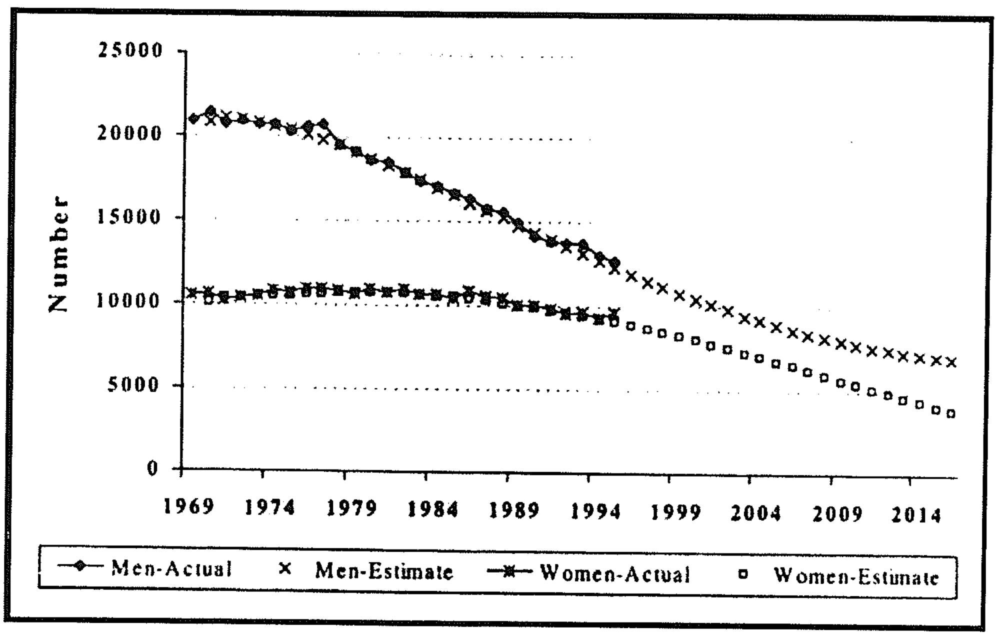


Figure 1.7
Number of Acute Myocardial Infarction Deaths by Sex, Actual and Projected, Canada, 1969–2016.

Social and Economic Burden

With the increased incidence and prevalence of CVD, it is not surprising that there is evidence of a significant impact on the normal functioning of affected individuals, as well as the potential of premature death. In 1999, potential years of life lost (PYLL) due to CVD was 1900 years for males and 800 years for females (Figure 1.8).

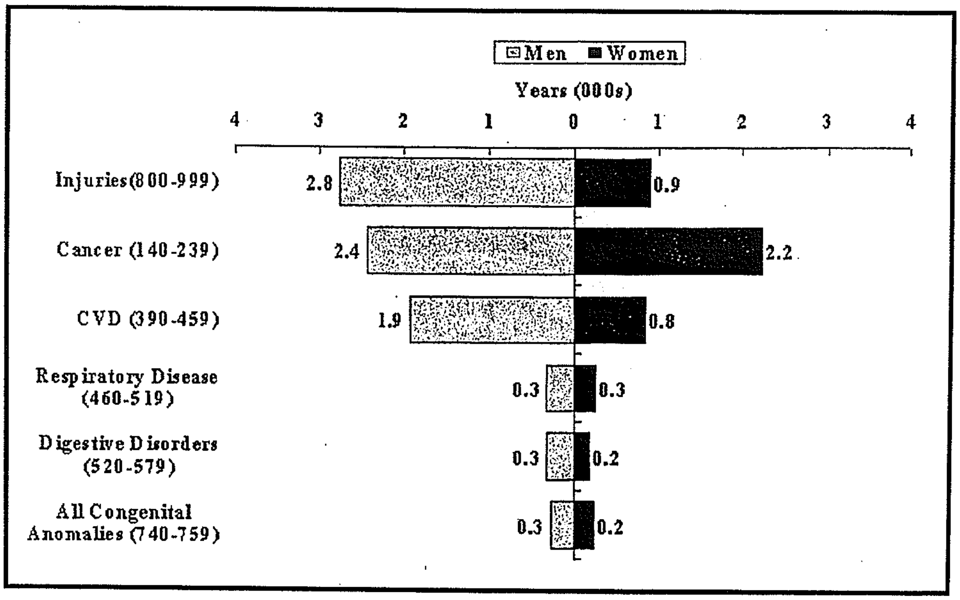


Figure 1.8
Number of Potential Years of Life Lost (PYLL) prior to Age 75, by Disease Category, 1999.

The social and economic burdens of CVD for both men and women are substantial. Estimates for the economic burden of CVD are $7.3 billion in total direct costs and $12.4 billion in indirect costs for Canadian men and women in 1993 (Moore, Mao, Zhang, & Clarke, 1997). Although it is difficult to calculate accurately, it has been estimated that in 1993, the cost of CVD in women accounted for 6% (over $2.7 billion) of the total direct costs (physicians, drugs, hospitals, and research) of heart disease in the total population. The indirect costs, including the loss of future income and costs of disability were in addition to these estimates (Hayes, 1996). Women with CVD experience twice the rate of depression as men, and this further compromises recovery from CVD (Health Canada, 2003). In 1998, CVD accounted for 18% of overall health care system costs and an estimated $18 billion for the total cost of CVD in Canada (Minister of Public Works and Government Services, 2002).

Health Service Utilization

Information about the access to and use of health care services by people who have CVD has been limited. Hospitalization is one indicator that is useful in identifying the impact of CVD. Cardiovascular disease accounts for the largest percentage of hospitalizations for Canadian women, excluding childbirth (Canadian Institute Health Information, 1998; Figure 1.9).

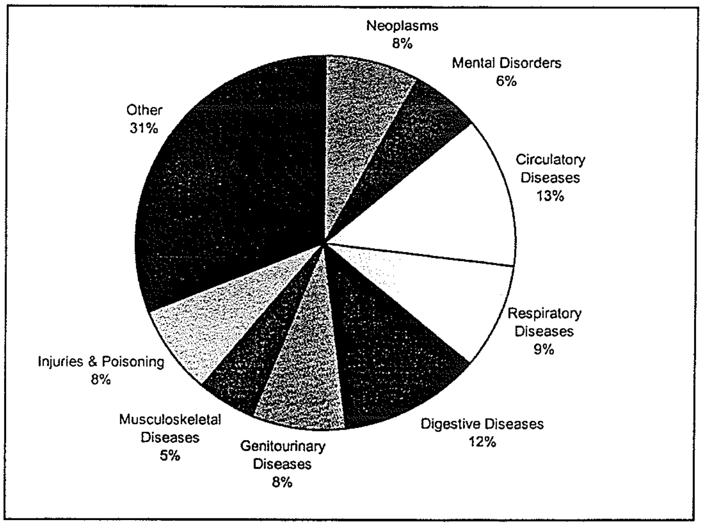


Figure 1.9
Proportions of Hospitalizations for Women by Diagnosis, Canada, 1996/97 (excluding pregnancy and childbirth, including newborns).

In 1999, 21% of all hospital admissions for Canadian women over 50 years of age were due to CVD (Health Canada, 2003). It is expected that the rates of hospitalization for women with ischemic heart disease and AMI will increase in the next fifteen years as the population ages (CIHI, 1998). Similarly, in the 1996/97 data, all circulatory diseases accounted for 18% of male hospitalizations (Figure 1.10.)

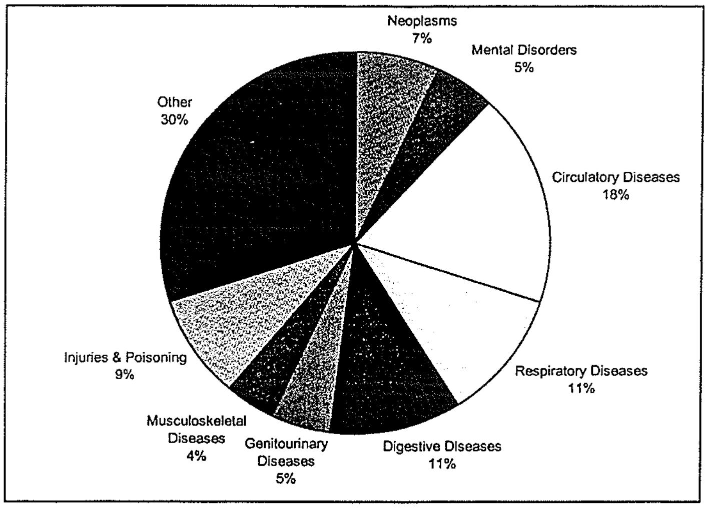
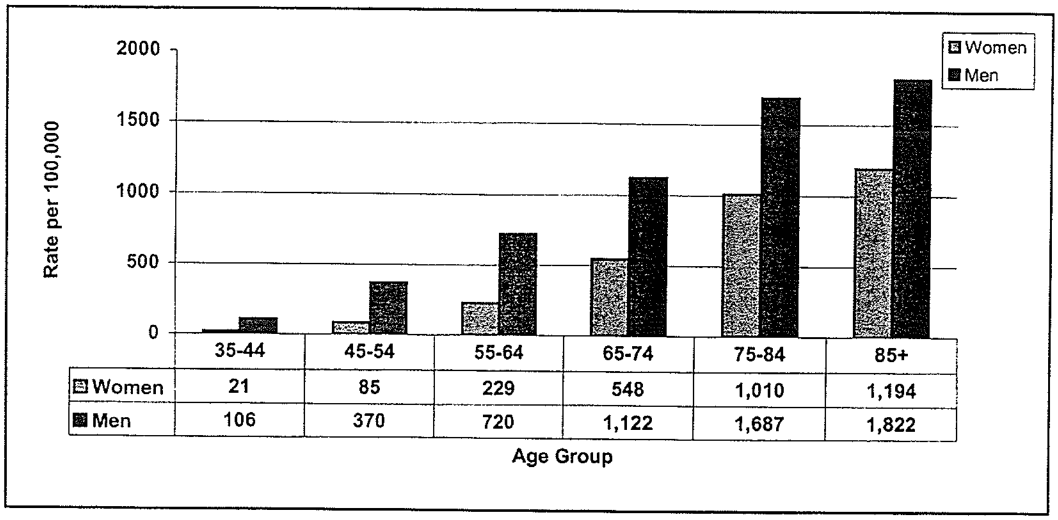


Figure 1.10
Proportions of Hospitalizations for Men by Diagnosis, Canada, 1996/97.

Age is a significant factor in the rate of hospitalizations for AMI for both men and women. With every increased decade in age there is an average increase of 500/100,000 population in hospitalizations related to AMI (Figure 1.11).



	35-44	45-54	55-64	65-74	75-84	85+
Women	21	85	229	548	1,010	1,194
Men	106	370	720	1,122	1,687	1,822

Figure 1.11
Crude Rates of Hospitalizations for AMI by Age Group and Sex, Canada, 1996/97.

A number of procedures can prevent death or make a significant difference to the quality of life for individuals with the CVD. Primary percutaneous transluminal coronary angioplasty (PTCA) is recognized as a successful alternative to thrombolytic therapy within the first 12 hours of the onset of the AMI (Ryan et al., 1999). PTCA is an intervention which requires the insertion of a small catheter with an inflatable balloon into the occluded coronary artery. This process, which allows reperfusion, eliminates the pain, prevents further ischemia, and therefore is often a life-saving procedure. As it is less invasive than the surgical alternative, it is used whenever clinically appropriate. PTCA may also be used for those for whom thrombolytic therapy is contraindicated, those who are beyond 12 hours post-AMI, and for those who have no symptoms of myocardial ischemia (Ryan et al., 1999). More recently, other methods have been developed to open the occluded coronary artery, such as the insertion of stents. The term percutaneous coronary intervention (PCI) is used to include both PTCA and other revascularization methods such as the insertion of stents.

Recent studies indicate that men may benefit more from the use of stents than women do in terms of short-term mortality (Mehilli et al., 2000). Other clinical studies indicate that both coronary angiography, a diagnostic procedure used to confirm the location and extent of the AMI and PTCA are used less frequently in women (Ayanian et al., 1991; Maynard, Litwin, Martin & Weaver, 1992; Rathorne et al., 2001; Steingart et al., 1991. It may be that the gender differences are due to differences in the clinical eligibility for therapy, or AS has been suggested by some researchers, treatment bias may the reason for the difference in these rates (Ayanian et al., 1991; Maynard et al., 1991). The gender differences may be decreasing, as indicated by a recent population-based study which identified that there were no gender differences in the revascularization (i.e., PTCA, CABG) procedures, after cardiac catheterization. However, these same researchers were unable to explain the gender differences in the cardiac catherization rates, with women having a lower rate of cardiac catheterizations (Gahli, Quan, Shrive, & Hirsch, 2003).

Coronary artery bypass graft (CABG) surgery is another procedure that has had a significant impact on improving the quality of life after an AMI. This surgery is not only an invasive open-heart procedure with significant risks, but it may also require a venous graft from the leg. Although artery grafts from the internal mammary arteries of the patient to bypass the occluded coronary artery have been used more frequently in the last decade, CABG surgery is still a significant surgical procedure. The Canadian numbers of CABG surgery and PTCA are considerably higher in men then in women (Statistics Canada, 1998; Figure 1.12).

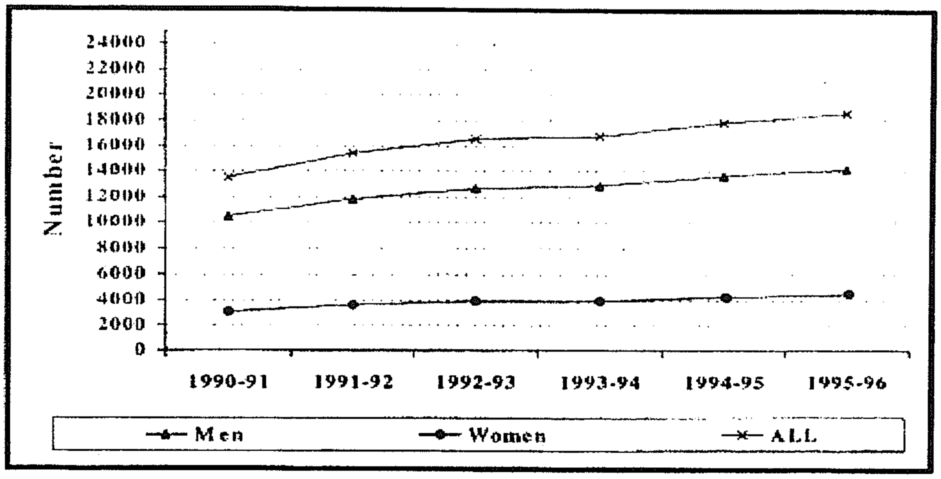


Figure 1.12
Number of Bypass Surgeries by Sex, Canada: 1990/91 to 1995/96.

This difference may be the result of the higher incidence of CAD in men as compared to women. The rate of CABG surgeries is continuing to increase with the increase in the aging population and with the increasing use of this procedure for older people.

Clinic visits to physicians can provide an indication of both the accessibility to follow-up care with physicians and the severity of the CVD. In Canada, in 1998, it was estimated that 26.4 million physician visits were directly related to cardiac disease (IMS, 1999). It is not known whether individuals suffering from CVD who received care from more than one physician relative to those whose medical care was provided by the same physician had better outcomes than those who did not. This concept of continuity of care is one that has not been studied in the population with an AMI or for that matter in any of the cardiovascular diseases.

It is also known whether certain medications can have a significant impact in the post-AMI period by decreasing some of the symptoms of CVD, such as pain (Garg et al., 1995; Scott, Eyeson-Annan, Huxley, & West, 2000). There have been some studies indicating that certain medications can also decrease the morbidity and mortality after an AMI (Daneman, Austin, & Tu, 2001; Den Hartog et al., 2001; Huckell et al., 1997). These studies have not been conclusive in their findings and few have included pre-AMI factors, which may influence the impact of using these medications after the AMI.

The recommended medications in the post-AMI period are angiotensin-converting enzyme inhibitors (ACEI), beta-blockers, statins, and acetylsalicylic acid (ASA). No research studies to date have examined the impact of these medications on health outcomes using entire populations of AMI patients, while controlling for possible confounding variables. Thus, it is not known whether the use of these medications after the AMI is an independent predictor of better health outcomes for those who take the medications as compared to those who do not take the medications. CVD is a personal, social, and economic burden for both men and women. There is, however, a dearth of information of the impact of an AMI, particularly for women. Women are as vulnerable as men are to AMI and therefore a number of research questions that remain unanswered. Specifically, no published research has identified the post-AMI quality of care and outcomes in women. For those women who survive an AMI, what type of morbidity occurs in the post-AMI period? What are the survival rates as compared to those of men? Are there certain groups of women who have longer survival rates then others? What factors predict survival post-AMI? There is clearly a need to investigate further the extent of the illness, and quality of care and health outcomes for both men and women in the post-AMI period.

To answer these questions for an entire population, database analysis is a reasonable methodology. The volume of data that can be extracted from the databases, however, needs to be placed within an organized framework in order to identify possible relationships and to create hypotheses that can be tested. A conceptual framework for the research facilitates this process.

Conceptual Framework

A conceptual framework provides the structure to identify symbolic relationships between phenomena or observations, which can guide the research project, and place findings within a meaningful context. Nevertheless, conceptual frameworks are not often used in epidemiological research. Recently, however researchers who use data base methodologies have recognized the importance of organizing the various databases within a conceptual framework, in order to identify research questions and to describe relationships that become evident as they utilize various databases (Roos et al., 1999).

The Population Health Model, a conceptual framework developed by the Canadian Institute for Advanced Research (CIAR), specifically Evans & Stoddart (1990), provides an appropriate organizing structure to explore the impact of a number of quality of care variables on the health outcomes of mortality, morbidity, and readmission rates by people who have had an AMI (Figure 1.13).

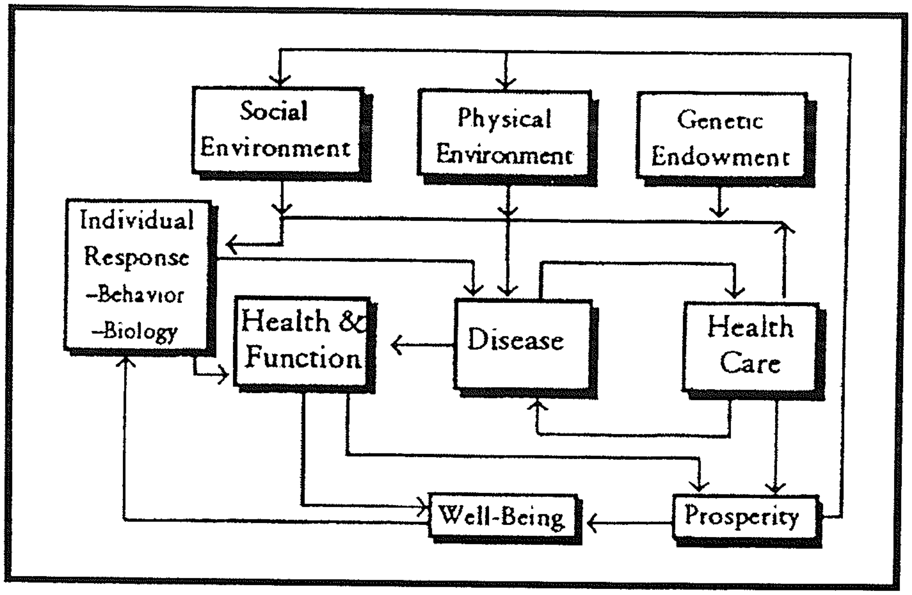


Figure.1.13
*Population Health Framework. In Evans, R., Barer, M., & Marmor, T. (Eds.), (1994).*Why are some people healthy and others not? *New York: Aldine de Gruyter, p.53. Used with permission.*

The Population Health Model is built on a variety of essential concepts and on hypotheses of the relationships between the concepts. The framework encompasses the health determinants and provides direction on the type and nature of the relationship between health care and health status at both the individual and population levels.

The model in its simplest explanation identifies that genetic endowment and the physical and social environment are mediated by the individual's response and will affect the health and functioning of the individual, which, in turn will affect the presence and absence of disease. It is further hypothesized that individuals respond differently to the social and physical environments because of different biological makeup and different behaviors. The presence of disease, as identified by the health care practitioner, may not necessarily affect the sense of well being that the individual experiences. If the individual is able to function and maintain their usual routine then a sense of wellbeing is fostered. In contrast, the presence of disease will create demands on health care, which results in a deleterious effect on economic prosperity. The feedback loops provide further clarification of the interrelationships that are hypothesized to exist between the concepts.

One of the key strengths of the Population Health Model is its flexibility. It allows for exploration of health status, the determinants that influence health, the impact or lack of impact of health services on health, and the impact of prosperity for a population at the macro level. This adaptation of the model to the population will be discussed within the following section.

Development of the Population Health Model

Most conceptual frameworks are based on previous theoretical or conceptual frameworks; the Population Health Model is no exception. The Population Health Model was developed on the foundation of a simpler model that described the relationship of factors, other than health services, on health.

In 1974, the Canadian government published the Lalonde Report, *A New Perspective on the Health of Canadians*, (Government of Canada, 1974), based on a health field concept, with four categories that were stated to influence health. The four categories were lifestyle, environment, human biology, and health care organizations. This model emphasized the importance of factors other than health care, on the presence of health or illness. The other factors that had not been identified in earlier conceptualizations of health were now evident and named as environment, lifestyles, and human biology. One of the significant outcomes of this model was the substantive research that occurred on the risk factors, embedded within the concept of lifestyles. From a sociological and anthropological perspective, this emphasis on the risk factors created a new state of being somewhere between health and illness (Gifford, 1986).

The reification or the assertion that risk was something that was measurable and concrete meant that the individual began to live the risk as a state of future ill health (Taussig, 1980). The construct of risk in the Health Field Model was defined in a significantly different manner than the classic epidemiological definitions of attributable and relative risk as a measurement of exposure to an agent. There was then a potential to focus on the issues or factors that the individual could control, such as their lifestyle, in order to maintain health. This increased emphasis on the individual's lifestyle, which was assumed to be under the control of the individual, led to some suggestion that the Health Field Model was a poorly veiled, politically conservative form of victim blaming (Labonte & Penfold, 1981). The focus on the health care organization remained an important factor but health became central and other factors (particularly those factors that were based on the individual's choices or lifestyle) were also evident in the model.

Other models followed that further identified the roles of social, economic, and environmental factors. Specifically, a subsequent Canadian government document named *Achieving Health for All: A Framework for Health Promotion* was published in 1986 shortly after an international conference hosted by Canada on population health.

The Population Health Model expanded on this model by identifying that social and physical environments as well as genetic endowment and individual responses affect the wellbeing of the individual and the level of prosperity of the population of interest. The inclusion of an economic perspective in the Population Health Model resulted in some critics of the model suggesting that a neoliberalism economic philosophy was inherent in it (Labonte, 1995). However, the economic dimension is useful to identify the relationship of economic parity, or disparity, within a population and how they relate to the morbidity and mortality of men and women who have had an AMI.

Key Concepts of the Conceptual Framework

Health

The Population Health Model identifies health "as the absence of illness or injury, of distressing symptoms or impaired capacity" (Evans, Barer, & Marmor, 1994, p. 47). This definition is a reduction of the more comprehensive definition developed by the World Health Organization (WHO). The WHO definition of health, states that health is a state of complete physical, mental, and social wellbeing and not merely the absence of disease or infirmity (World Health Organization, 1978). The proponents of the Population Health Model suggest that the WHO definition of health is more expressive of the concept of wellbeing than health. They further argue that a definition of health that incorporates the absence of illness as understood by the individual is reflective of the individual's unique understanding and experience of the meaning of health. Illness may be present as measured and diagnosed by the professional, but if it does not incapacitate nor create limitations, then the individual does not perceive a lack of health. Health is different from the determinants of health, which are the explanatory reasons for the observable differences in health among individuals.

The definition of health, as described within the Population Health Model, is limited to data accessible in databases. The major illnesses were used to identify the level of health outcomes after an AMI, but it was not possible to identify the presence of distressing symptoms or impaired capacity.

Determinants of Health

The determinants of health have ancient roots, although the current interest in the broad determinants of health would suggest that it is a modern day discussion. The discourse between Asclepiads, the god of medicine and Hygieia, the goddess of health has raged on for centuries. In the twentieth century, it has been argued, the scientific focus has overtaken the importance of wellbeing, and therefore medical interventions and health care services have gained supremacy as the key determinant of health. Despite the emphasis on medical and scientific treatment, modern day health determinants now also include genetic endowments, environmental sanitation, nutrition, stress, social environments, and the ability to cope (Black, Morris, Smith, Townsend, & Whitehead, 1988; Levine & Lilienfeld, 1987; Marmot, 1986). In the Population Health Model, these determinants, at both the individual and population levels, are proposed as accounting for the differences in health when the individual or population is exposed to the same illness-producing factors.

For the purpose of this research, the population health determinants that were proposed as being predictors or independent variables of the health outcomes were health care, social environment, individual response, and disease. As each of these determinants has many dimensions, this study used the following dimensions. (Each of these variables will be described in detail in Chapter 2, Literature Review; and Chapter 3, Methods.)

Health Care. Included the hospitalization are ICU days and access to cardiac procedures at the time of the AMI and within three years after the AMI. Receiving the appropriate medications at discharge and within three years after the AMI was another dimension of health care that was measured. Prior to the AMI, data was collected about access to continuity of care, which was defined in terms of receiving the majority of care from the same family physician or cardiologist respectively. These various determinants, for the purposes of this study, were described collectively as the major variable of Quality of Care.

Physical Environment. The geographical region and urban/rural location of residence of the population at the time of the AMI was the major regional variable. The regional location was based on the boundaries of the health regions in Manitoba, and those who lived in Winnipeg and Brandon were identified as urban and all others were classified as rural.

Social Environment. Using postal codes, income quintiles were identified for the cases in the research population. Marital status, defined as married, single, and widowed was identified for all cases.

Individual Response (Human Biology). Data base methodology does not allow one to measure individual response to illness. However, as gender was one of the major variables of interest in this study, gender was used as a proxy for the health determinant identified as individual response or human biology. Age was a second human biology characteristic that was included as a predictor for the health outcomes.

Disease. The selected pre-AMI comorbidities, which could potentially affect the health outcomes after an AMI, were diabetes and hypertension. Comorbidities were also taken into account.

Health and Functioning. The dependent variable for the study was measured by identifying the cases who were readmitted for congestive heart failure (CHF) and unstable angina. Survival within one and three years following the AMI was also assessed.

Purpose of the Research

The purpose of the study was to explore the gender and regional differences that may exist in the post-AMI period, as it relates to quality of care and health outcomes, using the Population Health Model. Specifically, the research focused on the following questions:

1) Are there gender differences after an acute myocardial infarction (AMI) in the quality of care received and health outcomes?

2) What are the regional variations in quality of care received and the health outcomes for people who have had an acute myocardial infarction (AMI)?

3) What is the relationship between quality of care and health outcomes in the post acute myocardial infarction (AMI) period?

The hypothesis was that there would be a difference between males and females in both the quality of care and the health outcomes after an AMI. As described earlier, some studies have identified that there are significant differences in access to some cardiac procedures for women at certain points in the disease trajectory (Ayanian et al., 1991; Chandra, Szko, Goldberg & Tonascio, 1998; Jaglal, Goel, & Naylor, 1994; Steingart et al., 1991; Tu, Naylor, & Austin, 1999). Suggestions that the differences exist because of a bias against women has been disputed by Gahli and his colleagues (2003), who have recently identified that the sex differences in cardiac procedures can be explained by the clinical differences between the sexes. Other recent studies have identified that the in-hospital mortality after PTCA is higher for women then men (Welty, Lewis, Kowalker, & Shubrooks, 2001). Using a population-based approach in the present study whereby all people within the province that had an AMI were included, allowed for a comprehensive analysis of the research questions. That is, it was possible to capture the disease trajectory for men and women that had an AMI using provincial health care databases, identify the differences in treatments, quality of care, and subsequent health outcomes in the post-AMI period.

Some research studies have found that access to cardiac procedures and treatments varied by geographical regions, but interestingly, the researchers did not find that less access to cardiac procedures had any relation to worse outcomes as measured by mortality and morbidity rates (Rodrigues et al., 2002). Tu and his colleagues (2003), although they obtained similar findings related to regional differences in the use of some cardiac procedures, found that there was also a direct relation to higher mortality rate. The lack of consistent findings in regional differences in both the quality of care and health outcomes highlights a need for a population-based approach to exploring this important question. More specifically, regional variation within Manitoba in the quality of care and the health outcomes in the post-AMI period has not been explored.

Summary

There is a considerable amount of knowledge about CVD and AMI in men and women. The differences in the ages when men and women are most vulnerable to an AMI are well documented, as discussed earlier. What is less well known is the difference in the long-term outcome of these differences in the age at which the AMI occurs.

Similarly, there is less data and knowledge about why there are differences in the use of cardiac procedures and cardiac medication prescriptions. Generally, there is now some research that shows that there are some differences in the types and the number of procedures that are provided for men and women post-AMI. The evidence is inconclusive as to whether or not the gender differences are related to different levels of acuity or whether it is related to some type of gender bias.

What is also not known is whether the treatment differences between men and women results in different health outcomes over time. To the extent that quality of care following an AMI is linked to health outcomes, one would therefore expect that morbidity and mortality rates would be higher for women than men. Tu et al. (2003) indeed found that the in-hospital mortality rate for both elderly and female patients was substantively higher than for men of the same age. It is not known whether this variation continues after hospital discharge in the suggested three-year follow-up period after an AMI (Marciniak et al., 1998). It may be that there are determinants other than cardiac procedures and cardiac medications which impact health outcomes after an AMI. For example, in the present study, continuity of care which is known to provide for better health outcomes for certain patient populations will be explored. Recognizing that there has been no research on this dimension of quality of care for people with an AMI, this study will provide new knowledge on the contribution of continuity of care to this population.

There is little research on the difference in the incidence and prevalence of AMI and even less on the differences in the treatment of AMIs within different geographical areas. There has been no published research on the quality of care and the health outcomes between different regions.

Based on this literature, it was therefore hypothesized that there would be a direct association between the quality of care, as measured by the access to cardiac procedures, appropriate post-AMI treatment including drug prescriptions, and continuity of care and the health outcomes over the three year study period. Using the Population Health Model, the study was developed to describe the post-AMI period to identify the predictors for health outcomes for both men and women and to identify the regional and gender variations for both the quality of care and the health outcomes.

CHAPTER 2
LITERATURE REVIEW

The focus of the selected literature review is on reviewing what is known and published about the major variables that were explored in this research study. Quality of care and health outcomes are described in a variety of ways in the research literature. Since these are key concepts for the study, they are defined first, and subsequently, the relevant research literature reviewed.

Definition of Concepts

For the purpose of this study, *Quality of Care* is defined as continuity of care, access to home care, access to cardiac procedures, and appropriate discharge medication prescriptions. These variables were compared by gender, age, geographical and urban-rural locations, and income quintiles. A full description of each of these variables is provided in the following paragraphs.

Quality of Care

There is little doubt that monitoring and reporting on the quality of health care is important. However, quantifying quality of care is complex and challenging. In order to respond to the demand for evidence of quality of care, clinicians need to agree on the quality indicators within the clinical realities. Standards of care, agreed upon by the clinicians, are most frequently used as the performance measures against which clinical care can be measured. Although there have been guidelines for the care of the AMI patient, only recently has there been agreement on the standards of practice which will identify quality of care. A corollary to the acceptance of the performance standards is an acknowledgment that inadequate clinical care has been provided when the standards have not been met.

In 2000, the American Heart Association developed quality of care standards for CVD and specific process and structural measures were identified (AHA/ACC Conference Proceedings, 2000). The structural measures, which included pre-hospital triage, access to invasive and noninvasive cardiac tests, appropriately trained staff, hospital protocols, etc. were not able to be collected using database analysis. However, many of the process measures were accessible in the database and these were selected to measure quality of care. In addition, continuity of care, which has been studied most frequently in the context of primary care, was also selected as one of the measures of quality of care (Dietrich, 1982; Hanson, 1975; Starfield, 1998).

Continuity of Care

Continuity of Care has been described as the process by which a person uses the services of a regular, consistent physician and/or service unit for health care (Haggerty, Reid, Freeman, Starfield, Adair, & McKendry, 2003). This long-term, patient-physician/practice relationship has been linked to improved outcomes, such as fewer health care visits, improved compliance to medication and treatment regimes, and to patient and staff satisfaction (Dietrich, 1982). With an increased emphasis on primary care (Advisory Committee on Health Services, 1995) as a means to controlling escalating health service costs, increasing disease prevention and health promotion strategies, continuity of care has become an important concept to research. Recently studies have shown that continuity of care is associated with fewer hospitalizations (Gill, 1997; Mainous & Gill, 1998), less physician visits (Lambrew, De Friese, Carey, Ricketts, & Biddle, 1996; Roos, N.P., Carriere, & Friesen, D., 1998), and better disease-specific outcomes for patients with hypertension (Ahluwalia, McNagny, & Rask, 1997). Better preventive care has similarly been linked with a consistent physician and/or source of care. A number of researchers have found that women specifically benefit from having a consistent caregiver for procedures such as regular breast and cervical cancer screening (Bindman, Brumback, Osmond, Vranizan, & Stewart, 1996; Ettner, 1996; Hayward, Bernard, Freeman, & Corey, 1991; Lambrew et al., 1996; O'Malley, Mandelblatt, Gold, Cagney, & Kerner, 1997; Mandelblatt et al., 1999; Martin, Calle, Wingo, & Heath, 1996; Menec, Sirski, & Attawar, 2005).

Chronic diseases such as diabetes and heart disease are particularly amenable to a consistent source of care. O'Connor et al. (1998) successfully demonstrated that adults with diabetes who had a regular source of care were more likely to have recommended cholesterol checks and preventive examination that those who did not have a regular source of care.

Heart disease and more specifically, AMI require regular follow-up and it intuitively seems reasonable to deduce that a consistent physician and/or a consistent source of care would result in better health outcomes. The examination and study of the impact of continuity of care has been studied most frequently within the parameters of primary care, but there has been little research into the influence of continuity of care on the post-AMI period.

In a recent study by Menec, Black, Roos, Bogdanovic, & Reid (1999), 60% of the Manitoba patients received at least 50% of their care from the same provider group. The study also demonstrated that many Manitobans utilize a number of different physicians for their care. The reasons for the lack of consistent care were not identified, but one can assume that accessibility to timely response to health needs may be partially responsible for the use of more than one physician. Thus, despite the known benefits of having a consistent source of care (Starfield, 1998), in the Manitoba study, a significant number of patients do not use or do not have access to a singular source of care.

Research has identified that the access to, and utilization of, a consistent source of care is highly dependent on gender, age, socioeconomic status, health status, health insurance, level of health, and level of satisfaction with physicians. Some researchers have found that women have an increased use of a single source of care (Hayward et al.,

1991) as compared to men. In contrast to Hayward, other researchers (Weiss & Blustein 1996) have not found any gender differences.

Low socioeconomic background has consistently been identified with a nonregular source of care (Hemingway, Saunders, & Parsons, 1997; Lambrew et al., 1996; Menec et al., 1999; Mustard, Mayer, Black, & Postl, 1996; Weiss et al., 1996). Children and older adults are more likely to have a consistent source of care as compared to young adults (Forrest & Starfield, 1998; Hayward et al., 1991; Weinick & Drilea, 1998; Veale et al., 1995). People who report good or excellent health (Hayward et al., 1991; Pilotto, McCallum, Raymond, McGilchrist, & Veale 1996) and those who are less satisfied with the last physician visit (Veale et al., 1995) also have a less consistent source of care. The lack of health insurance, although not an issue in Canada, is not surprisingly a consistent correlate to a nonregular source of care (Forrest et al., 1998; Hayward et al., 1991; Newacheck, Stoddard, Hughes, & Pearl 1998; Rask, Williams, Parker, & McNagny, 1994).

Finally, the geographical location and the urban/rural location of the patient and the physician appear to significantly affect the continuity of care. Menec et al. (1999) found that 70% of rural patients accessed health services for 50% or more of their care from 1 provider group in the rural area as compared to 50% of the urban patients. Although the access to a greater number of physicians in the urban area may account for some of the differences, there is likelihood that urban patients are also using the walk-in clinics for many of their health services for a variety of reasons.

It is unknown whether or not the findings that have been reported with the singular primary care physicians/practice are consistent with the regular patient-physician/practice relationship for nonprimary care. It is known that specialists, who are nonprimary physicians, frequently provide care that could be considered primary care as the care has the characteristics of continuity, comprehensiveness, accessibility, and coordination (Starfield, 1998). This type of primary care by nonprimary care physicians is particularly prevalent for pediatric care and for gynecological care. It appears as though patients may use specialists for primary care depending on the type of health care that is required. Rosenblatt, Hart, Baldwin, Chan, & Schneeweiss (1998) found that in their study population, about 30% of the patients used a primary physician for consistent care but only 15% used consistent specialists during the entire two-year study period. It is not known whether the care provided by specialists is "special" care related to the specific specialty, or as Rosenblatt et al. (1998) has described, within their "domain," or whether the specialists are providing other, more primary-like care. Recently, Abubakar and colleagues (2004) found that access to a cardiologist resulted in better survival rates for those admitted with an AMI. They suggested that the better access to appropriate medications may account for the better outcomes.

Access to physicians who have a higher volume of patients and therefore expertise in managing heart disease has also been identified recently as an indicator for better AMI outcomes (Tu, Austin, Benjamin, & Chan, 2001). The 30-day risk-adjusted mortality rate was 15.3% for physicians who treated five or fewer cases per year (lowest quintile) as compared with 11.8% for physicians who treated more than 24 AMIs per year (highest quintile). The one-year risk-adjusted mortality rate had an even higher difference at 24.2% for physicians in the lowest quintile and 19.6% for physicians in the highest quintile.

The impact of a consistent relationship with the specialist/practice group on the outcomes for the AMI population has not been previously investigated. If the presence of a relationship between consistent physician/practice and better outcomes were identified, then implications for policy and practice could be identified. In this study, the access to home care is also considered a component of continuity of care, as the primary physician maintains a longer term relationship with the individual by providing a care plan and monitoring health during the time home care services are provided.

Home Care

The need for home care was not expected to be a frequent requirement for those with an AMI, but for those who require home care, it may be an indicator of increased acuity, with a prolonged recovery. There is no published literature about the frequency of home care visits for people with CVD or for AMI in particular, nor is there any indication as to the nature of services that an AMI patient may require. There is, however, conflicting information as to the outcomes and benefits of post-AMI cardiac rehabilitation in the home as compared to the rehabilitation offered in the hospital (Fraseur-Smith, Lesperance, Prince, & Junien, 1997; Schuster, Wright, & Tomich, 1995; Young et al., 2003). Shuster and colleagues found that women who had post-AMI cardiac rehabilitation in the home had worse outcomes as compared to those women who had their rehabilitation in the hospital. However, in the same year a randomized control study comparing in-hospital and home care psychosocial nursing interventions found that women who had home care had a lower mortality rate than the women in the hospital (Fraseur-Smith et al, 1995). An exploration of this variable as it relates to the concept of continuity of care and its impact on the health outcomes provided a better understanding of the importance of home care for the AMI patient.

Process of Care Indicators

The process of care indicators, both pharmacological and nonpharmacological identified by Tran et al. (2003), the American College of Cardiology/American Heart Association (Ryan et al., 1999) the European College of Cardiology (Backer et al., 2003), and the Australian West Moreton Coronary Outcomes Project (Scott et al., 2000) were retrievable from administrative databases. Based on the seminal work of Donabedian (1998) who identified three components of evaluating health care quality, namely structure, process, and outcomes, a group of cardiac care experts recently identified the process of care indicators that are important to improve health outcomes for AMI patients (AHA/ACC, 2000; Tran et al., 2003). The process of care indicators referred to the use of appropriate diagnostic and therapeutic modalities based on the guidelines developed by both the American College of Cardiology/American Heart Association (Ryan et al.,

1999) and the Canadian Consensus Conference on Coronary Thrombolysis (Cairns et al., 1994).

Pharmacological indicators. The use of pharmacological indicators is indicative of the importance of the drug therapy in the treatment of AMI. Beta-blockers, angiotensin-converting enzyme inhibitors (ACEI) and serum lipid reducing agents (statins) continue to be identified as important process of care indicators (ACE Inhibitor Myocardial Infarction Collaborative Group, 1998; Antiplatelet Trialists' Collaboration, 1994; Held & Yusuf, 1993; Ryan et al., 1999; Smith, 1990). These drugs have been well documented in clinical trials as being extremely effective in improving outcomes in the immediate post-AMI period (The Beta-Blocker Pooling Project Research Group, 1988; Garg et al., 1995; Scandinavian Simvastatin Survival Study Group, 1994; Scott et al., 2000). Although it is well known that acetylsalicylic acid (ASA) is also a requirement for good post-AMI treatment (Anti-platelet Trialists' Collaboration, 1994), this drug is a nonprescription drug and thus cannot be measured accurately using the Manitoba administrative database (Metge, Kozyrski, & Roos, 2003).

Beta-blockers, also known as beta-adrenergic blocking agents, improve oxygen supply and demand, decrease sympathetic stimulation to the heart, promote blood flow in the small vessels of the heart, and have an effect on maintaining a regular heartbeat. The beta-blockers have been identified as having a significant effect on AMI mortality (Held & Yusuf, 1993). In a Canadian Quality Improvement Network study of patients with an AMI, there was a decrease in the relative risk of death of 36% with the use of beta-blockers (Tsuyuki, Ikuta, Greenwood, & Montague, 1994). In a more recent study, Daneman and colleagues (2001) found that between 1992 and 1997, AMI in-hospital mortality declined from 20% to 15% with a patient population of comparable baseline clinical characteristics. The researchers concluded that the drop in mortality was primarily related to the increase of in-hospital use of a variety of cardiac drugs including beta-blockers (Daneman, Austin, & Tu, 2001). There is some research indicating that although appropriate drug use may be improved within the hospital, the prescriptions outside the hospital are not at the recommended levels. In Manitoba, a recent study using the administrative databases found that in contrast to the recommended 90% of patients with an AMI receiving beta-blockers, there was a decrease from 19.3% in 1996/97 to 16.3% in 1999/2000 in the use of beta-blockers (Metge et al., 2003).

Angiotensin-converting enzyme inhibitors (ACEI) are drugs that are used to improve left ventricular dysfunction after an AMI. The drug acts by relaxing the blood vessels that lower blood pressure and increase the efficiency of heart as it pumps out the blood. As with beta-blockers, ACEIs have been shown to reduce mortality after an AMI (Huckell et al., 1997). An increased use of ACEIs was cited by the Halifax County MONICA Project in the analysis of in-hospital data from 4,283 patients with AMIs between 1989 and 1993 as the reason for the decrease in the AMI mortality rates (Bata, Gregor, Eastwood, & Wolf, 2000; Gregor, Bata, Brownell, & Wolf, 2000). Daneman and colleagues (2001) found a similar relation in the 200 patient charts that were reviewed in their study. In examining temporal changes between the two study periods, they found that the increased use of ACEIs upon discharge from the hospital was related to reduced mortality rates for the 1992 and 1997 time period. Although the literature has continued to support the earlier findings of a significant reduction in mortality with the use of ACEIs for AMIs, in Manitoba the use of ACEIs after discharge from hospital decreased from 14.4% in 1996/97 to 10.4% in 1999/2000 (Metge et al., 2003).

The statins or serum lipid reducing agents have been found to rapidly lower the serum total cholesterol, and most importantly the low-density lipoprotein (LDL), which has come to be known as the "bad" cholesterol. The statins also cause a slight rise in the high-density lipoprotein or "good" cholesterol. The use of the statins prevents the abnormalities in the blood lipid levels that have been linked to an increase in the risk of AMIs (The Long-Term Intervention with Pravastatin in Ischemic Disease (LIPID) Study Group, 1998). Lipid-lowering drug therapy is important for patients who have had an AMI to prevent another AMI (Arntz et al., 2000; Den Hartog et al., 2001; Sacks et al., 1996; Scandinavian Simvastatin Survival Study Group et al., 1994). Evidence is growing indicating that statins are equally cost-effective in preventing a second cardiac event, for all subgroups irrespective of the level of risk, related to smoking, high LDL cholesterol levels and hypertension (Prosser et al., 2000; Ganz, Kuntz, Jacobsen, & Avorn, 2000).

As with beta-blockers and ACEIs the use of statins post-AMI has decreased in Manitoba from 3.1% in 1996/97 to 2.6% in 1999/00 (Metge et al., 2003). Metge and colleagues (2003) further identified that 17% of persons with an AMI were not prescribed even one of the pharmacological agents known to improve health outcomes after an AMI and to decrease the risk of death related to the AMI. These findings were similar to those of the Canadian Cardiovascular Outcomes Research Team (Pilote et al., 2004), which found that secondary prevention after the AMI had improved in four provinces, based on the increased use of the recommended medications (i.e., statins, beta-blockers, and ACEIs). However, the research team also found that despite the improvement in the utilization of the recommended medications, between 1997 and 2000 improvement was still required to meet the stated guidelines (Pilote et al., 2004).

Based on the current research evidence, it is important to identify if there are better health outcomes in the three-year post-AMI for the 49.2% of the AMI Manitoba population (Metge et al., 2003) that use the appropriate drugs. These drugs are both expensive and there are some undesirable side effects. The percentage of filled prescriptions of these pharmacological agents was identified at the 30- and 90-day post-AMI timeframes.

Nonpharmacological indicators. Although drug therapy has the greatest impact on decreasing the mortality and morbidity rates post-AMI, there are a number of nonpharmacological indicators that also have had a significant impact on the health outcomes post-AMI. These indicators include physician visits post discharge, PTCA and CABG surgery, and cardiac catheterization post-AMI (Kennedy, Brien, & Tu, 2003; Tran et al., 2003).

Cardiac procedures like PTCA and other percutaneous coronary interventions (PCI) such as insertion of stents and CABG surgery are the major interventions, which when completed in a timely manner for appropriate patients, can result in enhanced outcomes post-AMI.

Reperfusion using PCI has been shown to improve outcomes in the United States (Lauer, Karweit, Cascade, Lin, & Topol, 2002), and more recently, in Canada as well (Jamal et al., 2003). The increased use of coronary stents, one method of increasing the lumen of the coronary arteries, has been postulated as being one possible reason why there was a 21% adjusted reduction in adverse cardiac events in the British Columbia population after an AMI (Rankin et al., 1999). The decrease in adverse cardiac events correlated with the increased use of stents from 14.2% to 58.7% in the same period (Rankin et al., 1999). In Canada the risk-adjusted, in-hospital, post-PCI death rates had not changed between 1992/93 and 2000/01 (Jamal et al., 2003), in contrast to the 37% decrease reported for the United States Medicare beneficiaries between 1987/90 (Hannan et al., 1992). The Canadian researchers, however, noted that there were significant differences in the risk-adjusted and expected death rates across the provinces, with Manitoba's observed death rate being higher than expected largely due to the older and sicker patients treated with PCI (Jamal et al., 2003). Therefore, the researchers suggest that there may be a variable quality of care for patients undergoing PCI within Canada. Although Manitoba achieved an overall decline in risk-adjusted death rates as compared to other provinces, there was no indication as to the differences in the mortality and morbidity rates after PCI that might exist within Manitoba.

Clinicians have used other PCI measures such as PTCA for a number of years as a means to open occluded coronary arteries that are non-amenable to pharmaceutical interventions. Differences in the PTCA utilization rates and subsequent outcomes for males versus females have been the major recent research foci. Tu et al. (1999) identified that despite the significant increase in the percentage of post-AMI people receiving coronary angiography, PTCA, and CABG surgery, between 1992/96 the most significant improvement in outcomes occurred within 30 days of admission. The researchers further noted that the rates of cardiac interventions were lower in both women and the elderly during the study period (Tu et al., 1999). The study was not able to elucidate the reason for the differences.

Ayanian & Epstein (1991) found a similar difference in the rate of revascularization (i.e., PTCA) between men and women who were hospitalized for AMI. These researchers hypothesized that differences may be explained by the absence of a true heart attack, perceived more severe heart disease in the men by the physicians, physicians' perception of sex-related differences in risk and efficacy, and a difference in the patient's preferences (Ayanian & Epstein, 1991). However, a recent study from Alberta disputes the suggestion that there are gender differences in the use of coronary revascularization (Gahli et al., 2002). In this prospective study, the rates of cardiac interventions, PCI (stents and PTCA), and CABG surgery between 1995 and 1998 were compared for men and women. The findings indicated that the differences in the rates of the cardiac interventions between men and women could be explained by the difference in the clinical disease (Gahli et al., 2002).

Although women may now be appropriately accessing PTCA, they appear to have a higher in-hospital mortality post-PTCA (Arnold, Mick, Piedmonte, & Simpendorfer, 1994; Bell et al., 1993; Kelsey et al., 1993; Malenka et al., 1999). In a 2001 study by Welty and colleagues, the increase in female in-hospital PTCA mortality was hypothesized to be related to procedural processes that make women vulnerable to post-PTCA complications. The study found that 24 hours post-PTCA, 67% of the women died from non-cardiac causes, as compared with 10% in the men (Welty et al., 2001). The importance of PTCA as a treatment for AMI is unequivocal; however, there are different health outcomes between the genders. It is not known whether differences in utilization are related to health outcomes in the three-year period after the sentinel AMI.

Rates of use of other procedures, such as CABG surgery and cardiac catheterization, continue to have gender differences, with women having lower rates (Gahli et al., 2002). CABG surgery is recognized as the major intervention for occluded coronary arteries that cannot be reopened by means of PCI. As indicated in the previous paragraph, the variation in the use of this surgery for women has been identified as being less than is appropriate (Ayanian and Epstein, 1991; Chandra, Szko, Goldberg, & Tonascio, 1998; Tu et al., 2003). Although Gahli and his colleagues (2002) identified that the differences in PCI and CABG were explainable by the application of appropriate clinical indicators, in the same study there was still a sex-based difference in the rate of cardiac catheterizations, an examination that often precedes PCI and/or CABG surgery. This finding was consistent with an earlier study by Rathore et al. (2001), who identified that women who had an AMI did undergo cardiac catheterization less frequently than men did.

In Canada there are still five times as many CABG surgeries done on men as there are on women (Statistics Canada, 1999). Some of the differences may be related to the higher incidence of coronary artery disease in men at younger ages. However, questions related to a possible gender bias have been raised as a possible explanation (Tobin, 1987). Whatever the reasons for the differences in the use of these procedures, the lack of access to these services is hypothesized to result in poorer health outcomes for women with AMI.

Population Health Model Predictors

The Population Health Model suggests that there are other predictors of health other than medical care, pharmacological agents, and nonpharmacological indicators. The physical and social environment, the individual response, and the presence of illness or disease can also influence the health of the population. In exploring the predictors of health outcomes after an AMI, the study also attempted to identify, where possible, the impact of these additional hypothesized predictors of health outcomes.

Physical environment. For the purpose of this study, the physical environment was defined as the geographical region and the urban-rural location. Variations in the treatment and management of AMI have been found between countries (Pilote, Granger, Armstrong, & Htlatky, 1995; Tu, Pashos, & Naylor, 1997; Yusuf et al., 1998) and within countries both in the United States (Pilote et al., 1995) and in Canada (Hartford, Ross, & Wald, 1998; Rodrigues, Simpson, Hugues, & Pilote, 2002). Most of these studies have focused on the access to invasive cardiac procedures and the studies consistently found a strong correlation between regional proximity to the services and the use of the procedures.

Differences in the care of, and the outcomes for, AMI patients between regional health service locations, within a province have recently been reported in Quebec (Rodrigues et al., 2002). Findings of the Quebec study (Rodrigues et al., 2002) indicated that the proximity to the large cities and thus the most acute care and technologically advanced hospitals, did indeed provide a significant increase in access to cardiac procedures. In contrast, the appropriate cardiac medication prescriptions were not related to living in the larger urban centers. The most significant finding was the lack of a relation between the use of cardiac procedures and cardiac medications on one-year and three-year mortality and on the incidence of cardiac complications, even after the risk adjustment. The researchers suggested that since the study used the health databases, there was no in-hospital information on the severity of the illness or in-hospital medication use, both of which may have had more impact on the mortality rate than the cardiac procedures and post-discharge medications. However, their findings were congruent with an earlier study by Pilote et al. (1995) in the United States, which similarly identified variability in cardiac procedures and cardiac medications across the country, but as in the Quebec study, there was no significant variation in the mortality rates. Clearly, there is a lack of consistent findings on the impact of the geographical region and the rural/urban location and the use of the appropriate procedures and medications on the health outcomes after an AMI.

Social Environment. Although there are many aspects of the social environment that may have an effect on the outcome after an AMI, this study used the income quintiles as a measure of the social environment. The relation of income and CVD has been well researched. Canadian women who live in poor neighborhoods have a substantively higher risk for CVD-related morbidity and mortality (Wilkins, 1995). Social status and consequently the neighborhood in which one lives were found to have a significant influence on the outcome of an AMI in Ontario (Alter, Naylor, Austin, & Tu, 1999). The researchers found that for every $10,000 increase in average neighborhood income there was an associated 10% reduction in the risk of death after an AMI, after adjustment for comorbidity, hospital factors, and patient proximity to the hospital.

It has been hypothesized that the reason for the differences in health status may be the presence of a constellation of factors within the lower socioeconomic strata, such as stress, coping ability, and lack of control in various situations of life. Other factors that may account for the less healthy life might be the reduced access to healthier foods, poor housing, and inadequate transportation. This socioeconomic gradient of a less healthy life with lower income appears to be consistent over an extended period of time for a variety of diseases (Brezinka & Kittel, 1995).

Although having a universal health care system should provide for universal equity in access, a recent Canadian study found that socioeconomic status was a significant predictor of having an angiogram after an AMI (Alter, Naylor, Austin, Chan, & Tu, 2003). The socioeconomic gradient was not explained by access to specialists or to tertiary hospitals (Alter et al., 2003). With access to the population income quintiles in the administrative database, it was possible to investigate the association between income, quality of care and the health outcomes after an AMI.

Marital status was also extracted from the database as the literature indicates that social support, as found in a permanent relationship, was found to be an independent risk factor for survival rates and recurrent infarction in women after CHD was diagnosed. Married women had significantly better survival rates than did those who were single (Chandra, Szko, Goldberg, & Tonascio, 1983). Other studies have reported that both males and females who did not have either a marriage partner or a confidant had a threefold increase in the risk of death within five years after a coronary angiogram (Williams, Barefoot, Califf, et al., 1992). Similarly, mortality rates are higher among the widowed than the nonwidowed. However, the bereavement studies did not differentiate the cause of death. Based on this selective review of the literature it is apparent that the presence of a social support network, as defined through marital partners, confidants, friends, or community involvement has a significant positive effect on the morbidity and mortality of women with CVD. The Population Health Model suggests the social environment impacts on how the individual will respond to an illness, and therefore marital status was included as one of the study variables.

Individual Response (Human Biology). In a population-based study, individual responses cannot be measured, but sex and age distribution of the AMI population were used as measures of the human response to the AMI.

The prevalence of CVD increases with age in both women and men. The gender difference lies in the steady increase of CVD in men as they age, whereas in women there is a significant increase after menopause (Statistics Canada, 2002). Acute myocardial infarctions (AMI), specifically, are the leading cause of death among the elderly, despite an overall reduction in the age-standardized mortality rates in the past 25 years (Boucher et al., 2001).). In a prospective registry study, with the population extracted from four teaching hospitals in Spain, Marrugat and colleagues (1998) found that there was a significant difference in the mortality rate between men and women in the first six months after the first AMI. Even after adjustments had been made for comorbidity and age, the women had more severe disease and worse outcomes than did the men.

The difference in access to treatments and in health outcomes for AMI between men and women has been shown to be related to age (Slaughter & Bondy, 2001; ICES, 2002). These studies found that age was a significant factor in the access to coronary angiography, with the younger women having the highest rates of procedures and the older women who had the highest rates of mortality after an AMI having the lowest rates of cardiac procedures (Slaughter et al., 2001; ICES, 2002). Not only is age a significant predictor of health outcomes after an AMI, but gender also appears to affect the outcomes.

In women, the reduced estrogen production during menopause, whether surgical or natural, has been correlated to an increased risk for CAD and consequently the risk for an AMI (Gohlke-Barwolf, 2000; Lerner, & Kannel, 1986; Limacher, 1996; Schwab, 2000). One study suggested that in naturally occurring menopause, the increase in the LDL and the decrease in HDL cholesterol may be the biochemical and metabolic risk factors that are responsible for the higher incidence of CVD at menopause (Gohlke-Barwolf, 2000). As a result, a number of studies have examined the effect of hormone replacement on the incidence of CVD in women (Herrington et al., 2000; Hu et al., 2000; Hulley et al., 1998; Schwab, 2000). Study results have been inconclusive and current evidence indicates that postmenopausal hormone preparations may not be effective in reducing the development or the progression of cardiac disease (Herrington et al., 2000; Hulley et al., 1998). In 2004, a comprehensive randomized control hormone replacement drug study was ended because of the increase in significant side effects and the lack of effect on decreasing heart disease in postmenopausal women (The Women's Health Initiative Steering Committee, 2004). A new nonhormonal therapy, selective estrogen-receptor modulators (SERMs), is being tested to treat osteoporosis and is being evaluated on its effect on preventing secondary cardiac disease (Barrett-Connor, Wenger, Grady, et al., 1998). Whatever the reason for the sudden increase in CVD after menopause, the rates of heart disease are almost identical for both men and women by the age of 50 years.

In sum, the relationship between the variables of age and gender needs to be further studied within a population-based study in order to describe their relation with the quality of care variables and the health outcomes after an AMI.

Disease. Certain familial diseases such as diabetes mellitus and hypertension also affect the development of cardiac disease. Type II (non-insulin dependent) diabetes mellitus has been consistently identified as a risk factor for CHD (Grundy et al., 1999). Diabetes mellitus increases mortality from cardiac disease and AMI more in women than in men (Johansen, Nargundkar, Nair, Neutel, & Wielgosz, 1990; Legato, 1994; Murabilo, 1998). In a twenty-year follow-up study of women with Type II diabetes, the age-adjusted relative risks of overall mortality from cardiac events were 3.39 as compared to women who did not have diabetes (Hu et al., 2001). In the current research, it was important, therefore, that diabetes be included as one of the independent variables considering the significance of diabetes on the occurrence of cardiac disease.

As with Type II diabetes mellitus, hypertension has consistently been an independent predictor of the development of CHD. Hypertension, as identified with a systolic blood pressure greater than 160 mm Hg or the diastolic pressure 85 mm Hg or greater, increases the coronary heart disease two-to-threefold in women as well as men (O'Rourke et al., 1988). Hypertension has been found in 40% to 80% of women with CHD and it is more common in women than in men with CHD (Carlson & Bottiger, 1985). In a study of women under 50 years of age, hypertension was associated with twice the risk of an AMI as compared to those who were not hypertensive (Rosenberg et al., 1983). In the Framingham study (Stokes et al., 1987) and the Stockholm study (Carlson & Bottiger, 1985), hypertension was the most consistent and significant risk factor for CHD. Krueger et al. (1988), in a case-controlled study identified that hypertension was persistently associated with the occurrence of fatal AMI in women. The significance of this variable is obvious and therefore pre-AMI hypertension was included as a predictor of post-AMI health outcomes.

Health Outcomes

The *Health Outcomes* were defined as those variables that reflect the patient's health status after the AMI. The measurements that were used have been used extensively in the research related to cardiac disease. They included the post-AMI illnesses, mortality and hospital readmission rates (Tran et al., 2003). For the purpose of this study, the population that had an AMI was followed for a three-year follow-up period. Three years has been identified as an appropriate follow-up period by a number of researchers (Herlitz, Bang, & Karlson, 1996; McGovern et al., 1996). Based on previous AMI research, the three-year follow-up period captured the recovery and illness related specifically to the AMI.

Quality of care, as defined and measured by access to appropriate and timely cardiac procedures, access to a consistent physician for follow-up care, and appropriate discharge pharmaceutical treatment was hypothesized to result in better health outcomes for the patients with AMI. The selected health outcomes were consistent with those of other studies which have explored the post-AMI trajectory. Specifically, Marciniak et al. (1998) identified the population mortality rates for the in-hospital stay, 30 days post-AMI, and one-year post-AMI. Other researchers have suggested that it is inadequate to follow the AMI patients for only one-year post-AMI and in contrast suggest that in order to capture all deaths related to the sentinel AMI, patients should be followed for a minimum of three years post-AMI (Herlitz et al., 1996; McGovern et al., 1996). As the methodology for the study was database analysis, it was both possible and feasible to use a three-year follow-up period for all of the outcome measures. Although mortality rates are an important outcome measure, the quality of life as measured by the presence of certain illnesses was equally important to explore.

There have been significant improvements in the diagnosis and treatment of an AMI and consequently many patients may survive the first AMI. A sizable percentage of the population may experience a second or subsequent AMI. Not only is there a possibility of another AMI but also there are other illnesses, such as CHF, that may be directly related to the sentinel AMI. The Canadian Cardiovascular Outcomes Research Team (CCORT) (Tran et al., 2003) has identified the importance of tracking illness such as CHF in the AMI follow-up period as one possible indicator of the quality of care that was received during the initial AMI. It was not the intention of this research to conclude that the presence of CHF post-AMI was an indicator of inadequate quality of care, but the occurrence of CHF was one of the illnesses that were tracked in study.

Finally, the readmission to hospital with the diagnosis of CHF and unstable angina was also considered an important outcome measure. The readmission data was collected at 30 days, one year and three years post-AMI discharge as recommended by Marciniak et al., 1998. These timeframes and the specific diagnosis of CHF and unstable angina have also been suggested as important variables to describe the post-AMI period by the CCORT (Tran et al., 2003).

Population-based trends in the health outcomes of patients who have had an AMI have not been studied as frequently as the outcomes after specific cardiac interventions such as CABG surgery (Gahli, Quan, Shrive, & Hirsch, 2003). Recently, Canadian researchers published a national study identifying the outcomes on the in-hospital mortality and hospital readmission rates for AMI survivors (Tu et al., 2003). The findings of the study indicated that the AMI mortality rate in Canada, especially in elderly and female patients is substantial, with significant variance among the provinces and regions (Tu, et al.). Recommendations by Tu et al. included the need for further research to identify the causes for the interregional variations in patient outcomes for the older adults and women. The proposed study adds further information about the regional and gender variations in the province of Manitoba, in the quality of care and the health outcomes after an AMI.

Summary

There is a significant amount of research identifying the importance of certain cardiac procedures in improving the health outcomes (Kennedy, Brien, & Tu, 2003; Tran, et al., 2003). Similarly, there has been an increasing amount of research completed in the last few years, describing the gender differences in the care of the AMI patients. However, the findings have been inconclusive, with some researchers identifying that the gender variation in treatments can be explained by differences in the clinical indicators (Gahli, et al., 2002; Rathore, et al., 2001). In contrast, other researchers have found that the differences in the cardiac procedures cannot be explained by the level of illness (Ayanian et al., 1991; Chandra et al., 1998; Tu et al., 2003). Most interesting is the lack of consistent finding that men in the population, who have more procedures, have better health outcomes (Rodrigues, et al., 2002).

Similarly, the research literature is inconclusive in identifying better outcomes for those who received the recommended discharge medications. Although extensive drug trials have shown a significant improvement in morbidity and a reduced population mortality after AMI in those using the medications, most of the studies have focused only on the in-hospital use and discharge medications within the first year after the AMI (ACE Inhibitor Myocardial Infarction Collaborative Group, 1998; Antiplatelet Trialists' Collaboration, 1994; Daneman, et al., 2000; Garg et al., 1995; Held et al., 1993; Ryan et al., 1999; Scandinavian Simvastatin Survival Study Group, 1994; Scott et al., 2000; Smith, 1990; The Beta-Blocker Pooling Project Research Group, 1988).

Regional variation in cardiac treatments has also become an area of interest in the last decade (Alter et al., 2003; Jamal et al., 2003; Hartford et al., 1998; Pilote et al., 1995; Rodrigues et al., 2002; Tu et al., 1997; Yusuf et al., 1998). As with the gender differences, the regional variation in cardiac treatments does not appear to consistently result in better outcomes (Rodrigues et al., 2002). Geographical differences in the use of the recommended medications have also been studied but again there is inconsistency as to the impact on the morbidity and mortality (Pilote et al., 1995; Rodrigues et al., 2002).

This study, based on a Population Health Model, was based on the assumption that there may well be other predictors of post-AMI health outcomes other than cardiac procedures and medication use. Although there have been other studies which included the Population Health Model variables such as the demographic and socio-economic variables, the inclusion of other potential predictive variables such as continuity of care and home care use have not been studied within the cardiac population. Finally, recognizing that although there is some indication that both gender and regional location influences the health outcomes, the inconsistency of the findings suggest there is a need to investigate whether these regional and gender variations exist when a comprehensive model is used to identify the effects of the independent predictors over a longer period after an AMI.

CHAPTER 3
METHODS

The methods chapter provides an overview of the data sources, the study design, and the Acute Myocardial Infarction (AMI) population of interest as well as the measures, methods, and the analyses used in the study. The process of preparation of the quantitative data for the analysis is also described.

Data Source

The Manitoba health administrative database (Manitoba Health Research Data Repository), which is housed at the Manitoba Centre for Health Policy (MCHP), was the primary data source. The database contains records for all individuals who access the provincial health care system, either through the physician's offices, acute care hospitals, and home care or through pharmaceutical prescriptions. Manitoba Health purges the databases of all personal identifiers before transfer to the MCHP. The specific files that were accessed included:

- Physician Data File — to access information about the specialty of physicians
- Medical Claims File — to examine pre- and post-AMI physician visits for continuity of care variable, pre-existing diseases (i.e., diabetes, hypertension)
- Hospital File — Discharge Abstract Database (DAD) to examine the hospital use patterns for AMI — admission and readmission; cardiac procedures, length of stay; ICU length of stay — index admission and readmission; readmission for cardiac procedures and post-AMI admission diagnosis of CHF and unstable angina
- Drug Programs Information Network (DPIN) — to access data about pharmaceutical use after AMI

- Home Care Data File — to be used for possible indicator of continuity of care
- Mortality File — from Vital Statistics — to identify post-discharge deaths
- Population Registry — to obtain information about gender, age, marital status
- Public Census data — to obtain relevant community (aggregate-level data only) on income quintiles

Study Design

The study used a retrospective, longitudinal design to identify the gender and regional differences in the quality of care and outcomes in the post-acute myocardial infarct (AMI) period for three cohorts of patients. These three cohorts were identified based on a diagnosis of AMI in the years 1996/97, 1997/98, and 1998/99. Each of the three cohorts was examined for specific variables three years pre-AMI and three years post-AMI. Data related to illness, health utilization, and death was extracted for the three years after the index event for the identified population.

Rationale for Methodology

Health administrative databases are the most comprehensive source for population studies which intend to identify service provision and utilization, physician billing, hospitalization discharge data, prescription drug claims, and other health related data. With current technology, it was feasible to use these comprehensive databases for this population study. Database analysis provided a means to study the gender and regional variations across geographical areas and specific patterns of health care utilization.

Finally, to achieve the purpose of the study within a reasonable timeframe, database analysis was the most appropriate.

The accessibility of large amount of data does not come without drawbacks (Black & Roos, 1998). Concerns about the accuracy, completeness, and comprehensiveness of the databases have been identified in a number of research studies (Blumberg, 1999; Hsia et al., 1998; Romano et al., 1999; Roos et al., 1991). However, the Manitoba databases have been validated extensively (Roos & Nichol, 1999; Roos et al., 1987; Roos et al., 1979). As well, these databases have been used for a variety of population health, clinical, epidemiological, and health policy studies (Black et al., 1999; Mustard et al., 1996; Roos & Mustard, 1997; Roos et al., 1997).

Research using population databases also provides ready access to populations that might otherwise not have been as accessible due to geographic location, political, and/or cultural issues. Similarly, sensitivity to gender issues might mitigate the inclusion of certain populations in primary data research. In contrast, the unobtrusive nature of database research eliminated these issues.

The cost of database research was also somewhat less than primary data collection, as data was already available on computer files, albeit there were other costs of accessing the data. The cost of collecting data through primary research methods for an entire population would have been prohibitive. The ready access to years of retrospective data as compared to searching primary documents for the data was another important reason in the selection of secondary data research methodology.

Another significant rationale for using secondary data was the confidence in both the comprehensiveness and the accuracy of the database. The diagnoses, the morbidity data, and the longitudinal record of service utilization were independent from the treatment site, and therefore the data could not purposefully be altered. The potential measurement errors were decreased as the study design was not dependent on subject recall, but rather the study used data that were collected and coded according to national and provincial standards. Recognizing that coding errors might exist within certain databases, this study was using data regularly verified for reliability and validity.

Researchers have demonstrated the accuracy of the cardiac diagnoses and procedures in administrative databases (Austin et al., 2002; Levy et al., 1999; Roos et al., 1991). In particular, AMI has been the most studied and accurately coded diagnosis, with sensitivity and specificity estimates of 90% or higher (Austin et al., 2002; Cox, Melady, Chen, & Naylor, 1997; Humphries et al., 2000; Jha, Deboer, Sykora, & Naylor, 1996; Levy, Tamblyn, Fitchett, McLeod, & Hanley, 1999; Richards, Brown, & Homan, 2001; Roos, Sharp, & Wajda, 1989). Secondary data research projects are by their very nature descriptive and as such, they cannot provide information about causal relationship. They can, however, provide valuable information about the burden of the disease and the type and extent of the health service utilization. Although prospective primary data collection may have provided more detailed outcome data (Cohen et al., 1999; Hannan et al., 1992; Pine et al., 1997; Romano, Roos, & Luft, 1994), numerous researchers have demonstrated that valid assessments can be made about patient outcomes with hospital discharge data (Gahli et al., 2000; Landon et al., 1996).

The correlational findings identified in this study can provide direction for the development of questions that need to be answered and the hypotheses that need to be tested in subsequent research using different methodologies.

Ethical Considerations

Database research is not dependent on provider approval or subject to agreement to participate and thus ethical approval for the research was less restrictive. Slaughter, Meslin, & Naylor (1994) recommend that one should assess three aspects in deciding whether or not consent needs to be sought for database research. First, they suggest that one needs to ensure that database research is truly research. Secondly, they recommend that there is confirmation that the findings will be used to improve equity and access to services for the entire population, and finally, that there will be neither harm nor benefit for an individual. As these requirements were met, the requirements to seek consent were appropriately waived.

Integrity, security, and confidentiality were further assured in this study through the formal agreements between the Manitoba Centre of Health Policy has with the provincial government, who is the trustee of the data. There are defined policies and procedures which control access and utilization of the databases. Most importantly, the routine scrambling of the personal identifiers ensured that there could be no tracking of information to a specific individual and therefore anonymity could be assured. The research received ethics approval by both The University of Manitoba and the Health Information Protection Committee (HPIC).

Information Handling System

The study data were in the form of computerized files that were derived from the Manitoba Health master files, Vital Statistics data, and public use Census data. The data was stored on tapes at the University of Manitoba, accessed via the Manitoba Centre for Health Policy's UNIX system, where stringent security measures are in place to protect the data files and to restrict access to the data.

Disposal of the Information

The results of the study were used to produce a completed thesis on the gender and geographical differences in the quality of care and the outcomes of an AMI. The data were presented in a form that prevented any patient, physician, hospital, or region to be identified. The data will remain within the secure environment of the MCHP for a period of five years and then will be destroyed in a confidential manner.

Access to Patients or Public

This study did not involve direct involvement with patients, the public, or physicians. The datasets that were used in the study did not contain any identifiable personal information. There were no names, addresses, or telephone numbers contained in the database and individual identifiers such as Manitoba Health numbers were scrambled so that they were not recognizable. The data are presented in summary form to ensure that individual identification is not possible. Cell sizes with fewer than five observations are suppressed. Adverse outcomes related to specific problems are presented in aggregate form only (e.g., rural versus urban), with no linkages to specific physicians.

The record linkage was not used for purposes that could be detrimental to the individuals involved, and the benefits that were derived from such a linkage were in the public interest.

Study Population

The residents of Manitoba who experienced an AMI in the years 1996, 1997, and 1998 comprised the research population. The population included all persons in the hospital records with the most responsible diagnosis of AMI.

Inclusion Criteria

All people with the most responsible diagnosis of AMI (*International Classification of Diseases*, 9th revision (ICD-9) code 410 with no limitation on the fifth digit comprised the population. Canadian studies have validated the accuracy of the coding of AMI in the hospital discharge databases (Austin et al., 2002; Humphries et al., 2000; Levy et al., 1999). Although AMI clinical validation criteria include the rise of troponin and rise and fall of creatinine kinase isoform-MB with at least one of the following: ischemic symptoms; development of pathological Q-waves on the ECG, and ECG changes indicative of ischemia. These criteria are currently not available in the administrative databases. Thus, only the ICD-9 code 410 was used to identify the AMI population. The population had to be between the ages of 20 and 105 years of age.

Exclusion Criteria

The exclusion criteria were similar to those identified by Kennedy et al. (2003) and Tu et al. (1999). Excluded were those who were under the age of 20 or over 105 years, those with an AMI coded as an in-hospital complication, and those who had an AMI admission within the preceding year. Those who died within the index hospitalization were not included in any further analyses (Tu et al. 2003). Although Kennedy et al. (2003) and Tu et al. (1999) also suggested those with a stay shorter than three days should also be excluded, as these persons might have had a diagnosis of a rule-out AMI rather than a confirmed diagnosis, this study included this segment of the population. With protocols for management of an AMI being initiated in the Emergency departments and with longer stays in the Emergency department, there is an increasing possibility that the diagnosis was accurate and that the hospitalization could be less than three days, and therefore, all those who had an AMI code were included in the study population.

A second exclusion criterion used by Tu et al. (2003), but not used in this study, was the exclusion of persons with an AMI diagnosis who had been transferred from another hospital. The researchers argued that there is the potential for the individual to be counted twice in the database. With the elimination of all duplicate records, there was no need to exclude persons based on transfers between hospitals. Also excluded were those who were from out of province; those who were in federal hospitals and nursing stations are not recorded in the databases and therefore they were not in the data used for this study. The population was grouped into three major regions: Winnipeg, South, and

Central/North based on processes recommended by Brownell et al. (2003). (See detailed description below.)

Measures

Population Health Model Determinants

The Population Health conceptual framework (Evans & Stoddart, 1994) provided the direction for the selection of the variables that were analyzed as possible predictors of the health outcomes identified as illness (i.e., CHF, Unstable Angina) and death in the three-year post-AMI period. Table 3.0 identifies the Population Health framework health determinants, the selected variables, and the database accessed to capture the variables of interest.

Table 3.0

Indicators of the Determinants of Health and Data Sources

Health Determinants	Variables	Type		Data Sources
		Predictor	Outcome	
Genetic Endowment	Age	^		Population
Registry				
Biology	Gender	^		
Social Environment	Income	^		Public Census
	Marital Status	^		
Physical Environment	Region	^		Public Census
Health & Function	Charlson Index	^		Medical Claims
	ADGs	^		DAD*
	Death		^	
Disease	Diabetes Mellitus	^		Medical Claims
	Hypertension	^		DAD
	CHF		^	DAD
	Unstable Angina		^	DAD
Health Care	Continuity of Care	^		Physician Database
	# of GP visits	^		
	# of Cardiologist visits	^		
	Home Care Visits	^		Home Care
Database				
	Index Admission			DAD
	➢ CABG	^		
	➢ PTCA	^		
	➢ Cardiac Cath	^		
	➢ LOS	^		
	➢ ICU days	^		
	Discharge Prescriptions			DPIN
	➢ ACEI	^	^	
	➢ Beta–blockers	^	^	
	➢ Statins	^	^	
	Readmission (30 day, 90 day)			DAD
	➢ CABG	^	^	
	➢ PTCA	^	^	
	➢ Cardiac Cath	^	^	

* Discharge Abstract Data

Variable Definitions

Genetic Endowment & Biology

Age. The age distribution was based on all persons in the population who were greater than 20 but less than 105 years of age. The population was categorized into four age groups based on the age at the time of the index AMI: 20–49 years of age, 50–64 years, 65–74 years, and 75 years and older.

Gender. Gender was defined as male or female at the time of the index AMI.

Prosperity

Neighborhood Income Level. Income quintile was based on the postal code and municipal code at the time of the index AMI. Based on previous research using the Manitoba databases, the entire population was assigned to five income groups based on their postal codes, which were sorted by average household income value (Roos & Mustard, 1997). Approximately 20% of the population was identified in each of the quintiles. Those who were in the lowest income quintile were identified as I_1 in the highest quintile as I_5. The quintiles were defined separately for the urban and the rural areas, but were subsequently combined for the inferential statistical analyses by means of combining the lowest two quintiles and the highest three quintiles to create two groups. Postal codes not recognized were given the value of nonassignable. Postal codes may be unrecognizable due to coding errors. The number of persons with a nonassignable postal code was 101. These individuals had to be excluded from the analyses.

Physical Environment

Region. Each individual's location of residence was identified within a regional health authority (RHA) boundary. The location was identified using the postal code that was stated at the time of the AMI. There were three people who did not have an RHA identified. Due to the very small numbers of people with an AMI in some of the RHAs, the 11 RHAs were combined into four groups, utilizing the process recommended by Brownell et al. (2003) in their study of premature mortality rates (PMRs). They identified that certain RHAs had similar PMRs. The researchers grouped those RHAs whose populations had PMRs significantly higher than the provincial average (i.e., indicating poorer health) into one group. This included the Nor–Man, Burntwood, and Churchill RHA. RHAs whose PMRs did not differ significantly from the provincial average were grouped into a second category: Marquette, Parkland, North Eastman, and Interlake. RHAs whose PMRs were significantly lower than the provincial average were classified into a third group: South Eastman, South Westman, Brandon and Central. These three regions are referred to as Northern, Central, and Southern respectively. Winnipeg represented the fourth category in their research.

Since the completion of Brownell et al. (2003)'s research, South Westman and Marquette RHAs have been amalgamated into one new RHA named Assiniboine. For the purpose of this study, the newly defined Assiniboine RHA was included in the Southern region, as it is most closely representative of other RHAs in the Southern group. A further reduction to three regions had to be made because of small numbers in the

Northern region. Thus, the three regional groups used in this study were Central/Northern (rural), Southern (rural) and Winnipeg (urban).

Social Environment

Marital Status. Three categories were used to identify the marital status: married, single and widowed, at the time discharge from the hospital after the index AMI episode.

Health and Function

Charlson Index. The Charlson Index (Charlson et al., 1987) is a measure of health, which contains 19 categories of comorbidity using the ICD-9-CM diagnostic codes. The 19 categories, based on similar diagnoses, have a weight calculated based on the adjusted risk of one-year mortality. The higher the cumulative score, the more severe the burden of comorbidity. The Charlson Index was used to identify the level of ill health at the time of the index AMI without differentiating between comorbidity and complications of the AMI.

Ambulatory Disease Grouper. A second indicator that identified the level of health, or in this case, the incidence of lack of wellness, was the Ambulatory Disease Grouper (ADG). This measure, based on the ICD-9/ICD-9-CM codes, categorizes diseases into 32 groups based on similar clinical and utilization criteria. The ADG assigned to an individual is based on the diagnosis of at least one of the diagnoses within the ADG over a one-year period. The number of ADGs is calculated for each individual in the entire population each year. Those with more than nine months of missing data (i.e., not covered by the provincial health system) do not have an ADG value calculated for that year. (See Appendix A for a fuller discussion on ADGs.) The ADGs for the population of interest were identified for the year before the index AMI. In the pre-AMI period, 12 (0.2%) did not have any ADG data; these were left as missing values so as not confuse them with the zero average ADGs. All those who died during the post-AMI three-year follow-up period should have had an ADG calculated and therefore should be included in the follow-up data.

Disease

Pre-AMI Disease. The pre-AMI diseases hypothesized to have an effect on the health outcomes after an AMI were diabetes mellitus and hypertension. These diseases were extracted from the hospital records and physician claims data using the codes 401 and 402 for hypertension and code 250 for diabetes mellitus.

Post-AMI Disease. In the post-AMI three-year follow-up period, the hospital readmissions were identified. The specific diseases for CHF (i.e., code 428.0 and unstable angina (i.e., code 411.0 and 411.1) were identified for the 30-days and 90-days post-AMI. These variables were designated as two of the health outcomes for this study.

Health Care

Physician Visits. In the two years prior to the index AMI, the number of visits to the General Practitioner (i.e., code 11) and the 46 Cardiologists (code 01— prior to 1998, code 04 — after 1998) were identified to differentiate the use of health services as a predictor of the health outcomes after the AMI.

Continuity of Care. The concept of continuity of care was another variable that was developed using the physician database. Continuity of care was defined in terms of majority of care. Consistent with previous research (Menec et al., 1999; Menec, 2005), a 50% majority of care definition was used. If 50% or more of the total number of ambulatory visits were made to the same general/family practitioners in the two years before the AMI and three years post-AMI, then the individual was identified as having high continuity of care. Those who had less than 50% of their visits to the same general/family practice physician in the pre- and post-AMI period were identified as having a low continuity of care. Those who saw only the same family practitioner were also identified. In a similar manner, continuity of care was identified for the visits to the cardiologist, both in the pre- and post-AMI period.

Home Care. Home care days were identified in both the year before the index AMI, and the year after the AMI. The persons identified as having had an assessment only were not included in the data set. People were classified as having home care versus those who did not have home care.

Hospitalization. The index hospitalization was identified using the separation diagnosis of AMI — code 410. The entire hospitalization for the index AMI was captured by means of identifying the episode of care. This ensured that any transfers made between hospitals and subsequent interventions were captured within the index hospitalization period. The length of stay (LOS) was calculated based on the hospital discharge data with AMI (code 410) as the most responsible diagnosis. Intensive Care

Unit (ICU) days were identified for the index admission and an average of all of the ICU days for the three year follow-up period was calculated. Readmission hospitalizations were captured in the three-year follow–up period.

Cardiac Procedures. The cardiac interventions of *CABG* Surgery (i.e., procedure code 36.1–36.16 or 36.19 in any field), *PTCA* (i.e., procedure code 36.01, 36.02, 36.03, 36.05, 36.06 in any field), and *cardiac catheterization* (i.e., procedure code 37.22, 37.23, 88.53–57) in any field were captured at the index event, at the 30-day and 90-day point after discharge for the index AMI.

Medications. The prescribed medications of interest were *statins*, *beta-blockers*, and *ACE-Inhibitors*. It was determined whether or not statins (i.e., code ATC*=C10AA), beta-blockers (i.e. code ATC=C07), and the ACEIs (i.e., code ATC=C09) were prescribed and filled within the 30 and 90 days post–index AMI period. (See Appendix A for further description of code ATC).

Death

The people who died within one and three-years post-AMI were identified.

Appendix A describes the various relevant variables as used within the Manitoba databases and it provides a more detailed description of the variables including where appropriate, the ICD-9 CM codes that were used to extract the data.

Analysis Approach

Using the accepted processes for data preparation and extraction from the eight databases, the data were prepared for analysis. The following section describes the processes which were used for each of the steps in the analysis.

Analysis of the Data

The data were analyzed using the SAS 6.12 software program (Statistical Analysis System Institute Inc.).

Both descriptive and inferential statistics were conducted. Descriptive statistical methods were used to identify the demographic parameters of the population who had an AMI. Continuous variables were expressed as mean $\pm$ SD and were compared by unpaired Student's *t* test or Wilcoxon ranked scores, when applicable. Chi-square tests were used for categorical variables. Frequency distributions, medians, and ranges were calculated as appropriate depending on the level of measurement for the variables of age, gender, geographical region, urban/rural location, income, prescription medication use, physician visits, and comorbidities including diabetes mellitus, hypertension, CHF, and unstable angina. Similarly, frequency distributions were calculated for the cardiac procedures, namely CABG surgery, PTCA, and cardiac catheterization. A series of hierarchical logistic regression analyses were calculated to identify the predictors of the health outcomes after the index AMI. Gender and regional variations for each of the independent variables were identified and tests of significance were completed.

Summary

Specifically, the following data were extracted from the previously identified databases in order to answer the research questions.

1) Are there gender difference after an acute myocardial infarction (AMI) in the quality of care received and health outcomes? If so, what are the differences in the quality of care and the health outcomes?

2) What are the regional variations in the quality of care received and the health outcomes for people who have had an acute myocardial infarction (AMI)?

The quality of care variables in the pre-AMI period were the continuity of care variable indicating consistent physician care, home care days, and access to physician care. At the time of the index AMI event the variables describing quality care were access to cardiac procedures (i.e., CABG surgery, PTCA, cardiac catheterization), and at discharge quality care was defined as having prescriptions for appropriate drugs (i.e., ACEIs, beta-blockers, and statins).

The health outcome variables were the readmission for CHF and unstable angina at 30 days and 90 days post-AMI discharge and readmission for cardiac procedures (i.e., CABG surgery, PTCA, cardiac catheterization). Mortality was identified for all causes within three years post-AMI.

3) What is nature of the relationship between quality of care and outcomes in the post-acute myocardial infarct period?

The quality of care variables and the health outcome variables were consistent with those used to answer questions 1 and 2 and all significant variables were included in the regression analysis. The variables examined were continuity of care (i.e., >50% visits to same General Practitioner and to same Cardiologist both pre- and post-index AMI), home care visits, prescriptions for certain pharmaceuticals, and cardiac procedures (i.e., CABG surgery, cardiac catheterizations, and PTCA).

CHAPTER 4
RESULTS

The first section of this chapter focuses on the description of the population before the index AMI, the variation in the treatments at the time of the AMI, and the health outcomes in the three years after the AMI. The second section identifies the predictors of the health outcomes after the AMI at the 30-day, 90-day, and the three-year follow-up time.

Social and Demographic Characteristics of the Population

Generally, each of the three cohorts had a comparable number of people who had had an AMI, with a total population of 4617 in the three years (Table 4.0).

Table 4.0
Frequency and Percent Distribution of AMI by Cohort Year

Year	Frequency			Percent
	Male	Female	n	
1996/97	1047	596	1643	35.6%
1997/98	979	536	1515	32.8%
1998/99	946	513	1459	31.6%
Total			4617	100%

The population was grouped into three major regions based on processes recommended by Brownell et al. (2003). The gender and regional distributions of the cases within the three cohorts are presented in Table 4.1.

Table 4.1
Population Distribution —Three Cohorts (1996/97; 1997/98; 1998/99)

Region	Gender		Age
	Male(n=2972)	Female(n=1645)	Mean(SD)
Central/North	601 (20.2%)	278(19.1%) = 879	66.53 (13.34)
South	754 (25.4%)	379 (24.5%) = 1133	69.43 (12.72)
Winnipeg	1617 (54.4%)	988 (56.4%) = 2605	68.15 (13.44)

Among the 4617 individuals who had their first AMI in the period between 1997 and 1999, there were 2972 males and 1645 females. The ages ranged from 21 years to 100 years, with an average age of 65 years.

As described in other studies, the women were older at the time of their first AMI as compared to men (Gohlke-Barwolf, 2000). The mean age for the first AMI in women in this study was 73.1 years as compared to the mean age of men, which was 65.4 years. There was a consistent decrease in the number of AMIs for both men and women in the three years of the study (Table 4.2).

Table 4.2
Gender and Age Comparisons at Index AMI

	Male (N 2972)			Female(N 1645)		
	Year			Year		
Age	96/97	97/98	98/99	96/97	97/98	98/99
20–49	156	131	121 (13.7%)	29	25	23 (5.0%)
50–64	297	311	307 (30.8%)	108	103	83 (17.5%)
65–74	292	278	249 (27.5%)	147	134	122 (24.5%)
75+	302	259	269 (27.9%)	312	275	285 (53%)
Total	1047	979	946	596	536	513

Although the main analyses focused on three regions only, an initial examination of all eleven RHAs was conducted for descriptive purposes to determine possible regional variation. The largest number of the population who had an AMI lived in the Winnipeg region, as compared to the other areas of the province. As approximately 66% of the province's population resides in the Winnipeg region, this difference in the incidence of AMI between the largely urban Winnipeg region and the other largely rural geographical regions was not unexpected.

There were gender differences in the age at which the AMI occurred within certain regions. Specifically, the Central (χ^2 29.382, df 3, p <0.0001), Interlake (χ^2 33.158, df 3, p<0.0001), Parkland (χ^2 23.374, df 3, p<0.0001) and Winnipeg (χ^2 212.606, df 3, p<0.0001) regions had significant gender differences in the age at which the AMI occurred. The lowest number of AMIs was in the 20–49 year age group for both men and women in all regions. Among women, there was a direct relation between age and the incidence of AMIs with the largest number of AMIs in the 75+age cohort. Only in the Central region was this pattern consistent among men with the highest incidence of AMI in the oldest age group. In some regions such as the Interlake region, there was an inverse relationship between age and incidence of an AMI in males, with a steady decrease in the number of AMIs with increase in age. In Winnipeg, the incidence of AMI among men was the highest in the 50–64 year age cohort with a decrease in the 65–74 cohort and then a slight increase in the 75+year cohort. In the Parkland region, the incidence of an AMI among men was highest in the 65–74 year age cohort.

Due to the small number of the AMI population in the eleven Regional Health Authorities (RHA), the data was then grouped for analysis using processes that have been used by other Manitoba researchers (Brownell et al., 2003) and described in the previous chapter. Winnipeg was the location for 56% of the AMI population in this study, followed by Central/Northern Regions at 27.6% (Table 4.3).

Table 4.3
RHA Location at Time of Index AMI

Location	Frequency	Percent
Central*/Northern*	1273	27.6%
Southern*	739	16.0%
Winnipeg	2605	56.4%
Total	4617	100%

*Central — includes the Interlake, Parkland, and North Eastman RHA.
Northern — includes Nor-Man, Burntwood, and Churchill RHA.
Southern — includes Brandon, Assiniboine, (formerly Marquette & South Westman), South Eastman, and Central RHA.

For descriptive purposes, Table 4.4 shows frequencies for all income quintiles, subsequently grouped into two categories (I_1 and I_2 versus I_3–I_5). The largest percentage (47.5%) of the study population was in the two lowest income quintiles (Table 4.4). There was a statistically significant difference between the men and the women, with 43% of the men and 51% of the women who had an AMI in the two lowest income quintiles. In contrast, in the upper three income quintiles, men had a larger representation (55.5%), as compared to the women (45.6%) in the same three quintiles.

Table 4.4
Income Quintile Differences by Gender at Index AMI for all Regions

Quintile*	Gender		Test of Significance	
	Male (n=2972)	Female (n=1645)	Total**	df 5
I_1	609 (20.4%)	465 (28.3%)	23.8%	χ^2 80.824 p<.0001
I_2	668 (22.5%)	372 (22.6%)	23.7%	
I_3	687 (23. %)	342 (20.8%)	21.2%	
I_4	498 (16.8%)	248 (15.1%)	17.8%	
I_5	467 (15.7%)	160 (9.7%)	13.5%	
Total			100% (N=4617)	

* The income quintiles are listed from lowest (i.e., I_1) to the highest income (i.e. I_5).
** Missing data for 43 males and 58 females.

When comparing the socioeconomic distribution of the AMI population within the three grouped regions (i.e., Central/North, South, and Winnipeg), the highest percentage of the population fell into the two lowest income categories. The Southern region had a significantly higher number of people in the third income quintile as compared to both Winnipeg and the Central/Northern region.

There was a statistically significant difference in the income between the sexes in the Winnipeg Region, with 30% of the women in the lowest income quintile as compared to 20% of the men. In the highest income quintile, there was 8% of the women and 16% of the men. There was no statistically significant difference in income between the sexes in the Central/Northern and Southern regions.

Health of the Study Population: Pre-AMI

The health of the study population prior to the AMI can affect the health outcomes included the study, namely readmission for CHF and unstable angina and mortality after the index AMI. The comorbidities of diabetes mellitus and hypertension, and the ADGs and Charlson Index were selected to identify the overall wellness of the study population.

In the study population, 26.6% (n=1228) had Diabetes Mellitus in the three years before the index AMI. There was a statistically significant difference in the diagnosis of diabetes mellitus in the age groups, with 65% of those with a diagnosis of Diabetes Mellitus, in the 65–75+ years group. There was a statistically significant difference in the diagnosis of Diabetes Mellitus between the men and women with the women having a higher prevalence (Table 4.5).

Table 4.5
Gender and Regional Variations in the Health of the Population before the Index AMI

Indicator	Gender		Region		
	Male (n = 2972)	Female (n =1645)	Central/North (n=1273)	South (n=739)	Winnipeg (n=2605)
Prevalence of Diabetes Mellitus	749 (25%)	479 (29%)	300(34.1%)	266(23.5%)	662(24.4%)
Prevalence of Hypertension	1038 (35%)	810 (50%)	379(43.1%)	394(34.8%)	1075(41.3%)
Charlson Index (Mean)	0.6(1.1)	0.7(1.1)	0.7(0.9)	0.5(0.9)	0.7(1.1)
ADGs (Mean)	3.5 (2.7)	4.4 (2.9)	3.7(2.8)	3.7(2.8)	4.0(2.8)

Hypertension was present in 40%, (n=1847) of the population of interest in the year before their AMI. The largest percentage, 42%, of the population with a diagnosis of hypertension was in the oldest age group of 75 years and older. The difference in the age of those who had hypertension was statistically significant. There was also a significant difference in the prevalence of hypertension between the men and women before the AMI (Table 4.5).

Analysis of the Charlson Index, a measure of health, indicated that 85.3% of the population had an index of 1 or less, meaning the population did not have any comorbidities identified in the year prior to the AMI. There was a statistically significant difference ($p=<.05$) between the sexes in the Charlson index in the year before the AMI.

In the year prior to the AMI, 9% of the population did not have any illnesses as identified by the lack of any identifiable Ambulatory Disease Groups (ADGs), and 89% had 1 to 10 ADGs. There was a significant difference between the sexes in the number of identified ADGs pre-AMI (Table 4.5).

Regional variations in the health of the population indicated that there was a statistically significant difference for both diabetes mellitus and hypertension between the three regions. The Central/Northern region had the highest prevalence of diabetes mellitus and hypertension, whereas the Southern region had the lowest for these two diseases. There were statistically significant differences in the number of ADGs and the Charlson Index among the three regions. The Central/Northern and Winnipeg regions had the same mean Charlson Index, which was significantly higher than that of the Southern region, and the Central/Northern and the Southern region had the same mean ADG score as compared to Winnipeg (Table 4.5).

Health Care Utilization: Pre-AMI

The variables capturing the utilization of health care before the index AMI included the number and frequency of visits to both cardiologists and general practitioners. The number of visits to a cardiologist in the two years before the AMI ranged from zero to 36 visits with 86% of the population having no cardiologist visits. In contrast to the number of cardiologist visits, the number of visits to the general practitioner (Family Physician) was significantly higher, with the range from zero visits to 110 visits. There was no significant difference between the men and women in the number of visits to the cardiologist, but women had a statistically significant higher number of general practitioner visits then did the men (Table 4.6).

Table 4.6
Gender Differences in Health Care Utilization before the Index AMI

Indicator		Gender		Test of Significance
Visits		Male(N=2972)	Female(N=1645)	Wilcoxon Two-Sample
Cardiologist (Mean)		0.4 (SD1.79)	0.3 (SD 1.29)	Z 0.0523 One-sided Pr>Z 0.4791 Two-Sided Pr>|Z0.9583 Z includes a continuity correction
General Practitioner (Mean)		11.8 (SD 10.7)	15.4 (SD 12.0)	Z 11.5683 One-Sided Pr> Z<0.0001 Two-Sided Pr>|Z|<0.0001 Z includes a continuity correction
Home Care	Yes	223 (7.5%)	364 (22.1%)	χ^2 204.07,df 1,
	No	2749 (92.5%)	1281(77.9%)	P<. 0001

Home care utilization, an indicator of a need for supportive and/or medical care because of ill health or disability, was identified in order to compare the level of home care use before and after the AMI. In the year before the AMI, 12.7% (587 people) of the AMI population received some type of home care services. Women had a significantly greater number of home care visits than men in the year before index AMI (Table 4.6).

Regional differences in these variables were also identified with a significant difference among the regions in the number of cardiologist visits. The highest average number of cardiologist visits was in Winnipeg and this difference between Winnipeg and the other two regions was statistically significant. The Central/Northern region and the Southern region had the same average number of cardiologist visits.

In contrast, the Central/Northern region had on average statistically significant more general practitioner visits than the Southern and Winnipeg region (Table 4.7). Regional variations in the average number of visits to the general practitioner ranged from 12 to 17 visits in the two years before the index AMI.

Table 4.7
Regional Variations in the Health Care Utilization before the Index AMI

Indicator	Region			Test of Significance
Visits	Central/Northern	Southern	Winnipeg	
Cardiologist (Mean)	0.1(SD 0.6)	0.1(SD 0.7)	0.5 (SD 2.1)	F 46.44,df 2, Pr>F <. 0001
General Practitioner (Mean)	14.9(SD 13.0)	13.8 (SD 11.7)	12.1(SD 10.4)	F 21.9,df 2, Pr>F <. 0001
Home Care	11.15%	11.39%	13. 82%	χ^2 6.6104,df 2, p 0.0367

There was a significant difference in the home care visits between the regions in the year before the index AMI, with Winnipeg having the highest percentage of home care visits (Table 4.7).

As a measure of continuity of care, the percentage of visits to the same physicians in the two years pre-AMI was identified. In 76% of the population, the same general practitioner was seen for more than 50% of their visits (Table 4.8).

Table 4.8
Percentage of Cases with Consistent Visits to the Same Physician for >50% of all Physician Visits: Two Years Pre-AMI

	General Practitioner >50% of visits	Cardiologist >50% of visits
	Frequency*	Frequency^
Consistent	3404 (76%)	609 (95%)
Not Consistent	1057 (24%)	32 (5%)
	* Frequency missing =156	^ Frequency missing =3976

There was no significant difference between the men and women in the frequency of visiting the same general practitioner or the same cardiologist for more than 50% of the visits in the two years before the index AMI.

In contrast, 95% of the population who saw cardiologists for their medical care visited the same cardiologists for more than 50% of their care in the two years before the AMI (Table 4.8). A significant number of the study population (n=3976) did not have any cardiologist visits before the AMI, indicating that they probably did not have any cardiac disease prior to the index AMI. The location of the most frequently seen general practitioner was either Winnipeg or Brandon at 63%, with the other 37% physician visits occurring in the remainder of the province.

Description of the Index AMI

At the time of the index AMI, the initial hospitalization was described using the variables of length of stay (LOS), ICU days, procedures-CABG surgery, PTCA, and cardiac catheterization. The initial hospitalization for the three cohorts indicated a wide variation in the variables of interest. The length of stay during the index hospitalization varied from 11% having no identified hospital days to 1% of the population having 80 or more hospital days.

CABG surgery was provided to 4% of the study population during the index hospitalization. Cardiac catheterization occurred in 23% of the population and PTCA occurred in 8% of the population. The average length of stay in the ICU during the index hospitalization was 22 days, with 91% not requiring any ICU days during the initial hospitalization period (Table 4.9).

Table 4.9
Initial Hospitalization Variables for Index AMI

Indicator	Frequency	Mean (s.d.)
Length of Stay		12 (21.2)
ICU Days		22.7(37.2)
CABG	200 (4.33%)	
PTCA	391 (8.47%)	
Cardiac Catheterization	1053 (22.81%)	

The gender variation in the identified admission variables indicated that women had a statistically significant longer hospital stay, but there was no statistically significant difference between men and women in the number of days in the ICU at the index AMI. There was, however, a statistically significant difference between men and women in the cardiac interventions at the time of admission for the AMI. More men had PTCA, cardiac catheterization, and CABG surgery than did the women at the time of the index AMI (Table 4.10).

Table 4.10
Gender Variations at the Time of Admission for the Index AMI

Indicator	Gender		Test of Significance
	Male n=2972	Female n=1645	α=0.05
Length of Stay (Mean)	10.71 (17.4)	14.4 (26.7)	t -5.61,df 4615, p<.0001
ICU Days (Mean)	0.1 (0.3)	0.12 (0.6)	t -1.41,df 2285, p 0.1575
CABG	140 (3%)	60 (1%)	χ^2 2.888,df 1, p 0.0892
PTCA	276 (9.3%)	115 (7%)	χ^2 7.200,df 1, p 0.0073
Cardiac Catheterization	727 (24.5%)	326 (19.8%)	χ^2 12.971,df 1, p 0.0003

Regional comparisons for the initial AMI hospitalization indicated that there was no statistical difference in the LOS (total hospital days) or the number of ICU days. However, there was a statistically significant difference in the number of cardiac interventions with people from Winnipeg having significantly more cardiac procedures than those from the other regions (Table 4.11).

Table 4.11
Regional Variations at the Time of Admission for the Index AMI

Indicator	Region			Test of Significance
	Central/Northern n=879	Southern n=1133	Winnipeg n=2605	
Length of Stay	11.9(SD15.4)	12.2(SD18.9)	11.9(SD 23.7)	ANOVA F= 0.06 Pr>F= 0.9434
ICU Days (Mean)	0.1(SD 0.34)	0.1(SD 0.6)	0.11(SD 0.4)	ANOVA F= 0.37 Pr > F=0.6933
CABG (Frequency)	42 (4.8%)	22 (2%)	136 (5%)	χ^2 21.007,df 3, p< .0001
PTCA	58 (7%)	58 (5%)	275 (10%)	χ^2 35.016, df 3, p< .0001
Cardiac Catheterization	167 (19%)	124 (11%)	762 (29%)	χ^2 159.253, df 3, p< .0001

Post Index AMI Trajectory

Variables that were measured to describe the post-AMI trajectory were the hospital readmission for CHF and unstable angina, the subsequent cardiac procedures (i.e., CABG surgery, PTCA, cardiac catheterization at 30 and 90 days), utilization of ACEI, beta-blockers, statins at 30 and 90 days, cardiologist and general practitioner visits, and home care utilization.

Within one year after the index AMI, 41% of the study population (n=1893) had been readmitted to the hospital for an average of 20 days (SD 53). In the 30-day period and the 90-day period post index AMI hospitalization, 11.5% and 23% of the population respectively were readmitted. In the three cohorts, 3% of the AMI population was admitted with a diagnosis of unstable angina and another 3% with a diagnosis of CHF within 30 days after discharge post index AMI. Within 90 days, after discharge for the index AMI, 7% of the readmissions had a diagnosis of unstable angina and 6% had a diagnosis of CHF. After one year the percentage of the population who was readmitted with a diagnosis of unstable angina had risen to 11% and those who had a readmission diagnosis of CHF had risen to 12%.

Within 30 days after the index AMI, of those who had been readmitted, 2% had a cardiac catheterization, 1% had CABG surgery, and 1% had PTCA. Within 90 days after discharge following the index AMI, 5% of those who were readmitted had a cardiac catheterization, 2.7% had CABG surgery, and 2% had PTCA. One year after the index AMI, 8% of those who were readmitted had a cardiac catheterization, 6% had a CABG, and 3.4% had PTCA. In the three years after the index AMI, 11.3% of the population were admitted to the ICU for a period ranging from 1 to 5 days, with the average being 0.14 days. In this same period, 2% of the population had a cardiac catheterization, 1% had CABG surgery, and 1% had PTCA.

In the total AMI population (N=4617) during the three-year follow-up period, 51% had 1 to 5 ADGs, 44% had 6 to10 ADGs and 5% had ≥ 11 ADGs identified in the physician visits, with an average of 6 ADGs (SD 2.4). The number of people who had one visit to a cardiologist in the four weeks after the AMI was 455 (10%). Most of the population (89%) did not visit a cardiologist in the four-week post AMI period. Ninety-five percent (95%) of the population who had a cardiologist visit in the three-year follow-up period went to the same cardiologist for more than 50% of their visits. The cardiologist who had the highest volume of patients also saw the largest number of this population (63%) as compared to the next highest volume cardiologist who saw 18% of those who saw a cardiologist in the follow-up period.

In contrast to the 11% who had a cardiologist visit in the four-week period after the AMI, 31% had a minimum of one visit, 26% had two visits, and 18% had between three and 5 visits to the general practitioner in the four-week post-AMI. In the three-year follow-up period, the average number of general practitioner visits was 21 (SD 17.6) in the three years, in contrast to the average number of cardiologist visits, which was 1.5 (SD 3.6). For those who went to see a general practitioner during the three-year follow-up period, 81% went to the same physician for 50% of their visits, and 53% of those, who saw a general practitioner went to the highest volume physician and another 31% went to the next highest volume physician.

Medications identified as important for post-AMI patients were tracked by identifying the percentage of the population that had filled the prescriptions. In the 30 days after the index AMI, 34% had prescriptions filled for ACEIs, 56% for beta-blockers and 14% for statins. Ninety days after the index AMI, 40% had prescriptions filled for

ACEIs, 61% had prescriptions filled for beta-blockers, and 21% had prescriptions filled for statins.

Home care assessments were completed for 5% of the AMI study population in the three-year follow-up period after the index AMI. In that period, 28% of those who utilized home care had between 1 and 1100 home care days with an average number of 137 days (SD 301).

Gender differences were very apparent in the post-AMI period. Women had a statistically significant greater percentage of readmissions for CHF within the 90 days after the AMI. During this same period, the men in the population had a significantly higher percentage of CABG surgeries and cardiac catheterizations as compared to women (Table 4.12).

Within 90 days, women had significantly more readmissions, but there was no corresponding significant increase in the cardiac procedures. In fact, within 90 days there was no statistically significant difference in the cardiac procedures between the men and women (Table 4.12).

Men also had more of the recommended prescriptions filled than did the women in the post-AMI period. Specifically, the men had statistically significant higher percentage of the recommended prescriptions of ACEIs, beta-blockers, and statins at both the 30- and 90-day period than did the women.

In contrast, women had significantly more home care visits than did the men in the three-year follow-up period, and women had significantly more general practitioner visits, but men had significantly more cardiologist visits than did the women (Table 4.12).

Table 4.12

Gender Variations in Health Care Utilization — Three-Year Follow-Up Period

Indicator		Male n=2972	Female n=1645	Test of Significance
Readmission				
CHF	30 day	75(2.5%)	57(3.5%)	χ^2 3.3797 df 1, p 0.0660
	90 day	153(5.2%)	134(8.2%)	χ^2 16.3239 df 1, p <.0001
Unstable Angina	30 day	103(3.5%)	47(2.9%)	χ^2 1.2475 df 1, p 0. 2640
	90 day	199(6.7%)	114(6.9%)	χ^2 0.0920 df 1, p 0. 7617
ICU days (Mean)		0.14(SD 0.4)	0.14(SD 0.4)	t 0.01, df 4615, p >. 9897
PTCA	30 day	34 (1.1%)	17 (1.0%)	χ^2 0.1185, df 1, p 0.7306
	90 day	61 (2.0%)	39 (2.4%)	χ^2 0.5064, df 1, p 0.4767
CABG	30 day	43 (1.4%)	9 (0.55%)	χ^2 7.697, df 1, p 0.0055
	90 day	90 (3.0%)	36 (2.2%)	χ^2 2.8134, df 1, p 0.0935
Cardiac Catheterization	30 day	83 (2.8%)	28 (1.7%)	χ^2 5.368, df 1, p 0.0205
	90 day	160 (5.4%)	70 (4.3%)	χ^2 2.847, df 1, p 0.0915
ACEI	30 day	980 (33%)	610 (37.1%)	χ^2 7.9132, df 1, p 0.0049
	90 day	1143 (38.5%)	700 (42.5%	χ^2 7.4010, df 1, p 0.0065
Beta-Blockers	30 day	1789 (60.2%)	812(49.4%)	χ^2 50.5216, df 1, p<.0001
	90 day	1924 (64.7%)	891(54.2%)	χ^2 49.7476, df 1, p<. 0001
Statins	30 day	480 (16.1%)	193 (11.7%)	χ^2 16.6003, df 1, p<.0001
	90 day	692 (23.3%)	297(18.0%)	χ^2 17.2026, df 1, p<. 0001
Home Care Utilization (Mean)		85.9 (SD 23.6)	231.7(SD 37.5)	t -16.16, df 4615, p<. 0001
Cardiologist Visits (Mean)		1.69(SD 3.8)	1.2(SD 3.0)	t 4.18, df 4615, p<. 0001
General Practitioner Visits (Mean)		21 (SD 17.2)	22(SD18.5)	t -2.37, df 4615 p<. 0176

Regional variation after the index AMI was also apparent. There was a statistically significant difference ($p<.05$) in the readmissions within the 30 and 90 days after the initial discharge from the hospital (Table 4.13). Winnipeg had the lowest readmission rate at both the 30 and 90-day period. The Central/Northern region had the greatest number of readmissions at the 30-day period and the Southern region had the greatest readmission at the 90-day period with both being statistically significant as compared to Winnipeg. There was no statistically significant difference among the regions in the number of ICU days after the index hospitalization, or in the cardiac procedures provided within the 30 and 90 days after the index AMI hospitalization, except for cardiac catheterizations. Winnipeg had statistically significantly more cardiac catheterizations within 90 days after the AMI.

Regional differences were also statistically significant in the prescriptions filled within the follow-up period. There was a statistically significant difference in the number of ACEI prescriptions among the regions within the 30 and the 90-day periods after the index AMI. The Southern region had a greater percentage of ACEI prescriptions, as compared to both Winnipeg and the Central/North regions (Table 4.13).

People in Winnipeg had a statistically higher number of cardiologist visits and the people in the Central/North region had more visits to the general practitioner than did the people in the South and Winnipeg region (Table 4.13). Winnipeg residents also had a significantly higher use of home care after the AMI than did the residents of the Central/Northern or the Southern regions.

Table 4.13
Regional Variations in Health Care Utilization — Three-Year Follow-Up

Indicator		Central/Northern n=879	Southern n=1133	Winnipeg n=2605	Test of Significance
ICU Days (Mean)		0.13(SD 0.4)	0.13(SD 0.4)	0.14(SD0.4)	ANOVA F=0.85, df 2, p< .4293
PTCA	30 day	10 (1.1%)	12 (1.1%)	29 (1.1%)	χ^2 0.032 , df 2, p< 0.9841
	90 day	18 (2.0%)	23 (2.0%)	59 (2.3%)	χ^2 0.277, df2, p< 0.8706
CABG	30 day	12 (1.4%)	8 (0.71%)	32 (1.3%)	χ^2 2.49, df 2, p<0.2878
	90 day	25 (2.8%)	28 (2.5%)	73 (2.8%)	χ^2 0.38, df 2, p<0.8269
Cardiac Catheterization	30 day	20 (2.3%)	21 (1.8%)	70 (2.7%)	χ^2 2.415, df 2, p< 0.2989
	90 day	33 (3.7%)	47 (4.1%)	150 (5.8%)	χ^2 7.78, df 2, p<0.0205
ACEI	30 day	318 (36.2%)	440 (38.8%)	832 (31.9%)	χ^2 18.087, df 2, p<.0001
	90 day	366 (41.6%)	508 (44.8%)	969 (37.1%)	χ^2 20.552 ,df 2 ,p<.0001
Beta-Blockers	30 day	475 (54%)	623 (55%)	1503 (57.7%)	χ^2 4.685, df 2, p<0.0961
	90 day	518 (58.9%)	681 (60%)	1616 (62%)	χ^2 3.132, df 2, p<0.2088
Statins	30 day	149 (16.9%)	155 (13.7%)	369 (14.2%)	χ^2 5.065, df 2, p<0.0795
	90 day	208 (23.7%)	234 (20.6%)	547 (21.%)	χ^2 3.299 ,df 2, p<0.1921
Home Care Utilization (Mean)		134(SD 296)	111(SD 277)	151(SD 313)	ANOVA F=6.89, df 2, p<.0010
Cardiologist Visits (Mean)		1.0(SD 2.0)	0.7(SD 1.7)	2.0(SD4.4)	ANOVA F=68.95 df 2, p<. 0001
General Practitioner Visits (Mean)		24.5(SD 19)	23(SD17.9)	20(SD17)	ANOVA F=28.85,df2, p<. 0001

Predictors of Quality of Care and Health Outcomes

The regional and gender differences which were apparent in the descriptive statistics required further investigation to ascertain whether they would continue to be significant if all other factors were controlled. In order to evaluate the impact of these factors on quality of care and health outcomes, it was imperative that the significant variables be included in a series of predictive models.

The first set of models was designed to answer the first two questions of the research study.

1) What are the gender differences after an acute myocardial infarction (AMI) in the quality of care received and the health outcomes?
2) What are the regional variations in the quality of care received and the health outcomes for people who have had an acute myocardial infarction (AMI)?

Logistic regression models were developed in a sequential process. Model I included the population health determinants of biology, genetic endowment (gender), prosperity, and social environment indicators. Gender and age were used as indicators of biology and genetic endowment, income level as prosperity, and marital status as social environment. In Model II, the regions were added, as they were significant variables in the descriptive analyses. In Model III the pre-AMI diseases of Diabetes Mellitus and hypertension, the ADGs, and the Charlson Index, statistically different for both gender and regions in the univariate analyses, were included in the model. In Model IV, pre-AMI continuity of care in relation to family practitioner was included as a possible predictor. There were both gender and regional differences in the general practitioner continuity of care variable in the descriptive statistical analyses. Although cardiologist visits were also captured and there was significant regional and gender variation, relatively few individuals had a cardiologist visit. Continuity of care in relation to cardiologists was therefore not included in the multivariate models that were conducted, as shown in Table 4.14. (Note that the Model IIIa was used only for analyses involving home care as the outcome measure.)

Table 4.14
Logistic Regression Predictor Variables

Model I. Sex, age groups, income groups, marital status
Model II. Model I + region (3 groups)
Model III. Model II + Pre-AMI — Diabetes, Hypertension, ADGs, Charlson Index
Model IIIa). Model II + home care pre-AMI
Model IV. Model III + Pre-AMI — Continuity of Care 50% visits to same GP

Outcome measures in these models included the following:

- Prescription for ACE inhibitors within 30 days and within 90 days
- Prescription for beta-blockers within 30 and 90 days
- Prescriptions for statins within 30 and 90 days
- PTCA at index admission and at 30 and 90 days
- Cardiac catheterizations at index admission and within 30 and 90 days
- CABG at index admission and within 30 and 90 days

- Home care use three years after the AMI
- Readmission with a diagnosis of CHF within 30 days and 90 days
- Readmission with a diagnosis of unstable angina within 30 and 90 days
- Mortality — within one and three years after the AMI

Prescription for Recommended Medications

Predictors for ACEI Prescriptions. Within the four logistic regression models developed to identify the predictors for the recommended prescriptions, the gender and regional variation noted in the descriptive analyses did not necessarily translate into predictors for the prescriptions for the recommended medications. In the models for the ACEI prescriptions, region was a predictor but gender was not evident in any of the models (Table 4.15).

Table 4.15
Multivariate Predictors of Prescriptions for ACEIs within the 30 Days after the Index AMI

Variables	Model I OR(CI)	Model II OR(CI)	Model III OR(CI)	Model IV OR(CI)
Gender (Male)	n.s	n.s.	n.s.	n.s.
Age				
50–64	1.579(1.241-2.009)	1.576(1.238-2.006)	1.484(1.162-1.895)	1.465(1.140-1.881)
65–74	1.675(1.316-2.131)	1.652(1.298-2.103)	1.511(1.181-1.933)	1.479(1.1501.903)
75+	1.742(1.374-2.209)	1.726(1.361-2.191)	1.639(1.283-2.093)	1.595(1.2412.049)
Income (I_{1-2})	n.s.	n.s.	n.s.	n.s.
Marital				
Single	1.325(1.104-1.589)	1.338(1.115-1.606)	1.345(1.117-1.619)	1.382(1.146-1.668)
Widowed	n.s.	n.s.	n.s.	n.s.
Region				
Central/North	________	1.242(1.055-1.461)	n.s.	1.211(1.023-1.432)
South	________	1.340(1.156-1.554)	1.387(1.193-1.612)	1.428(1.226-1.664)
Diabetes	________	________	1.516(1.302-1.766)	1.529(1.310-1.784)
Hypertension	________	________	1.419(1.246-1.616)	1.441(1.263-1.644)
ADG (pre-)	________	________	0.974(0.951-0.998)	n.s.
Charlson Index (pre)	________	________	n.s.	n.s.
COC (pre-)	________	________	________	n.s.

*n.s = not significant; ________ not included in the model

The location of residence of the study population was a predictor of ACEI prescriptions, with the Central/Northern and the Southern regions having increased odds of having a prescription for ACEIs as compared to those who lived in Winnipeg. Even when the pre-AMI diseases were included in the model (Model III and Model IV), there continued to be an increased odds of having prescriptions for ACEIs in the Central/North and the South as compared to Winnipeg. Age was a predictor of ACEI prescriptions in all four models, with those who were older than 49 years of age having increased odds of having prescriptions for ACEIs.

Other predictors which increased the odds of having prescriptions for ACEIs included being single and having a pre-AMI diagnosis of diabetes and hypertension. The same predictors were used in the four models to identify the prescriptions for the ACEIs at the 90-day period after the AMI (Table 4.16).

Table 4.16
Multivariate Predictors of Prescriptions for ACEIs 90 Days after Index AMI

Variables	Model I OR(CI)	Model II OR(CI)	Model III OR(CI)	Model IV OR(CI)
Gender (Male)	n.s.	n.s.	n.s.	n.s.
Age				
50–64	1.658(1.315-2.091)	1.656(1.313-2.089)	1.518(1.198-1.924)	1.504(1.180-1.915)
65–74	1.892(1.500-2.387)	1.868(1.480-2.357)	1.636(1.289-2.077)	1.608(1.260-2.051)
75+	1.833(1.458-2.305)	1.817(1.444-2.286)	1.629(1.285-2.065)	1.598(1.254-2.037)
Income (I_{1-2})	n.s.	n.s.	n.s.	n.s.
Marital Status				
Single	n.s.	n.s.	1.207(1.004-1.450)	1.227(1.019-1.478)
Widowed	n.s.	n.s.	n.s.	n.s.
Region				
Central/North	________	1.238(1.056-1.450)	n.s.	1.200(1.018-1.414)
South	________	1.356(1.174-1.567)	1.436(1.239-1.664)	1.469(1.264-1.706)
Diabetes	________	________	1.545(1.330-1.796)	1.559(1.339-1.815)
Hypertension	________	________	1.753(1.544-1.990)	1.782(1.567-2.017)
ADG (pre-)	________	________	n.s.	n.s.
Charlson Index (pre)	________	________	n.s.	n.s.
COC (pre-)	________	________	________	n.s.

*n.s = not significant; ________ not included in the model

Gender was not a predictor for the prescriptions of ACEIs in any of the models at 90 days post-AMI. As was evidenced in the 30-day post-AMI regression models, older people had greater odds of having prescriptions for ACEIs than did the under 50-age group. Those who lived in the Central/Northern and Southern regions of the province had greater odds of having ACEI prescriptions within the 90 days after the AMI and those with pre-AMI diabetes and hypertension had greater odds of having ACEI prescriptions.

Predictors for Beta-Blockers Prescriptions. As for the ACEIs, four logistic regressions were developed and analysed to identify the predictors for the prescriptions for beta-blockers at the 30 and the 90-day period after the AMI. (See Tables 4.17, 4.18.)

Table 4.17
Multivariate Pre-AMI Predictors for Beta-Blockers Prescriptions within 30 Days after Index AMI

Variables	Model I	Model II	Model III	Model IV
	OR(CI)	OR(CI)	OR(CI)	OR(CI)
Gender (Male)	n.s.	n.s.	n.s.	n.s.
Age				
50–64	0.661(0.516-0.848)	0.659(0.513-0.845)	0.693(0.535-0.897)	0.693(0.532-0.901)
65–74	0.387(0.303-0.495)	0.386(0.302-0.494)	0.431(0.334-0.556)	0.435(0.335-0.564)
75+	0.212(0.167-0.271)	0.209(0.164-0.267)	0.242(0.188-0.312)	0.240(0.185-0.311)
Income ($I_{1\text{-}2}$)	0.838(0.740-0.949)	0.839(0.740-0.951)	0.877(0.771-0.997)	0.866(0.760-0.987)
Marital Status				
Single	n.s.	n.s.	n.s.	n.s.
Widowed	n.s.	n.s.	n.s.	n.s.
Region				
Central/North	________	0.762(0.648-0.897)	0.768(0.650-0.909)	0.768(0.648-0.910)
South	________	n.s.	0.847(0.727-0.986)	0.844(0.723-0.986)
Diabetes	________	________	n.s.	n.s.
Hypertension	________	________	n.s.	n.s.
ADG (pre-)	________	________	0.953(0.930-0.976)	0.954(0.930-0.978)
Charlson Index (pre)	________	________	0.680(0.632-0.731)	0.674(0.26-0.726)
COC (pre-)	________	________	________	n.s.

*n.s = not significant; ________ not included in the model

Table 4.18
Multivariate Pre-AMI Predictors of Beta-Blockers Prescriptions within 90 Days after Index AMI

Variables	Model I OR(CI)	Model II OR(CI)	Model III OR(CI)	Model IV OR(CI)
Gender (Male)	n.s.	n.s.	1.18(1.00-1.40)	n.s.
Age				
50–64	0.713(0.548-0.929)	0.710(0.545-0.925)	0.734(0.558-0.966)	0.725(0.548-0.960)
64–74	0.380(0.294-0.492)	0.379(0.292-0.490)	0.412(0.315-0.539)	0.411(0.312-0.541)
75+	0.209(0.163-0.270)	0.206(0.160-0.266)	0.231(0.177-0.302)	0.228(0.174-0.299)
Income (I_{1-2})	0.809(0.713-0.919)	0.812(0.715-0.922)	0.852(0.747-0.972)	0.846(0.740-0.967)
Marital Status				
Single	n.s.	n.s.	n.s	n.s.
Widowed	n.s.	n.s.	n.s.	n.s.
Region				
Central/North	______	0.778(0.660-0.918)	0.778(0.655-0.923)	0.846(0.740-0.967)
South	______	n.s.	n.s.	n.s.
Diabetes	______	______	n.s.	n.s.
Hypertension	______	______	n.s.	n.s.
ADG (pre-)	______	______	0.957(0.934-0.981)	0.958(0.934-0.982)
Charlson Index (pre)	______	______	0.666(0.620-0.716)	0.662(0.616-0.712)
COC (pre-)	______	______	______	n.s.

*n.s = not significant; ______ not included in the model

Gender was not a predictor for the prescriptions for beta-blockers within the 30 or the 90-day period. Age and location of residence were predictors for beta-blocker prescriptions as they were for ACEIs. Those who were 50 years or older were less likely to receive beta-blockers than those 49 years and younger. With each increasing age category there was a decreased likelihood that the population would receive beta-blockers. Residents of the Central/Northern region were less likely to have prescriptions for beta-blockers, at both the 30 and 90-day periods. The southern region also had lower odds of having beta-blocker prescriptions than did Winnipeg but only at the 30-day period.

Income was a predictor for the prescriptions for beta-blockers, with individuals in the two lower income groups having reduced odds of having prescriptions than those in the three higher groups. Whereas the pre-AMI diagnosis of diabetes and hypertension were predictors for the ACEI prescriptions, pre-AMI ADGs and the presence of a pre-AMI Charlson Index were predictors for beta-blocker prescriptions within the 30 and 90 day period after the AMI.

Predictors for Statin Prescriptions. Prescriptions for the statins within 30 and 90 days after the AMI were analyzed with the same four regression models as were used for ACEIs and beta-blockers (Tables 4.19 and 4.20).

Table 4.19

Multivariate Pre-AMI Predictors of Prescriptions for Statins within 30 Days after Index AMI

Variables	Model I OR(CI)	Model II OR(CI)	Model III OR(CI)	Model IV OR(CI)
Gender (Male)	n.s.	n.s.	n.s.	n.s.
Age				
50–64	n.s.	n.s.	n.s.	n.s.
65–74	0.5311(0.405-0.696)	0.533(0.407-0.699)	0.531(0.403-0.699)	0.566(0.428-0.750)
75+	0.230(0.170-0.310)	0.232(0.172-0.314)	0.235(0.172-0.320)	0.239(0.174-0.328)
Income (I_{1-2})	n.s.	n.s.	n.s.	n.s.
Marital				
Single	0.735(0.564-0.958)	0.738(0.567-0.962)	0.766(0.588-0.999)	n.s.
Widowed	n.s.	n.s.	n.s.	n.s
Region				
Central/North	______	n.s.	n.s.	n.s.
South	______	n.s.	n.s.	n.s.
Diabetes	______	______	n.s.	n.s.
Hypertension	______	______	1.272(1.065-1.520)	1.260(1.053-1.509)
ADG (pre-)	______	______	n.s.	n.s.
Charlson Index (pre)	______	______	n.s.	0.900(0.811-0.999)
COC (pre-)	______	______	______	n.s.

*n.s = not significant; ________ not included in the model

Table 4.20
Multivariate Predictors of Prescriptions for Statins within 90 Days Post Index AMI

Variables	Model I OR(CI)	Model II OR(CI)	Model III OR(CI)	Model IV OR(CI)
Gender (Male)	n.s.	n.s	n.s.	n. s.
Age				
50–64	n.s.	n.s.	n.s.	n.s.
65–74	0.579(0.456-0.734)	0.579(0.457-0.735)	0.599(0.470-0.764)	0.628(0.491-0.805)
75+	0.203(0.156-0.264)	0.204(0.156-0.266)	0.214(0.163-0.281)	0.213(0.161-0.281)
Income (I_{1-2})	n.s.	n.s.	n.s.	n.s.
Marital				
Single	0.706(0.563-0.887)	0.708(0.564-0.890)	0.730(0.581-0.919)	0.737(0.585-0.930)
Widowed	n.s.	n.s.	n.s.	n.s.
Region				
Central/North	______	n.s.	n.s.	n.s.
South	______	n.s.	n.s.	n.s.
Diabetes	______	______	n.s.	n.s.
Hypertension	______	______	1.239(1.060-1.448)	n.s.
ADG (pre-)	______	______	0.966(0.938-0.996)	0.962(0.932-0.992)
Charlson Index (pre)	______	______	0.887(0.811-0.970)	0.885(0.808-0.969)
COC (pre-)	______	______	______	n.s.

*n.s = not significant; ______ not included in the model

As for prescriptions for beta-blockers, those who were 65 years or older were less likely to have received prescriptions for statins. However, there were no regional predictors as there had been for the beta-blockers. The level of income and the pre-AMI diagnosis of diabetes were not predictors but those in the study population with a pre-AMI diagnosis of hypertension were more likely to receive statins and those with a greater number of pre-AMI ADGs and a higher Charlson Index were less likely to receive prescriptions for statins.

Summary

The strongest predictor for the prescriptions for recommended medications was age, although the pattern of findings was inconsistent across the different prescription drugs. The 50 years or older age group was more likely to have received prescriptions for ACEIs, but the reverse was true for the statins and the beta-blockers. Namely, those in the population who were in the three oldest age categories were less likely to receive prescriptions for beta-blockers and those who were in the two oldest age categories were less likely to receive statins. The side effects of the beta-blockers and statins, the decision to adhere to only one medication regime or a change in the illness as the population ages may account for this pattern of medication prescriptions.

Location of residence also predicted the odds of receiving the recommended prescriptions for the ACEIs and the beta-blockers. The odds of having prescriptions for the ACEIs were the greatest for individuals that lived in the Central/North and the South regions as compared to those living in the Winnipeg region. In contrast, those who lived in the Central/North and South regions were less likely to have prescriptions for beta-blockers as compared to those who lived in the Winnipeg region. Residents of the Central/North and South region may have been prescribed the ACEIs for pre-existing hypertension as compared to Winnipeg residents. Residents of the Central/North region did have the highest percentage of hypertension of the entire population. The regression models, indeed, showed that the pre-AMI diagnoses of diabetes and hypertension were predictors for the ACEIs prescriptions, as expected as, as ACEIs are being prescribed more frequently now for hypertension. A greater number of ADGs and a higher Charlson Index were also associated with increased odds of having prescriptions for beta-blockers and the statins. Hypertension was also a consistent predictor of Statin prescriptions.

Predictors for Cardiac Procedures

The descriptive information shown above demonstrated that at the time of the admission to hospital for the AMI, there were some significant gender and regional variations in the cardiac procedures. As for the prescription drugs, possible predictors for the cardiac procedures at the index admission were entered stepwise into a series of logistic regressions. Model I included all of the demographic variables. Model II included the region, and in Model III, pre-AMI illness and health variables were added. Finally, Model IV included continuity of care. Table 4.21 shows results for Model III for cardiac procedures at index admission.

Table 4.21
Multivariate Predictors for Cardiac Procedures at Index Admission

Variables	Model III OR(CI) PTCA	Model III OR(CI) Cardiac Catheterization	Model III OR(CI) CABG
Gender (Male)	n.s.	n.s.	n.s.
Age			
50–64	0.680(0.498-0.927)	0.674(0.534-0.850)	n.s.
65–74	0.490(0.352-0.685)	0.463(0.363-0.590)	2.203391.143-3.614)
75+	0.233(0.160-0.340)	0.201(0.155-0.262)	n.s.
Income (I_{1-2})	0.795(0.637-0.994)	n.s.	n.s.
Marital Status			
Single	n.s.	n.s.	n.s
Widowed	n.s.	n.s	n.s
Region			
Central/North	0.562(0.415-0.760)	0.512(0.421-0.624)	n.s
South	0.443(0.328-0.598)	0.285(0.231-0.353)	0.338(0.211-0.540)
Diabetes	n.s.	n.s.	n.s.
Hypertension	n.s.	1.196(1.026-1.395)	1.461(1.087-1.964)
ADG (pre-)	n.s.	n.s.	n.s.
Charlson Index (pre)	0.816(0.705-0.944)	0.888(0.816-0.965)	n.s.

*n.s = not significant; ________ not included in the model

Those who were older than 50 years of age were less likely to have a PTCA or cardiac catheterization than those who were younger than 50 years of age. Those who were in the lower income groups were also less likely to have PTCA. Regional variation was evident with those in the areas outside of Winnipeg being less likely to have PTCA or cardiac catheterizations than those in Winnipeg. However, age was not a consistent predictor for the all of the cardiac procedures, as those who were in the 65–74 years of age were more likely to have CABG surgery than the other age groups. Similarly, region was not a consistent predictor of having CABG surgery, although those who lived in the South were less likely to have CABG than those from the other regions. The pre-morbid condition of hypertension did predict a greater likelihood for the use of cardiac catheterizations and CABG surgery. Those with a higher Charlson Index indicating compromised health were less likely to have a PTCA and a cardiac catheterization.

Analogous analyses were then conducted for cardiac procedures within 30 and 90 days post-AMI. The results indicated that there were no predictive variables for CABG surgery within 30 days.

Table 4.22 shows that only age was a predictor for CABG surgery at 90 days, with those who were 75 years or older being less likely to have CABG surgery.

Table 4.22
Multivariate Predictors for CABG Surgery 90 Days after AMI

Variables	Model I OR(CI)	Model II OR(CI)	Model III OR(CI)	Model IV OR(CI)
Gender (Male)	n.s.	n.s.	n.s.	n.s.
Age				
50–64	n.s.	n.s.	n.s.	n.s
65–74	n.s.	n.s.	n.s.	n.s.
75+	0.424(0.215-0.835)	0.427(0.217-0.843)	0.428(0.214-0.856)	0.422(0.207-0.861)
Income (I_{1-2})	n.s.	n.s.	n.s.	n.s.
Marital Status				
Single	n.s.	n.s.	n.s.	n.s
Widowed	n.s.	n.s	n.s.	n.s
Region				
Central/North	____	n.s.	n.s.	n.s.
South	____	n.s.	n.s.	n.s.
Diabetes	____	____	n.s.	n.s.
Hypertension	____	____	n.s.	n.s.
ADG (pre-)	____	____	n.s.	n.s.
Charlson Index (pre)	____	____	n.s.	n.s.
COC (pre-)	____	____	____	n.s.

*n.s = not significant; ________ not included in the model

The consistent predictor for having a PTCA within the 30 and the 90-day period after the AMI was age. Those who were 65 years or older were less likely to have a PTCA within 30 days after the AMI than those who were 64 years or younger (Table 4.23).

Table 4.23
Multivariate Predictors for PTCA 30 Days after AMI

Variables	Model I OR(CI)	Model II OR(CI)	Model III OR(CI)	Model IV OR(CI)
Gender (Male)	n.s.	n.s.	n.s.	n.s.
Age				
50–64	n.s.	n.s.	n.s.	n.s.
65–74	0.394(0.163-0.955)	0.394(0.163-0.956)	0.383(0.156-0.940)	n.s.
75+	0.128(0.041-0.397)	0.127(0.041-0.397)	0.117(0.037-0.375)	0.133(0.041-0.436)
Income (I_{1-2})	n.s.	n.s.	n.s.	n.s.
Marital Status				
Single	n.s.	n.s.	n.s.	n.s
Widowed	n.s.	n.s	n.s.	n.s
Region				
Central/North	______	n.s.	n.s.	n.s.
South	______	n.s.	n.s.	n.s.
Diabetes	______	______	n.s.	n.s.
Hypertension	______	______	n.s.	n.s.
ADG (pre-)	______	______	n.s.	n.s.
Charlson Index (pre)	______	______	n.s.	n.s.
COC (pre-)	______	______	______	n.s.

*n.s = not significant; ________ not included in the model

Within 90 days after the AMI, those who were 75 years or older had decreased odds of having a PTCA (Table 4.24). Gender differences were found at the 90-day period with men being less likely to have PTCA within the 90-day period after the AMI (Table 4.24).

Table 4.24
Multivariate Predictors for PTCA 90 Days after AMI

Variables	Model I OR(CI)	Model II OR(CI)	Model III OR(CI)	Model IV OR(CI)
Gender (Male)	0.511(0.324-0.804)	0.513(0.325-0.808)	0.523(0.330-0.830)	0.497(0.311-0.793)
Age				
50–64	n.s.	n.s.	n.s.	n.s.
65–74	n.s.	n.s.	n.s.	n.s.
75+	0.145(0.062-0.339)	0.144(0.061-0.337)	0.143(0.060-0.342)	0.165(0.067-0.401)
Income (I_{1-2})	n.s.	n.s.	n.s.	n.s.
Marital Status				
Single	n.s.	n.s.	n.s.	n.s
Widowed	n.s.	n.s	n.s.	n.s
Region				
Central/North	______	n.s.	n.s.	n.s.
South	______	n.s.	n.s.	n.s.
Diabetes	______	______	n.s.	n.s.
Hypertension	______	______	n.s.	n.s.
ADG (pre-)	______	______	n.s.	n.s.
Charlson Index (pre)	______	______	n.s.	n.s.
COC (pre-)	______	______	______	n.s.

*n.s = not significant; ________ not included in the model

The third cardiac procedure, which was identified as having significant gender and regional variation in the descriptive analyses, was cardiac catheterization. However, as with the other cardiac procedures, gender was not an independent predictor of having a cardiac catheterization after the AMI. At the 75-year and older stage, age was a consistent predictor when all of the other variables were controlled in the four models. Individuals in the 75 years and older category were less likely to have a cardiac catheterization within the 30 days after the AMI. The pre-AMI Charlson Index was also an independent variable with those who had a higher Charlson Index having increased odds of having a cardiac catheterization at 30 days (Table 4.25).

Table 4.25
Multivariate Predictors for Cardiac Catheterization 30 Days after AMI

Variables	Model I OR(CI)	Model II OR(CI)	Model III OR(CI)	Model IV OR(CI)
Gender (Male)	n.s.	n.s.	n.s.	n.s.
Age				
50–64	n.s.	n.s.	n.s.	n.s.
65–74	n.s.	n.s.	n.s.	n.s.
75+	0.337(0.176-0.644)	0.343(0.179-0.656)	0.343(0.179-0.656)	0.378(0.192-0.746)
Income (I_{1-2})	n.s.	n.s.	n.s.	n.s.
Marital Status				
Single	n.s.	n.s.	n.s.	n.s
Widowed	n.s.	n.s	n.s.	n.s
Region				
Central/North	_____	n.s.	n.s.	n.s.
South	_____	n.s.	n.s.	n.s.
Diabetes	_____	_____	n.s.	n.s.
Hypertension	_____	_____	n.s.	n.s.
ADG (pre-)	_____	_____	n.s.	n.s.
Charlson Index (pre)			0.730(0.550-0.969)	0.694(0.515-0.935)
COC (pre-)	_____	_____	_____	n.s.

*n.s = not significant; _______ not included in the model

Within the 90 days after the AMI, age continued to be a predictor for a cardiac catheterization, as did region and the Charlson Index (Table 4.26). For those who were 75 years or older, the odds of having a cardiac catheterization were reduced. Regional location was an independent predictor. Residents of the Central/Northern or Southern regions had decreased odds of having a cardiac catheterization within the 90 days after the AMI, as compared to those who lived in the Winnipeg region. As was noted in the 30-day period after the AMI, those who had a higher Charlson Index had decreased odds of having a cardiac catheterization within the 90 days after the surgery (Table 4.26).

Table 4.26

Multivariate Predicators for Cardiac Catheterization 90 Days after AMI

Variables	Model I	Model II	Model III	Model IV
	OR(CI)	OR(CI)	OR(CI)	OR(CI)
Gender (Male)	n.s.	n.s.	n.s.	n.s.
Age				
50–64	n.s.	n.s.	n.s.	n.s.
65–74	n.s.	n.s.	n.s.	n.s.
75+	0.401(0.245-0.658)	0.399(0.243-0.656)	0.391(0.236-0.650)	0.388(0.231-0.650)
Income (I_{1-2})	n.s.	n.s.	n.s.	n.s.
Marital				
Single	n.s.	n.s.	n.s.	n.s.
Widowed	n.s.	n.s.	n.s.	n.s.
Region				
Central/North	______	0.607(0.412-0.895)	0.617(0.418-0.910)	0.639(0.432-0.946)
South	______	0.695(0.494-0.978)	0.689(0.489-0.970)	n.s.
Diabetes	______	n.s.	n.s.	n.s.
Hypertension	______	n.s.	n.s.	n.s.
ADG (pre-)	______	n.s.	n.s.	n.s.
Charlson Index (pre)	______	n.s.	0.804(0.671-0.962)	0.781(0.648-0.942)
COC (pre-)	______	______	______	n.s.

*n.s = not significant; ________ not included in the model

Summary

Those who were in the oldest age group (75+ years) were less likely to have any of the three cardiac procedures within the follow-up period after the AMI. When all other variables were controlled, age was the only consistent predictor of CABG surgery, PTCA, and cardiac catheterizations. The presence of a higher Charlson Index score in the pre-AMI period was a predictor for a cardiac catheterization in the follow-up period.

Regional differences, which were highly significant in the descriptive statistics, were still apparent in the multivariate analyses, with location of residence being an independent predictor for all cardiac procedures at the Index admission. Some regional variation was also evident in the follow-up period, with those who lived outside of Winnipeg having decreased odds of having a cardiac catheterization.

Finally, the men in the population were less likely to have a PTCA within the 90-day period after the AMI. According to the descriptive statistics, significantly more men then women had a PTCA at the time of the admission for the index AMI. Therefore, it may be that the men who needed a PTCA had the PTCA at the index admission, whereas the women had the PTCA at different points within the period between the discharge from the hospital and the 90-day period.

Predictors for Home Care Use

There was both regional and gender variation in the use of home care services prior to the AMI in the descriptive analyses. However, when the previously identified variables were entered into Model I, II, and III there were no predictors for home care use. An expansion of Model III was developed to include the pre-AMI home care visits. The results indicated that all of the variables in the model were independent predictors except for pre-AMI hypertension and a pre-AMI Charlson Index (Table 4.27).

Table 4.27
Multivariate Predicators for Home Care Use after AMI

Variables	Model III
	OR (CI)
Gender (Male)	0.685(0.572-0.820)
Age	
50–64	1.873(1.282-2.735)
65–74	4.423(3.068-6.377)
75+	8.605(5.986-12.371)
Income (I_2)	1.194(1.034-1.379)
Marital Status	
Single	1.403(1.138-1.731)
Widowed	1.549(1.207-1.988)
Region	
Central/North	0.708(0.584-0.857)
South	0.545(0.457- 0.650)
Diabetes	1.579(1.331-1.872)
Hypertension	n.s.
ADG (pre-)	1.073(1.044-1.102)
Charlson Index (pre)	n.s.
Home Care (pre)	2.442(1.956-3.049)

*n.s = not significant

Gender and regional variation was evident in the model. Men were less likely to use home care than were women, and those living in the Central/North and the South were less likely to use home care than were those from the Winnipeg region (Table 4.27). As expected, those who were 50 years or older were more likely to use home care than those who were younger than 50 years (Table 4.27). The impact of social supports was evident with those who were single or widowed being more likely to use home care than those who were married when all other pre-AMI variables were controlled (Table 4.27). Social status as measured by the income levels was also a predictor of home care use with those who were in the lower two income groups having increased odds of home care utilization (Table 4.27).

Predictors for Readmissions After AMI

Similar logistic regressions using the four models were used to predict the readmissions for CHF and unstable angina within the two time periods after the AMI. Although gender was not a predictor of readmission for CHF within the 30- and 90-day period, regional location was an independent predictor, with residents of the Central/Northern region having increased odds for being readmitted (Table 4.28). Not surprising, those who had more pre-AMI ADGs, those who had a higher Charlson Index, and those 75 years and older had increased odds of being readmitted with a diagnosis of CHF within 30 days after the AMI (Table 4.28).

Table 4.28
Multivariate Predictors of Readmission for CHF 30 Days after AMI

Variables	Model I	Model II	Model III	Model IV
	OR (CI)	OR(CI)	OR(CI)	OR(CI)
Gender (Male)	n.s.	n.s.	n.s.	n.s.
Age				
50–64	n.s.	n.s.	n.s.	n.s.
65–74	n.s.	n.s.	n.s.	n.s.
75+	3.010(1.352-6.701)	3.147(1.1412-7.012)	2.556(1.137-5.743)	2.526(1.120-5.697)
Income (I_{1-2})	n.s.	n.s.	n.s.	n.s.
Marital Status				
Single	n.s.	n.s.	n.s.	n.s.
Widowed	n.s.	n.s.	n.s.	n.s.
Region				
Central/North	______	1.773(1.165-2.698)	1.713(1.120-2.621)	1.695(1.106-2.596)
South	______	n.s.	n.s.	n.s.
Diabetes (pre)	______	n.s.	n.s.	n.s.
Hypertension (pre)	______	n.s.	n.s.	n.s.
ADGs (pre-)	______	n.s.	1.077(1.013-1.145)	1.071(1.007-1.140)
Charlson Index (pre)			1.189(1.036-1.364)	1.199(1.045-1.376)
COC (pre-)	______	______	______	n.s.

*n.s = not significant; ________ not included in the model

Within 90 days, the regional predictors were not apparent, but age and the pre-AMI illnesses of diabetes and hypertension, the pre-AMI ADGs, and the comorbidity Charlson Index were predictors of increased odds of being readmitted with a diagnosis of CHF (Table 4.29).

Table 4.29
Multivariate Predictors of Readmission for CHF 90 Days after AMI

Variables	Model I OR(CI)	Model II OR(CI)	Model III OR(CI)	Model IV OR(CI)
Gender (Male)	n.s.	n.s.	n.s.	n.s.
Age				
50–64	n.s.	n.s.	n.s.	n.s.
65–74	2.767(1.360-5.632)	2.791(1.371-5.682)	2.202(1.075-4.507)	2.138(1.042-4.384)
75+	5.319(2.673-10.585)	5.449(2.736-10.850)	4.288(2.140-8.591)	4.117(2.050-8.265)
Income (I_{1-2})	n.s.	n.s.	n.s.	n.s.
Marital Status				
Single	n.s.	n.s.	n.s.	n.s.
Widowed	n.s.	n.s.	n.s.	n.s.
Region				
Central/North	______	1.381(1.018-1.879)	n.s.	n.s.
South	______	n.s.	n.s.	n.s.
Diabetes (pre)	______	______	1.533(1.166-2.015)	1.495(1.133-1.971)
Hypertension (pre)	______	______	1.346(1.045-1.733)	1.362(1.055-1.758)
ADGs (pre)	______	______	1.061(1.016-1.107)	1.059(1.014-1.106)
Charlson Index (pre)	______	______	1.237(1.124-1.362)	1.235 (1.21-1.361)
COC (pre-)	______	______	______	n.s.

*n.s = not significant; ______ not included in the model

Age was the only predictor for being readmitted with a diagnosis of unstable angina within 30 days after the AMI (Table 4.30). The population who were 75 years or older were less likely to be readmitted with a diagnosis if unstable angina within 30 days (Table 4.30).

Table 4.30
Multivariate Predictors of Readmission for Unstable Angina 30 Days after AMI

Variables	Model I	Model II	Model III	Model IV
	OR(CI)	OR(CI)	OR(CI)	OR(CI)
Gender (Male)	n.s.	n.s.	n.s.	n.s.
Age				
50–64	n.s.	n.s.	n.s.	n.s.
65–74	n.s.	n.s.	n..s.	n.s.
75+	0.549(0.320-0.944)	0.570(0.331-0.982)	n.s.	n.s.
Income (I_{1-2})	n.s.	n.s.	n.s.	n.s.
Marital Status				
Single	n.s.	n.s.	n.s.	n.s.
Widowed	n.s.	n.s.	n.s.	n.s.
Region				
Central/North	_____	n.s.	n.s.	n.s.
South	_____	n.s.	n.s.	n.s.
Diabetes (pre)	_____	_____	n.s.	n.s.
Hypertension (pre)	_____	_____	n.s.	n.s.
ADGs (pre-)	_____	_____	n.s.	n.s.
Charlson Index (pre)	_____	_____	n.s.	n.s.
COC (pre-)	_____	_____	_____	n.s.

*n.s = not significant; _______ not included in the model

Similarly, age was also an independent predictor of readmission for unstable angina within the 90-day period. Those in the 75-year or older category had decreased odds of being readmitted with the diagnosis as compared to those under 50 years of age (Table 4.31).

Table 4.31

Multivariate Predictors of Readmission for Unstable Angina 90 Days after AMI

Variables	Model I	Model II	Model III	Model IV
	OR(CI)	OR(CI)	OR(CI)	OR(CI)
Gender (Male)	n.s.	n.s.	n.s.	n.s.
Age				
50–64	n.s.	n.s.	n.s.	n.s.
65–74	n.s.	n.s.	n.s.	n.s.
75+	0.625(0.418-0.935)	0.627(0.419-0.939)	0.588(0.389-0.889)	0.621(0.406-0.951)
Income ($I_{1\text{-}2}$)	n.s.	n.s.	n.s.	n..s.
Marital Status				
Single	n.s.	n.s.	n.s.	n.s.
Widowed	n.s.	n.s.	n.s.	n.s.
Region				
Central/North	_____	n.s.	n.s.	n..s.
South	_____	n.s.	n.s.	n.s.
Diabetes	_____	_____	n.s.	n..s.
Hypertension	_____	_____	n.s.	n.s.
ADG (pre-)	_____	_____	1.079 (1.033-1.126)	1.077(1.031-1.125)
Charlson Index (pre)	__	_____	_____	_____
COC (pre-)	_____	_____	_____	n.s.

*n.s = not significant; ________ not included in the model

Summary

The post-AMI trajectory was described by readmissions within the 30- and 90-day period. Specifically, readmission with diagnoses of CHF and unstable angina were identified for the study population. The only consistent predictor of readmission with either diagnosis was age. For individuals 75 years or older, there was a decreased odds of being readmitted with a diagnosis of unstable angina, but an increased odds of being readmitted with a diagnosis of CHF.

Regional variation was evident, but only for the readmission with a diagnosis of CHF in that residents of the Central/North region had increased odds of being readmitted within 30 days with CHF. Although the pre-AMI diseases and morbidity index were independent predictors for increasing the odds of readmission of CHF, this was not the case in the readmission for unstable angina.

Predictors of Mortality

In the first year after the AMI, 764 (16.6%) died, and of those who died 413 (54.1%) were men. Within the three regions, there was a wide variation, with 57.6% of all deaths occurring among Winnipeg residents, 18.6% among Central/Northern residents, and 23.8% among Southern residents. There was a difference in the percentage of deaths among the men and women, with 5% more deaths among the men than the women in Winnipeg, but there were 15% more deaths among men in the Central/ Northern region and 18% more deaths among men than women in the Southern region. The pre-AMI predictors were included in the same logistic regression models as had been used in the other analyses; however, only the results of Model III are being represented (Table 4.32). Not unexpected, age was a predictor for death occurring one year after the AMI. The cases that were older than 50 years of age were more likely to die than those who were 49 years or younger. The other predictor was the Charlson Index, with those with a higher Charlson Index being more likely to die in the first year (Table 4.32).

Table 4.32

Multivariate Pre-AMI Predictors of Mortality One Year and Three Years Post Index AMI

	Year 1	Year 3
Variables	Model III	Model III
	OR(CI)	OR(CI)
Gender (Male)	n.s.	n.s.
Age		
50–64	3.017(1.419-6.41)	2.49(1.522-4.080)
65–74	9.30(4.812-20.491)	6.458(4.026-10.385)
75+	22.287(10.864-45.721)	19.595(12.248-31.347)
Income (I_{1-2})	n.s.	n.s.
Marital Status		
Single	n.s.	n.s.
Widowed	n.s.	n.s.
Region		
Central/North	n.s.	n.s
South	n.s.	n.s.
Diabetes (pre)	n.s.	1.207(1.069-1.444)
Hypertension (pre)	n.s.	n.s.
ADGs (pre-)	n.s.	n.s.
Charlson Index (pre)	1.533(1.424-1.650)	1.792(1.357-1.939)

*n.s = not significant

Within the three years after the AMI, 1267 (27.5%) deaths had occurred. The cause of the deaths in the three-year follow-up period was identified for the study population and the largest percentage of the deaths, 44.4%, were identified as cardiac disease-related deaths. Another 18.4% of the deaths were identified as deaths related to coronary atheroslerorsis and other ischemic heart diseases. Diabetes mellitus accounted for 2.5% and cerebral vascular accidents accounted for another 2.5% of the deaths. The pre-AMI predictors were included in logistic regression models to identify the independent predictors for mortality within three years after the AMI (Table 4.32). As anticipated, age was also a predictor for mortality within the three years after the AMI, with those who were older than 50 years more likely to die (Table 4.32). Those with a diagnosis of diabetes and those with a higher Charlson Index pre-AMI were also more likely to die within three years after the AMI (Table 4.32).

Summary

Age and a higher Charlson Index were consistent predictors for mortality within both the one- and three-year periods after the Index AMI. Diabetes Mellitus was also a predictor within the three-year period, with those in the study population with Diabetes Mellitus having greater odds of dying within this time period.

Index and Post-AMI Quality of Care Predictors for the Post-AMI Health Outcomes

Recognizing that there were some consistent pre-AMI predictors of the quality care at the index AMI period, and the post-AMI health outcomes, additional logistic regression models were developed to identify the index and post-AMI quality of care predictors for the post-AMI health outcomes. These models were designed to answer the last research question:

3) What is the relationship between quality of care and health outcomes in the post-AMI period?

In order to answer the question a series of logistic regression models using the quality of care variables were developed. Each of the models was tested to indicate the independent predictors of a readmission with a diagnosis of CHF and unstable angina within 30 and 90 days and morbidity within one and three years. Building on the four models developed previously, with Model IV including the demographic characteristics, regions, pre-AMI disease and comorbidity, and pre-AMI continuity of care, additional variables were sequentially added (Table 4.33). Specifically, each of the prescription drugs and cardiac procedures was sequentially added to the model.

Because the univariate analyses suggested that gender was related to cardiac medications and procedures, it was decided that an interaction variable of gender with each of the medications and procedures would also be included in the subsequent models. Interaction variables allow for the identification of the significance of the interaction between two variables in the model. Interaction between variables occur when in this case gender is in some way modifying or fundamentally altering the effect of the use of the cardiac medications. Since the focus of the study was to identify gender variation and previous research indicates that women with AMIs appear to be treated less aggressively than men, it was critical to identify possible interaction effects.

Table 4.33

Logistic Regressions Predictor Variables — Index AMI Interventions

Model IVa).	Model IV + Continuity of care 50% visits to same GP after AMI
Model Vb).	Model IV + ACEI + ACEI x gender interaction
Model Vb).	Model IV + Beta-blockers + Beta-blockers x gender interaction
Model Vc).	Model IV + Statins + Statins x gender interaction
Model VIa).	Model IV + Index CABG + Index CABG x gender interaction
Model VIb).	Model IV + Index PTCA + Index PTCA x gender interaction
Model VIc).	Model IV + Index cardiac catheterization + Index cardiac catheterization x gender interaction
Model VId).	Model IV + Index CABG*

*Due to the small numbers, it was not possible to include a CABG x gender interaction.

Relationship between Prescription Drugs and Readmissions

The results of Model IVa indicated that age, region, and pre-AMI ADGs and the Charlson Index were independent predictors for CHF readmission within 30 days after the AMI (Table 4.34).

Table 4.34
Multivariate Predictors of Readmission for CHF 30 Days after AMI

Variables	Model IV a OR(CI)	Model V a OR(CI)	Model V b OR(CI)	Model V c OR(CI)
Gender (Male)	n.s.	n.s.	n.s.	n.s.
Age				
50–64	n.s.	n.s.	n.s.	n.s.
65–74	n.s	n.s.	n.s.	n.s.
75+	2.776 (1.225- 6.294)	2.305(1.010-5.258)	n.s.	2.772(1.216-6.318)
Income (I_{1-2})	n.s.	n.s.	n.s.	n.s.
Marital Status				
Single	n.s.	n.s.	n.s.	n.s
Widowed	n.s.	n.s.	n.s.	n.s.
Region				
Central/North	1.849 (1.194-2.864)	1.738 (1.116- 2.707)	1.807(1.165-2.804)	1.849 (1.194-2.864)
South	n.s.	n.s.	n.s.	n.s.
Diabetes (pre)	n.s.	n.s.	n.s.	n.s.
Hypertension (pre)	n.s.	n.s.	n.s.	n.s.
ADGs (pre-)	1.076 (1.008-1.148)	1.081(1.012-1.154)	1.070(1.003-1.142)	1.076(1.008-1.148)
Charlson Index (pre)	1.255 (1.086-1.450)	1.226(1.056-1.423)	1.219(1.052-1.414)	1.255(1.086-1.450)
COC (pre-)	n.s.	n.s.	n.s.	n.s.
COC (post-)	n.s.	n.s.	n.s.	n.s.
ACEI	______	0.196(0.099-0.390)	n.s.	n.s.
ACEI*Gender	______	n.s.	n.s.	n.s.
Beta-Blocker	______	______	n.s.	n.s.
Beta-Blocker*Gender	______	______	2.576(1.197-5.541)	n.s.
Statin	______	______	______	n.s.
Statin*Gender	______	______	______	n.s.

*n.s = not significant; ________ not included in the model

Those who were in the 75-year and older group were more likely to be readmitted with a diagnosis of CHF, as were those who were from the Central/North region, those with more pre-AMI ADGs and those with a higher Charlson Index (Table 4.34).

In Model Va, the ACEI prescriptions were included as well as an interaction variable of gender and ACEIs (Table 4.34). The results were similar to those in the previous Model IVa. With individuals 75 years and older, those from the Central/North region and those with more pre-AMI ADGS and a higher Charlson Index were more likely to be readmitted with a diagnosis of CHF within 30 days. As expected, those who had prescriptions filled for ACEIs were less likely than those who did not have ACEI prescriptions to be readmitted with a diagnosis of CHF within 30 days of the AMI (Table 4.34).

In Model Vb, the predictors were consistent with the previous two models in terms of regional effects. In addition, those with more pre-AMI ADGs and a higher Charlson Index were still more likely to be readmitted with a diagnosis of CHF within 30 days (Table 4.34). A gender interaction was identified in this model with the men who had been prescribed beta-blockers being more likely to be readmitted for CHF than the men who did not receive the beta-blockers. Men were more likely to be readmitted than all of the women whether or not they had received prescriptions for beta-blockers (Table 4.34). In Model Vc, the same predictors for readmission for CHF within 30 days were identified but the prescription for the Statin medications was not an independent predictor for readmission within 30 days after the AMI (Table 4.34).

Within 90 days after the AMI, the readmission predictors for CHF, using the same models, were similar (Table 4.35).

Table 4.35
Multivariate Predictors of Readmission for CHF 90 Days after AMI

Variables	Model IVa OR(CI)	Model Va OR(CI)	Model Vb OR(CI)	Model Vc OR(CI)
Gender (Male)	n.s.	n.s.	n.s.	n.s.
Age				
50–64	n.s.	n.s.	n.s.	n.s.
65–74	2.154(1.045-4.437)	n.s.	n.s.	2.128(1.032-4.388)
75+	4.602(2.283- 9.280)	4.123(2.035-8.353)	3.656(1.800-7.427)	4.496 (2.223-9.091)
Income (I_{1-2})	n.s.	n.s.	n.s.	n.s.
Marital Status				
Single	n.s.	n.s.	n.s.	n.s.
Widowed	n.s.	n.s.	n.s.	n.s.
Region				
Central/North	1.385(1.000-1.917)	n.s	n.s.	1.384(1.000-1.916)
South	n.s.	n.s.	n.s.	n.s.
Diabetes (pre)	1.453(1.088-1.939)	n.s.	1.437(1.076-1.920)	1.441(1.079-1.925)
Hypertension (pre)	1.356(1.042-1.766)	n.s.	1.379(1.058-1.797)	1.358(1.043-1.769)
ADGs (pre-)	1.064(1.016-1.114)	1.068(1.019-1.118)	1.056(1.008-1.106)	1.063(1.016-1.113)
Charlson Index(pre)	1.323(1.194-1.465)	1.306(1.176-1.450)	1.281(1.154-1.422)	1.324(1.195-1.467)
COC (pre-)	n.s.	n.s.	n.s.	n.s.
COC (post-)	n.s.	n.s.	n.s.	n.s.
ACEI	_______	0.325 (0.215-0.490)	_______	_______
ACEI*Gender	_______	n.s.	_______	_______
Beta-Blocker	_______	_______	n.s.	_______
Beta-Blocker*Gender	_______	_______	1.922(1.131-3.267)	_______
Statin	_______	_______	_______	n.s.
Statin*Gender	_______	_______	_______	n.s.

*n.s = not significant; _______ not included in the model

Individuals aged 75 years or older and those who were between the ages of 65 and 74 years were more likely to be readmitted for CHF within the 90 days than those younger than 65 years of age (Table 4.35). Those who lived in the Central/North region were more likely to be readmitted for CHF than those who lived in the Winnipeg region (Table 4.35). The pre-AMI diseases and the comorbidity indicators (ADGs, Charlson Index) were independent predictors for readmission with CHF within the 90 days (Table 4.35). The medications were predictive of a readmission with a diagnosis of CHF. Those with ACEI medications were less likely to be admitted than those without ACEI medications (Table 4.35). As was apparent in the 30-day post-AMI period for readmission with a diagnosis of CHF, the beta-blocker interaction variable was an independent predictor for readmission with a diagnosis of CHF within the 90 days (Table 4.35). This interaction between gender and the use of beta-blockers indicates that beta-blockers are dependent on gender in terms of predicting readmission. In this study, the effect of the use of the beta-blockers differs between men and women in the subsequent readmission for CHF. The men who used beta-blockers were more likely to be readmitted with CHF within 90 days than men who were not on beta-blockers. They were also more likely to be readmitted than women, regardless of whether they received beta-blockers.

Models IVa, Va, Vb and Vc were also used to identify the predictors for the readmission with the diagnosis of unstable angina within the 30 and the 90-day period. The logistic regressions indicated that the only predictor for readmission with unstable angina was the access to a consistent general practitioner in the post-AMI period (Table 4.36).

Table 4.36
Multivariate Predictors of Readmission for Unstable Angina 30 Days after AMI

Variables	Model IVa OR(CI)	Model Va OR(CI)	Model Vb OR(CI)	Model Vc OR(CI)
Gender (Male)	n.s.	n.s.	n.s.	n.s.
Age				
50–64	n.s.	n.s.	n.s.	n.s.
65–74	n.s	n.s.	n.s.	n.s.
75+	n.s.	n.s.	n.s.	n.s.
Income (I_{1-2})	n.s.	n.s.	n.s.	n.s.
Marital Status				
Single	n.s.	n.s.	n.s.	n.s
Widowed	n.s.	n.s.	n.s.	n.s.
Region				
Central/North	n.s.	n.s.	n.s.	n.s.
South	n.s.	n.s.	n.s.	n.s.
Diabetes (pre)	n.s.	n.s.	n.s.	n.s.
Hypertension (pre)	n.s.	n.s.	n.s.	n.s.
ADGs (pre-)	n.s.	n.s.	n.s.	n.s.
Charlson Index (pre)	n.s.	n.s	n.s.	n.s.
COC (pre-)	n.s.	n.s.	n.s.	n.s.
COC (post-)	1.565(1.054-2.325)	1.562(1.051-2.320)	1.570(1.057-2.334)	1.561(1.051-2.320)
ACEI	______	n.s.	______	______
ACEI*Gender	______	n.s.	______	______
Beta-Blocker	______	______	n.s.	______
Beta-Blocker*Gender	______	______	n.s.	______
Statin	______	______	______	n.s.
Statin*Gender	______	______	______	n.s.

*n.s = not significant; ________ not included in the model

Individuals who received 50% or more of their care from the same general practitioner were more likely to be readmitted with unstable angina within 30 days (Table 4.36). The increased vigilance by a consistent physician may be responsible for increasing the likelihood of being readmitted with a diagnosis of unstable angina within 30 days.

Within 90 days, the only predictor for readmission for unstable angina was the presence of a greater number of pre-AMI ADGs (Table 4.37).

Table 4.37
Multivariate Predictors of Readmission for Unstable Angina 90 Days after AMI

Variables	Model IVa OR(CI)	Model Va OR(CI)	Model Vb OR(CI)	Model Vc OR(CI)
Gender (Male)	n.s.	n.s.	n.s.	n.s.
Age				
50–64	n.s.	n.s.	n.s.	n.s.
65–74	n.s	n.s.	n.s.	n.s.
75+	n.s.	n.s.	n.s.	n.s.
Income (I_{1-2})	n.s.	n.s.	n.s.	n.s.
Marital Status				
Single	n.s.	n.s.	n.s.	n.s
Widowed	n.s.	n.s.	n.s.	n.s.
Region				
Central/North	n.s.	n.s.	n.s.	n.s.
South	n.s.	n.s.	n.s.	n.s.
Diabetes (pre)	n.s.	n.s.	n.s.	n.s.
Hypertension (pre)	n.s.	n.s.	n.s.	n.s.
ADGs (pre-)	n.s.	1.075(1.027-1.124)	1.080(1.032-1.130)	.076(1.029-1.125)
Charlson Index (pre)	n.s.	n.s.	n.s.	n.s.
COC (pre-)	n.s.	n.s.	n.s.	n.s.
COC (post-)	n.s	n.s.	n.s.	n.s.
ACEI	______	n.s.	______	______
ACEI*Gender	______	n.s.	______	______
Beta-Blocker	______	______	n.s.	______
Beta-Blocker*Gender	______	______	n.s.	______
Statin	______	______	______	n.s.
Statin*Gender	______	______	______	n.s.

*n.s = not significant; ________ not included in the model

Summary

In summary, the recommended cardiac medications were not consistent predictors of readmissions for CHF and unstable angina in the regression models, although both the ACEIs and the beta-blockers were independent predictors for some of the health outcomes. Those who had prescriptions for ACEIs were less likely to be readmitted for CHF within the 30 and the 90-day periods. Within both the 30 and the 90-day period, the men who had prescriptions for beta-blockers were more likely to be readmitted with CHF than were the men who did not have beta-blockers, and all of the women whether they had taken beta-blockers or whether they had not taken beta-blockers. It may be that the men who took the beta-blockers may have had a more severe AMI and that the readmission was related to the severity of the illness, as one would have expected that the use of the beta-blockers would decrease the likelihood of readmission as compared to those who did not have the beta-blocker prescriptions. Other predictors of readmission for CHF within 30 days were the pre-AMI variables of age 75 years and older, Central/North region, and the pre-AMI ADGs and Charlson Index. Within 90 days, those aged 65 years and older tended to be more likely to be readmitted for CHF than were younger individuals. Pre-AMI diabetes and hypertension were also predictors for readmission for CHF within the 90-day period.

Recommended medications were not predictors for readmission for unstable angina at either of the two time periods. However, pre-AMI ADGs predicted readmission for unstable angina within 90 days and the continuity of care variable (>50% of visits) was predictive of readmission for unstable angina within the first 30 days after the AMI. General practitioner's vigilance of the patient's condition may account for this readmission activity.

The Relation between Cardiac Procedures and Readmissions

The cardiac procedures at the time of the AMI admission were hypothesized to impact the post-AMI trajectory and, therefore, three new models were created with the three cardiac procedures entered into the models in a stepwise progression. The first model, Model VIa, included the pre-AMI variables, the post-AMI continuity of care variable, the CABG surgery variable, and the CABG surgery, gender interaction variable. In the Model VIb, the cardiac procedure of PTCA and the PTCA gender interaction variables were added to the base model. In the final Model VIc, cardiac catheterization and the cardiac catheterization by gender interaction variable was included (Table 4.38).

Table 4.38
Multivariate Predictors of Readmission for CHF 30 Days after AMI

Variables	Model V a OR(CI)	Model VIb OR(CI)	Model VIc OR(CI)
Gender (Male)	n.s.	n.s.	n.s.
Age			
50–64	n.s.	n.s.	n.s.
65–74	n.s.	n.s.	n.s.
75+	2.811 (1.239- 6.381)	2.647 (1.166- 6.011)	2.403(1.054-5.431)
Income (I_{1-2})	n.s.	n.s.	n.s.
Marital Status			
Single	n.s.	n.s.	n.s.
Widowed	n.s.	n.s.	n.s.
Region			
Central/North	1.859(1.200-2.881)	1.809(1.167- 2.804)	1.736(1.119-2.694)
South	n.s.	n.s.	n.s.
Diabetes (pre)	n.s.	n.s.	n.s.
Hypertension (pre)	n.s.	n.s.	n.s.
ADGs(pre)	1.076(1.008-1.148)	1.076(1.008-1.148)	1.077 (1.010-1.149)
Charlson Index (pre)	1.258(1.088-1.454)	1.248 (1.080-1.442)	1.244 (1.076-1.438)
COC (pre-)	n.s.	n.s.	n.s.
COC (post-)	n.s.	n.s.	n.s.
CABG	n.s.	______	______
CABG*Gender	n.s.	______	______
PTCA	______	n.s.	______
PTCA*Gender	______	n.s.	______
Cardiac Cath	______	______	3 528(1.077-11.55)
Cardiac Cath*Gender	______	______	n.s.

*n.s = not significant; ________ not included in the model

In all three models, age was a consistent predictor of readmission with a diagnosis of CHF within 30 days (Table 4.38). Specifically, individuals 75 years or older were more likely to be readmitted than those who were younger than 75 years of age. Region of residence was also a predictor with residents of the Central/North region more likely to be readmitted with CHF than those who lived in the South or the Winnipeg region (Table 4.38). Finally, greater number of pre-AMI ADGs and a higher Charlson Index were independent predictors of readmission for CHF within 30 days after the AMI (Table 4.38). The only additional independent predictor was cardiac catheterization gender interaction variable, in Model VIc. Individuals who had a cardiac catheterization at the time of the AMI were more likely to be readmitted within 30 days with a diagnosis of CHF than those who did not have a cardiac catheterization (Table 4.38).

Models VIa, VIb, and VIc were used to identify the independent predictors for readmission for CHF within 90 days after the AMI (Table 4.39).

Table 4.39

Multivariate Predictors of Readmission for CHF 90 Days after AMI

Variables	Model VIa OR(CI)	Model VIb OR(CI)	Model VIc OR(CI)
Gender (Male)	n.s.	n.s.	n.s.
Age			
50–64	n.s.	n.s.	n.s.
65–74	2.153(1.045-4.436)	n.s	n.s.
75+	4.603(2.282-9.281)	4.290(2.125-8.662)	4.077(2.014-8.251)
Income (I_{1-2})	n.s.	n.s.	n.s.
Marital Status			
Single	n.s.	n.s.	n.s.
Widowed	n.s.	n.s.	n.s.
Region			
Central/North	n.s	n.s.	1.736(1.119-2.694)
South	n.s.	n.s.	n.s.
Diabetes (pre)	1.452(1.088-1.939)	1.438(1.077-1.920)	1.444(1.082-1.928)
Hypertension (pre)	1.356(1.041-1.766)	1.360(1.044-1.771)	1.387(1.065-1.807)
ADGs (pre-)	1.064(1.016-1.113)	1.064(1.016-1.114)	1.065(1.017-1.115)
Charlson Index (pre)	1.323(1.194-1.466)	1.312(1.184-1.454)	1.314(1.185-1.455)
COC (pre-)	n.s.	n.s.	n.s.
COC (post-)	n.s.	n.s.	n.s.
CABG	n.s.	______	______
CABG*Gender	n.s.	______	______
PTCA	______	n.s.	______
PTCA*Gender	______	n.s.	______
Cardiac Cath	______	______	2.097(1.121-3.924)
Cardiac Cath*Gender	______	______	n.s.

*n.s = not significant; ________ not included in the model

Region and age were predictors of being readmitted with a diagnosis of CHF within 90 days, as they had been within 30 days. Although neither age nor region was a consistent predictor in all of the models, there was a trend for those who were 65 years or older and for those who lived in the Central/North region to be more likely to be readmitted with CHF within the 90 days after the AMI (Table 4.39). The pre-AMI illnesses were also independent predictors for readmission with CHF within 90 days. Those who had a cardiac catheterization at the time of the initial hospitalization for the AMI were also more likely to be readmitted with a diagnosis of CHF within 90 days, as had been the case within 30 days.

The same three models were used to predict the readmission for unstable angina within both the 30 and the 90-day period (Tables 4.40 and 4.41). Individuals who had 50% or more of their visits to the same physician after the AMI were more likely to be readmitted with a diagnosis of unstable angina within 30 days than those with a poorer continuity of care profile (Table 4.40).

Table 4.40

Multivariate Predictors of Readmission for Unstable Angina 30 Days after AMI

Variables	Model VIa OR(CI)	Model VIb OR(CI)	Model VIc OR(CI)
Gender (Male)	n.s.	n.s.	n.s.
Age			
50–64	n.s.	n.s.	n.s.
65–74	n.s.	n.s.	n.s.
75+		n.s.	n.s.
Income (I_{1-2})	n.s.	n.s.	n.s.
Marital Status			
Single	n.s.	n.s.	n.s.
Widowed	n.s.	n.s.	n.s.
Region			
Central/North	n.s.	n.s.	n.s.
South	n.s.	n.s.	n.s.
Diabetes (pre)	n.s.	n.s.	n.s.
Hypertension (pre)	n.s.	n.s.	n.s.
ADGs (pre-)	n.s.	n.s.	n.s.
Charlson Index (pre)	n.s.	n.s.	n.s.
COC (pre-)	n.s.	n.s.	n.s.
COC (post-)	1.575(1.060-2.340)	1.566(1.054-2.328)	1.567(1.055-2.329)
CABG	7.251(1.005-52.302)	______	______
CABG*Gender	n.s.	______	______
PTCA	______	n.s.	______
PTCA*Gender	______	n.s.	______
Cardiac Cath	______	______	n.s.
Cardiac Cath*Gender	______	______	n.s.

*n.s = not significant; ________ not included in the model

Model VIa which included the CABG surgery and the CABG surgery interaction variable did not converge properly, meaning that the CABG surgery or the CABG surgery gender interaction variable completely explained the outcome variable. Patients who had a CABG surgery at the time of the AMI had unstable angina, or conversely, those who had a diagnosis of unstable angina had a CABG surgery at the time of the index AMI. Therefore, the CABG gender interaction variable was removed from Model VIa and then the model converged with the CABG surgery being an independent predictor, indicating that those who had a CABG surgery at the time of the index AMI were more likely to be readmitted with at diagnosis of unstable angina within 30 days (Table 4.40).

Similarly, within 90 days those who had a CABG surgery at the index admission for the AMI were more likely to be readmitted with a diagnosis of unstable AMI than those who did not have the CABG surgery at the index admission (Table 4.41).

Table 4.41
Multivariate Predictors of Readmission for Unstable Angina 90 Days after AMI

Variables	Model VIa OR(CI)	Model VIb OR(CI)	Model VIc OR(CI)
Gender (Male)	n.s.	n.s.	0.599(0.362-0.990)
Age			
50–64	n.s.	n.s.	n.s.
65–74	n.s.	n.s.	n.s.
75+	n.s.	n.s.	n.s.
Income (I_{1-2})	n.s.	n.s.	n.s.
Marital Status			
Single	n.s.	n.s.	n.s.
Widowed	n.s.	n.s.	n.s.
Region			
Central/North	n.s.	n.s.	n.s.
South	n.s.	n.s.	n.s.
Diabetes (pre)	n.s.	n.s.	n.s.
Hypertension (pre)	n.s.	n.s.	n.s.
ADGs (pre-)	1.076(1.029-1.125)	1.075(1.028-1.124).	1.074(1.027-1.123)
Charlson Index (pre)	n.s.	n.s.	n.s.
COC (pre-)	n.s.	n.s.	n.s.
COC (post-)	n.s.	n.s.	n.s.
CABG	5.168(1.636-16.323)	______	______
CABG*Gender	n.s.	______	______
PTCA	______	n.s.	______
PTCA*Gender	______	n.s.	______
Cardiac Cath	______	______	n.s.
Cardiac Cath*Gender	______	______	n.s.

*n.s = not significant; ________ not included in the model

The only other predictor for readmission with unstable angina within 90 days was the presence of pre-AMI ADGs. Greater number of pre-AMI ADGs was predictive of readmission with a diagnosis of unstable angina (Table 4.41).

Summary

The consistent predictor for a readmission of CHF within the 30 and 90-day period was regional location with those in the Central/North being more likely to be readmitted with a CHF. In contrast, readmission for unstable angina within 30 and 90 days was not predicted by the regional location. Similarly, age was a predictor for readmission for CHF, but age was not a predictor for readmission with unstable angina at either time period. Pre-AMI illnesses were predictors for readmission for CHF, but only pre-ADGs were predictors for readmission with unstable angina and then only within the 90-day period not at 30 days. The continuity of care variable was an independent predictor for readmission for unstable angina only, but only within the 30 days. The cardiac procedures were predictors but different procedures were predictors for the two diagnoses. Cardiac catheterization was a predictor for CHF and CABG surgery was a predictor for readmission with unstable angina.

The Relation between Prescription Drugs and Cardiac Procedures and Mortality

As for readmissions, a series of regression models were computed to examine the relation between prescription drugs and cardiac procedures, respectively, and mortality. Predictors of mortality within one-year post-AMI were examined (Tables 4.42 and 4.43).

Table 4.42
Multivariate Treatment Predictors for Mortality One-Year Post Index AMI

Variables	Model IVa OR(CI)	Model Va OR(CI)	Model Vb OR(CI)	Model Vc OR(CI)
Gender (Male)	n.s.	n.s.	n.s.	n.s.
Age				
50–64	4.775(1.452-5.705)	4.656(1.415-15.321)	4.124(1.251-13.590)	4.774 (1.451 15.709)
65–74	12.044(3.759-3.8.587)	11.743(3.664-37.637)	9.861(3.071-31.667)	1.742(3.663-37.635)
75+	25.521(8.028-81.131)	24.644(7.745-78.416)	18.787(5.887-59.954)	24.211(7.606-77.071)
Income (I_1-$_2$)	n.s	n.s.	n.s.	n.s.
Marital Status				
Single	1.707(1.205-2.419)	1.692(1.193-2.399)	1.698(1.194-2.414)	4.211(7.606-77.071)
Widowed	n.s.	n.s.	n.s.	n.s.
Region				
Central/North	n.s.	n.s.	n.s.	n.s.
South	n.s.	n.s.	n.s.	n.s.
Diabetes (pre)	n.s.	n.s.	n.s.	n.s.
Hypertension (pre)	n.s.	n.s.	n.s.	n.s.
ADGs (pre-)	n.s	n.s.	n.s.	n.s.
Charlson Index (pre)	1.566(1.427-1.719)	1.563(1.423-1.716)	1.494(1.359-1.643)	1.562(1.423-1.715)
COC (pre-)	n.s.	n.s.	n.s.	n.s.
COC (post-)	n.s.	n.s.	n.s.	n.s.
ACEI	______	n.s.	______	______
ACEI*Gender	______	n.s.	______	______
Beta-Blockers	______	______	2.075(1.396-3.086)	______
Beta-Blockers*Gender	______	______	n.s.	______
Statins	______	______	______	n.s.
Statins*Gender	______	______	______	n.s.

*n.s = not significant; ________ not included in the model

In these models, age was a consistent predictor of increased likelihood that death would occur within the year after the AMI for those who were older than 50 years of age. Individuals who were single and those with a higher Charlson Index before the AMI were more likely to die within the first year after the AMI. Region of residence, which was an independent predictor in most of the models developed to predict the health outcomes, was not a predictor of one-year mortality. In terms of medications, only those who had prescriptions for beta-blockers were more likely to die within the first year after the AMI. It might be that these people had more severe illness and therefore their disease was qualitatively different, which increased their likelihood of dying within the first year after the AMI. The ACEIs and the statins were not independent predictors of death in the year after the AMI.

With the knowledge that the cardiac procedures provided at the time of the AMI should decrease the likelihood that people would die within the first year after the AMI, subsequent regressions added the cardiac procedures in a stepwise process (Table 4.43).

Table 4.43

Multivariate Predictors of Mortality One-Year Post Index AMI

Variables	Model VIa OR(CI)	Model VIb OR(CI)	Model VIc OR(CI)
Gender (Male)	0.090(0.010-0.820)	n.s.	n.s.
Age			
50–64	4.750(1.445-5.613)	4.709(1.431-15.495)	4.573(1.390-15.045)
65–74	12.064(3.768-38.630)	11.672(3.641-37.415)	11.274(3.518-36.134)
75+	25.317(7.972-80.402)	24.441(7.681-77.767)	22.798(7.160-72.588)
Income (I_{1-2})	n.s.	n.s.	n.s.
Single	1.693(1.195-2.399)	1.681(1.185-2.384)	1.670 (1.177-2.369)
Widowed	n.s.	n.s.	n.s.
Region			
Central/North	n.s	n.s.	n.s
South	n.s.	n.s.	n.s
Diabetes (pre)	n.s.	n.s.	n.s
Hypertension (pre)	n.s.	n.s.	n.s.
ADGs(pre-)	n.s.	n.s.	n.s.
Charlson Index (pre)	1.563(1.424-1.717)	1.561(1.422-1.714)	1.557(1.419-1.710)
COC (pre-)	n.s.	n.s.	n.s.
COC(post-)	n.s.	n.s.	n.s.
CABG	n.s.	________	________
CABG*Gender	15.131(1.663-137.630)	________	________
PTCA	________	n.s.	________
PTCA*Gender	________	n.s.	________
Cardiac Cath	________	________	n.s.
Cardiac Cath*Gender	________	________	n.s.

*n.s = not significant; ________ not included in the model

Age was a predictor for mortality within one year after the AMI, with those who were older than 50 years being more likely than those who are younger than 50 years to die within the first year (Table 4.43). Other predictors of mortality within one year were being single and having a higher score on the Charlson Index prior to the AMI (Table 4.43). The only cardiac procedure, which was an independent predictor of mortality, was CABG surgery. Men who had CABG surgery at the time of the AMI were more likely to die within the year after the AMI as compared to those men who did not have the surgery and all women whether or not they had CABG surgery (Table 4.43).

Summary

The hypotheses of this research study were that there would be gender and regional variation in both the quality of care and the health outcomes after an acute myocardial infarction. Gender variation was apparent in only a few of the quality of care variables but there was no significant variation in the health outcomes. Men had increased odds of 1.18 (CI 1.00–1.40) in having prescriptions for beta-blockers within 30 days as compared to the women. Women were less likely (Odds Ratio [OR] 0.52[CI 0.33–0.83]) to be treated with PTCA 90 days after the AMI as compared to men.

In contrast, regional variation was evident in both the quality of care and the health outcomes. Residents of the Central/North and the South regions were less likely to have beta-blocker prescriptions, but they were more likely to have prescriptions for statins and ACEIs.

There were differences in access to cardiac procedures at the time of the AMI, with those who lived in the Central/North region less likely to have a PTCA at index admission (Odds Ratio 0.562[CI 0.415–0.760]), and also decreased odds of 0.512(CI 0.421–0.624) of having a cardiac catheterization as compared to those who lived in the Winnipeg region. Residents of the Southern region were less likely (Odds Ratio 0.338[CI 0.211–0.539]) than those who lived in the Winnipeg region of having CABG surgery, and also less likely (Odds Ratio 0.443[CI 0.328–0.598]) of having a PTCA and decreased odds (Odds Ratio 0.286[CI 0.231–0.353]) of having a cardiac catheterization at the time of the AMI.

The regional variation in the cardiac procedures at the time of the AMI did not relate to a difference in readmission with a diagnosis of CHF or unstable angina nor mortality within one and three years after the AMI in the Central/Northern and the Southern regions. A summary of the results for gender and regions are presented in Tables 4.44 and 4.45.

Table 4.44
Summary of Gender and Regional Variations — Model III

Quality of Care	Gender OR (CI)	Region OR(CI)	
Prescription of Meds			
ACEI			
30 day	Male 0.97(0.83-1.14)	Central/North	1.17(0.99-1.38)
		South	1.39(1.19-1.61)*
90 day	Male 0.89(0.73-1.07)	Central/North	1.17(0.99-1.37)
		South	1.44(1.24-1.66)*
Beta-Blockers			
30 day	Male 1.17(0.99-1.38)	Central/North	0.77(0.65-0.91)*
		South	0.85(0.73-0.99)*
90 day	Male 1.18(1.00-1.40)*	Central/North	0.78(0.65-0.92)*
		South	0.88(0.75-1.02)
Statins			
30 day	Male 0.99(0.79-1.23)	Central/North	1.16(0.94-1.44)
		South	0.99(0.81-1.22)
90 day	Male 0.89(0.73-1.07)	Central/North	1.08(0.89-1.31)
		South	1.01(0.84-1.21)
Cardiac Procedures			
CABG			
Index	Male 1.13(0.76-1.62)	Central/North	0.83(0.58-1.19)
		South	0.34(0.21-0.54)*
30 day	Male 1.91(0.82-4.48)	Central/North	1.13(0.57-2.22)
		South	0.53(0.24-1.17)
90 day	Male 1.17(0.62-1.58)	Central/North	0.99(0.62-1.58)
		South	0.87(0.56-1.37)
PTCA			
Index	Male 0.92(0.70-1.21)	Central/North	0.56(0.41-0.76)*
		South	0.44(0.33-0.60)*
30 day	Male 0.70(0.35-1.38)	Central/North	1.01(0.48-2.19)
		South	0.99(0.50-1.97)
90 day	Male 0.52(0.33-0.83)*	Central/North	0.90(0.52-1.55)
		South	0.94(0.58-1.54)
Cardiac Catheterization			
Index	Male 0.95(0.78-1.14)	Central/North	0.51(0.42-0.62)*
		South	0.29(0.23-0.35)*
30 day	Male 1.27(0.76-2.13)	Central/North	0.79(0.47-1.31)
		South	0.64(0.38-1.06)
90 day	Male 0.10(0.71-1.41)	Central/North	0.62(0.42-0.91)*
		South	0.69(0.49-0.97)*

*significant odds ratio

Table 4.45
Gender and Regional Variations in Mortality and Readmission for CHF and Unstable Angina — Model III / Model IVa

Indicator	Gender		Region	
		OR(CI)		OR (CI)
Readmission				
CHF-30 day	Male	1.06(0.66-1.72)	Central/North	1.69(1.11-2.60)*
			South	1.00(0.63-1.59)
90 day	Male	0.86(0.62-1.19)	Central/North	1.30(0.95-1.78)
			South	1.10(0.81-1.49)
Unstable Angina				
30 day	Male	1.00(0.65-1.54)	Central/North	1.32(0.89-1.98)
			South	0.75(0.48-1.16)
90 day	Male	0.82(0.61-1.09)	Central/North	1.15(0.85-1.56)
			South	1.06(0.80-1.41)
Mortality (1 yr)	Male	1.29(0.925-1.80)	Central /North	1.23(0.93-1.80)
			South	0.95(0.71-1.28)
Mortality (3 yrs)	Male	1.01(0.82-1.23)	Central/North	1.13(0.92-1.38)
			South	1.01(0.84-1.21)

*significant odds ratio

Residents of the Central/Northern regions and to a lesser extent those who lived in the Southern regions were less likely to have received certain cardiac procedures such as cardiac catheterizations and certain medications such as beta blockers, but more likely to receive ACEIs. However, these variations in treatment did not result in any difference in the mortality within one year and within three years.

CHAPTER 5
DISCUSSION

This research provides an important contribution to the understanding of how gender and region of residence influences health outcomes after an acute myocardial infarction (AMI) using a population-based approach. This discussion chapter is divided into two sections. In the first section, the findings will be discussed in relation to the research hypotheses. The second section focuses on the implications of the study findings for future research, clinical practice and health policy, and planning.

Gender and Regional Variations

The overall purpose of this research was to answer the question as to whether there were gender differences in the quality of care received and the subsequent health outcomes after an AMI. Secondly, the goal was to identify the predictors of quality of care and health outcomes. Finally, this research attempted to identify if the region of the AMI population could predict differences in both the quality of care and the health outcomes. Using a retrospective database analysis of Manitoba residents who experienced an AMI in 1996/97, 1997/98, and 1998/99, logistic regression models were built to identify the variables that contributed to quality of care and the health outcomes up to three years after the index AMI. The population health framework provides the parameters in which the findings will be discussed.

Gender Variations

The hypothesized gender differences were not substantiated in this research. This concurs with findings by other researchers which show that many of the gender differences obtained in the past have been eliminated. Nevertheless, there are still some recent research studies that indicate differences in the frequency of cardiac procedures for men and women (Ayanian & Epstein, 1991; Gahli et al., 2002; Rathore et al., 2001; Tu et al., 1999). However, as in the current study, these gender differences in cardiac procedures did not significantly predict worse outcomes after the AMI.

Age differences were apparent in this study with a lower percentage of women having the AMI prior to 65 years of age as compared to men. However, by the age of 75 years the number of men and women with AMIs in the population was almost equal. This finding was consistent with previous studies and supports the argument that the difference may be related to the reduction in the estrogen hormone in menopause (Gohlke-Barwolf, 2000; Lerner & Kannel, 1986; Limacher, 1996). The differences in the ages at which the AMI occurred in men and women did not appear to predict different health outcomes for the men and women. In this study, both men and women who were 75 years or older were more likely to die within the three-year follow-up period than those who were younger. Gender was not a predictor of mortality, however, when all other variables were controlled in the regression models.

Premorbid conditions such as diabetes and hypertension are known to increase the risk for reinfarction and increased risk of CHF (Donahue, Goldberg, Chen, et al., 1993;

Liao, Cooper, Gahli, et al., 1993; Wenger, 2003). Although both men and women in the study population suffered from hypertension, the prevalence of hypertension was significantly higher in women. This pre-AMI comorbidity did not predict mortality within the three years after the AMI, nor did it predict the readmission for CHF within the 30 or 90 days after the AMI. However, the presence of hypertension in both men and women did increase the odds of being readmitted within 90 days after the index AMI. In the Framingham Heart Study, hypertension appeared to predispose women to silent or unrecognized AMI (Kannel, 1986). The lack of significant findings in the differences in the health outcomes between the genders may be related to the fact that different presenting symptoms of an AMI in women resulted in a missed or undiagnosed AMI; therefore, some women who had hypertension and an AMI may not have been included in the study population. This contention is supported by a recent study that found that women continue to be less likely than men are to have their heart conditions accurately diagnosed as an AMI (Kilpatrick & Willingham, 2005).

The contribution of Type II diabetes in women, as a more consistent predictor for subsequent CHD mortality than any other previous CVD, has been identified in a number of research studies (Barrett-Connor, Giardina, Gitt, et al., 2004; Natarajan, Liao, Cao, et al., 2004).

There were a higher percentage of women as compared to men with diabetes in this study. Diabetes was a predictor of mortality within three years in the model, which include the pre-AMI variables of comorbidity, health indices, continuity of care, and the sociodemographic variables.

Although Hannan and colleagues (2003) found that women had higher rates of being readmitted with complications within 30 days after CABG surgery hypothesized to be related to the older age of women, this was not supported in the current study. Within both the 30 and the 90 days, individuals older than 75 years and 65 years and older, respectively, did have increased odds of being readmitted with CHF when controlling for health status, but there was no gender difference. The lack of gender differences may well be related to the fact that this study included a number of other variables such as income and pre-AMI illness in the regression models as compared to somewhat more limited models used in other published research.

Women also had significantly more identified ADGs in the two years prior to the AMI, but this did not predict different outcomes after the AMI. Both men and women in Model III (i.e., all of the pre-AMI variables) had increased odds of being readmitted with CHF within 30 and 90 days if they had identified ADGs in the two years prior to the index AMI. Although women tended to be older at the time of the index AMI, when controlling for comorbidities and sociodemographic variables, there was no difference in the readmission for post-AMI illnesses such as CHF. Similarly, ADGs did not predict mortality within the three years after the AMI.

The Charlson Index, an indicator of health, was predictive of mortality within three years, for both genders. Gender differences were apparent in the descriptive analyses, but they were not predictive in the multivariate analyses. Women had a higher Charlson Index score, which was weakly significant. Women also used more health care services such as home care before the AMI, indicating that they may have been more ill at the time of the AMI or they may not have had anyone to provide care at home.

Nevertheless, although women were older at the time of the AMI and appeared to be somewhat less healthy as identified in the number of ADGs, the higher percentage of hypertension and diabetes in the pre-AMI period, higher Charlson Index, and greater use of health services, there were no increased odds of death for the women in the three-year follow-up period. As well, there were no gender differences in the readmission rates for CHF or unstable angina within 90 days.

What this study was not able to identify was whether there are gender differences in the quality of life experienced after the AMI. There is some evidence from recent research that indicates women experience a significantly lower, self-assessed quality of life as compared to men after an AMI (Agewall, Berglund, & Henareh, 2003). Agewall and colleagues (2003), using a prospective research method, found that there were no gender differences in the age, hemodynamic data, smoking habits, laboratory data, concomitant CVD, and revascularization between the sexes. However, there were differences in the quality of life scores on the validated Minor Symptoms Evaluation Profile (MSEP). The focus of further research should include the other determinants identified within the Population Health Framework, using alternate methods such as interviews and questionnaires, which could identify possible gender differences in quality of life after an AMI.

There is research evidence indicating that there are gender differences in both the treatments and the health outcomes after an AMI (Ayanian et al., 1991; Jaglal et al., 1994; Steingart et al., 1991). However, more recent research has focused on gender differences in access to the revascularization treatments such as PTCA and CABG and cardiac catheterizations (Bertoni, Bonds, Lovato, Goff, & Brancati, 2004; Chandra et al., 1983; Rathore et al., 2001). Recent Canadian research revealed that the difference in treatments for women with AMI might be related to clinical indicators rather than a bias against women. Gahli and colleagues (2002) from Alberta found that the difference in the access to coronary revascularization after a cardiac catheterization between the men and the women could be explained with the addition of clinical variables such as the extent of coronary artery disease and cardiac ejection fraction.

The extensive population-based registry used in the Alberta research included clinical data not found in the database used for this study. When these clinical indicators were included to create adjusted crude rates, there was no difference between men and women in the revascularization procedures after the cardiac catheterizations. However, the researchers were unable to identify why the women still had lower rates of cardiac catheterizations then the men prior to revascularization. This current study is congruent with the Gahli et al. (2002) study, as there were gender differences in the cardiac catheterization procedures before revascularization. Although clinical indicators may identify the reason for the gender differences in the CABG and PTCA procedures, clinical indicators have not been identified for the differences in the cardiac catheterizations. Other reasons that have been provided include patient preference or clinical characteristics such as smaller coronary vessels in women or the older age of women at the time of the AMI (Bertoni et al., 2004; Krumholz, Douglas, Lauer, & Pasternak, 1992). Whatever the reason for the difference in the cardiac catheterization, findings showed that there was no gender difference in mortality or readmission for CHF or unstable angina within the three-year follow-up period.

Providing prescriptions for recommended medications such as beta-blockers, statins, and ACEIs after the AMI is considered an important quality of care indicator. Although prescriptions may be provided, not all people will ensure that the prescriptions are filled and some people may fill the prescriptions but never adhere to taking the medications. With this population-based study, the focus was on identifying the gender differences in the prescriptions for the three medications commonly recommended post-AMI. The men in this study population had significantly more beta-blockers and statins prescriptions filled compared to the women at the univariate level, but this did not translate into being a predictor in the logistic regressions once potential confounders were controlled. A recent study from Calgary comparing the discharge medications for both men and women who had an AMI also found no difference in the rate of prescriptions for these medications when a correction for age and comorbidities were included in the logistic regression models (Jelinski, Ghali, Parsons, & Maxwell, 2004).

Regional Variations

Centralization of health care for cardiac illnesses within one city in a province can be beneficial for the population but it may also compromise the equitable access for those who live in the more remote areas of the province. One of the research questions in this study was to identify whether there was a significant difference among the regions in access to cardiac care and in the health outcomes for the AMI population. As the cardiac interventions and treatments, specifically CABG and PTCA, are only provided within the capital city, those outside the city region may be disadvantaged in receiving timely access to these procedures.

In a number of studies in Canada, the United States, and Great Britain, geographical differences have been identified in the treatments for AMI (Hartford et al., 1998; Pilote, Granger, Armstrong, & Htlatky, 1995; Pilote et al., 2004; Yusuf et al., 1998). These studies consistently found a relation between geographical proximity to the regional centers and the number of cardiac invasive procedures completed. More recently, Canadian studies (Pilote et al., 2004, Rodrigues et al., 2002; Seidel, Ghali, & Faris, 2004) have provided further support for these regional variations in post-AMI treatments.

Using a regression model in the present study, which included gender, age, income status, comorbidities, and health status, the Southern region, had lower odds of having a CABG, PTCA, or cardiac catheterization at the time of the index AMI compared to those in the Winnipeg region. The Southern region included the Regional Health

Authorities (RHAs) of South Eastman, South Westman, Brandon, and Central Health Authorities. In the same regression model, the Central/North also had lower odds of undergoing PTCA and cardiac catheterizations at the index AMI event. The Central/ North region was comprised of Nor-Man, Churchill, Burntwood, Marquette, Parkland, North Eastman, and Interlake Health Authorities.

Although accessible by road, the teaching hospitals where the interventional cardiac procedures of CABG, PTCA, and cardiac catheterizations are done are still a significant distance for southern residents. While it is not possible within this study to identify the reason why this region had lower odds for the cardiac procedures, the findings are consistent with the research done in other provinces. In one study, those who lived further than 450 km from the regional centers were less likely to undergo cardiac catheterization at the time of the AMI. There were, however, increased odds of having cardiac revascularization within a year after the event as compared to those who lived in the cities where cardiac procedures were done (Seidel et al. 2004). In the current study, there were continued lower odds of cardiac catheterization within 90 days for those who lived in the South and the Central/North regions.

Rodrigues and colleagues (2002) also found significant regional differences in the cardiac procedures in patients who had an AMI in Quebec but, as in this current study, there was no impact on mortality rates. While the Quebec study also found no impact on the post-AMI morbidity, in this study, the Central/North region did have increased odds of being readmitted with a diagnosis of CHF within 30 days after the

AMI, which could be considered a possible proxy for a post-AMI complication. Similarly, Beck and colleagues (2003) similarly did not find that proximity to the aggressive post-AMI treatment, available in the larger hospitals decreased the mortality rates.

Regional differences were also identified in the filling of the prescription medications of beta-blocker, statins, and ACEIs, in the present study. Residents of the Central/North and the South regions had lower odds of having prescriptions filled for beta-blockers within 30 days after the AMI. Residents of the Central/North region were also less likely to have beta-blocker prescriptions filled within 90 days after the AMI. Research in Quebec identified similar geographical differences in the medication prescriptions after discharge in the AMI population (Rodrigues et al., 2002).

However, compared to Winnipeg region, the South, and the Central/North regions had higher odds for prescriptions for statins and ACEIs within 30 and 90 days. This research was not able to identify why there would have been increased odds for filled prescriptions for two of the three cardiac medications. Based on research literature, there is evidence to suggest that individual physician preference practice affects the prescription patterns (Borrello et al., 2004; Wilt et al., 2004). Other possible explanations include the potential cost of filling the prescriptions and the personal decisions to use only some of the medications. The beta-blockers, although the least expensive of the three medications, have very unfavorable side effects, as do the other medications and the drug must be taken three to four times a day. In contrast, the statins and the ACEIs only need to be taken once or twice a day and side effects are in some cases, less noticeable.

Only the Central/North region was less likely to have beta-blockers, more likely to have statins and ACEIs and they were more likely to be readmitted with a diagnosis of CHF within 30 and 90 days. It may be that the post-AMI care is different from that of the major urban regional health authority, resulting in increased readmission rates. The Central/North region includes the far north regional health authorities of Churchill, Nor-Man, and Burntwood. Physicians who provide care in these more remote areas may also be more responsive to the clinical indications of post-AMI complications, and therefore, they may send the person back to the regional centre for readmission as a proactive measure.

Although there were regional differences in the quality of care variables analyzed in this study, there was only minimal apparent effect on post-AMI health outcome variables. The increased odds for readmission with the diagnosis of CHF for the population of the Central/North are a possible indicator of a lower level of care. However, it could also be an indicator of increased vigilance by the attending family physician. Whatever the reason for the increased odds of readmission, as in the Rodrigues (2002) study, there was no difference in the mortality within the three year follow-up period. It is, nevertheless, important to complete further analysis of the increased odds of readmission for CHF to identify the longer-term effect on mortality and the individual quality of life.

Other Health Determinants

Although the major health determinants of interest in this study were gender and region, other health determinants were included in the regression models, as they were confounders to the two key variables. As well, the Population Health Model suggests that other determinants may predict both quality of care and health outcomes.

Age

Age as one of the biological health determinants was clearly a consistent predictor of mortality and readmission for CHF and to a lesser extent unstable angina in almost all of the models. Age also predicted a decreased use of the recommended medications and older adults were less likely to be treated with all three of the cardiac interventions. This finding is consistent with other studies that have found a significant age bias in the treatment of the AMI in the elderly (Barchielli et al., 2004; Ko et al., 2004; MacDonald, Johnstone, & Rockwood, 2000).

In a recent population based study, Barchielli and colleagues (2004) found that 40% fewer coronary reperfusions occurred for those over the age of 85 years as compared to those with similar clinical manifestations, and that those who received coronary reperfusions had a significantly lower risk of death at one year. Similarly, Graham and colleagues (2002), in a population-based study found that AMI patients $\geq$80 years had a greater absolute risk reduction with surgical revascularization (i.e., PTCA and PCI) than the younger patients, indicating that older patients do benefit from aggressive therapy after the AMI. Although CABG surgery mortality rates were higher for those who were ≥80 years, those who did not have significant comorbidities had mortality rates comparable to those of younger patients (Alexander et al., 2000; Graham et al., 2002). Welty and colleagues (2001) reported that gender differences found in the in-hospital mortality after PTCA could be explained by age. After the age adjustment, mortality was no longer statistically significantly higher in women, suggesting that differences in the outcomes between men and women were related to age, which predisposes women to worse outcomes.

Similarly, the cardiac medications appear to be of benefit to older adults, according to a meta-analysis study of CHD patients (Wilt et al. 2004). Wilt and colleagues (2004) found that statin therapy reduced CHD mortality by 25% and all-cause mortality by 16% in both women and older adults. Clinical trials have supported these findings, with evidence that older adults benefit from statins (Shepherd et al., 2002, Heart Protection Study Collaborative Group, 2002). However, despite the known benefits of statins for all clinically appropriate patients, a recent study by Brophy and colleagues (2003) found that there was still an under utilization of statins after revascularization, especially among older adults.

Social Environment

Social environment, operationalized as marital status, was a significant variable in some of the models. Being single was a predictor of mortality within one year after the

AMI. Those who were single were more likely to die within one year after the AMI when the variables of age, gender, comorbidity, and medications were included in the model. A supplementary analysis showed that marital status did not interact with gender suggesting that the effect of marital status did not vary across gender.

Being single was also a predictor of the use of statins and ACEIs but in converse directions. For those who were single, the odds were lower to have prescriptions for statins at both the 30 and 90 days but there was an increase in the odds for ACEIs prescriptions for the single population. Although it is not possible to identify the reason for these different results within this study, other research has confirmed that single people do have lower survival rates after coronary heart disease (Chandra et al., 1983) and an increased risk of death within five years after a coronary angiogram (William et al., 1992). Being single may be confounded with age, meaning that many of those who are single are also older and therefore they may have a greater risk for morbidity and, consequently, be at higher risk for death within the first year. However, social isolation may also predispose individuals to a decreased adherence to prescribed medications and lifestyle changes required for optimal functioning.

Socioeconomic Status (Prosperity)

One of the health determinants hypothesized to predict quality of care and outcomes was the socioeconomic indicator named prosperity in the conceptual framework. In the present study, 23.8% of the study population was in the lowest income group, compared to 13.5 % in the highest income category. Thus, there is a clear income gradient in terms of who had an AMI, consistent with previous research that shows that socioeconomic status is strongly related to health (Wilkins, 1995).

Recent research has consistently identified the influence of socioeconomic status on the access to cardiac procedures after an AMI (Alter, Naylor, Austin & Tu, 1999, Alter, Naylor, Austin, Chan, & Tu, 2003). Even in a country with universal health insurance coverage, there are disparities in access to cardiac catheterization after AMI. Those in the lower income groups have a lower percentage of catheterizations according to an observational research study in Quebec (Pilote, Joseph, Belisle, & Penrod, 2003). Alter and colleagues (2004) found that people who were more affluent had higher rates of PTCA than did those who were in the lower socioeconomic levels. Similar findings were obtained in this current study; individuals in the lowest two quintiles were less likely to have a PTCA at the time of their AMI. However, there were no differences between the two income groups in the access to cardiac catheterizations and CABG at the time of the AMI.

The people in the lowest two income quintiles were also less likely to have prescriptions for beta-blockers within 30 and 90 days after the AMI than those in the higher income quintiles. These medications are the least expensive but they do need to be taken more frequently than the other medications. Interestingly, there was no difference between the income groups in the filling of the prescriptions for statins and ACEIs. The difference may be related to the known significant side effects of the beta-blockers or physician prescription patterns. Knowing that people are reluctant to take medications that have side effects may result in limiting prescriptions in the hope that fewer medications with less noticeable side effects and those that are less expensive may increase adherence.

Health Care Utilization

Continuity of Care. This study attempted to identify the significance of having a consistent care provider in the two years before the AMI, as well as in the three years post-AMI. Although there has been substantive population-based research on continuity of care (COC) with older adults who have chronic diseases and who require primary care (Ahluwalia et al., 1997; Martin et al., 1996; Menec et al., 1999), few studies have examined this concept in the younger population with acute illnesses. This study did find that COC was a significant independent predictor of being readmitted with a diagnosis of unstable angina within 30 days. Those who had 50% or more of their physician visits to the same physician had increased odds of being readmitted within 30 days with a diagnosis of unstable angina. A readmission for unstable angina after being treated for an AMI is usually considered a potential indicator of inadequate or inappropriate treatment at the time of the event. In this case, it may indicate that those with a consistent physician were being monitored closely and readmitted appropriately in a timely manner (Quality of Care and Outcomes Research in CVD and Stroke Working Group, 2000).

As this was a population-based study, the concept and impact of COC was limited to the COC provided by the family physician and the cardiologist. As few people in the population had access to a cardiologist, there was no attempt to identify whether or not having access to a cardiologist had an impact on outcomes. Recent research has found that AMI patients who were followed by a cardiologist had better survival rates when all patient characteristics were controlled (Abubakar et al., 2004). This suggests that further research into the benefits of continuity of care, be it in relation to family physicians or cardiologists, should be conducted.

Other researchers have found that CHF patients had reduced hospitalizations when a multidisciplinary team provided the continuity of care (McAlister et al., 2001). The COC definition may need expanding in order to further explore the predictive value of COC on health outcomes. Cardiac disease is both chronic and complex and the needs of this population are equally complex. Care provided by a consistent multidisciplinary team may have a greater impact on the health outcomes than attempting to identify the impact of the care from a singular, albeit consistent physician. As with other chronic diseases the adherence to medication, exercise, diet, and lifestyle regimes are critical to maintain functioning and good long-term outcomes. For the post-AMI population, many changes are recommended to facilitate a return to pre-AMI functioning and living. Adherence to the post-AMI medication regime alone is both expensive and unpleasant due to the side effects of the medications. A multidisciplinary team, with a significant role for the new nurse practitioner professional, may be the best way to ensure COC resulting in increased communication and coordination, patient education, and regular follow-up that will increase the odds of better health outcomes.

Prescription Medication Use. In the logistic regression models, those who filled the prescriptions for beta-blockers had increased odds of dying within the year after the AMI. This unusual finding requires more exploration, but the most likely explanation is that those who received beta-blockers and who died in the first year had more severe disease. However, when the cardiac interventions were added to the model the beta-blockers were no longer predictor variables. This change in the predictive value of the beta-blockers might suggest that the use of the cardiac interventions were effective in preventing death within the first year, even among those who were quite ill.

In contrast, those who filled the prescriptions for ACEIs were less likely to be readmitted with CHF within 30 days and 90 days, but when the beta-blockers were added to the model, the use of ACEIs was no longer a protective factor against readmission for CHF. This might suggest that those who were using both ACEIs and beta-blockers had more severe disease then those who used ACEIs only. Contrary to the expectations, the results indicated that the addition of the specific cardiac medications did not consistently affect the health outcomes of the study population. One of the explanations for the lack of predictive value of the prescriptions for better outcomes (i.e., less likely to be readmitted for CHF and unstable angina) may be related to the underfilling and perhaps under-prescription of the recommended post-AMI medications for both men and women. In other words, the study population may not have received the number and type of prescriptions that could potentially make a difference in the health outcomes measured in this study.

The Canadian Cardiovascular Outcomes Research Team (CCORT) has established recommended guidelines for the prescriptions for beta-blockers, statins, and ACEIs medications for AMI patients (Tran et al., 2003). The CCORT guidelines, based on population and clinical studies and expert clinician experience and opinion, suggest that a certain percentage of the AMI population should have prescriptions for the three recommended medications. They suggest that 85% of the AMI population, irrespective of age, should have prescriptions for beta-blockers, 70% for statins, and 85% for ACEIs. In this study, the medication prescriptions were significantly lower than the recommended guidelines set by CCORT (Table 5.0).

Table 5.0
Filled Prescriptions for Post-AMI Medications as Compared to CCORT Recommendations

Medications		Prescriptions — Current Study	
CCORT (Recommended %)	Time Post-AMI	Male (%)	Female (%)
Beta-blockers	30 days	60.2	49.4
(85%)	90 days	64.7	54.2
Statins	30 days	16.1	11.7
(70%)	90 days	22.3	18.0
ACEIs	30 days	33	37
(85%)	90 days	38	42.5

The significant difference in the filled prescriptions, when compared to the recommended prescription percentages, indicates that potentially a significant number of deaths related to AMI could be prevented if prescriptions were provided at the recommended level. However, this study found that the use of these medications did not predict better health outcomes within the first year after the AMI. The low percentage of prescriptions for the recommended medications did not predict readmission for CHF or unstable angina within 30 and 90 days nor did the low percentage of prescriptions predict mortality within the first year. This finding may be related to the fact that other significant pre-AMI and post-AMI variable were controlled in the models and as a result, the impact of these recommended medications did not predict readmission and mortality. The Quality of Care and Outcomes Research in CVD and Stroke Working Group (2000), suggest that the published benefit of these medications on mortality should be based on population studies whereas many of the studies base the assertions of the positive impact of these medications on outcomes for AMI patients on in-hospital and inter-hospital comparisons. However, this same working group suggested that looking at readmission rates only might not include data that would identify planned readmissions based on the pre-AMI status of the patient. Consequently, suboptimal care is not necessarily the reason for the readmission.

The side effects of the medications have been cited as one of the reasons that the recommended medications have not been prescribed. For example, beta-blockers are sometimes not prescribed because of the side effects of fatigue, decreased heart rate, hypotension, and diminished libido (Borrello et al., 2004). The significant positive, potentially lifesaving effect of this drug has prompted the American Medical Association, along with five other organizations, to issue alerts, reminding physicians of the benefits of these medications (Borrello et al. 2004). Further, there have been recent suggestions that beta-blockers might not be an appropriate in-patient medication, but that they should be prescribed on an outpatient basis when the patient is stable (Quality of Care and Outcomes Research in CVD and Stroke Working Group, 2000). There is also research that indicates that there is a small sub population who should not be prescribed beta-blockers because of significant contraindications (Marciniak et al., 1998).

While statins have been underused in the older post-AMI patients, there is evidence that age should not be a limiting factor on the prescription of statins (Wilt et al., 2004). ACEIs have been identified as having applicability to a smaller cohort based on clinical indicators but the low percentage of the AMI population in this study receiving ACEI prescriptions suggests that factors other than clinical indicators influenced the use of these medications (AHA, 2000). Side effects of ACEIs include allergic responses, hyperkalemia, impaired renal function, hypotension, and chronic cough. The significantly lower than recommended filling of these lifesaving medications for the AMI population suggests that more research needs to be completed to identify the reasons for low levels of use.

There is, however, also the alternative hypothesis that should be explored, namely that these drugs may not result in significant changes in mortality or morbidity. Comparisons should be made between geographical areas to ascertain if there are differences in mortality and morbidity after prescription guidelines have been implemented. For example, within the three years after the AMI, 27.5% of the population in this research study had died. Compared to recent results from a research study from Saskatchewan where 22% died within the first year after the AMI, the Manitoba population appears to have had a worse post-AMI trajectory (Chan et al., 2004).

Readmissions. The current study identified that within one year after the AMI, 41% of the population had been readmitted for an average of 20 days. In the 30-day and the 90-day period post-AMI hospitalization, 11.5% and 23% of the study population respectively had been readmitted. The percentages of the population with the readmission primary diagnosis of CHF and unstable angina were almost equal at each time period. This seemingly high readmission rate might reflect the severity of the illness or conversely it might reflect the less than appropriate treatment at the time of the index AMI.

There is recent Canadian data that suggests that Manitoba has a lower utilization of some of the cardiac procedures and that the health outcomes after the AMI are less favourable (CIHI, 2005). Although there is no consensus as to the percentage of the population who should have the cardiac procedures at the time of the AMI, comparisons across the provinces do allow some assertions to be made. In this study, 4% of the study population had CABG surgery, 23% had cardiac catheterizations, and 8% had PTCA at the time of the AMI. During the readmissions at the 30 and 90-day periods, a range of 1% to 5% of the population had one or more of the three cardiac procedures. It would appear that the people with an AMI in Manitoba could be treated with more cardiac procedures at the time of the AMI with potentially better outcomes based on the national comparisons. Although this study did not support the assertion that cardiac procedures predict better outcomes, it may be that those in the study population who had the cardiac procedures did not have them at the appropriate time and that is the reason that the procedures were not predictors for better outcomes.

Design Limitations

The completeness of the data in the administrative databases is one of its major strengths. Nevertheless, the findings of the research are limited to the population whose health services utilization is included in the database. In this study, the AMI population in the North may not have had all of their health care captured in the database, as the nurses in the local nursing station would have provided much of the follow-up care.

The issue of accurate and complete coding of comorbidites is one of the more significant threats to the validity of the data. Recently published research cautions investigators against depending on secondary data alone for the identification of comorbidites in people with cardiac disease (Powell et al., 2001). The researchers contend that there is a consistent underestimate of comorbidites when there is dependence on secondary data alone. O'Shea et al. (2001), at a recent expert meeting on cardiovascular disease, presented similar concerns about database research. However, these same researchers also identified the advantages of administrative data research, especially in the areas of inclusiveness, external validity, and longitudinal tracking.

A limitation of any epidemiological study is the fact that it is not possible to control for the effects of all other confounding factors which could lead to the conclusion that there is an association between variables, when in fact there is no relationship. However, with the variables of age, gender, geographical location, and income quintiles included as some of the predictor variables for the health outcomes, some of the confounding factors were controlled. Conversely, the study may have failed to find differences between the genders and the geographical locations when there may in fact be significant differences. The study is limited to the data which was accessible within the database, and therefore clinical indicators, known to affect the health outcomes, might have been significantly different between men and women.

Future Research

One of the major assumptions of this study was that there would be differences between the genders in the number and types of cardiac treatments received, as well as the subsequent health outcomes. As the logistic regression analyses revealed that there was little evidence of gender effects, it appears as though for both diagnostic and therapeutic treatments at the time of the AMI and in the post-AMI period men and women have equity in access to these treatments. Yet research continues to find that women access diagnostic treatments and cardiac interventions less frequently and later than men do (Bertoni, Bonds, Lovato, Goff, & Brancati, 2004; Rathore, Chen, Wang, Radford, Vaccarino, & Krumholz, 2001). The difference in the access to the procedures has not been shown to have consistently different outcomes. This current study indicates that there is no long-term effect of cardiac interventions at the time of the AMI. More population-based research needs to focus on identifying the relation of cardiac procedures to outcomes over a prolonged period to ascertain as to whether or not the difference in the rates of cardiac procedures has any impact in the post-AMI period.

There has been a significantly increased focus on research and clinical activity related to cardiac disease in women in the last decade. Descriptions of the differences in the risk factors, the presenting symptoms of an AMI, types of revascularization, and post-AMI period for men and women has substantially increased the knowledge about the AMI trajectory in women. This knowledge has resulted in a more consistent and different approach to the clinical care of women as compared to men with an AMI. The result should be an elimination of the differences in the mortality rate between men and women. Using a comprehensive database and a rigorous control of confounding variables, this research has found that indeed there is no difference in mortality between the genders within three years after the AMI.

Although most research studies use the three years after the AMI as an appropriate timeframe to evaluate outcomes related to the AMI, future research should be done using to identify the longer-term outcomes after the AMI, using a prospective longitudinal research methodology. It may be that gender differences will become apparent if women are followed for a longer time after the AMI period. Morbidity specifically may be quite different between the men and women, which might have a significant impact on quality of life. A recent announcement that a major cardiac study will be undertaken in Alberta comparing the experience of men and women with AMI, from the emergency department to the three years after the AMI should provide both qualitative and quantitative data that can inform the decision makers (Necheff, 2003).

The current study focused on a three-year period following AMI, but individuals' experiences of an AMI were not explored. There is some research to indicate that the quality of life may be different for men and women even though the outcomes are the same. Quality of life after the AMI can be presumed to be an important predictor for future cardiac events. An AMI is stressful and often is a life-threatening event. There are inconsistent findings related to the gender differences in the quality of life after an AMI. Some studies have found that there are gender differences in the quality of life, namely that women generally identify a lower level of quality of life after the AMI as compared to the men (Agewall et al., 2004; Westin et al., 1999; Wiklund et al., 1993). Other studies have failed to identify gender differences in the post-AMI quality of life (Maeland & Havik, 1988). The causal relationships between the AMI and the lower quality of life post-AMI in women have not been identified. The development of reliable and valid measurement tools to evaluate quality of life, in this population is an important research priority. Elucidating this relationship could provide direction for the treatment strategies that need to be developed and implemented to improve the quality of life for women.

There is evidence that low self-assessed quality of life is predictive of an increase in the intima-media thickness in the common carotid (Agewall et al., 1996) and cardiovascular events (Everson et al., 1997) in hypertensive men. This relationship between the physiological changes that occur in men who have a self-identified lower quality of life provides direction for another important research study focused on men and women's experience after the AMI. It may be that men are overall less likely to self-assess a lower quality of life and that those who do may in fact be at a significantly greater risk for repeat cardiovascular events.

Continuity of care was limited to the physician care. Based on recent research, other studies should be developed which will examine the differences in health outcomes with different continuity of care delivery models. The multidisciplinary team approach suggested by some clinicians should be developed and compared to existing physician office models. A randomized controlled trial could evaluate both clinical and financial outcomes. Further models may require sensitivity to both gender and age as both may affect the preference for certain continuity of care service models.

The medication regime after an AMI can be difficult. This study captured the filling of prescriptions within 30 and 90 days. Adherence to the medications is data that can be extracted from the database, but was not included in this study. This dimension of the post-AMI trajectory of prescription drug use should be investigated. Medication adherence for the three cardiac medications should be measured to identify the impact on the mortality and the readmission rates within the three-year follow-up period.

Observational research suggests that statins can provide for an improved outcome only when they are given within 48 hours after admission (Ferrieres et al., 2005). One could use qualitative methods designed to capture the experience of the people who have had an AMI and who are being prescribed a series of medications to provide some information as to the reason for the small percentage of people on recommended medications

Although not expected, the finding that being single significantly increases the odds of death within the first year of the AMI indicates that more research needs to be done to elucidate the significance of social isolation, which may be a component of being single at the time of an AMI.

Significant regional differences were identified in access to both investigational and interventional cardiac procedures. These differences, although not related to a difference in the mortality within the three years after the AMI, should be researched further to identify the reasons for lower rates of access to the cardiac procedures. Comparisons of clinical data between the populations of various regions should be made to elucidate potential clinical rationales for the differences in the revascularization procedures.

Health outcomes research is gaining recognition by clinicians and funding bodies alike. In Manitoba, there is a substantive database research which provides information to decision-makers about mortality, morbidity, and some other health measures. Other research opportunities exist, using other methodologies, to ascertain the resulting health outcomes, by using functional status, and other physiological and psychological measurements.

This study used database analysis to identify the gender and regional differences in the AMI trajectory. Having identified some gender and regional variation, research designs including both qualitative and quantitative methods should now be used to describe the post-AMI trajectory to provide information to develop more consistent use of medications and to guide regional and gender appropriate clinical care.

Implications for Policy

Although there have been numerous research projects completed in the recent past which described the use of the cardiac medications, this study highlighted that the filling of prescriptions for the three major cardiac medications is still considerably lower than the Canadian Cardiovascular Outcomes Research Team (CCORT) guidelines.. The CCORT recommends that 85% of AMI patients at the time of discharge after an AMI be on beta-blockers and 70% be on ACEIs and statins. In this study, the rates were considerably lower than the recommended levels (Table 5.0)

However, the current study did not reveal any significant differences in the health outcomes because of the low level of filled prescriptions; nevertheless, it seems that there needs to be an exploration as to why there is such a low rate of "uptake" on well-published literature about the value of the recommended medications. Based on the findings, it might be appropriate to develop a province wide plan to implement the guidelines and to ascertain whether compliance improves the post-AMI outcomes. Grover and colleagues (2003) found that offering statin therapy could potentially be cost saving for society when one calculates the lost productivity at home and at work when the person with the AMI is unable to return to full functioning.

The consistent application of best practice guidelines seems to be obvious but policy makers are reluctant to state that adherence is an expectation and even more reticent to tie funding to the expectations. However, some governments, through initiatives such as the cardiac report cards have motivated hospitals in Ontario to increase their adherence to the Canadian guidelines for both the diagnosis and treatment of the AMI population. Young et al. (2003) recently reported on a project focused on developing integrated community pathways to provide care that is more consistent for the post myocardial infarction patients. A similar project in Australia showed that implementing clinical practice guidelines for post-AMI care and providing feedback of clinical indicators resulted in a decrease in the in-hospital death rate, incidence of post infarction angina, and the mean length of stay in hospital care (Scott et al., 2000). Mehta et al. (2004) further suggested that moving the focus from key clinical indicators to process of care tools such as guidelines, standardized forms, and consistent discharge planning improved the quality of the care for all AMI patients. With an increased investment of automated information technology, some health care institutions have found that using both the evidence-based practice guidelines and the automated information technology has reduced AMI mortality from 10% to 3% over a one-year period (Goepfarth & Cacchione, 2005). With the increased focus on quality, health care road maps are important to ensure that variability is reduced between the practitioners and that evidence-based practice is the expectation of all the institutions within the publicly funded health system. Policy makers should support the increased activity in the development of Minimum Data Sets (MDS) as a means to identify the gaps in service, consistency of care, and measurable outcomes.

Other researchers have suggested that having a common data base for Canada would allow for a better understanding of how AMIs are managed, the quality improvements made, and a national trending system for AMI (Jackevicius et al., 2005). In a province like Manitoba, with a million people spread across a vast distance, it is even more critical that a provincial approach is used to ensure that similar care is provided within the scope of the local health system. Researchers in Sweden found that a significant difference in the use of intravenous beta-blockers, intravenous nitroglycerin, anticoagulants, and lipid-lowering (statins) medications resulted in lower short and long-term mortality rates for the AMI patients (Stenestrand, Lindback, & Wallentin, 2005). The researchers reported even more discrepancy in revascularization rates within 14 days (Stenestrand et al., 2005). Canada is not the only country struggling to find ways to find methods to improve consistency in care for the AMI person, with the goal to improve outcomes regardless of geographical location. Development of minimal standards that could be applied to all sizes and complexity of institutions and systems should be explored. Policy makers could provide the leadership required to support this initiative.

Continuity of Care was a variable that was selected as one of the predictor variables for health outcomes. Although the variable only predicted readmission for CHF, as identified in the previous discussion, this concept needs to be expanded and developed more fully within a multidisciplinary team model. Considering the improved outcomes for those who had access to a cardiologist as compared to the general physicians, (Abubakar et al., 2004) policy makers may want to ensure that cardiologists are available or ensure that there is some form of care coordination between the general practitioners and the cardiologists.

Whether in the health system at a government or service level, policy makers can use the results of this study to direct resources to address some of the inequities that continue to exist in the quality of care indicators. An equally important focus should be on confirming the impact of the cardiac interventions and the cardiac medications on the long-term mortality and morbidity.

Implications for Clinical Care

This current study highlights that individuals aged 75 years or older do less well in the three years after the AMI. It appears that age has become the new frontier for cardiac care. Older people in the population can now recover well from invasive cardiac procedures which had previously been deemed only to be appropriate for younger people. There is a variety of reasons as to why this has happened. With an increased use of mammary arteries for CABG surgery, older people are having CABG surgery and having good outcomes. Similarly, the increased use of stents, a less invasive procedure than CABG, has increased the use of cardiac interventions for older adults. Clinicians may do well to focus less on the age of the patient and more on the clinical evidence to decide on treatment. Research evidence indicates that even the frail elderly benefit from aggressive treatment of the AMI (Barchielli et al., 2004). The implementation of age appropriate clinical practice guidelines may further improve the outcomes for older adults. Clinical practice guidelines appear to have made a significant improvement in the health outcomes and therefore should be implemented by clinicians to ensure that patients are receiving the best and comparable care, even though skill and experience may be variable between the physicians (Mehta et al., 2004; Scott et al., 2000).

Continuity of care was a variable that had not been studied for the AMI population. Although COC was not a consistent predictor of better health outcomes, intuitively it could be expected that those with a consistent physician would have better outcomes. As indicated in the preceding section of this chapter, it might be that the COC concept needs to be expanded to include a multidisciplinary team in order to identify the impact of continuity of care. A multidisciplinary team including nurses, dietitians, and rehabilitation therapists might provide better outcomes for the post-AMI person. For example, a randomized control study found that nurse-led clinics focused on health care and lifestyle changes, for those with CHD were cost-effective and increased quality adjusted life year (Raftery, Yao, Murchie, Campbell, & Ritchie, 2005). With the certification process in place for nurse practitioners in most provinces, independent nurse practitioners who are licensed to prescribe treatments and medications are an appropriate caregiver to provide continuity to these people with cardiac disease. Kowalyk and colleagues (2004), using continuity of care questionnaires, found that there were a number of gaps in the continuity of care from the patient's perspective. Clinicians in the health system could use the results from questionnaires such as the ones used by Kowalyk et al (2004) to guide the development of appropriate team approaches to ensure continuity of care to this complex and chronic patient population.

The prescription patterns have not met the stated recommendations as described earlier. The barriers for the under prescribing has recently been studied by Mehta and colleagues (2004). In an observational study, they found that physicians were reluctant to prescribe beta-blockers, ACEIs, and statins for the post-AMI patient who had CABG surgery. Reasons that were given related to the lack of randomized control studies supporting the use of these medications. Nevertheless, the researchers indicated that guidelines suggest that these medications should be provided based on observational studies and the generalized benefits of these medications for the post-AMI patients. Similarly, Butler and colleagues findings (2004) recommended low levels of ACEI utilization upon discharge and that quality management initiatives should focus on discharge planning and outpatient care (Butler, Arbogast, Daugherty, Jain, Ray, &

Griffin, 2004). Another study had similar findings related to the low rate of beta-blocker use where the researchers found that the important correlate to the low prescription rates was the lack of physician leadership (Bradley et al., 2005). In order to improve the prescription rates there needs to be administrative support for the development of clinical pathways for the AMI patient which would include the discharge medications. The Institute for Healthcare Improvement (IHI) in their 100,000 Lives campaign has targeted AMI as one of the diseases that if treated according to best practice could assist in achieving the goal of saving 100,000 lives (Institute for Healthcare Improvement, 2005). The IHI has developed a comprehensive kit that can guide organizations in the development and implementation of the best practice guidelines.

Not only in the hospitals is there a need to create best practice directives based on sound research, but also in the community and home care services require a similar base for practice. The Partners for Health's Home Care after a Heart Attack group in Toronto has developed community-based pathways to improve the care and teaching for post myocardial infarction patients (Young et al., 2003). Based on a model from the American Heart Association, (2000) this cross-sectoral group developed and implemented an integrated rehabilitation approach for the post-AMI patients (Young, 2003). Rehabilitation after an AMI is an important aspect of the AMI trajectory and one that requires further focus from all of the clinicians. The non-salaried physician is an important member of the multidisciplinary team required to achieve success in the implementation of post-AMI pathways. Research based practice directions should therefore be developed at a national level to achieve economies of scale, and individual physicians and organizations should then utilize them rather than creating their own pathways. Administrative support in the form of creating linkages with Home Care would provide for a more consistent uptake by the community care providers after discharge. Clearly, there are many opportunities to improve the health outcomes for the people living with the CHD.

Summary

The research study was focused on answering the following questions:

1) Are there gender differences after an acute myocardial infarction (AMI) quality of care received and the health outcomes?

2) What are the regional variations in the quality of care received and the health outcomes for people who have had an acute myocardial infarction (AMI)?

3) What is the relationship between the quality of care and health outcomes in the post acute myocardial infarction period?

The hypothesis that there would be significant differences between the males and females was not supported by the research. However, the fact that a population-based research study identified that there was no gender difference in both the quality of care and the health outcomes provides confidence that there is equity in the treatments and outcomes as measured in this study. This finding is similar to the more recent research which indicates that gender differences in the treatment of AMIs are being eliminated. An alternative hypothesis could however be that differences in treatments exist, but that they do not alter the health outcomes that were being measured in this study. Qualitative research focused on interviewing and measuring psychosocial wellbeing and functioning should be completed to determine if there are gender differences in outcomes other than mortality and readmission for CHF and unstable angina. One outcome that requires further study is the quality of life after an AMI. Gender differences have been noted in the symptoms of an AMI. If, as has been suggested, in the literature, that women have more silent AMIs or AMIs with symptoms that are not recognized, then women may have died without being included in the hospital database, which was the identifier for the population.

The regional variations were supported within this research study. Residents of the Central/Northern and the Southern regions had different levels of quality of care, as measured by recommended filled prescriptions for cardiac medications, cardiac procedures at the time of the index AMI, and cardiac catheterizations within 90 days after the AMI. Those who lived in the Central/North and South regions of the province had decreased odds of having prescriptions filled for beta-blockers but increased odds for filling ACEIs and statins. This regional difference in the filling of prescriptions the drugs cannot be explained by this study. Possible explanations include physician prescribing patterns or self-selection based on side effects of the medications. The fact that the Central/North and the South had significantly reduced odds for cardiac procedures at the time of the index AMI also requires further investigation and action to ensure that our universal health system supports equity in access.

The health outcomes of mortality and readmission were not significantly different between the regions except for the readmission for CHF. The Central/North region did have increased odds of being readmitted with a diagnosis of CHF within 30 and 90 days. However, there was no significant difference in the mortality rates for these regions as compared to those who had lower rates of readmission for CHF.

This research provides important information as to the state of post-AMI treatment and outcomes in this province. Although many of the gender differences appear to have been eliminated, regional variations exist and thus these findings can provide a focus for further research, policy, and practice aimed at improving the quality of care, particularly to the more remote areas of the province.

Heart disease is a chronic disease and as such, is one of the diseases that comprise the third frontier of health. The World Health Organization (WHO) has recognized that chronic diseases will be our greatest challenge as we enter the new millennium (2002). Understanding the post-AMI trajectory assists in setting directions for researchers, policy makers, and clinicians.

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APPENDIXES

APPENDIX A

GLOSSARY AND DESCRIPTION OF TERMS

Age Calculations

Patients were divided into the following age groups: <39 years, 40–50 years; 51–60 years; 61–70 years; 71–80 years; >81 years. If there were an insufficient number of patients in any of the groups, some were combined.

Ambulatory Diagnostic Groups (ADGs)

With the assistance of expert clinicians, just over 14,000 ICD-9/ICD-9-CM codes were categorized into 32 groups, called Ambulatory Diagnostic Groups (ADGs) on the basis of the following either clinical and expected utilization criteria:

1. Clinical similarity
2. Likelihood of the persistence of recurrence of the condition over time
3. Likelihood that the patient will return for a repeat visit/continued treatment
4. Likelihood of a speciality consultation or referral
5. Expected need and cost of diagnostic and therapeutic procedures for the condition
6. Expected need for a required hospitalisation
7. Likelihood of associate disability
8. Likelihood of associated decreased life expectancy

If, over a defined interval (usually one year) and individual has at lease one of the diagnoses in an Ambulatory Diagnostic Group s/he is assigned that ADG. A patient can be assigned as few as none and as many as 32 ADGs.

The Adjusted Clinical Group (ACG) system then clusters the ADGs into 12 Collapsed ADGs or CADGs and then combines CADGs into common patterns called Major Ambulatory Categories (MACs).

Recent refinements to the ACG system have resulted in the development of the concept of "major ADGs." With the addition of variables on the delivery status of pregnant women and infant birth weight there are now 92 ACG categories and sub-categories. Thus, ACGs are the mutually exclusive terminal groups of the ACG system and (to summarize) represent combinations of ADG, age, and gender categories.

As opposed to other diagnosis grouping systems, the ACG system does not rely on identifying principal diagnoses.

It identifies common combinations of morbidities (related and unrelated) that build upon each other both additively and multiplicatively to determine as individual's need for health services. Thus, ACGs categorize people while most other grouping systems categorize events or episodes.

Angioplasty

Percutaneous Transluminal Coronary Angioplasty (PTCA) — any hospitalization occurring in a teaching hospital with ICD-9-CM codes of 36.10, 36.02, 36.05 present in any procedure field.

ATC

Anatomical Therapeutic Classification System is a system used to classify or group drugs. It is a measuring unit recommended by the World Health Organization for drug utilization studies. In the system the drugs are classified in groups according to the organ or system on which they act and their chemical, pharmacological, and therapeutic effect. Drugs are classified in groups at 5 different levels. The drugs are divided into fourteen main groups — 1st Level.

Level	Main Group
A	Alimentary tract and metabolism
B	Blood and blood forming organs
C	Cardiovascular system
D	Dermatologists
G	Genito-urinary system and sex hormones
H	Systemic hormonal preparations
J	Anti-infectives for systemic use
L	Anti-neoplastic and immuno-odulating agents
M	Musculo-skeletal system
N	Nervous system
P	Antiparasitic products
R	Respiratory system

S	Sensory system
V	Various

1st Level: The first level of the code is based on a letter and signifies one of the 14 anatomical signs.

2nd Level: This level signifies either a pharmacological or a therapeutic subgroup.

3rd Level: This level is a chemical or therapeutic or pharmacological subgroup.

4th Level: This level is a chemical, therapeutic, or pharmacological subgroup. It is used to count the number of different drugs just above the description of the chemical substance; it approximates a measure of comorbidity.

5th Level: This level is the subgroup for the chemical substance.

CABG

Coronary Artery Bypass Graft (CABG) is any hospitalization occurring in a teaching hospital with ICD-9-CM codes within the range of 36.1 to 36.16 or 36.19 in any procedure field.

Cardiac Catheterization

Cardiac catheterization refers to any hospitalization occurring in a teaching hospital with ICD-9- CM Codes of 37.22. 37.23 or 88.53-88.57 present in any procedure field.

Charlson Index

The Charlson Index contains 19 categories of comorbidity, which are primarily defined using ICD-9-CM diagnoses codes. Each category has a weight, based on the original Charlson paper, which is based on the adjusted risk of one-year mortality. The overall comorbidity score reflects the cumulative increased likelihood of one-year mortality; the higher the score the more severe the burden of comorbidity.

Diabetes Mellitus

During two years at least one prescription for insulin or hypoglycemic drug (ATC: C01A) or during three years at least one hospitalization or two physician visits for diabetes. ICD- 9-CM code 250.

Fiscal Year

Manitoba Health fiscal year April 1 to March 31 comprises the data record year.

Geographical Regions

Region of residence were based on the work by Brownell et al. (2003). Regional Health Authorities (RHAs) were classified according to the premature mortality rates (PMRs). Those whose PMR was greater than the provincial average were classified into one group known as North and included Nor-Man, Burntwood, and Churchill. Those whose PMR did not differ significantly from the provincial average were known as

Central and included Marquette, Parkland, North Eastman, and Interlake. Those RHAs whose PMR was significantly lower than the provincial average are known as South and included South Eastman, South Westman, Brandon, and Central. Winnipeg is the fourth category.

Home Care

Home Care days were defined as the number of days "open" in the Home Care Program (i.e., registered with Home Care) as recorded in the Manitoba Support Services Payroll (MSSP) file. In the analyses, home care days were expressed as days per AMI patient.

Hospitals

Hospitals were classified into three categories: teaching (St. Boniface General Hospital; Health Sciences Centre), urban community hospitals (Brandon, Grace, Seven Oaks, Concordia, Victoria, Misericordia) and rural hospitals.

Hospital Days

Hospital days for all acute care hospitals were derived from the Hospital Discharge Abstract file.

Hospital separation occurs when a patient leaves because of death, discharge, or transfer. The number of separations is the common measure of utilization of the hospital services. This was the measure that was used to identify the AMI patient's hospitalizations.

Hypertension

A person was defined as hypertensive if they had at least one hospitalization or two physician visits for hypertension in three fiscal years (ICD-9-CM code 401–405). This definition was chosen for its ability to closely match clinical measures and survey results (Robinson et al., 1997).

Income Quintiles: (Age-Sex Adjusted)

The population was assigned to five income groups based on their postal codes. Postal codes are sorted by average household income value (lowest to highest income), based on publicly available Census data from 1996. Postal code population values (specific to the year 1996) are classified by average income from lowest to highest income, so that approximately 20 % of the population is present in each class. Each class of postal codes forms an income quintile with the lowest income quintile representing areas with the lowest average income, and the highest income quintile representing area with the highest income.

	Minimum	Maximum	Mean
Q1	8,767	23,740	18,946
Q2	23,740	28,393	26,037
Q3	28,393	34,150	31,381
Q4	34,150	43,048	38,373
Q5	43,048	126,512	54,967

Index Hospitalization

AMI was identified as hospitalization for acute myocardial infarct (AMI) with discharge diagnosis of ICD-9-CM 410 (410.0-410.9 — no limitation on the fifth digit. It included all AMI inpatient admissions transferred to another hospital.

Marital Status

Marital status was determined from the Manitoba Health Registry file with the individuals classified as being married versus not married, which included those who were never married, widowed, and divorced.

Mortality Rates

These rates were derived from the Manitoba Department of Vital Statistics data.

Physician Visits

Physician visits were the total number of ambulatory physician visits that occurred outside of the hospital. Physicians paid on a salary basis shadow bill should therefore be captured in the database.

Prescription Drugs

Information was derived from the Drug Program Information Network (DPIN) databases. The databases captured all prescriptions under the provincial Pharmacare Program and the drugs tracked are ACEIs, beta-blockers, and statins.

APPENDIX B

LETTERS OF APPROVAL FOR THE

HEALTH RESEARCH ETHICS BOARD
(UNIVERSITY OF MANITOBA)

AND

HEALTH INFORMATION PRIVACY COMMITTEE
(MANITOBA HEALTH)

UNIVERSITY
OF MANITOBA

BANNATYNE CAMPUS
Research Ethics Boards

P126-770 Bannatyne Avenue
Winnipeg, Manitoba
Canada R3E 0W3
Tel: (204) 789-3255
Fax: (204) 789-3414

APPROVAL FORM

Principal Investigator: Ms. Carole Ringer

Protocol Reference Number: H2003:167
Date: December 8, 2003
Date of Expiry: December 8, 2004

Protocol Title: **"Gender and Regional Variations in the Quality of Care and the Health Outcomes after an Acute Myocardial Infarction"**

The Health Research Ethics Board at the Bannatyne Campus, University of Manitoba, which is organized and operates according to Health Canada/ICH Good Clinical Practices, Tri-Council Policy Statement, and the applicable laws and regulations of Manitoba reviewed the above mentioned study at the REB meeting held on December 8, 2003. The membership of this Research Ethics Board complies with the membership requirements for Research Ethics Boards defined in Division 5 of the *Food and Drug Regulations.* The research was approved as submitted.

The following is/are approved for use:

- **Research proposal (submitted November 24, 2003)**

This approval is valid for one year only. A study status report must be submitted annually and must accompany your request for re-approval. Any significant changes of the protocol and informed consent form should be reported to the Chair for consideration in advance of implementation of such changes. The REB must be notified regarding discontinuation or study closure.

This approval is for the ethics of human use only. For the logistics of performing the study, approval should be sought form the relevant institution, if required.

Sincerely yours,

Ken Brown, MD, MBA
Chair, Health Research Ethics Board
Bannatyne Campus

Please quote the above protocol reference number on all correspondence.
Inquiries should be directed to the REB Secretary
Telephone: (204) 789-3255/ **Fax:** (204) 789-3414

Manitoba
Health

300 Carlton Street
Winnipeg, MB R3B 3M9

HEALTH INFORMATION
PRIVACY
COMMITTEE

January 9, 2004

File No.: 2003/2004 - 21

Carol Ringer

Dear Ms. Ringer:

Re: Gender and regional variations in the quality of care and health outcomes for myocardial infarction patients in Manitoba

Thank you for supplying the requested ethics approval. Your request for the data itemized in your document "Gender and regional variation in the quality of care and health outcomes in acute myocardial infarction patients in Manitoba: Data requirements from the Manitoba Health databases" for this study has been *approved.*

Any significant changes to the proposed study design should be reported to the Chair for consideration.

If you have any questions regarding the Committee's decision, please contact Leonie Stranc, Committee Coordinator at 786-7204.

Yours truly,

Dr. R.Walker
Chair

Please quote the file number on all correspondence

cc. L. Barre

0-494-08794-3

Your file *Votre référence*
ISBN:
Our file *Notre référence*
ISBN: