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UTILIZATION OF ACUTE CARE HOSPITAL SERVICES BY CARDIOVASCULAR PATIENTS IN ALBERTA

BY

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ABSTRACT

The highest proportion of total health care costs is attributed to the use of acute care hospital beds, and cardiovascular disorders are the leading cause of hospitalization volumes. Accordingly, cardiovascular utilization patterns and trends in Alberta acute care hospitals between 1971 and 1983/84 were investigated in this study.

To provide a descriptive analysis of cardiovascular utilization over time at a provincial and district level, an exploratory and descriptive research design was used, incorporating population-based per capita utilization rates. Hospital separations were categorized according to the circulatory component of the DRG classification system to examine relative cost and resource need measures of cardiovascular utilization.

Major findings of this study were:

1. Although overall cardiovascular utilization rates declined, it appeared that a substitution of the cardiovascular medical DRGs by the higher cost cardiovascular surgical DRGs had been occurring during the study period, substantially impacting the amount of resources devoted to cardiovascular services. Coronary bypass procedures exhibited the most dramatic and consistent utilization rate increases, followed by the nonoperating procedures of cardiac catheterizations and angiocardiographies.

2. The total amount of charges which would have been incurred for cardiovascular services, if the Alberta hospital system had adopted a volume-based reimbursement system similar to the United States DRG reimbursement system during the study period, was estimated to have

increased from $104 million in 1971 to $145 million in 1983/84, yielding a total of $1.6 billion (expressed in constant 1986 U.S. dollars).

3. High cardiovascular per capita utilization rates were primarily a characteristic of sparsely-populated areas in Alberta. Conversely, urban areas had cardiovascular utilization rates which were consistently lower than the corresponding provincial values, a phenomenon which may have been attributed to a tighter bed supply and the availability of comprehensive health delivery services.

4. The average cardiovascular separation increasingly required more resources during the study period. This increasing cardiovascular case mix complexity coincided with a significantly increasing resource dependency by referral patients on metropolitan cardiovascular hospital resources. Among the tertiary hospitals, the University of Alberta Hospitals assumed the predominant cardiovascular referral centre role in Alberta.

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CHAPTER I

INTRODUCTION

The use of acute care hospital beds is the most expensive component of the health care system; and circulatory system disorders are the leading cause of time spent by Canadians in acute care hospitals. This high utilization rate, coupled with the growing emphasis on health cost containment, merits considerable concern about the use of acute care hospital resources by individuals with diseases of the circulatory system, also traditionally called cardiovascular disease. Development of an information base is required to facilitate rational decision-making with respect to the delivery of cardiovascular services. In response to this requirement, this study focuses on inpatient utilization of Alberta acute care hospitals from 1971 to 1983/84 by individuals diagnosed with selected cardiovascular diseases and surgical procedures. Utilization patterns and trends are examined, supplemented with relevant health care planning and policy formulation implications.

1.1 Statement of the Problem

Notwithstanding any controversy regarding funding adequacy of the Canadian health care system, hospitals are being forced to restrict spending. Hospitals account for approximately one-half of total health care costs, and nearly two-thirds of all governmental health expenditures, compelling health care administrators, planners, and researchers to assess inpatient utilization patterns. Accordingly, the most important cause of hospitalization volumes in acute care facilities, namely that ascribed to circulatory system disorders, warrants considerable scrutiny.

In the past 20 years, an overall decline in cardiovascular mortality has been reported in several western industrialized nations (Feinleib, 1984, p. 20). Canadian age-adjusted cardiovascular death rates have fallen 25 percent between 1968 and 1979 (Kannel, 1982, p. 877). Despite this encouraging trend in cardiovascular mortality, heart disease continues to rank first among the leading causes of death and number of patient-days in Canadian and Alberta acute care hospitals, creating a vast impact on both the afflicted individual and the health care economy.

Accompanying the decline in cardiovascular disease mortality has been the development of increasingly specialized cardiovascular medical practices including notable growth in the quantity, quality, and complexity of coronary treatment facilities and technology. The advantages associated with these trends are not without a balancing disadvantage, as illustrated by the paradox of health care "... that each advance in medical science breeds a new need that is more expensive to treat than the last ..." (Bennett & Krasny, 1977, p. 3).

The magnitude of problems surrounding the delivery of health care to individuals with cardiovascular disease dictates that the rational allocation and utilization of health resources for cardiovascular services be considered a priority for health care planning and decision-making. Pivotal to this planning process is the transformation of voluminous amounts of cardiovascular-related utilization data into comprehensive information. To achieve that end, a longitudinal, exploratory study was undertaken to investigate acute care hospitalization patterns and trends in Alberta, from 1971 to 1983/84, by individuals diagnosed with selected cardiovascular system diseases and procedures.

For this study, the basic unit of cardiovascular services was predicated upon the revised ICD-9-CM version of the Diagnosis Related Groups (DRG) classification system. The Major Diagnostic Category (MDC) of this classification system, entitled "Diseases and Disorders of the Circulatory System," is associated with cardiovascular diseases and procedures. The primary diagnostic categories of this study included (in whole or in part): rheumatic heart disease; hypertension; ischaemic heart disease; diseases of the arteries, arterioles, capillaries, and veins; congenital anomalies of the circulatory system; other forms of heart disease; and, operations on the cardiovascular system.

1.2 Objectives of the Study

The purpose of this study was to explore the utilization patterns of cardiovascular patients in Alberta acute care hospitals. The following research objectives were established to achieve the exploration of utilization patterns:

I. To examine global patterns and trends in acute care hospital utilization by the Alberta population with selected cardiovascular disorders over a period of 13 years, 1971 to 1983/84.

2. To identify and compare cardiovascular medical and surgical utilization rates over the study time frame and among geographic districts of Alberta.

3. To investigate the care-seeking patterns of patients with cardiovascular conditions among Alberta acute care hospitals and geographic districts and regions, by means of patient origin-destination analysis.

4. To investigate the stability of the circulatory system component of the revised ICD-9-CM DRG classification methodology, by determining the volume of cases for selected circulatory DRG groups in Alberta from 1971 to 1983/84, and by examining per capita circulatory DRG utilization rates for the census years of 1971, 1976, and 1981.

1.3 Significance of the Study

Analyses of the utilization characteristics of the health delivery system are vital to the development of a sound information base to facilitate more objective health care planning and policy determination. Such analyses should elucidate relationships between the utilization of health facilities by, and health status of, the population, and between patterns of utilization behaviour and potential strategies for the rational allocation of health care resources.

Health care expenditure moderation has become a priority concern for local, provincial, and federal levels of government. Acute care hospital costs are the most rapidly escalating component of health care expenses. Consequently, hospitals have become primary targets for cost reduction efforts. The prominent contribution of cardiovascular diseases to the volume of acute care patient-days renders the investigation of cardiovascular service utilization patterns of major importance.

Investigation of cardiovascular utilization data over 13 years should facilitate trend analysis, providing a basis to project future cardiovascular trends of Alberta residents. Population-based measures for deriving per capita utilization rates should enhance objective and meaningful comparisons among geographic districts and regions in the province. Detection of geographic variations, attained by exploration of utilization patterns and patient origin-destination analyses, might illustrate potential differences in the availability, accessibility, and comprehensiveness of cardiovascular services throughout Alberta. Hence, the estimation of accurate utilization rates, and the identification of trends and regional variability, should support decision-making by those responsible for the assessment, resource allocation, and potential reorganization of cardiovascular services.

To the author's knowledge, this type of investigation has not been done for cardiovascular services in acute care hospitals, although it may be considered an extension of previous utilization studies conducted in Alberta (Allen, 1985; MacDonald, 1983; Paine & Wilson, 1975; Raasok, 1979; Romeril, 1984; Szafran, 1985; Toll, 1982). Unique to this study, however, was the analysis of comprehensive diagnostic-specific utilization data for a major medical service. Furthermore, classifying the clinical data into DRG groups, each of which is intended to reflect clinical and resource use homogeneity, was a novel approach for utilization studies in Alberta. Such an approach should render the findings of this study valuable to both clinical and non-clinical health care decision-makers, providing significant resource and planning implications for the effective and efficient delivery of cardiovascular services in Alberta.

1.4 Scope of the Study

This study encompassed a longitudinal, exploratory, population-based analysis of the quantity and utilization patterns of inpatients with cardiovascular conditions. It was restricted to residents of Alberta with selected cardiovascular diagnoses who were hospitalized in acute care facilities between January 1, 1971 and March 31, 1984. The analyses were descriptive in nature, exploring associations among variables, with no attempt to infer causal relationships.

1.5 Assumptions

The study objectives and research methodology were predicated upon the following assumptions:

1. The Alberta health care system functions as a closed system. Thus, non-residents using Alberta acute care hospitals and residents seeking care outside the province were excluded. It was assumed that these exclusions would minimally impact overall utilization patterns and subsequent research results.

2. The province can be divided into mutually exclusive and exhaustive geographic areas. Existing general hospital districts were

assumed to provide appropriate geographic divisions for the purpose of district analysis.

3. The unavailability of data concerning true health needs of the Alberta population required the assumption that utilization rates, aggregated at the provincial level, serve as the closest proxy of actual need for inpatient acute care services in Alberta.

1.6 Limitations

This study was subject to the following limitations which are primarily methodological in nature:

1. Although prospective data would be more accurate and subject to the control of the investigator, cost efficiency and availability of retrospective data outweighed those advantages. Nevertheless, the disadvantages of using past data records must be acknowledged as a limitation to this study. Many agencies were involved in the collection of the administrative and clinical data, and the massive volume of the data precluded data verification. In view of quality control checks by the Commission on Professional and Hospital Activities (CPHA) and Statistics Canada, however, the data can be considered to exhibit sufficient reliability and validity for the purpose of this study.

2. Census tabulation by Statistics Canada may have underestimated the true population size caused by incomplete enumeration. These underestimations, however, should occur across all segments of the population, negating systematic data distortion.

3. Professional Activity Study (PAS) and census data are not precisely compatible since PAS data were collected continuously as opposed to the cross-sectional nature of census data collection. Census data reflect an average of the number of persons since enumeration occurs in the mid-year, while the continuous collection of PAS data cannot be considered to represent the average.

4. The unit of a PAS abstract is the hospital separation episode, which precluded analyses of individual patient utilization of the health care delivery system. This constraint inflated the actual number of patients. To partially compensate for this limitation, patient-days and DRG weighted separations were also used as measures of hospital utilization.

5. Patient origin-destination analyses were restricted to the use of the hospital district as the unit of analysis. Although it would be preferable to utilize more precise location data, collection of such data was not feasible for this investigation. Nevertheless, the hospital district most closely approximates a geographic unit which has comparable population characteristics and relatively stable boundaries over time.

6. During the study period of 1971 to 1983/84, two major adaptations occurred in the International Classification of Diseases (ICD) coding methodology. Consequently, precise matching of diseases and surgical procedures among the three coding periods (1971-1973; 1974-1978; 1979-1983/84) could not be achieved. This limitation necessitated approximated conversion of medical and surgical diagnostic codes within each DRG group, and aggregation of some related DRG classes.

This process was deemed sufficient to yield meaningful utilization trends even though exact coding could not be attained.

1.7 Definitions of Terms

ACUTE CARE: diagnostic and treatment services rendered to inpatients of acute care hospitals.

ACUTE CARE HOSPITAL: "a [general] hospital which provides primarily for the diagnosis and short-term treatment of patients for a wide range of diseases or injuries" (Alberta Hospitals and Medical Care, 1983/84, p. 72).

AVERAGE LENGTH OF STAY (ALOS): the average number of days stay of inpatients who were separated from a facility, geographic area or diagnostic category during the reporting year. It is calculated by dividing the total days stay by the number of separations during the reporting year.

CARDIOVASCULAR SERVICES: the utilization of acute care hospital beds by inpatients diagnosed with diseases and operative procedures of the circulatory system. Selected diagnoses approximate the classification scheme of circulatory diseases and disorders as defined by the revised ICD-9-CM version of the DRG classification system.

COMPLICATION OR COMORBIDITY (CC): a condition, that because of its presence with a specific principal diagnosis, would cause an increase in the length of stay by at least one day in at least 75 percent of the patients in that class (Health Systems International, 1983, p. 10). For this study, a CC refers to separation abstracts which list more than one discharge diagnosis, provided that the principal diagnosis is a cardiovascular disorder.

DIAGNOSIS RELATED GROUPS (DRGs): "... DRGs form a manageable, clinically coherent set of patient classes that relate a hospital's case mix to the resource demands and associated costs experienced by the hospital. DRGs are defined based on the principal diagnoses, secondary diagnoses, surgical procedures, age, and discharge status of the patients treated" (Health Systems International, 1983, p. 16).

MAJOR DIAGNOSTIC CATEGORIES (MDCs): "the process by forming the DRGs was begun by dividing all possible principal diagnoses into 23 mutually exclusive principal diagnosis areas referred to as Major Diagnostic Categories (MDCs). In general, each MDC was constructed to correspond to a major organ system (e.g., Respiratory System, Circulatory System, Digestive System) rather than etiology (e.g., malignancies, infectious diseases)" (Health Systems International, 1983, p. 9).

PATIENT-DAY (PDAY): "the day, or portion thereof, which an individual spends as an inpatient in a hospital, usually determined by his/her presence in a facility at 2400 hours" (Toll, 1982, p. 13).

PATIENT-DAY RATE (PDAYRATE): the number of patient-days divided by the number of persons residing in a particular geographic area.

PATIENT DESTINATION: the acute care hospital to which a patient is admitted.

PATIENT ORIGIN: the hospital district in which the patient resides.

SEPARATION (SEP): the discharge (alive or dead) of an inpatient.

SEPARATION RATE (SEPRATE): the number of separations divided by the number of persons residing in a particular geographic area.

SERVICE POPULATION: "refers to the age-sex adjusted census population of a particular area. Provincial or hospital district service populations are equivalent to the age-sex adjusted census population for the province or the hospital district respectively. The term is used somewhat differently, however, when it is applied to hospital service populations. In this case the service population is not associated with a specific geographic area but represents an age-sex adjusted 'population' or number of persons which could be described as potential users of the hospital under study" (Romeril, 1984, p. 12).

UNITED STATES REIMBURSEMENT EQUIVALENT (USRE): the amount of resources in constant 1986 U.S. dollars which would have been expended for cardiovascular services if the Alberta hospital system had adopted the DRG-based reimbursement system with the same payment schedule during the study period. The average USRE (AUSRE) is the standardized cost for each separation within a particular DRG category, and the total USRE (TUSRE) is the sum of all separations weighted by their respective AUSRE values.

UNITED STATES REIMBURSEMENT EQUIVALENT RATE (USRERATE): the total USRE (TUSRE) divided by the number of persons residing in a particular geographic area.

UNITED STATES WEIGHT EQUIVALENT (USWE): an index which measures the resource requirements of separations within a particular DRG relative to the resource requirements of separations within all other DRG categories. The average USWE (AUSWE) is the standardized resource need index for each separation within a particular DRG group, and the total USWE (TUSWE) is the sum of all separations weighted by their respective AUSWE values (weighted SEPS).

UNITED STATES WEIGHT EQUIVALENT RATE (USWERATE): the total USWE (TUSWE) divided by the number of persons residing in a particular geographic area.

UTILIZATION RATE: the inpatient use of an acute care hospital, measured in terms of the PDAYRATE, SEPRATE, USRERATE, USWERATE, or ALOS.

1.8 Format of Thesis

The text of this thesis is presented in five chapters. In Chapter I, the problem statement, research objectives, significance and scope of the study, assumptions and limitations, and definitions of terms are discussed. Chapter II provides an overview of research developments and findings which are relevant to the study objectives, including a selective review of the literature pertinent to health services utilization concepts, selected aspects of cardiovascular disease, and health care classification and patient origin-destination methodologies. Chapter III discusses the research process which was used to achieve the purpose and associated objectives of the study, and Chapter IV presents the study results. Chapter V provides an overall synopsis of this study, followed by major conclusions and recommendations.

CHAPTER II

A SELECTIVE REVIEW OF THE LITERATURE

The following literature review is designed to provide an overview of research developments and findings in health care and related disciplines which are relevant to the objectives of this study. Four major components are included: (1) concepts related to health services utilization; (2) selected aspects of cardiovascular disease; (3) classification methodologies in health care; and (4) patient origin-destination methodologies.

2.1 Concepts Related to Health Services Utilization

In view of the absence of a cohesive theory of health care utilization, clarification of concepts associated with the health care system and utilization behaviour provides a framework for analysing and interpreting health care-seeking patterns. Three conceptual aspects of relevance to this investigation are reviewed: (1) the health care system; (2) relationships among the concepts of need, demand, access, and utilization; and (3) determinants of health care utilization.

2.1.1 The Health Care System

The term "system" is generally defined as "... a set of parts coordinated to accomplish a set of goals" (Churchman, 1979, p. 29). The systems approach is a way of thinking about a system and its components in a relatively logical and objective manner. Churchman (1979, p. 29) further elaborated on the systems approach by delineating five major factors that should be considered when thinking about the meaning of a system: (1) the total system's objectives and its performance measures; (2) the system's environment (which consists of unmodifiable constraints); (3) the resources of the system; (4) the objectives, functions, and performance measures of the system's components; and (5) the management of the system. When attempting to precisely describe a specific system, however, application of these considerations becomes confusing and complicated. The health care system is no exception, and indeed, well illustrates the inherent problems in clearly delineating a system.

Definitions of the health care system have been offered from a variety of perspectives and disciplines. DeMiguel (1975, p. 11) described the health system as a conglomerate of political-power relationships, resource allocation problems, social control, and medical scientific activity. Field (1973, p. 772) broadly depicted the health care system as the transformation of inputs (generalized resources) into specific outputs (health services) which are directed toward alleviating societal health problems. From a somewhat narrower perspective, Soderstrom (1978, p. 11) defined the health services system according to five major elements: (1) potential users of the system; (2) manpower, capital, and material resources in the system; (3) institutions providing the vast array of health services; (4) resources which finance and regulate the system; and (5) principal outcomes (improved health status) and costs of the system. It is evident that the broad inclusiveness of the aforementioned definitions precludes a definitive, universal meaning of a health care system.

In an attempt to simplify the conceptualization process, the health care system has been apportioned into macro-system and micro-system perspectives. Andersen and Anderson (1979) portrayed the macro-system perspective as a separation of health services into two categories: public and personal services. Public health services included those programs which benefit the whole population, such as environmental protection, immunization, and public sanitation. Personal health services, which must be initiated by individuals, were classified into seven subcategories (one of which included hospital services). Greenhill and Haythorne (1972) described the micro-system perspective as an emphasis upon individual and family health care-seeking behaviour, and the interaction between the provider and client. Whereas the macro-perspective is characterized by large volumes of individuals and institutions involving complex decision-making, the micro-orientation has fewer individuals, is not contingent upon the presence of a health care facility, and reflects more simplified decision-making.

Cardiovascular services, while only a component of the wider health system, can be depicted by objectives, environmental constraints, available resources, subcomponents, and system management. Viewing cardiovascular services as a "system within a system" requires the interaction of selected elements from both the macro-system and micro-system perspectives in order for cardiovascular utilization to occur. Comprehension of the interdependent relationships among need, demand, access, and utilization are essential to the delineation of cardiovascular services utilization. These concepts are reviewed in the following sections.

2.1.2 Concepts of Need, Demand, Access, and Utilization

The literature abounds with definitions of need, demand, access, and utilization. Ambiguity and controversy surround these terminologies, and there appears to be a general misunderstanding of their fundamental differences. As a result, the concepts are often used interchangeably, depending upon the orientation of the writer and the purpose to which the concepts are directed.

Need appears to be the most elusive of these concepts, particularly in view of the empirical difficulties in operationalizing need. Donabedian (1973, p. 65) stated that need could be used to "... describe states of the client that create a requirement for care and therefore represent a 'service-requiring potential'." Donabedian (1973, p. 62) further maintained that there were at least two perspectives related to need: that of the client and that of the provider (physician). Frequently, these two need perspectives are incongruent resulting in "unmet-need" (unrecognized by the provider and/or the client) and "overmet need" (needs reported by clients that cannot be substantiated by the physician).

Other researchers have defined need according to the dual perspective of client and provider. Ohmura (1978) described need as an individually-perceived state that occurred when the person made a decision to seek medical care. Jeffers, Bognanno, and Bartlett (1971) equated individually-perceived need with "wants," and conceptualized true health needs as those confirmed by the medical profession. Similarly, MacStravic (1978, p. 4) stated that "... need is first defined by the consumer's decision to seek health services, then by the professional's decision to render or prescribe health services to a given patient...." Generally, the literature suggested that health needs are more accurately defined by medical expert opinion than by consumer perception of need.

The discrepancy between individually-perceived need and medically-determined need appears to stem firstly, from consumer ignorance of available medical services and secondly, from the absence of a clear definition of health itself. Donabedian (1973, p. 64) noted that:

> Congruence in the definitions of need should increase as clients learn more about the professional viewpoint through formal education and through personal experience of medical care, and as professionals broaden their own viewpoints to embrace nonsomatic disease and to acquire greater sensitivity to the interrelationship between social and health needs.

It would seem that the differences between the client and the provider in perception of need, coupled with the phenomenal growth of medical technology and its controversial value in meeting health needs, have contributed to the difficulties in accurately defining the concept of health need (MacStravic, 1978, p. 5).

The conceptual ambiguity of need has created major difficulties in operationalizing or measuring need. In view of the fact that the resources available for health care are finite, it is essential to develop indices which can objectively assess the degree to which health needs are being met by those resources. To that end, numerous endeavours to operationally define health need and subsequently design measurement models have been pursued. Generally, the measurement tools have equated health need with health status, which has been reflected by such criteria as traditional medical definitions, patient-reported symptoms, and distinctive areas of functioning. Notwithstanding laudable attempts, instruments designed to measure health need rely substantially on the application of value judgements to discern operational criteria, and reaffirm the fundamental issue raised by Glass, "Who is to declare what is need?" (Acheson, 1978, p. 108).

Although a relatively less elusive term than need, the concept of "demand" has been variously defined and used in the literature. Boulding (1966) used demand to characterize an individual seeking medical services, while Ohmura (1978) described demand as the use of medical resources upon physician initiation of a care plan. Feldstein (1966) separated the concept into "initial" demand (initiated by the patient) and "derived" demand (the result of physician action).

Other researchers have attempted to elucidate the concept of demand by indicating the relationship between need and demand. Warner, Holloway, and Grazier (1984, pp. 255-256) presented two overlapping circles to depict a comparison of "services needed" to "services sought," separating the total amount of health services into three areas: (1) services needed and demanded; (2) services needed but not demanded; and (3) services demanded but not needed. These researchers equated demand with the amount of services sought directly by patients or indirectly by physicians. Griffith (1972) separated the concept of demand into "expressed" demand (explicit requests for medical service by the patient or physician) and "unexpressed" demand (a demand for services which is not translated into explicit demand). Griffith (1972, p. 21) summarized the distinction between expressed demand, unexpressed demand, and need by suggesting six possible states in which a patient could be: (1) with need, without demand; (2) with need, with unexpressed demand; (3) with need, with expressed demand; (4) without need, with expressed demand; (5) without need, with unexpressed demand; and (6) without need, without demand. There appears to be a consensus in the literature that demand (like need) assumes a client perspective and a provider perspective, and that need plays an important role in determining the demand for health services.

While the literature is replete with descriptions of need and demand, the concept of "utilization" is rarely defined. This may partially be attributed to the fact that actual demand often is equated with observed utilization. Although the concepts of need, demand, and utilization are not clearly differentiated, it would appear that utilization is an interaction of the physician's confirmation of a patient's perceived need with the available health resources to meet that need (MacDonald, 1983, p. 18).

The concept of "access" is often interspersed with conceptual analyses of need, demand, and utilization. Aday, Andersen, and Fleming (1980) and their associates, who have conducted comprehensive studies regarding access to health services, defined access "... as those dimensions which describe the potential and actual entry of a given population group to the health care delivery system" (p. 26). Potential access reflects the probability of an individual gaining entry into the health system, and is influenced by characteristics of the delivery system itself and the perceived wants and needs of potential clients. Realized access, on the other hand, describes the actual utilization of health services, and is evaluated by consumer satisfaction and utilization indicators (for example, type of service used and purpose of the care received).

In summary, the literature presented complex interrelationships among the concepts of health need, demand, access, and utilization. While several aspects of these concepts are used interchangeably, it may be concluded that need plays a prominent role in the demand for health services (potential access), and the interaction of demand with available health resources results in the utilization of health services (realized access). In conjunction with the problem of conceptually differentiating these terms, the multitude and complexity of factors which determine health care utilization further illustrate the nebulous relationships among need, demand, access, and utilization. A selected review of these determinants is discussed in the following section.

2.1.3 Determinants of Health Care Utilization

In view of the volume and nature of factors which influence health care utilization, researchers have endeavoured to classify these determinants into meaningful categories. Anderson (1973b) reviewed five approaches which had been used to investigate the variables affecting health services utilization: (1) the sociocultural approach; (2) the sociodemographic approach; (3) the social-psychological approach; (4) the organizational approach; and (5) the social systems approach. Noting that health services utilization research was predominantly descriptive and narrow in scope, Anderson (1973b, p. 197) suggested that the social systems approach afforded the most valuable methodology for empirically determining causal relationships among variables. In 1985, Hulka and Wheat also reviewed health services utilization literature according to five broad categories: (1) health status and need; (2) demographic features; (3) physician availability; (4) organization of health care services; and (5) financing mechanisms. The two categorization approaches are relatively similar in content, with the emphasis on financial variables (Hulka & Wheat, 1985) reflecting the social and political environment during the 1960s and 1970s. It is interesting to note that Hulka and Wheat (1985, p. 456) raised the same issue as Anderson had 13 years earlier: "Most important is the need for research designs that can better establish cause and effect relationships." These reviews and accompanying conclusions underscored the complex interrelationships of variables influencing health care utilization.

For purposes of this review, the aforementioned categories are condensed into three dimensions which determine health care utilization behaviour, congruent with Andersen and Newman's (1973) theoretical framework: (1) societal trends; (2) organization of the health care system; and (3) individual characteristics.

2.1.3.1 Societal Determinants

Societal determinants generally reflect changing norms and technology. Andersen and Newman (1973) noted two major effects of increasingly sophisticated medical technology during the 1900s: (1) the changing orientation of the hospital from a "care" to a "cure" institution; and (2) substantial improvement in public health measures. Both effects produced dramatic increases in hospital utilization rates. Advances in such areas as antibiotic therapy, renal dialysis, open heart surgery, CAT scanners, and coronary care units are evidence of the recent explosion in medical technology.

While there is little doubt that modern medical technology has eradicated some diseases and has been instrumental in extending human life expectancy (Russell, 1976), technology has also been characterized by substantial shortcomings. Fuchs (1968) posed the problem of the "technological imperative" which implied a tendency for the medical profession to use modern technologies solely because they exist. Thomas (1977) noted that "half-way" technologies (developed for palliative and symptom control) have surpassed "definitive" technologies (designed for cure) in both volume and costs. Similarly, Bennett (1977) noted the significant impact on health costs and utilization associated with "add-on" technologies (which provide additional support to existing technology). Undoubtedly, the rapid proliferation and application of medical technology have contributed dramatically to increased health services utilization.

The norms and values of society have also influenced the resources devoted to the health care system and its associated utilization patterns. Prior to 1950, Canadians primarily relied on their own resources for health care. Today, Canadians have access to a "public" health care system solely on the basis of medical necessity without regard to their personal financial circumstances. This achievement emanated from two major health Acts. The Federal Hospital Insurance and Diagnostic Services Act of 1958 made prepaid coverage available to all Canadian residents, including diagnostic and treatment services and a wide array of outpatient services for patients in acute care hospitals. There were no incentives to use less expensive facilities or modes of care. The Medical Care Act of 1966 extended government financial hospital insurance benefits to encompass medical care services, and explicitly included specific conditions designed to establish and maintain national standards. These conditions are referred to as the essential principles of medicare and include universal coverage, reasonable access, comprehensive coverage, portability, and public administration. While hospital utilization increased sharply immediately following the passage of these Acts, the rate of increase stabilized within a few years (Vayda, Evans, & Mindell, 1979).

Notwithstanding the stabilization of high utilization rates, increasingly informed health care consumers have staunchly supported the medicare principles, and have established an ethic that relates to a right to health care. Concomitant with this ethic are the high expectations which society imposes upon the medical profession. In attempting to meet those expectations, Ferguson (1982) described the "crisis of excellence" in which the medical profession has found itself, resulting in the practice of "... defensive medicine rather than good medicine ..." (p. 162). Closely associated with high public expectations is a heightened preoccupation with medical uncertainty. Fox (1980, p. 19) noted that "public tolerance of medical uncertainty appears to have diminished, and indignation about its persistence has grown." As a consequence, societal attitudes toward medical care have effected a paradox, whereby indignation with medicine's incapacity to solve all health problems coexists with anxiety concerning the adverse side-effects of medical endeavours to alleviate those problems (Illich, 1976). As the focus of health care shifts from the treatment of acute disease to an emphasis on chronic disease, prevention, and quality of life, this paradox is likely to intensify.

2.1.3.2 Health Care System Determinants

A substantial body of research has suggested that utilization patterns are influenced markedly by factors related to the health care system itself. A selected review of the literature indicated that hospital bed supply and physician volume and specialty mix were the major contributing factors.

The pioneering study by Roemer (1961) concluded with the widely referenced postulate known as Roemer's law: an increase in acute care hospital bed availability will lead to an increase in utilization. This finding has been confirmed by other researchers (Anderson, 1973a; Harris, 1975; Rogatz, 1974), although some studies have indicated that the effect of Roemer's law is moderated by physician behaviour (Rothberg, 1982).

There has been considerable evidence supporting a link between physician supply and hospital use. In a study which examined the extent of health care delivery variations among hospital service areas in Vermont, Wennberg and Gittelsohn (1973) reported significant positive correlations between the total surgical rate and the input of surgeons, and between the volume of non-surgical diagnostic procedures and the supply of physicians who did not perform surgery. Similar findings, which indicated that the overall supply of physicians and/or hospital bed supply were highly correlated with the incidence of hospital utilization, have been observed in Kansas (Lewis, 1969), Maine (Wennberg & Gittelsohn, 1975), Ontario (Stockwell & Vayda, 1979), across Canadian provinces (Vayda, Morison, & Anderson, 1976), and in a study which compared the volume of operations and surgeons in the United States, England, and Wales (Bunker, 1970). More recent studies have supported this general finding of physician-induced demand, but have also suggested that there are a host of intervening delivery system characteristics such as hospital ownership, urban-rural status, nursing-related variables (Cannoodt & Knickman, 1984-5), and supply of nursing home beds (Knickman & Foltz, 1985). Roos and Roos (1981), who reported a slightly different finding, attributed the high variability of surgical rates in rural Manitoba to greater numbers of operations performed by general practitioners rather than by surgical specialists.

In an effort to analyse the impact of physician manpower on hospital utilization, Wennberg (1979) conjectured that both the number and type of physicians, in conjunction with available hospital beds, strongly influenced utilization. Wennberg (1979, p. 118) further suggested that the large variations attributed to physician volume and specialty mix reflected the uncertainty of medical treatment protocols and variable physician beliefs.

In contrast to the above finding, some studies have indicated that an increasing volume of physicians is not a significant variable in explaining higher utilization rates (Weil, 1981; Wilensky & Rossiter, 1983). Notwithstanding these latter studies, the preponderance of research evidence suggested that the supply of hospital beds and physician manpower were major determinants of utilization. There appears to be an unclear distinction between these two variables, however, and "it may be that beds and physicians are surrogate measures for each other" (Stockwell & Vayda, 1979, p. 393).

Understandably, the research findings relating physician volume to the incidence of operations triggered the "unnecessary surgery" debate. Two responses to the allegation of unnecessary surgery were "second-opinion" programs and the national Study on Surgical Services for the United States (SOSSUS). The SOSSUS report recommended a restriction in the number of surgeons being trained, and improved monitoring of all residency training programs (Moore, Zuidema, & Ballinger, 1978). Second-opinion consultation programs were perceived to be major prospective endeavours to directly influence the consumer and thus indirectly modify physician behaviour. Evaluative studies of these programs indicated a substantial reduction in the volume of elective surgical procedures (Martin et al., 1982; Ruchlin, Finkel, & McCarthy, 1982). Further analyses revealed however, that second-opinion programs may "... prevent the performance of elective operations at a time when the patient is at lower risk of sequelae ...," and may "... deter both needed and unneeded surgery ..." (Brook & Lohr, 1982, p. 2). It was suggested that the lack of professional consensus on the efficacy of surgical technology mandated the development and assessment of surgical outcomes to facilitate explanations of surgical rate variations (Gertman & Mitchell, 1980; Wennberg, Bunker, & Barnes, 1980). To that end, research was conducted to explore the relationship between volume of surgery and outcome (post-operative mortality). The evidence strongly suggested that mortality rates were lower in those hospitals with higher volumes, although none of the studies could resolve whether the observed relationship reflected a causation from better outcomes to higher volumes or higher volumes to better outcomes (Bunker, Luft, & Enthoven, 1982; Flood, Scott, & Ewy, 1984; Luft, 1980; Luft, Bunker, & Enthoven, 1979; Maerki, Luft, & Hunt, 1986). Regardless of the direction of the relationship, the findings of surgical volume-outcome research supported the concept of regionalization for selected health services.

2.1.3.3 Individual Determinants

The identification of individual characteristics as explanatory variables in health services utilization has appeared to receive more emphasis in the literature than either health care system or societal factors. This phenomenon has been ascribed to the "demographic" orientation of earlier health care researchers, primarily sociologists and public health investigators (Rothberg, 1982, p. 4).

Andersen's (1968) behavioural model of health services utilization is a widely recognized framework for analysing the effect of individual variables or groups of variables. The model consists of three major components which are ordered sequentially to illustrate the conditions affecting an individual's decision to seek health care: (1) predisposing factors; (2) enabling factors; and (3) illness (need) factors. The predisposing component describes the propensity of individuals to use services, exists prior to the onset of illness, and is operationalized by demographic, social structure, and health belief factors. Although these variables are considered immutable, relationships among these measures facilitate the identification of groups with potential need (Andersen, McCutcheon, Aday, Chiu, & Bell, 1983, p. 67). The enabling component describes the means available to individuals for the use of health services, and encompasses both family resources and community characteristics. The need component refers to the immediate reason for the use of health services, and includes various illness measures as they are perceived by the individual. The perceived symptoms and conditions of individuals are evaluated by health professionals in order to determine the nature and severity of illness. Although Andersen's behavioural model clarifies the sequential process used by an individual to seek health care, the research related to predisposing, enabling, and need factors generally assumes a multivariate and interactive approach.

Age has been frequently identified as an important determinant of utilization, and the U-shaped relationship between age and health services utilization has been partially explained by the similar U-shaped relationship between age and frequency of illness (Guzick, 1978). Newman (1975) analysed several predisposing variables (age, sex, race, education, and health beliefs) to determine their relative impact on utilization. Initial multivariate analysis indicated that educational level of the household head and age of the patient were the two major determinants of physician utilization. Subsequent analyses, in which enabling and illness variables were incorporated, revealed that illness measures were the most important predictors of utilization. To analyse hospital use by the elderly from a community perspective, Wilson (1981) observed that "... the best single predictor of any component of hospital use in a community for the elderly population is the corresponding measure for the general population" (p. 332). Thus, communities which are characterized with discharge rates or lengths of stay higher than expected, relative to other communities, will have similar higher rankings for their elderly population.

Numerous studies have investigated the effect of ethnicity on health services utilization. Wolinsky (1982) found no racial differences between blacks and whites when the predisposing, enabling, and need characteristics were controlled. Further analysis indicated significant differences between blacks and whites regarding the predisposing, enabling, and need factors, implying the existence of separate health cultures. To assess the contribution that characteristics of the elderly made to surgical rate variations, Roos and Roos (1982) observed that education (proportion of the elderly with nine or more years of education) and ethnicity (percentage of the elderly with Canadian, American, or British origins) were highly associated with the overall surgical rates; high surgical rate areas were not characterized by a more disabled or sicker geriatric population. Wilson, Griffith, and Tedeschi (1985) attributed the higher utilization rates by the black population in 23 Michigan communities to higher morbidity and lower socioeconomic status levels.

With respect to gender differences, it has been reported that females use health services to a greater extent than males, a differential which may be partially ascribed to the use of obstetrical and gynecological services (Anderson, 1973a). Excluding pregnancy and preventive health services, Hibbard and Pope (1983) nevertheless found a significantly higher utilization rate for females, although there were salient differences in the perceptual (symptom reporting) and behavioural (adopting the sick role) aspects of illness behaviour. The perception and reporting of symptoms were the major contributors to sex differences in utilization rates, suggesting that further efforts to investigate sex differences in health services utilization should focus on the experience of symptoms.

Other factors which have been suggested as predisposing determinants of health care utilization include health beliefs and social network patterns (Berkanovic & Telesky, 1982; Blake, Roberts, Mackey, & Hosokawa, 1980; Thomas & Penchansky, 1984), marital status (Morgan, 1980), lifestyle (Shephard, Corey, Renzland, & Cox, 1983), employment status (Wheeler, Lee, & Loe, 1983), and family size (Kasper, 1975). The complex interaction and measurement problems associated with the predisposing variables preclude definitive conclusions regarding their differential effect on utilization.

Even though individuals may be predisposed to use health services, the means must be available for them to do so. The available means, or enabling determinants, include family resources and community characteristics. The advent of health insurance coverage has resulted in increased utilization of health services in the United States (Benham & Benham, 1975; Phelps, 1975; Shortell, 1975) and in Canada (Enterline, Salter, McDonald, & McDonald, 1973). Consequently, the introduction of health insurance has reduced the impact of family income on utilization (Aday, Andersen, & Fleming, 1980, p. 246). Initial conclusions of the Rand Health Insurance Study indicated that individuals with complete universal health insurance coverage had significantly higher utilization rates than did those persons who shared the costs of services at the time of services. This prospective controlled clinical trial further revealed that the availability of "free" health insurance did not appear to lead to improved health status (Korcok, 1984), although limitations of the study (health status indicators, exclusion of the elderly and the disabled, and the relatively short duration of observation) precluded definitive results.

The presence of a regular source of care has been cited as an important predictor of utilization (Aday & Eichorn, 1972; Aday, Andersen, & Fleming, 1980). Miller, Lairson, Kapadia, and Kennedy (1985) found that the existence of a regular source of health care was negatively correlated with freestanding emergency centre visits, and conversely, positively correlated with non-freestanding emergency utilization.

The community-oriented enabling variables are most frequently related to urban-rural status, and the volume, type, and accessibility of health care resources. Traditionally, urban residents used more health services than rural residents, a phenomenon which was attributed primarily to time and distance factors (Bashshur, Shannon, & Metzner, 1971). Today however, rural residents use more health services than the urban population (Szafran, 1985). Recent studies have indicated that the effect of time and distance is notably mitigated by such variables as health insurance coverage, ethnicity, income, age, sex, and education (Berk, Bernstein, & Taylor, 1983; Bombardier, Fuchs, Lillard, & Warner, 1977).

Individual illness (need) determinants of health services utilization encompass both individually-perceived need and medically evaluated need. Extensive research has indicated that illness factors were the strongest determinants of utilization (Andersen, 1968; Andersen & Newman, 1973). Newman (1975) stated that "... health status is directly related to utilization with other predisposing and enabling variables influencing use through health status" (p. 163). McFarland, Freeborn, Mullooly, and Pope (1985) noted that the major determinant of high utilization was the propensity of consistently high users to "... perceive their health status as fair or poor and to report a higher number of physical symptoms" (p. 1228). They concluded that utilization patterns were unrelated to marital status, lifestyle, income, occupation, and socioeconomic status.

2.1.4 Summary

Three major aspects relevant to the utilization of health care services were reviewed. The health care system has been variously and broadly defined, usually contingent upon the researcher's orientation and objectives. The division of the health care system into micro-system and macro-system perspectives was presented as a framework for simplifying the conceptualization process of a health care system, and it was posited that the occurrence of cardiovascular utilization requires the interaction of selected elements from each perspective.

Health services utilization is inextricably bound with the ambiguously-defined concepts of need, demand, access, and utilization. It was concluded that need performs a major role in the demand for health services (potential access), and demand interacts with available health resources to determine the actual utilization of health services (realized access).

Determinants of health care utilization were associated with three dimensions. Societal factors were discussed in terms of changing technology, norms, and values of society. The major health care delivery system determinants encompassed hospital bed supply and physician volume and mix. Individual determinants were theoretically presented according to the predisposing, enabling, and need components, although the related studies primarily incorporated multivariate, interactive approaches.

In the main, research investigating health services utilization has employed three different methodological strategies. Illness-behaviour studies are concerned with sociocultural, organizational, and psychosocial factors affecting the individual's decision to seek services. Multivariate studies typically involve large samples, cross-sectional survey approaches, and more generalized measures to operationalize the concepts being studied (Mechanic, 1979). The third methodological orientation concentrates on health care-seeking behaviour within geographically-defined hospital service areas and demographically-defined service populations (Wennberg, 1985). Contradictions in findings among the three research perspectives are not unusual, a phenomenon which is partially accounted for "... by the types of populations studied, the definitions of the variables, the analytic strategies used, and the manner in which data are aggregated" (Mechanic, 1979, p. 394).

There was a paucity of studies which adopted a diagnostic-specific approach to utilization analysis. It has been recommended that the study of utilization at the patient or diagnostic level would elucidate more precise relationships among the determinants of health services utilization, in view of the substantial variability of utilization determinants from one diagnosis to another (Goldfarb, Hornbrook, & Higgins, 1983; Griffith, Wilson, Wolfe, & Bischak, 1985).

2.2 Selected Aspects of Cardiovascular Disease

To provide a background for the study of cardiovascular utilization in Alberta acute care hospitals, the following sections overview aspects relevant to heart disease including mortality and morbidity trends, causes of the decline in cardiovascular mortality rates, and estimated costs. A review of this background information was deemed essential in view of the lack of research concerning cardiovascular utilization, coupled with the absence of a cohesive theory of general health services utilization.

A preliminary review of the cardiovascular-related literature indicated that cardiovascular disease was variously referred to as "heart disease," "coronary artery disease," "coronary heart disease," "ischaemic heart disease," "cerebrovascular disease," and combinations thereof. In some instances, authors would elaborate the disease category by delineating its ICD rubrics; in other cases, no definitional boundaries were provided.

The parameters of cardiovascular disease for this study are defined within the major diagnostic category of the DRG classification system associated with circulatory diseases and disorders. The primary medical disease groups include: circulatory disorders with/without acute myocardial infarction and cardiovascular complications; circulatory disorders with/without a complex diagnosis; acute and subacute endocarditis; deep vein thrombrophlebitis; cardiac arrest; peripheral vascular disorders; atherosclerosis; hypertension; cardiac arrhythmia and conduction disorders; angina pectoris; and other circulatory diagnoses. Of notable exclusion are all diagnoses related to cerebrovascular disease (stroke) which were assigned to a different major_ diagnostic category of the DRG system. The primary surgical categories include: cardiac valve procedures; coronary bypass procedures; cardiothoracic procedures; vascular procedures;

amputation; cardiac pacemaker implantation with/without acute myocardial infarction or congestive heart failure; and vein ligation and stripping.

Although the following sections do not address specifically the aforementioned parameters of cardiovascular disease, the content is deemed a sufficient, overall representation of mortality and morbidity trends, causes of declining mortality rates, and costs pertaining to cardiovascular disease as defined by this study.

2.2.1 Mortality and Morbidity Trends

Although heart disease experienced an upward trend in most industrialized countries until the mid 1960s, declining trends have been noted in several of these countries during the past two decades. Pisa and Uemura (1982) reported mortality data for various cardiovascular diseases in 27 industrialized countries between 1968 and 1977, and found substantial differences among the countries studied. Excluding cerebrovascular disease, all countries reported a decrease in cardiovascular disease mortality among females, most notably in Italy (-5.0 percent), Japan (-4.1 percent), and Finland (-4.1 percent). Among males, there was an increasing trend in cardiovascular disease mortality in Bulgaria (+4.0 percent), Denmark (+1.1 percent), Hungary (+1.0 percent), Ireland (+1.1 percent), Poland (+1.9 percent), Romania (+1.4 percent), Sweden (+0.6 percent), Northern Ireland (+0.7 percent), and Yugoslavia (+2.0 percent). The remaining countries reported a decreasing trend among males, particularly in the United States (-2.8 percent) and in Belgium (-2.2

percent) (Pisa & Uemura, 1982, p. 15). The World Health Organization reported remarkably diverse national trends in coronary heart disease mortality rates, noting an eight-fold variation in 1978 between the two countries at the extremes: 99.2 per 100,000 persons and 870.1 per 100,000 persons for Japan and Finland, respectively (Feinleib & Rifkind, 1982, p. 1101).

In North America, heart disease became the leading cause of death and disability shortly after the turn of the century, and has remained so ever since (Oberman, 1980). The pattern of mortality among age categories however, has been shifting during the past 20 years. In the United States in 1968, cardiovascular disease mortality was higher than the next leading cause of death, cancer, across every adult age group (Feinleib, 1984). By 1976, heart disease became the third leading cause of death for the 35-44 year age category, preceded by accidents and cancer. In 1982, cancer overtook cardiac disease as the primary cause of death in individuals aged 45 to 54 years. For those persons from 55 to 64 years of age, heart disease continues to be the leading cause of death, although the gap between cancer and cardiovascular disease mortality rates appears to be narrowing (Feinleib, 1984, p. 3C). Thom and Kannel (1981) noted that all age, race, and sex groups experienced similar declining mortality trends, although younger adults and black women manifested the most rapid decline in coronary heart disease mortality.

Cardiovascular mortality trends in Canada have shown similar patterns as those reported in the United States, although the rate of decline has been less dramatic. Nicholls, Jung, and Davies (1981) communicated recent changes in Canadian cardiovascular disease mortality, with a primary focus on ischaemic heart disease since it is Canada's leading cause of death. The mortality rates for males, attributed to ischaemic heart disease, increased until 1965 and then declined approximately 1.7 percent annually thereafter. Mortality rates for females declined 0.4 percent annually after 1960, and decreased more dramatically during the 1970s (2.4 percent annually). Mortality rates for rheumatic heart disease and hypertensive cardiovascular disease have been declining since the 1950s (Kannel, 1982, p. 877), although the mortality rates for diseases of the arteries, arterioles and capillaries and those for "other forms of heart disease" have displayed a slight increase (Nicholls, Jung, & Davies, 1981, p. 986). With respect to regional variations in ischaemic heart disease mortality, Ontario maintained the highest rates in Canada, followed by the Atlantic region, Quebec, the Pacific region, and lastly, the Prairie Provinces (where the decline in ischaemic heart disease mortality rates was the first to become apparent in Canada) (Nicholls, Jung, & Davies, 1981, p. 986). Overall, the Canadian age-adjusted mortality rates for ischaemic heart disease declined by 16.4 percent between 1969 and 1977 for both sexes combined, as compared to a 20.7 percent decrease in ischaemic heart disease mortality between 1968 and 1976 in the United States.

By consolidating numerous health indicators from Statistics Canada and other federal sources, Newman (1984) attempted to elucidate health trends in Alberta within the context of Canada as a whole. He noted that the five most important causes of death (according to ICD-9 definitions) in Alberta and Canada in 1982 were circulatory disease, neoplasms, external causes, respiratory disease, and digestive disease. The five causes combined accounted for more than 85 percent of all deaths in Alberta and Canada; circulatory disease and neoplasms together accounted for more than 60 percent of all deaths. With respect to selected components of the aforementioned causes of death, ischaemic heart disease accounted for approximately as many deaths as all the other selected causes combined.

Although the ratio for major cardiovascular disease to cancer declined from 3.4 in 1950 to 2.5 in 1980, the magnitude of heart disease mortality remains clearly significant. The rate of mortality for the various categories of heart disease is not homogeneous (Nicholls et al., 1981, p. 985). In nearly all reported studies, the anticipated mortality from single-vessel disease ranges from 2 to 3 percent annually during the five year interval following arteriography. Five year cumulative survival rates for patients with two-vessel disease (excluding left main disease) range from 61.8 percent to 70.5 percent; and for those individuals with three-vessel disease, cumulative survival rates are 65 percent to 70 percent at two years, 60 percent to 65 percent at three years, and 50 percent to 55 percent at five years (Oberman, 1980, pp. 26, 28). On the basis of pooled data results, Rahimtoola (1977, p. 2) reported that the annual mortality of patients with one-vessel, two-vessel, and three-vessel disease was 2.2 percent, 6.8 percent, and 11.4 percent, respectively.

Although most industrialized countries have adequate data concerning cardiovascular disease mortality, available information on cardiovascular morbidity rates is more difficult to obtain and evaluate. Feinleib and Rifkind (1982, p. 1101) documented four factors which must be considered in monitoring the incidence of cardiovascular disease: (1) population group variations in the utilization of medical services; (2) varying physician practice patterns; (3) technological advances in diagnosing and treating heart disease; and (4) increased awareness of the impact of symptoms by patients and physicians. These factors coupled with definitional problems related to specific disease categories, impede the collection of reliable morbidity data.

Data on the incidence of heart disease are available for population subgroups from various prospective studies. For example, the Framingham Heart Study is a comprehensive research effort to examine time trends in cardiovascular risk factors, mortality and morbidity. That study has had a representative cohort of the general population of Framingham, Massachussetts, under surveillance for the development of cardiovascular diseases since 1948. Although not all of the identified trends in that study are consistent with national incidence patterns, the majority of national trends have been similarly observed in the Framingham Study population (Thom & Kannel, 1981, p. 431). Over the study time frame, the Framingham Study has yielded annual incidence rates per 1,000 persons for coronary heart disease ranging from 4.0 for males in the 35-44 year age group to 20.9 for those aged 55-64 years; for females, incidence increased with age from 0.6 to 12.7 (Oberman, 1980, p. 10). The evidence from this study and other similar research projects is conflicting, and the variation in results demonstrates the need to acquire reliable morbidity data from more representative populations.

Hospital separation rates are frequently employed as proxy indicators of cardiovascular disease incidence. Feinleib and Rifkind

(1982) stated that caution must be exercised in equating hospital separation rates with morbidity rates. For example, although the U.S. Hospital Discharge Survey indicated that there was relatively little change in hospital discharges for the category of myocardial infarction between 1972 and 1978, the statistic should be compared with the general increase in all hospitalizations during that time period. Feinleib and Rifkind (1982, p. 1101) concluded that: "A [illegible] trend for MI, therefore, would not be inconsistent with a slight decline in incidence according to previously used standards."

Although hospital morbidity statistics are not synonymous with actual cardiovascular disease incidence, utilization rates reflect a large amount of morbidity data from representative populations. Consequently, in the absence of comprehensive morbidity surveys in Canada, hospital utilization rates can be considered as the closest estimates of true disease morbidity.

Newman (1984) reported that circulatory disease in 1980/81 ranked as the fourth and sixth most important cause of hospitalization for Alberta males and females, respectively. In contrast, circulatory disease was the outstanding cause of time spent in Alberta acute care hospitals, accounting for about 20 percent of the rate for all causes. Newman (1984) further noted that the patient-day rates for all causes of hospitalization in Alberta were markedly higher than comparable Canadian rates.

In summary, although reported cardiovascular morbidity rates are relatively variant, it is generally conceded that there has been a **real** decline in cardiovascular mortality which is not simply an artefact of diagnostic variations, increased awareness, or changes in disease classification. The incidence and case-fatality rates of cardiovascular disease are two major factors considered integral to the interpretation of the decline in cardiovascular mortality. These two factors are addressed in the following section.

2.2.2 Causes of the Decline in Cardiovascular Mortality

Several hypotheses have been suggested in an attempt to explain why the decline in cardiovascular mortality is occurring. Although there is not yet a clear explanation, the decreasing mortality rates have generally been attributed to: (1) a declining incidence of cardiovascular diseases (which is related to **primary prevention**, involving a reduction in the risk factors of cardiovascular disease); and (2) a decrease in the case fatality rate among patients with cardiovascular disease (which is ascribed to an improvement in **secondary prevention** measures including advances in medical practice patterns and improved accessibility to health services) (Feinleib & Rifkind, 1982). A decline in the incidence of cardiovascular disease would suggest that the mortality decline is due to primary prevention; if the incidence remains steady or rises, the decline in mortality would most likely be attributed to secondary prevention. With no definitive information concerning the incidence of heart disease in the general population however, the causes of the dramatic decline in cardiovascular mortality will remain predominately speculative.

Although no unequivocal cause of cardiovascular disease has been determined, a multiplicity of factors, habits, and traits have been identified that appear to single out those individuals at increased risk for heart disease. Interestingly, a decrease has been observed in several risk factor categories, prompting researchers to correlate the declining cardiovascular mortality rates with these reductions in risk factors (Kottke, Puska, Salonen, Tuomilehto, & Nissinen, 1985; Levy, 1984). Criqui, Barrett-Connor, Holdbrook, Austin, and Turner (1980) addressed the complex interrelationships between risk factors and cardiovascular disease, as well as among the risk factors themselves, and emphasized the difficulties in attempting to isolate the independent effect of each risk factor. Nevertheless, there are major cardiovascular risk factors, and clusters of those factors, which are known to subject individuals to increased risks of developing cardiovascular disease.

Several epidemiologic studies have demonstrated the strong relationship between hypertension (usually defined as a blood pressure of 160/95 mm Hg or greater) and the development of cardiovascular disease. In a report of the Framingham Heart Study population, Castelli (1983) documented that hypertension conferred a two-fold to three-fold increased risk for most coronary heart and peripheral vascular diseases, and a seven-fold increased risk for stroke. While cardiovascular disease mortality for the Framingham population was related to an elevated systolic and diastolic blood pressure for males and females, a similar study of an Australian population cohort revealed that hypertension was not a significant risk factor for any cause of death for females, and coronary heart disease in men was linked with an elevated systolic blood pressure only (Cullen, Stenhouse, Wearne, & Welborn, 1983).

Kannel (1982) supported the link between hypertension and the incidence of cardiovascular disease by noting that "... black women, who are particularly prone to hypertension, have exhibited the largest decline in cardiovascular mortality" (p. 879). Stern (1979) suggested that women have experienced a more dramatic decline than men in ischaemic heart disease mortality since the higher proportion of diagnosed and treated hypertensive subjects are female.

Rose (1984) noted that in many countries, stroke rates were declining prior to the advent of effective hypertensive therapy. He suggested that blood pressures may have been falling due to the influence of diet, or alternatively, the early decline in stroke mortality may have been "... due to the rise in coronary heart disease which provided a competitor to cause the death of hypertensives ..." (Rose, 1984, p. 375). Nevertheless, the preponderance of research has suggested that the response to national hypertensive education programs and the introduction of therapeutic agents for the control of blood pressure are highly correlated with the reduction in overall cardiovascular disease mortality (Feinleib & Rifkind, 1982; Levy, 1984; Levy & Moskowitz, 1982; Schroll & Larsen, 1981; Stern, 1979).

Three major surveys conducted in the United States during the 1960s and the 1970s (the National Health Examination Survey; the National Health and Nutrition Examination Survey; and the Lipid Research Clinics Program) indicated a reduction from 1960 to the late 1970s in the average serum cholesterol level for each age category, prompting some researchers to associate lower cholesterol levels with declining cardiovascular mortality rates (Hawthorne, 1983; Feinleib, 1984; R[illegible] 1984). Early in the Framingham Heart Study, a linear relationship appeared between total blood cholesterol and the risk of several cardiovascular disease endpoints, particularly coronary heart disease, although this risk factor lost its significance as a predictor of cardiovascular disease as the study population aged (Castelli, 1983).

During the 1960s and 1970s, there was much controversy concerning the relative contribution of lower serum cholesterol levels to the decline in mortality. Since the mean level of serum cholesterol declined modestly (approximately 5 percent), researchers and clinicians tended to dismiss this reduction as statistically insignificant. Conversely, Stern (1979, p. 633) commented that "... statistical significance does not necessarily mean biological importance"; although definitive evidence was lacking, changes in the average cholesterol levels across the American population suggested that this risk factor accounted for at least a portion of the decline in cardiovascular mortality.

Recent findings have provided more conclusive evidence with respect to the role of serum cholesterol as a risk factor. In considering the transport of cholesterol by various fat particles, researchers focused on the effects of high-density lipoproteins (HDLs) and low-density lipoproteins (LDLs). A negative correlation was found between HDL and coronary heart disease; conversely, LDL levels were shown to be strongly and directly associated with cardiovascular disease (Castelli, 1983; Criqui et al., 1980; Feinleib & Rifkind, 1982; Levy, 1984). Levy and Moskowitz (1982) further elaborated on the function of HDL as a cardiovascular disease protective factor, noting that HDL levels were positively correlated with exercise and moderate alcohol ingestion, and negatively associated with smoking, poor diabetes control, and the use of progestin-related contraceptives. They concluded that: "The cause and effect of the inverse relation between HDL and coronary heart disease, however, remains unclear" (Levy & Moskowitz, 1982, p. 124).

Cigarette smoking has been shown to markedly increase the risk of myocardial infarction and sudden death (Castelli, 1983; Kannel, 1982), although the relationship between changes in smoking habits and cardiovascular mortality is complex. Levy (1984) credited the 29 percent decrease in per capita consumption of tobacco since the early 1960s to the advent of public awareness programs, and stated that "... the risk of heart disease from smoking is 90 percent eliminated after only one year of nonsmoking" (p. 10C).

In the Australian prospective study, smoking was found to be a significant cardiovascular risk in 40-59 year aged women, and in 60-74 year old men (Cullen et al., 1983). In contrast, cigarette smoking was shown to be a major cardiovascular risk factor for the Framingham study population under 60 years of age; for the individual who stopped smoking, coronary heart disease risk declined to the level of a non-smoker within one year (Castelli, 1983). Nicholls, Jung, and Davies (1981) reported that the prevalence of cigarette smoking among Canadian adults decreased by 16 percent between 1965 and 1977, and they suggested that the reduction in nicotine and tar levels may also have contributed to declining cardiovascular mortality rates.

With reference to specific age groups for each sex however, the relationship between changes in smoking habits and cardiovascular mortality becomes more obscure. While the mortality of heart disease has declined more rapidly in women and in younger adult groups, changes in the prevalence of cigarette smoking among these groups have been minimal (Nicholls, Jung, & Davies, 1981). Some research has indicated that American women have not reduced their cigarette consumption (Hickey, Mulcahy, Graham, & Daly, 1980), while other studies have documented a modest decline for women between 21 and 54 years and increases among elder women and teenage girls (Feinleib & Rifkind, 1982; Stern, 1979). Consequently, although trends in smoking may have contributed to the decline in cardiovascular mortality among middle-aged males, the rate of cigarette smoking reduction in women is low in contrast to their declining coronary heart disease mortality rates (Kannel, 1982; Thom & Kannel, 1981).

The role of physical activity in the incidence of cardiovascular disease continues to be nebulous. While some evidence has indicated that the benefits of physical activity emanate from work-related activities (Castelli, 1983), other findings have implied that the positive effect of physical exercise is associated with leisure-oriented activities (Kannel, 1982; Stern, 1979). Levy (1984) stated that the positive influence of physical activity on cardiovascular mortality can be attributed to its direct effect on blood pressure, body weight, smoking habits, and HDL and LDL levels. Epidemiologic investigations concerning cardiovascular disease and physical activity have been characterized by numerous unresolved issues: selection bias; subjective indicators of physical activity; the impact of leisure-oriented versus work-oriented activity; the isolated effect of physical activity when other risk factors have been considered; and the distinction between physical activity and physical fitness

(Kannel, Wilson, & Blair, 1985; La Porte et al., 1984). Thus, the evidence generally supported the contention that regular physical activity is associated with a reduced incidence of cardiovascular disease, although the rationale underlying that relationship is largely unknown.

Other factors have been documented as influencing the declining cardiovascular mortality rates, although the evidence suggested that weaker relationships exist among these risk factors and the incidence of heart disease than among the generally accepted major risk factors of hypertension, cigarette smoking, and serum cholesterol levels. Some of these less prominent cardiovascular risk factors include: obesity (Castelli, 1983; Criqui et al., 1980; Cullen et al., 1983; Hawthorne, 1983; Stern, 1979); lower social class (Dobson, Gibberd, Leeder, & O'Connell, 1985; Hickey et al., 1980; Ioannidis & Efthymiopoulou, 1982; Leren, Helgeland, Hjermann, & Holme, 1983; Pan American Health Organization, 1984; Rose, 1984); personality characteristics (Castelli, 1983; Harlan et al., 1981; Ostfeld & Eaker, 1985); elevated serum glucose levels (Castelli, 1983; Cullen et al., 1983); environmental influences such as noise, radiation, and inhalant exposures (Harlan et al., 1981); moderate alcohol consumption (protective effect) (Cullen et al., 1983), and an association with the measles virus (Mercer, 1983). It is postulated that several of the aforementioned risk factors contribute to the incidence of cardiovascular disease through the "major" risk factors, thus concealing their independent effects on cardiovascular disease.

It has been suggested that the decline in cardiovascular mortality may be partially attributed to improvements in coronary medical care practices and accessibility. Levy and Moskowitz (1982) discussed the advances which have been occurring in the diagnosis, treatment, and rehabilitation of patients with cardiovascular disease since the organization of the first coronary care unit (CCU) in 1963: heart-lung machines in open heart surgery; noninvasive technologies such as echocardiography and computerized tomographic X-ray techniques; coronary artery bypass operations, and their most recent alternative, percutaneous transluminal coronary angioplasty; more widespread and effective emergency medical services; therapeutic agents for the treatment of angina pectoris, cardiomyopathy, and hypertension; antiarrhythmic and antiadrenergic drug therapy for the prevention of cardiovascular sequelae; and artificial and human cardiac transplantations. Thom and Kannel (1981) also suggested that the introduction of health insurance programs, coupled with the proliferation of coronary medical care advances, may be associated with the decline in cardiovascular mortality. It was submitted that although major advances have been achieved in the treatment of cardiovascular disease, the etiology and pathogenesis must be better understood to make prevention a reality (Levy & Moskowitz, 1982).

Stern (1979) suggested that while CCUs probably contributed to the decline in ischaemic heart disease mortality, the impact of emergency medical services and coronary artery bypass surgery was minimal. Similarly, Nicholls, Jung, and Davies (1981) argued that the recent implementation of CCUs and coronary bypass surgery techniques in Canada, in conjunction with the relatively localized availability of sophisticated emergency services, largely negate their effect on cardiovascular mortality rates which began to decline in the early 1960s.

Hickey et al. (1980) stated that the reduction in CCU mortality does not necessarily indicate a decrease in mortality among survivors of coronary heart disease: approximately two-thirds of those deaths occur outside the hospital. In view of this latter statistic, Kannel (1982, p. 878) submitted that "... CCUs could improve medical overall CHD mortality by at most 4 percent or 5 percent."

In summary, numerous hypotheses have been postulated to explain the decline in cardiovascular disease mortality, but none can account for all aspects of the decline. Specific causes of declining mortality rates have been predominantly related to changes in cardiovascular risk factors, and secondarily, to improvements in, and accessibility of, coronary medical services. The paucity of cardiovascular disease morbidity data however, precludes determining whether decreased mortality rates reflect declining incidence rates, improved case fatality rates, or a combination thereof.

2.2.3 Estimated Costs

Heart disease was estimated to be a $60 billion expense in the United States in 1977, and its projected cost by the year 2000 is $366 billion (Charles & Kronenfeld, 1980, p. 1). Over and above this cost is the devastating social and emotional impact on patients and families.

The National Cooperative Unstable Angina Study revealed that in 1979, the average medical cost for heart disease was $7,666 and the mean surgical cost was $12,674; the average cost for cardiovascular patients requiring later surgery was $23,500 (Wayne, Kronenfeld, & Charles, 1980, p. 83). In the late 1970s it was estimated that 100,000 coronary bypass operations were being performed annually in the United States (Charles & Kronenfeld, 1980, p. 2) at an average cost of $15,000-$20,000 per case (Cohen, Solnick, & Stephenson, 1982, p. 111-50; Rapaport, 1982, p. 111-4). With the advent of the Medicare Prospective Payment System (PPS) in the United States in 1984, an average charge has been computed for each DRG. The charges have been derived on the basis of U.S. data associated with all Medicare separations during a particular fiscal year. From a financial perspective, the all-encompassing category of "heart disease" can thus be more meaningfully depicted in terms of smaller and relatively similar groups of diseases and procedures. For example, although endocarditis and atherosclerosis are both considered under the umbrella of heart disease, the average charge per case for each category differs substantially [approximately $12,500 (U.S.) and $3,000 (U.S.) for endocarditis and atherosclerosis, respectively].

Because of the very large number of individuals afflicted by heart disease, there was growing public concern during the past decade regarding the proliferation of bypass surgery, with the attendant fear that other medical programs would be jeopardized by the rising expense associated with heart surgery (Charles & Kronenfeld, 1980, p. 3; Collins, 1980, p. 271). Collins argued that the cost of bypass surgery has not been adequately reported, and that consideration should be given to a cost-benefit analysis, including direct expense (hospitalization, medication, physician fees), indirect expense (loss of productivity), and intangible expense (pain, fear, grief, and death) (Collins, 1980, p. 279). Such cost-benefit analyses however, are rarely done and, if done, are difficult to assess.

2.2.4 Summary

A brief review of selected aspects relevant to cardiovascular disease has demonstrated the magnitude and complexity of this problem. Comprehensive research efforts to identify and alleviate suspected risk factors coupled with advances in medical and surgical techniques for immediate and long-term coronary care, illustrate the intense scrutiny which cardiovascular disease has received in recent years. The research associated with the potential causes of the downward trend in cardiovascular disease mortality remains complex, and to a large extent, speculative.

2.3 Classification Systems

The complexity of the health care system as it pertains to utilization behaviour requires the analysis of voluminous amounts of data. In an attempt to transform these data into meaningful categories or classes of information, classification is used as a data reduction technique. Last (1983, p. 18) described five essential characteristics of a classification system: "(1) naturalness - the classes correspond to the natural structure of the entity being classified, (2) exhaustiveness - every member of the group will fit into one (and only one) class in the system, (3) usefulness - the classification is practical, (4) simplicity - the subclasses are not excessive, and (5) constructability - the set of classes can be constructed by a demonstrably systematic procedure."

There are three major applications of classification in the health care field: (1) disease classification; (2) patient classification; and (3) hospital classification. The following sections review these three classification applications, with particular emphasis on DRG classification in view of its relevance to the methodology of this study.

2.3.1 Disease Classification

Disease classification, an etiologically oriented system, was the first application of classification in the health care field. The initial formal system, developed in 1883, categorized causes of death to assess the utility of public disease control programs (World Health Organization, 1977, p. xiii). It was not until 1948 that the disease classification system expanded to include both mortality and morbidity statistics. This system was known as the International Classification of Diseases (ICD), formulated by an internationally representative group of experts who advise the World Health Organization (WHO). The comprehensive classification list is published in the Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death, which is revised approximately every ten years by the WHO (Last, 1983, p. 51; Lilienfeld & Lilienfeld, 1980, p. 67).

Various modifications of the ICD classification manual have evolved to more adequately meet the unique needs of North American hospitals. During the 1950s, experimentation with the ICD for indexing medical records occurred in several American hospitals, culminating in 1959 with publication of the first ICDA (International Classification of Diseases, Adapted for Indexing Hospital Records). The ICDA, which contained standard modifications for disease classification and accompanying surgical codes, was initially operationalized in hospitals using Professional Activity Study (PAS) data, but rapidly spread throughout numerous hospitals in the United States and Canada during the 1960s [Commission on Professional and Hospital Activities (CPHA), 1970, pp. xi-xiii].

In 1967, the WHO published the eighth revision of the ICD (ICD-8). The United States Public Health Service subsequently issued an adaptation of the ICD-8, entitled the Eighth Revision of the International Classification of Diseases, Adapted for Use in the United States (PHS publication, 1693). This latter revision became commonly known as the ICDA-8. In view of the lack of emphasis on morbidity classification, amongst other problems, it was believed that the ICDA-8 should be modified for more effective use in hospitals. Rather than submitting a list of suggested deletions and additions, a complete printed adaptation was published by the CPHA, entitled the Hospital Adaptation of ICDA (H-ICDA), and was implemented in 1969. The H-ICDA varied most notably from ICDA-8 with the inclusion of components regarding mental disorders, causes of perinatal morbidity and external causes of injury, and the classification of operations according to body systems rather than surgical specialties. The three-digit rubric structure of the ICD was retained (CPHA, 1970, pp. xiii-xiv).

Stimulated by the rapid changes in clinical medicine and the need to classify health data at several levels of care, the second edition of H-ICDA (H-ICDA-2) was introduced in 1974 by the CPHA Nosology Group. Major deviations from the first edition included: (1) some expansion at the fourth-digit level to increase clinical detail; (2) creation of some new disease categories; (3) addition of a new section dealing with signs and symptoms to facilitate recording in ambulatory and outpatient care facilities; (4) addition of a supplementary classification (Y codes) to accommodate descriptions of reasons other than diagnoses or traditional symptoms for which a patient accesses the health care system; and (5) a complete revision of the surgical classification (CPHA, 1973, pp. vii-viii). Hospitals throughout North America were divided in their usage of the H-ICDA and H-ICDA-2 classification systems.

In 1977, the WHO released the ninth revision of the ICD (ICD-9). The United States National Center for Health ~~Statistics~~ convened a steering committee (composed of clinicians, statisticians, epidemiologists, and nosologists) for the purpose of developing a clinical modification of the ICD-9. As a result, the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) was introduced in January 1979, supplanting all the aforementioned classification systems. The ICD-9-CM far exceeds previous systems in the quantity of detail, providing greater specificity at the fifth-digit level. A significant inclusion was a classification of procedures in medicine (non-surgical procedures) which was segregated from the section on surgical procedures (CPHA, 1980, pp. iii-iv, xxi-xxvii).

All Canadian provinces adhere to an abridged version of the ICD-9 nosology, published by Statistics Canada. Originally established as the Canadian Diagnostic Coding (CDC) system, it was modified in 1979 and is now referred to as the Canadian Diagnostic List (CDL). The CDC and CDL were purportedly derived to reflect Canadian health care patterns. In addition to the CDL system, all Alberta acute care hospitals employ the ICD-9-CM classification system for tabulating morbidity and mortality data.

Recognizing the limitations of an etiologically-based classification system to analyse medical care utilization behaviour, Hurtado and Greenlick (1971) described a modified disease classification system which was developed for a utilization study of the Kaiser Foundation Hospitals in Oregon. Using the ICDA as the basic morbidity coding system, the researchers grouped conditions listed in the ICDA into ten behavioural groups, each of which delineated a similar medical care utilization response among individuals with similar background characteristics. The researchers believed that the flexibility of the classification system was essential to health services utilization research since "... diseases can be grouped according to the special needs of the investigators and the system can be adapted to solving both clinical and behavioral research questions" (Hurtado & Greenlick, 1971, p. 237).

Although disease classification systems are widely accepted as simple and objective techniques for reducing vast amounts of health data, several disadvantages in relation to health services research have been identified. Bay, Leatt, and Stinson (1982, p. 470), in reference to a study involving long-term care patients, outlined the following weaknesses of an etiologically oriented classification system: (1) There is an inadequate basis for predicting patient care requirements; (2) some diseases are diagnosed by manifestation rather than etiology; (3) several cases involve subjective evaluation with respect to the differentiation of primary and secondary diagnoses; (4) wide variation of resource use and illness severity occur within a disease category; and (5) frequently, there are problems associated with designating an etiological basis to patients with long-term care and psychiatric illnesses. In partial response to these inherent disadvantages, the development of patient-oriented classification systems evolved.

2.3.2 Patient Classification

Bay, Leatt, and Stinson (1982, p. 470) stated that a patient-oriented classification system "... is based on observed similarities of patient characteristics, rather than on cause or etiologic considerations." They further noted that a patient classification system must involve the accurate assessment of a comprehensive range of health-related attributes, rather than a few etiological factors, prior to each classification decision.

There are basically two kinds of patient classification systems: classification by **types of care** and classification by **levels of care.** Bay, Leatt, and Stinson (1982, p. 471) stated that these two classification systems "... differ in their purpose, the composition of target patient population, and operate at different strata in the health care system."

Classification by types of care, initially introduced by The Report of the Working Party on Patient Care Classification, attempted to categorize patient needs with respect to the type and amount of medical and social services required (National Health and Welfare, 1973). Consequently, the allocation of resources was predicated upon the accurate and comprehensive identification of needs. The Working Party presented three interdependent categories as a foundation for classifying patient needs at three different phases of the health care system: (1) health and social needs which apply to all individuals in the general population; (2) manifest specific individual needs which require direct intervention; and (3) patient needs according to their requirements for nursing care within a specific care setting. It was proposed that the types of care classification was required at the second phase, whereby persons with similar care requirements would be placed in the most appropriate health care program or delivery setting. The manifest needs of patients were numerically designated into five distinct types of care: Type I (associated with an ambulant individual requiring minimal care), Types II to IV (reflecting various types of chronic patients), and Type V. (designated for patients requiring treatment in an acute care hospital setting). It was emphasized that classification by types of care was a conceptual technique for describing the nature of patient needs, the purpose of which was to facilitate assignment of patients to appropriate health care settings. The classification methodology was not intended to define treatment within the system (National Health and Welfare, 1983, p. 49).

The third category of needs described by the Working Party referred to classification by levels of care. Whereas types of care qualitatively described patient needs, levels of care were conceptually defined as a quantitative measure of the amount and complexity of nursing care resources required by a patient in a particular health care setting (National Health and Welfare, 1973, p. 45). Classification by levels of care, most widely described in the nursing literature, has been applied primarily in acute care hospitals with medical-surgical patients. In a monograph, Giovannetti (1978) outlined the theory and rationale of patient classification systems by levels of care, and provided a detailed description of their application in various settings. The major impetus for levels of care classification was a response to the need for the appropriate determination and allocation of nursing personnel. The majority of levels of care classification instruments contain three or four categories which are differentiated on the basis of descriptors of patients' nursing care requirements; quantification of the instrument is achieved through observational studies which determine the nursing care time associated with those descriptors (Giovannetti, 1979, p. 5).

There are several inherent limitations of the patient classification methodologies. It is often difficult to clearly differentiate between the concepts of types of care and levels of care, the terminology lacks precise delineation and universal acceptance, and the categories within each methodology are not mutually exclusive (Bay, Leatt & Stinson, 1982, p. 471). Further, the validity of patient classification instruments has not been adequately demonstrated, severely limiting the utility of these methodologies.

Bay, Overton, Harrison, Stinson, and Hazlett (1979) attempted to validate the types of care classification outlined by the Federal Working Party. A sample of long-term patients was assessed and subjectively classified by program practitioners and an independent criterion team; an objective and empiric classification model was developed by applying discriminant and cluster analyses techniques. Two major findings by the researchers included: (1) an inconsistency of classification between the practitioners and the criterion team caused by subjectivity; and (2) an unclear delineation of the patient population which was attributed to overlapping definitions of types of care (Bay et al., 1979, pp. 266-267).

Although numerous attempts have been undertaken to establish the validity of levels of care classification instruments, quantification of patients according to their nursing care needs is continually subject to the value judgements and observational skills of the observer, and the organizational influences unique to each health care setting (Chagnon, Audette & Tilquin, 1977; Giovannetti, 1979; Sjoberg & Bicknell, 1968). Finally, the interdependent nature of classification by types of care and levels of care further complicates the problem of validity determination. Bay et al. (1979) stated that the levels of care classification assumes the appropriate placement of patients, and thus, without a valid types of care classification system, the validity of the levels of care classification is markedly jeopardized.

The inadequacy of patient classification methdologies for comparing and allocating resources amongst hospitals is evident, and indeed, these classification systems were not designed for such purposes. The study of hospital classification evolved as a technique for grouping health care facilities in order to facilitate resource utilization comparisons and equitable allocation decisions.

2.3.3 Hospital Classification

Hospitals can be described on a multiplicity of characteristics, many of which "... have important implications for the nature and quality of the hospital output and are therefore important considerations in the assessment of the hospital establishment" (Donabedian, 1973, p. 242). Hence, measures of hospital productivity and how the product or output is defined are germane to the differentiation and categorization of hospitals.

Outputs of hospitals are not easily quantified in view of their multifaceted nature and emphasis on quality of service. At the turn of the century, Codman (1913) acknowledged the challenge of defining the heterogeneous product of a hospital:

> What, then, are the products of a large hospital, whether in the forms of healed wounds, healthy babies, faithful nurses, promising young surgeons and physic[illegible]s, or in the more abstract forms of original ideas on pathology or treatment, model methods of administration, or such intangible things as enthusiasm and ideals? (p. 491).

Donabedian ([illegible]ssed three approaches to the definition of hospital product: [illegible]) the process-oriented perspective, which is concerned with the contributions of services to the medical care process; (2) the outcome-oriented approach, which focuses on the results of medical care with respect to the health status of the patient; and (3) the episodes of illness appropriately cared for, which is a synthesis of the two previous approaches (pp. 250-251). Regardless of the approach adopted, however, Donabedian (1973) emphasized that "comparisons of productivity require measurement of standard product" (p. 253).

Traditionally, the hospital standard product is defined according to the process-oriented perspective which relates intermediate inputs (services) with intermediate outputs (patient-days, number of admissions) (Tatchell, 1983, p. 871). These measures were criticized in that firstly, they could not adequately explain differences among "similar" hospitals and secondly, the services provided by a hospital bore little relationship with the outcome or health status of individual patients (Fetter, Youngsoo, Freeman, Averill, & Thompson, 1980; Tatchell, 1983). As an alternative to the traditional output measures, researchers found that **case mix** was a significant variable in the measurement of output, reflecting the hospital product in terms of the type and volume of treated patients (Bentley & Butler, 1982; Hornbrook, 1982a).

Two general approaches have been used to measure a hospital's case mix: (1) the indirect approach, which employed surrogate case mix measures such as teaching status and [illegible] beds to define the hospital output; and (2) the direct [illegible] whereby diagnostic-specific case mix indicators were used [illegible] lineate similar groups of patients (treated cases) to describe the hospital output (Klastorin & Watts, 1980, p. 675; Williams, Kominski, Dowd, & Soper, 1984, p. 18).

The following sections review the literature related to these two approaches.

2.3.3.1 Indirect Case Mix Measurement

Several indirect techniques for measuring hospital case mix evolved during the 1960s and 1970s. Although not mutually exclusive, each measure was predicated upon a different output dimension. In an early study by Feldstein (1961), a linear relationship was demonstrated between cost data and the number of patient-days which ~~was used~~ as a surrogate measure of hospital output. Carr and Feldstein (1967) employed eight different proxy measures of hospital services to determine the effect of hospital size on the costs of inpatient care. By including both the number of services offered by each hospital and the product of that number and patient-days, they grouped the hospitals into five service-capability groups. In an attempt to more explicitly adjust for product mix, Feldstein (1968) used the proportion of a hospital's patients in each of eight clinical service specialties to describe the case mix differences of 177 British hospitals, and found that specialty differences accounted for 25 percent of the variation in per-case costs amongst the hospitals.

Using the patterns of facilities and services as surrogates for product mix heterogeneity, Berry (1973) identified a hospital typology with four groups: (1) basic service hospitals; (2) quality-enhancing service hospitals; (3) complex service hospitals; and (4) community service hospitals (p. 9). Berry (1973, p. 12) concluded that there was a relationship between the availability of facilities and services and the capacity of hospitals to provide specific services, and that each hospital grouping represented an increasing level of case mix complexity. Berry (1974) further noted that product mix had a significant impact on hospital costs. With a view to replicating and expanding Berry's research, Klastorin and Watts (1982) applied Berry's methodology and various statistical techniques to a 1978 data base. They discovered that although hospital facilities and services continued to exist in some well-defined order, a distinct hospital typology of facilities and services no longer applied, indicating that hospitals were more differentiated in 1978 than at the time of Berry's study (Klastorin & Watts, 1982, p. 449).

Several studies employed clustering techniques, in conjunction with surrogate case mix measures, to yield hospital typologies. Phillip and Iyer (1975) described a hospital scheme which categorized the entire universe of American community hospitals that were as similar as possible with respect to 14 proxy variables for product mix and 11 surrogate variables for external socioeconomic and demographic characteristics. The researchers acknowledged that it was not a definitive classification system but could "... be used as a basis for making tentative identifications of hospitals whose operations call for closer scrutiny" (Phillip & Iyer, 1975, p. 366). Trivedi's (1978) clustering analyses yielded a classification subsystem which enabled hospitals with similar market conditions and output composition to be placed in a peer group. The resulting clusters of hospitals were delineated as primary (small hospitals in rural settings, typically staffed by general practictioners), secondary (a synthesis of primary and tertiary hospitals), and tertiary (large, metropolitan teaching hospitals with a wide variety of medical specialists).

In an effort to circumvent the subjectivity used to select the classification criteria of Trivedi's and similar hospital classification models, Neumann (1980) proposed a modified approach for classifying hospitals. Rather than basing the classification process on judgements that were subsequently validated by statistical testing, Neumann adopted a statistical method to select the initial attributes and characteristics by which large community hospitals could be classified. Trivedi (1979) criticized the methodology used in Neumann's research, and stressed the importance of validating a hospital classification system on the basis of both expert judgement and statistical analyses. Klastorin and Watts (1981) applied cluster analysis to a random sample of 200 short-term hospitals, and identified various constraints which could be used within the classification process to reduce subjectivity. Nevertheless, the researchers concurred with Trivedi that "no statistical methodology can, or should, totally remove the subjective element from decisions that, by definition, involve value judgements" (Klastorin & Watts, 1981, p. 216).

Some indirect case mix research attempted to assess the more direct influence of patient-related variables on hospital differentiation. Lave and Lave (1971) compared the relationship between hospital characteristics of 65 western Pennsylvania hospitals (size, number of facilities and services, and teaching status) and diagnostic output measures (aggregation of patients with respect to the broad ICDA groups). They concluded that case mix varied significantly amongst the hospitals but was relatively stable within a specific hospital over time. Further, they emphasized that hospital characteristics could not be considered adequate surrogate indicators for case mix (Lave & Lave, 1971, p. 36). Evans (1971) also endeavoured to develop a hospital classification approach by incorporating diagnostic influences. Ontario hospitals were differentiated with respect to the proportion of total patient-days within each of 41 ICDA-based disease categories. Regression analysis, using average cost per case and average cost per day as dependent variables, revealed that diagnostic mix had a significant impact on hospital costs. Evans (1971) acknowledged however, that his model did not have the capacity to differentiate the effect of individual diagnoses.

To more thoroughly investigate the impact of specific diagnoses on British Columbia hospital cost variations, Evans and Walker (1972) used information theory to adjust for case mix differences. The researchers developed an index of relative complexity for each hospital on the assumption that the more complex, costly cases were concentrated in large specialized hospitals while straightforward cases tended to be treated more evenly throughout the system. The study indicated that higher cost hospitals were characterized by a different mix of patients (with longer than average lengths of stay) than lower cost hospitals. Milne and Stein (1981) reviewed six studies from Britain, Canada, and the United States (including the research by Evans and Walker) which tested the relationship between hospital costs and hospital complexity or specialty. Aggregating the results of these studies, the researchers confirmed Evans and Walker's assumption that "... treatment for diseases that are expensive to treat is available at only a few hospitals, and when hospitals specialize, it is to provide high-cost care" (Milne & Stein, 1981, p. 466). Although not developing classification schemes per se, the research by Evans (1971) and Evans and Walker (1972) indicated that diagnostic mix was a far more significant influence on hospital cost variation than surrogate case mix measures.

Recognizing the importance of economically relevant dimensions of disease in the development of case mix measures, Luke (1979) identified three such dimensions and assessed the validity of the measures used to represent these dimensions. The economic disease dimensions included: (1) the complexity/prognosis dimension which determined the quantity of resources needed to treat a given case; (2) the intensity of disease which reflected the amount of resources required to treat a given case per day of hospital stay; and (3) the acuity of illness which indicated a patient's need for immediate intervention. Luke (1979, p. 45) tested the construct validity of various measures reflecting the economically relevant disease dimensions, and concluded that the consistent pattern of correlations "... supports the finding of relatively independent dimensions ...." Further, Luke (1979) observed that when these measures were aggregated into diagnostic categories and compared across 16 heterogeneous hospitals, there was a highly consistent pattern between resource use (measured as patient charges) and length of stay. An important implication of this study was that hospitals could be differentiated on the basis of diagnostic categories which were relatively resource homogeneous, a basic premise underlying direct case mix measurement.

2.3.3.2 Direct Case Mix Measurement

Although some of the studies reviewed in the previous section incorporated diagnostic groupings, the categories were defined in terms of medical specialties or broad ICDA groups. The direct approach to case mix measurement attempts to explain hospital variation by defining "... large sets of patient-specific data that combined exact diagnostic categories with information on cost or length of stay" (Williams et al., 1984, p. 18). It was proposed that this approach to hospital classification would permit the direct comparison of individual case costs and lengths of stay among hospitals, and facilitate intra-hospital analysis regarding the reasons for differential costs or lengths of stay for case types (Besner, 1985, pp. 22-23).

ICD-9-CM List A. One of the earliest attempts to categorize patients into diagnostic groups which were relatively resource homogeneous was the first length of stay book published by the CPHA for use in utilization review (Plomann, 1982, p. 9). There were 183 medical groups and 178 surgical groups, resulting in 3,660 cells and 1,780 cells, respectively. The evolution of the length of stay manual coincided with revisions in the ICD coding scheme. The latest revision, entitled the ICD-9-CM List A, occurred in 1978. Statisticians, physicians, and nosologists collaborated to subdivide 398 diagnostic groups into relatively homogeneous length of stay classes on the basis of age, comorbidity, and the performance of surgery. Limitations cited were the equal weighting given to secondary diagnoses, the non-specification of the type of surgery, and the extremely large number of case types (7,960) which limited the utility of statistical analyses (Ament, Dreachslin, Kobrinski, & Wood, 1982; Bentley & Butler, 1982; Hornbrook, 1982b; Plomann, 1982). While the resulting classification scheme allowed hospitals using Professional Activity Study (PAS) data records to compare (with peer hospitals) average lengths of stay by diagnostic group, the inherent difficulties of using such a large number of classes stimulated researchers to design alternative case mix measures.

DRG Classification System. As an alternative classification scheme, the Diagnoses Related Groups (DRGs) were constructed in the late 1960s and early 1970s at Yale University. The purpose of the DRG methodology was "... to identify in the hospital acute-care setting a set of case types, each representing a class of patients with similar processes of care and a predictable package of services (or product) from an institution" (Fetter et al., 1980, p. 3). To achieve that objective, the researchers believed that the classification system should have the following attributes: (1) medically meaningful subclasses of patients from homogeneous diagnostic categories; (2) individual classes that could be defined on variables commonly available on discharge abstracts and relevant to output utilization; (3) a manageable number of mutually exclusive and exhaustive classes; (4) classes of patients with similar expected measures of output utilization; and (5) class definitions that would be comparable across various coding schemes (Fetter et al., 1980, p. 5).

The first step in constructing the DRGs was the aggregation of ICDA-8, H-ICDA-2, and the CPHA List A disease coding schemes into 83 mutually exclusive and exhaustive Major Diagnostic Categories (MDCs).

The MDCs were established according to the following general principles:

1. Major Diagnostic Categories must have consistency in terms of their anatomic, physiopathologic classification, or in the manner in which they are clinically managed.

2. Major Diagnostic Categories must have a sufficient number of patients.

3. Major Diagnostic Categories must cover the complete range of codes without overlap (Fetter et al., 1980, p. 6).

The second step involved examination of actual distributions of length of stay within each MDC to identify subgroups on the basis of statistical algorithm. Rather than actual costs, length of stay was used as the indicator of output level or resources used since "... it is still an important indication of utilization as well as being easily available, well standardized, and reliable" (Fetter et al., 1980, p. 5). The data base consisted of approximately 700,000 discharge abstracts from hospitals in New Jersey, Yale-New Haven, and South Carolina. Prior to partitioning each MDC into subgroups, abstracts containing deaths, coding errors, and particularly long lengths of stay were deleted.

The remaining cases were subdivided on the basis of variables yielding the highest reduction in length of stay variance within groups. The five independent variables selected as input to the algorithm were predetermined in view of their contribution to variation in length of stay, and included diagnoses, surgical procedures, age, sex, and clinical services. When the initial partitioning of the MDCs was completed, a "... decision to accept, to reject or possibly revise the recommended partitioning was based on both the statistical evidence and the clinician's medical knowledge" (Fetter et al., 1980, p. 12). The partitioning process ceased when the number of observations in the group was less than 100 and/or none of the variables reduced the unexplained variation by at least one percent. In some cases, the process was terminated for non-statistical purposes, such as medical interpretability, although the clinical evaluation criteria were not explicitly documented. The iterative process resulted in the formulation of 383 terminal groups or DRGs, reflecting "... patient classes that are clinically consistent and that have similar patterns of output utilization as measured by length of stay" (Fetter et al., 1980, p. 38).

With the adoption in 1979 of the ICD-9-CM disease classification system, the development of the ICD-9-CM version of the DRGs was initiated in 1980 by the Yale researchers. The experience gained through use of the original DRG system suggested that some weaknesses could be alleviated during the reformulation process. Although guided by similar objectives, principles, and methodology, there were several salient differences between the two systems (Health Systems International, 1983; Williams et al., 1984, p. 19).

The data base differed markedly for the ICD-9-CM DRG system. A stratified national sample of United States hospitals subscribing to CPHA resulted in approximately 1.4 million discharge abstracts, with length of stay as the measure of hospital resources. A subsample of 394,814 records was used for the development of the system, while the remaining data records were used to verify the results. Further verification was done on a database obtained from the New Jersey

Department of Health, containing 334,924 discharge abstracts with direct cost as the indicator of hospital resources (Plomann, 1982, p. 18).

All possible principal diagnoses were divided into 23 MDCs (mutually exclusive aggregated groupings of the ICD-9-CM codes) by physician panels. Clinical judgement was given greater priority throughout the development of the new system, and clinical decision criteria were well documented (Williams et al., 1984, p. 19). In general, each MDC corresponded to a single organ system, and in a few cases, to the underlying etiology. Rather than initially partitioning the MDCs according to ~~the~~ variable which caused the greatest reduction in length of stay variance, most MDCs were dichotomized into medical and surgical groups. This was based on the premise that the presence of a surgical procedure which required the use of the operating room would have a significant impact on the amount of hospital resources used. The clinical team hierarchically ranked all operative procedures, and cases were classified according to the most resource intensive procedure received.

The process of defining the surgical and medical classes within each MDC was determined by organizing principles such as anatomy, surgical approach, diagnostic approach, pathology, etiology or treatment process. The assignment of each diagnosis and surgical procedure to a particular medical or surgical class had to correspond to the specific organizing principle for that class. Upon formulation of the medical and surgical groups, each group of patients was assessed to determine if the following variables would consistently affect the consumption of hospital resources: (1) a substantial complication or comorbidity (defined as a condition that, because of its presence with a specific principal diagnosis, would cause an increase in length of stay by at least one day in at least 75 percent of the patients in that class); (2) age; and (3) discharge status. The reformulation process resulted in 467 patient classes, with additional groups reflecting patients for whom all surgical procedures were unrelated to their principal diagnosis (DRG 468) and for patients with medical record coding errors (DRGs 469 and 470). The ICD-9-CM version of the DRGs was completed in January of 1982. During the subsequent year, technical errors and definitional problems prompted a revision of the ICD-9-CM DRGs by Health Systems International, which was released in June of 1983 (Health Systems International, 1983).

A Canadian version of the DRG system has been adopted by the Hospital Medical Records Institute (HMRI). This version is based on the ICD-9 rather than the ICD-9-CM disease classification system, and contains 23 Major Clinical Categories (MCCs) and 465 case mix groups (CMGs), consistent with the MDCs and DRGs, respectively. The difference in coding schemes precludes an identical comparison between the two systems, although the overall structures of DRGs and CMGs are highly congruent.

Application of the DRG Classification System. A number of potential applications for the DRG classification system have been identified. Yoder and Connor (1982, p. 29) succinctly stated the multifaceted potential for DRG application: "Information provided by linking DRGs with other variables is particularly significant in that it creates a bridge between the relatively isolated realm of medical practice and other relatively well-analyzed realms, such as financial management." Using DRGs as a framework of case types that reflects the relative complexity of patients, the DRG case mix measure would also facilitate intra-hospital and inter-hospital resource utilization comparisons.

Several studies have integrated the DRGs with other variables to test a diverse number of hypotheses. Frick, Martin, and Schwartz (1985) used the DRGs to analyse the extent to which case mix differences contributed to variances in average costs per case between groups of teaching and non-teaching hospitals. From a slightly different perspective, Jones (1985) examined the extent to which teaching hospital patients were more costly than non-teaching hospital patients, holding case mix constant through the use of DRGs and other measures to isolate the "teaching effect." Horn and Schumacher (1979), in an effort to verify the underlying assumption of Evans' information theory approach to case mix measurement, demonstrated a statistically significant relationship between case mix complexity (as measured by DRGs) and information theory measures of case mix complexity.

Some authors have discussed the feasibility of applying a DRG/CMG system in Canada. Zuckerman (1983) commented that implementation of a DRG-type system in Canada could lead to an improved understanding of medical care practice patterns, provide a refined mechanism for health cost control, and facilitate intra-facility management and planning. Since the validity of a scheme reflecting Canadian medical practice and hospital costs could take years, Botz (1985, p. 41) asserted that the high correlation between the average length of stay for each DRG and CMG justified the applicability of the DRG system for case mix management purposes in Canada.

Although there are a multitude of DRG applications, prospective per case reimbursement has become the most well-known and controversial applic[illegible]liams et al. (1984, p. 17) defined a per case reimbursement system as "... one in which prospective rates are determined on the basis of case type, rather than on a per diem or per admission basis." Foster (1982, p. 408) further elaborated on this definition by stating that the predetermined payment amounts are paid to hospitals regardless of the costs actually incurred.

The first case-based system for setting hospital rates was established in Maryland in 1976. Maryland's Guaranteed Inpatient Revenue (GIR) program applies to approximately one-half of that state's acute care hospitals, employs a case mix measure based on the DRGs, ICD-9-CM classification and broad medical specialties, and bases the current year's rate on last year's rate (Hellinger, 1985, pp. 79-82). New Jersey tested a case-based system in a demonstration project sponsored by the Health Care Financing Administration (HCFA) between 1978 and 1980. By 1982, all New Jersey acute care hospitals were enrolled in a state-wide prospective case-based system which used only DRGs to define case mix (Davies, Westfall, & Haskins, 1983; Iglehart, 1982b; May & Wasserman, 1984-5; Rosko, 1984).

The DRG-based reimbursement system prompted the United States federal government to adopt a program that uses DRGs for Medicare reimbursement. The Tax Equity and Financial Responsibility Act of 1982 (TEFRA) approved two broad measures: (1) an interim program of higher Medicare controls on hospitals; and (2) a directive to the Department of Health and Human Services (DHSS) that it develop a prospective payment system to impose a price ceiling on hospitals for Medicare inpatients (Iglehart, 1982a, p. 1288). The Social Security Amendments of 1983 introduced the Medicare Prospective Payment System (PPS) which applies to approximately 30 percent of all patients in United States acute care hospitals (May & Wasserman, 1984-5, p. 551). The Federal Register of September 1, 1983, interpreted the Congressional legislation on the Medicare PPS. The document set forth the interim final rule concerning the revised conditions and procedures for making Medicare payments to hospitals with inpatient services, including for example, detailed explanation of applicability, DRG features, and determination of prospective payment rates. The Medicare PPS became effective on October 1, 1984, and was expected to be fully implemented nation-wide by October 1986.

Of particular relevance to this study is the interpretation of DRG weighting factors. The HCFA developed weighting factors (for each DRG) that are intended to reflect the relative resource consumption associated with each DRG. Each factor reflects the average cost, across all hospitals, of treating cases classified in that DRG relative to all other DRGs. It was intended that the HCFA would adjust the DRG classification and weighting factors for fiscal year 1986 and at least once every four years thereafter to reflect changes in treatment patterns, technology, and other factors that could modify the consumption of hospital resources. In actuality, the HCFA has published three sets of DRG weights for 1984, 1985, and 1986 (Federal Register, 1983; 1984; 1985).

Outliers which are defined as those cases "... that have either an extremely long length of stay or extraordinarily high costs when compared to most discharges classified in the same DRG" (Federal Register, 1983, p. 39776), are reimbursed according to the geometric mean length of stay (GMLOS) for each DRG. The geometric mean (the antilogarithm of the mean of the logarithms of length of stay) was used rather than the arithmetic mean because length of stay data are highly skewed. Hence, by using the geometric mean, the proportion of cases that will be outliers within each DRG is more predictable. The GMLOS is used only to determine payment for outlier cases. The arithmetic mean, which is the measure of the average length of stay for a DRG, is used for comparative purposes (Federal Register, 1985, p. 35650).

The actual amount paid to each U.S. hospital for patients within each DRG is a complex formula integrating various factors. Under the current system, nine hospital peer groups are defined in nine census regions, and each region is subdivided into urban and rural categories. Each hospital's operating cost per case is computed by accounting for average wage rates, teaching/non-teaching status, and average case mix. The Medicare DRG rates for the three year transition period (1983-1986) consists of a blend of hospital-specific, regional, and national rates, during which time a declining portion of the total prospective payment will be based on hospitals' historical costs and a gradually increasing proportion will be based on a federal rate (Federal Register, 1983; Hellinger, 1985, p. 84; Williams et al., 1984, p. 18).

Limitations of DRGs. The literature is replete with criticisms of the DRG system, and it is frequently difficult to discriminate those limitations which are directed toward the methodology used to create and reformulate the system, the problems surrounding implementation of the system, and the feasibility of a DRG case-based reimbursement system. Overall criticisms which are frequently lodged against the DRG system include: (1) the problem of inaccurate and incomplete coding on discharge abstracts; (2) the potential for manipulating data to increase reimbursement ("DRG-creep"); (3) the use of historical hospital data in the DRG system development, reflecting the state of medical technology and practice at one point in time; (4) insufficient clinical homogeneity within groups; (5) the potential non-applicability of a standard DRG system to all United States acute care hospitals; and (6) limitations of the statistical classification algorithm used in the DRG development (Barnard, 1985; Bentley & Butler, 1982; Hornbrook, 1982b; Johnson & Appel, 1984; Plomann, 1982; Simborg, 1981; Smits & Watson, 1984; Stern & Epstein, 1985; Studnicki, 1983; Tatchell, 1983; Walker, 1985; Williams et al., 1984; Yoder & Connor, 1982).

One of the major criticisms of DRGs is that they cannot be used to assess the quality of care received by patients since DRG assignment "... is based on what was actually done for a patient versus what should have been done" (Plomann, 1985, p. 108). Indeed, one might observe that DRG assignment is based on what one might expect was done rather than on what was actually done. Researchers have suggested that it is essential to measure the severity of illness in order to create more clinically homogeneous categories for the purpose of quality review (Arbeit, Fears, & Plomann, 1985; Horn, Chachich, & Clopton, 1983). In view of the fact that DRGs fail to discriminate among patients in various stages of the same disease, the DRG case mix system cannot be used to determine the appropriateness of the diagnostic and therapeutic regime provided. In an effort to overcome that limitation, various direct case mix measures to incorporate illness severity have been developed or are in the process of development. The best known of these case mix measures include the Severity of Illness Index, disease staging, and Patient Management Paths.

The **Severity of Illness Index** is a four-level index determined from the values of seven dimensions which are intended to reflect the burden of illness of a hospitalized patient. These seven dimensions include: (1) stage of principal diagnosis; (2) extent of complications; (3) extent to which the patient requires more than the usual amount of nursing care; (4) requirement for life support treatment; (5) response time to therapy; (6) remission of acute symptoms; and (7) non-operating room procedures (Horn, 1985, p. 20). The Severity of Illness Index is not designed to be a free-standing methodology; rather, it is to supplement other measures in order to refine diagnostic categories with respect to illness severity. When compared with other case mix methodologies, the severity index produced groups of patients that were more resource homogeneous (Horn, Sharkey & Bertram, 1983). A major limitation however, is the time required to perform a medical chart review coupled with the subjectivity involved in assigning a final score. A Computerized Severity Index (CSI), incorporating the severity of illness criteria, is currently being developed and may partially alleviate this limitation (Horn & Horn, 1986, p. 167).

Disease staging was originally developed in the area of oncology to assess the efficacy of various treatment modalities (Garg et al., 1978). It was gradually generalized and refined "... to produce predictive clusters useful for a valid analysis of quality assurance programs" (Gonnella & Goran, 1975, p. 468). Staging involves the delineation of medical disease into four levels of illness severity: Stage I - minimal severity with no complications; Stage II - moderate severity with local complications; Stage III - all serious problems or disease with systemic complications; and Stage IV - death (Gonnella, Hornbrook & Louis, 1984, p. 638). Stage definitions have been derived for approximately 400 medical and surgical problems, and a computer algorithm has been developed that will apply the staging criteria to data from discharge abstracts on the basis of primary and secondary diagnoses. Large data bases may be staged efficiently providing a detailed clinical assessment of case types at a particular hospital (Hornbrook, 1982b, p. 80). Although staging categories have a high degree of medical meaningfulness, the categories may be heterogeneous from a resource consumption perspective since only one variable--illness severity--is isolated (Bentley & Butler, 1982, p. 7; Plomann, 1982, p. 33). Hornbrook (1982b, p. 81) further noted that the staging criteria have not yet demonstrated adequate reliability and validity.

Patient Management Paths (PMPs) involve "... a physician-specified patient category and a recommended management strategy for the typical patient in that category" (Young, Swinkola & Zorn, 1982, p. 509). Although conceptually similar to a synthesis of disease staging and DRGs, PMPs define clinically homogeneous groups **a priori** with respect to the reason for admission, components of care, and discharge diagnoses. The underlying premise of the PMP methodology is "... that physicians diagnose and treat patients based on their known symptoms, not on diagnoses that may be confirmed several days after admission" (Bentley & Butler, 1982, p. 8). Consequently, patient categories are predicated upon clinical input rather than length of stay or hospital cost data. To limit the number of potential categories, physician panels have restricted patient management algorithms to typical admission diagnoses and treatment patterns (Bentley & Butler, 1982, p. 8). A relative cost weight has been derived for each category, incorporating variable practice patterns among physicians and hospitals.

2.3.4 Summary

The three major applications of classification techniques in the health care system were reviewed to provide a conceptual and empirical basis for the classification methodologies used in this study. Disease classification is considered the most well-established classification system, and is generally ac[illegible] simplest and objective technique for reducing large amounts of data. The limitations of an etiologically-oriented system, however, prompted researchers to develop alternate classification methodologies. Patient classification was designed to categorize patients according to a comprehensive range of health-related characteristics rather than disease etiology. The "levels of care" patient classification schemes were applied primarily within an acute care hospital setting to differentiate patients according to their nursing care requirements. Classification by "types of care" was a conceptual approach which categorized manifest individual patient needs in order to facilitate the designation of patients to appropriate health programs or facilities. Review of the literature pertaining to hospital classification revealed that multiple dimensions must be considered in the development of techniques for measuring a hospital's case mix. The indirect approach to analysing case mix initially focused on hospital characteristics such as number of beds, teaching status, and number of clinical services. The indirect method evolved to incorporate aggregated diagnostic variables, in conjunction with proxy measures, to estimate case mix. The findings of this latter research indicated that diagnostic mix was a far more significant factor in explaining differences among hospitals than surrogate measures reflecting hospital services and facilities. Consequently, the focus of hospital classification research shifted toward the direct approach of case mix measurement which employed large amounts of patient specific data to form reasonably homogeneous diagnostic categories. By combining these diagnostic categories with information on cost or length of stay, the case mix of hospitals could be more accurately estimated and compared. The DRG classification system is currently the most highly developed technique for directly estimating hospital case mix. Although DRGs are not intended to evaluate the quality of care, other case mix measures have been developed for that purpose.

2.4 Patient Origin-Destination Methodology

Investigation of the care-seeking patterns of patients among acute care hospitals and geographic districts and regions requires that the population consuming specified resources be known. Hospitals do not have predetermined service populations or geographic boundaries, however, and quantification of such parameters is difficult. Patient origin-destination research has evolved to permit the estimation of hospital service areas and service populations predicated on patterns of patient flow behaviour.

These research strategies, which incorporate data describing the place of origin (patient's residence) and the destination of care (health care facility), are used primarily to: (1) examine patient care-seeking patterns by origin and destination; (2) delineate service areas and service populations; and (3) compare per capita resource utilization from a community (origin) and a provider (destination) perspective. Research pertinent to these three aspects of health care utilization are reviewed in the following sections.

2.4.1 Patient Care-Seeking Patterns

Health planning endeavours, whether from a service-specific, facility-specific or regional-wide perspective, are markedly enhanced through identification of patient flow patterns. Knowledge of patient flow behaviour provides a better understanding of geographic variations in health care utilization.

Initial studies concerning the care-seeking behaviour of patients are not recent. In 1945, Ciocco and Altenderfer quantified the movement of patients among counties within eight American states, and established an index of the interdependence of counties with respect to medical services. Using birth certificates which included both patient origin and destination data, the researchers developed an in-residence birth ratio (IR) which measured the degree to which patients obtained obstetrical services within their home county, and an out-residence birth ratio (OR) which quantified the extent to which patients sought obstetrical care outside their own county. These ratios elucidated variations in patient care-seeking behaviour among the counties, which appeared to be most closely related to the size of medical facilities and the income level of patients. A significant finding made by the researchers was that political boundaries could not account for county interdependence. Ciocco and Altenderfer (1945, p. 984) argued that an alternative such as medical trade areas would more accurately describe, from a broad perspective, the movement of patients in seeking medical care, while the use of IR and OR ratios would provide a more refined description of the intercounty movement of persons seeking obstetrical services.

Several studies concentrated on the impact of time and distance on patient care-seeking behaviours. Marrinson (1964) noted that approximation of a hospital service area in the Greater Cincinnati area was more accurately conveyed by a time circle based on minutes of travel time rather than a space circle. Particularly in urban areas, the impact of expressways eliminated the traditional limitations of travel distance, expanding the service areas of hospitals. Other researchers corroborated the significance of travel time over actual distance as a measure of accessibility (Drosness, Reed, & Lubin, 1965; Lubin, Drosness, & Wylie, 1965). McGuirk and Porell (1984) developed a spatial demand model of hospital selection in order to assess the influence of distance and time on hospital utilization patterns. Their findings suggested that travel effort was a more sensitive measure of hospital selection than either total time or distance from a hospital. The researchers further emphasized that "... planning at the individual hospital level must minimally proceed at the level of service category, since the sensitivity of total patient admission volume to physical access factors will vary depending on the service mix of patients" (McGuirk & Porell, 1984, p. 93). A similar study by Cohen and Lee (1985), who developed a model incorporating several attributes of hospital selection, revealed travel time to be "... a significant major deterrent to hospital utilization, whereas the size of a hospital is a major attraction" (p. 37). The authors identified several patterns of utilization with respect to various socioeconomic, demographic, and medical service population subgroups.

Other researchers have incorporated patient origin-destination data to investigate the differential effects of distance, time, and various socioeconomic and demographic factors on health care-seeking utilization patterns. Sharp and McCarthy (1971) analysed patient origin data in three western American states to ascertain significant parameters influencing patient flow patterns. They concluded that "... patients prefer to be hospitalized near where they live, [and] that physicians prefer to treat patients in hospitals close to geographic locations of their professional practices ..." (Sharp &

McCarthy, 1971, p. 841). The researchers noted that factors such as diagnosis and type of hospital influenced the distance travelled by patients for medical care. Bashshur, Shannon, and Metzner (1971) analysed travel patterns to selected medical facilities in Cleveland with respect to socioeconomic variables. They observed that although distance was a significant determinant of health care facility utilization,

> ... patterns of discrimination, as well as status, related to ethnicity and occupation and involving the economics and sociology of reward distribution and the oddities of the medical care market, modulate distance and in some instances determine it (Bashshur, Shannon, & Metzner, 1971, p. 75).

Miners, Greene, Salber, and Scheffler (1978) examined selected socioeconomic and demographic factors influencing the demand for health care in a southern rural American community, and found that travel time to the provider of care had a more significant impact than price on the utilization behaviour for both black and white households (p. 274). Conversely, Whitehouse (1985) examined the effect of distance on physician consultation rates in an urban medical practice in England. By surveying the frequency of consultation according to distance, age, and social class, he observed that distance from the health centre was only a slight deterrent to utilization. A more viable explanation of varying utilization patterns appeared to be associated with sociodemographic variables and patients' perceived medical needs (Whitehouse, 1985, pp. 361-362). Bosonac, Parkinson, and Hall (1976) combined travel time with several sociodemographic variables to investigate geographic accessibility to health facilities in West Virginia. Using a 30-minute travel time standard for hospital care, the authors discovered that 10 percent of the population lacked access; these individuals were characterized by attributes associated with high health care needs (Bosanac, Parkinson, & Hall, 1976, p. 622).

Some researchers have demonstrated that characteristics of health care facilities and the regionalization process influence patient care-seeking behaviours. Studnicki (1975b) explored relationships between travel time from the patient's residence to the hospital of care and numerous health system variables. He found that organizational factors such as patterns of physician location, physician hospital privileges, and payment status were more influential than distance minimization in explaining hospital selection by 20 percent of obstetrical patients in Baltimore (Studnicki, 1975b, p. 689). Morrill and Earickson (1968), evaluating the Chicago area hospital systems, found that "a few variables involving the characteristics of communities and hospitals and the relationships between them were able to account for about two-thirds of the variation in the pattern of flows" (p. 225). Raasok (1979) concluded in a study of Alberta nursing home utilization that facility ownership and accreditation status influenced the selective patterns of patients. Romeril (1984), applying origin-destination analysis to the Alberta paediatric population, reported that "rural children seeking care beyond their area of residence, tended to bypass secondary care centres, regardless of the diagnosis, and travelled directly to metropolitan tertiary centres" (p. 251). This regionalization process was also typical of Alberta residents seeking surgical care (MacDonald, 1983), and of Alberta elderly residents seeking care in acute hospitals (Szafran, 1985).

While patient origin-destination literature states that distance and travel time minimization significantly influence patient care-seeking behaviours, the impact of socioeconomic, demographic, and health status determinants cannot be underestimated. The degree of influence and interdependence of these latter variables however, requires further investigation, particularly in relation to diagnostic-specific medical service categories.

2.4.2. Service Area and Service Population

It is generally accepted that health planning endeavours are enhanced by the accurate assessment of "... the distribution of a hospital's patients among various geographic units" (Studnicki, 1975a, p. 15). The two major components of a hospital's "service constituency" include the geographic service area and the demographic service population (MacStravic, 1978, p. 31).

Early hospital service areas were primarily based on existing administrative or governmental subdivisions for which census data were readily available. This method of equating hospital service areas with predetermined jurisdictional boundaries was premised on the fallacious assumption that residents sought health care solely from health facilities located within their service area (Shonick, 1976, p. 61).

Lembcke's (1952) study, which attempted to comparatively assess the quality of medical care in relation to appendectomy rates, was one of the earliest studies to define hospital service areas on the basis of patient origin data. He developed 23 mutually exclusive hospital service areas according to the place of residence of all patients, recognizing that individuals did not always seek care in their home regions. He allocated each surgical event to the point of patient origin, regardless of where the surgery was actually done. Since the hospital service areas conformed to township boundaries, census data were available to describe the population of each service area. Lembcke (1952, p. 278) acknowledged that defining service areas in this manner would be inaccurate if one community contained several hospitals.

In 1962, Poland and Lembcke extended the concept of hospital service areas by applying an equal-likelihood approach. Service area boundaries corresponded to the points at which a patient was equally likely to travel to one particular hospital as he was to travel to all other hospitals. The researchers further analysed patient flow patterns among service areas, noting that diagnostic complexity and specialized hospitals were positively correlated with the distance travelled to receive care (Shonick, 1976, p. 67).

A mathematical gravity model was employed by Meade (1974) to establish service areas in the rural state of Idaho. He compared the map derived from the gravity equation with actual patient origin survey results, and found a high degree of congruence between the two techniques. Meade (1974, p. 364) concluded that the logistic and economic benefits of the gravity model for predicting hospital service areas obviated the need for conducting patient origin surveys, although its utility was restricted to sparsely populated areas. In

1976, Meade also demonstrated that the relative stability over time of rural hospital service areas precluded the need for repetitive patient origin surveys. He reported that it was both more effective and efficient from a hospital's perspective to examine its known service area on a continual basis rather than to embark on additional costly origin studies (Meade, 1976, p. 65).

Plessas and Carpenter (1975) described the application of a computer model to delineate health service areas in the state of Michigan. The model was designed to obtain clusters of counties that were as similar as possible with respect to 56 relatively weighted structural variables. Thirteen alternative patterns were evaluated, resulting in the selection of an eight-region model whereby each region was characterized by similar demographic, social, and economic indicators.

Application of origin-destination analysis to determine service areas in metropolitan areas has met with limited success. Urban communities contain multiple hospitals which vary in size and specialization; the communities are also interspersed with a dense, heterogeneous population distribution. Drosness, Reed, and Lubin (1965) attempted to resolve these problems by developing a computer graphics technique to map urban California service areas. To determine how the residents of a particular census tract utilized a specific facility, the number of admissions to a hospital (total volume and individual arrays representing the distribution of admissions to designated medical services) was tabulated as a proportion of total admissions to all the study hospitals. Alternatively, the number of admissions from each census tract to a particular hospital was computed as a percentage of the total admissions to the hospital. This approach however, could not circumvent the com[illegible] variable of boundary crossing behaviour. Similarly, Morrill and E[illegible]ckson (1968) [illegible] origin-destination data to describe service areas of Chicago hospitals. Significant variations among hospitals and patient utilization behaviour were attributed to facility characteristics such as volume and scope of services. Zimmerman (1975, p. 46) succinctly stated some inherent difficulties in delineating an urban hospital service area: "In the current pluralistic health system, consumers tend to be mobile, eclectic in their health care habits, and unable or unwilling to establish a permanent relationship with one family physician or health institution."

Research in the development of service areas led to identification of service populations, the second major component of a service constituency. The methodological limitations of geographically mapping a service area challenged researchers to find an alternative approach to determining a service population without reference to a specified hospital service area. Griffith (1972) made one of the earliest and most significant contributions toward the conceptualization of a hospital service population. Recognizing that the equal likelihood approach (based on Poland and Lembcke's research in the early 1960s) was primarily limited to rural areas with defined county boundary lines, Griffith (1972, p. 65) devised two indices for algebraically defining a hospital service population. He constructed a utilization matrix which depicted the number of admissions coming from various geographic areas to the hospitals under study. The Relevance Index

(RI) represented the proportion of total admissions from a particular geographic area which used a specific hospital (Griffith, 1972, p. 76). Estimation of the hospital's service population was obtained by multiplying each area population by its respective RI, and then summing these values for all areas. The Commitment Index (CI) reflected the extent to which a particular hospital served a given geographic area, and was calculated as the proportion of a hospital's total admissions originating from a particular geographic area (Griffith, 1972, p. 76). Zimmerman (1975, p. 47) summarized the intent of these indices by stating: "The index of relevance refers to the extent to which the population of a given geographic area uses the hospital; the index of commitment refers to the proportion of the hospital's resources committed to serving that population or area."

Zuckerman (1977) reported a study which was designed to explore community-to-hospital flow patterns for inpatient services, outpatient clinics, and emergency services of 88 Pennsylvania acute care hospitals. Analysis of patient origin-destination data for 1965 and 1974 "... provided the basis for grouping hospitals according to the residences of the patients using the facilities and for grouping communities according to the similarity of patterns of hospital use in the region" (Zuckerman, 1977, p. 85). This information was transcribed into a utilization matrix depicting the RI and CI for each study hospital in 1964 and 1974. By examining these indices, changes in community-to-hospital flow patterns over the ten year period provided meaningful data for sub-area and area-wide hospital planning.

Bay and Nestman (1980) expanded and modified Griffith's conceptual basis of relevance and commitment indices. Significant contributions of their research included: (1) "The service population of a hospital should and can be defined without direct association with a geographic area" (p. 680); (2) the methodology could be generalized to include other utilization measures (beyond the number of admissions) such as patient-days and separations (p. 680); (3) the service population model could be utilized not only for individual hospital planning but also for regional and province-wide planning efforts (p. 681); and (4) since this methodology was an estimation of hospital service populations, the importance of homogeneity assumptions with respect to physician practice patterns and hospital characteristics were emphasized. Bay and Nestman (1980) applied the service population model to 1971 Alberta utilization data, and found that resource consumption rates varied more among hospitals than districts. The authors clearly documented reservations and deficiencies of this approach which required further investigation (Bay & Nestman, 1980, p. 694).

2.4.3 Resource Utilization

A primary objective of health planners is to facilitate the equitable distribution of resources among health service areas and hospitals. Traditionally, utilization statistics such as occupancy rates have served as the accepted standards of comparison among areas and facilities. The inappropriateness and insensitivity of these measures, however, have prompted researchers to search for a more valid measure of distribution. To that end, the use of per capita utilization rates which account for patient movement across service area boundaries has been highly endorsed by researchers in recent years (Bay & Nestman, 1984; Shaughnessy, 1982; Struening, 1974).

Two methods for computing per capita measures, described by Shaughnessy (1982), are the community-based (CB) and the provider-based (PB) techniques. CB measures refer "... to the consumption of health care services for a specific population or population group" (Shaughnessy, 1982, p. 64). These measures are derived by delineating a specific geographic area, summing the service utilization of all residents in that area (regardless of where the utilization occurred), and then dividing the total utilization measure of all residents by the area's total population. The PB method, which pertains to resource consumption from the hospital's perspective, is initially determined "... by allocating (to the provider group) portions of the population from each community served" (Shaughnessy, 1982, p. 63). The size of this population yields the denominator for the per capita measures, while the numerator corresponds to total resources used by the provider. Given that CB measures refer to resource consumption by a specific population, these measures are considered "population-based" per capita indices. Conceptually, PB measures reflect per capita rates but are not considered population-based as they do not pertain to an area-specific population. Shaughnessy (1982) recommended that CB and PB methods be used conjointly since "PB measures assess provider performance in the same per capita units as those employed to reflect the consumption of health services by residents of a particular community" (p. 63). Meaningful PB and CB per capita utilization rate comparisons are predicated on the assumption of homogeneity with respect to service area, provider, and population variables.

Review of the literature which applied origin-destination data to derive per capita utilization measures indicated that the particular method used was contingent upon the purpose of the research. In the majority of these studies however, the CB method was most frequently used. Wennberg and Gittelsohn (1973) applied the CB methodology to examine the variability of resource input, service utilization, and costs among 13 hospital service areas in Vermont. The authors found wide variability among the service communities, indicating population-based differences in the use and delivery of health services which could not be attributed to varying illness patterns. In 1982, Wennberg and Gittelsohn used the same approach to investigate surgical rates among small service areas in six New England states. They observed large regional differences in surgical rates and hospital expenditures which, they suggested, were partially in response to physician and hospital bed supply but primarily related to "... differences among physicians in perceptions of illness and preferences for treatment..." (Wennberg & Gittelsohn, 1982, p. 126). In 1985, Griffith, Wilson, Wolfe, and Bischak developed utilization profiles for 60 Michigan hospital service communities to conduct a comparison of high and low hospital-use communities. Using a 1980 data base, population-based discharge rates and percentages of total discharges were assessed on a variety of clinical dimensions: diagnostic-specific categories, selected surgical procedures, frequency of diagnoses, and length of stay characteristics. Their findings indicated that "high-use communities have a 50 percent greater propensity to hospitalize overall, and this percentage recurs in many of the dimensions explored" (Griffith et al., 1985, p. 145).

The CB method has been used to examine hospital utilization patterns by Alberta residents. Raasok (1979) studied patient origin-destination flow patterns in an attempt to describe regional variations in population-based utilization rates with respect to the supply of Alberta nursing home beds. The Alberta Hospital Utilization Committee conducted a study in 1981 to compare regional surgical utilization rates of 20 operative procedures. The methodological limitations of that study prompted MacDonald (1983) to replicate and refine the research strategy in the calculation of per capita surgical utilization rates. She concluded that factors other than geographic variations, such as physician practice patterns and epidemiological variables, may explain the variability of surgical rates in Alberta (MacDonald, 1983, p. 201). Romeril (1984) and Szafran (1985) demonstrated the utility of the CB method for detecting regional variations in paediatric and geriatric utilization rates, respectively.

Studies which have incorporated the PB method for computing per capita utilization rates are sparse. In a monograph, Griffith (1978) defined 18 hospital performance indicators related to quantity, costs, and quality of services which would facilitate objective comparisons of hospital performance. These per capita measures of hospital use were applied to several Michigan hospital communities (Griffith, Restuccia, Tedeschi, Wilson, & Zuckerman, 1981). Although they acknowledged that the measures could not adequately account for case mix differences among hospitals nor be applied to individual hospitals, Griffith et al. (1981, p. 156) emphasized the importance of linking per capita utilization to hospital performance indicators in order to enhance health planning and decision-making.

Bay and Nestman (1984, p. 156) integrated the CB and PB methods to "... identify potentially over- or under-bedded districts and over- or under-loaded hospitals." Bed allocation within the province of Alberta was empirically determined by computing two indices. The bed distribution index (BDI) measured the distribution of beds over geographic districts, while the service population index (SPI) measured the number of persons served by each hospital bed. Bay and Nestman (1984) advocated two advantages of incorporating the SPI in conjunction with the BDI: (1) Even though the BDI alone could provide meaningful information regarding underbedded or overbedded districts, "... the BDI does not necessarily provide the actual means for reallocating hospital beds, because the beds are allocated to hospitals and not directly to hospital districts" (p. 153); and (2) the SPI is not highly correlated with occupancy rate, thus permitting a more accurate assessment of hospital bed requirements (p. 155). It is evident that research studies which employ population-based per capita measures from both a community and provider perspective produce valuable information for objectively assessing and comparing utilization rates.

2.4.4 Summary

From the previous review, it is evident that origin-destination methodologies are instrumental in analysing utilization behaviour.

Health care-seeking flow patterns may be quantified and correlated with numerous variables. Initial research suggested that distance and travel time were the major factors influencing utilization behaviour. More recent studies have identified a myriad of hospital selection factors such as diagnostic service categories, health system organizational and functional components, socioeconomic and demographic population characteristics, and physician practice patterns. It would appear that future studies of hospital utilization must incorporate a comprehensive data base to more accurately describe and explain patterns of utilization and patient flow.

Patient origin-destination methodologies have also been used to delineate service areas and service populations. Recognizing that patients move freely across traditional jurisdictional boundaries, researchers have formulated the Relevance Index (RI) and Commitment Index (CI) methods to estimate associations between hospitals and districts. A notable development in this regard includes the technique of estimating a hospital service population without direct reference to a geographic area.

Finally, patient origin-destination methodologies may be employed to derive community-based (CB) and provider-based (PB) measures of per capita resource consumption and allocation. Population-based per capita indicators have been shown to effect meaningful comparisons of utilization rates, substantially enhancing health care planning endeavours.

2.5 Chapter Summary

A review of the literature pertinent to the purpose and objectives of this study indicated that:

(1) There is an absence of a cohesive theory of health services utilization. Fragmented conceptual models have been developed, but there appears to be ambiguity and general misunderstanding surrounding the definitions and interrelationships of the concepts relevant to those models. In conjunction with the confusion regarding the concepts of need, demand, access, and utilization, the research revealed numerous societal, health delivery system, and individual determinants which influence utilization; however, the relative impact of these factors remains to be determined. Given that the determinants of utilization are closely interwoven with the concepts underlying utilization, this outcome is not unexpected.

(2) There is a paucity of diagnostic-specific research with respect to the concepts and determinants of utilization. This finding, coupled with the absence of a theory of health services utilization, prompted a review of selected aspects relevant to cardiovascular disease. It was revealed that cardiovascular disease is the major contributant to the volume of patient-days in acute care hospitals. Although the mortality rates of heart disease have been declining in recent years, the reasons for the trend are largely unknown. This phenomenon may be attributed to the fact that there is no recognized etiology of cardiovascular disease, and the research directed toward the identification and interrelationships of cardiovascular risk factors remains predominately speculative.

(3) There are three major applications of classification in the health care field: disease classification, patient classification, and hospital classification. Disease classification represents the most widely used system of classification, although the etiologic foundation of disease classification limits its capacity to differentiate the wide variability among diagnostic categories. Patient classification by types of care and by levels of care were designed to group categories of patients according to observed similarities of manifest needs and requirements for nursing care, respectively. Although these two patient classification methodologies attempted to effect the appropriate placement of patients and the rational allocation of staffing personnel, they were not intended to facilitate equitable resource comparison and allocation amongst health care facilities. To that end, hospital classification was developed which attempted to differentiate hospitals on a variety of dimensions. The inherent complexity and multidimensional nature of hospital output resulted in the creation of numerous indirect and direct measures for estimating a hospital's case mix. The DRG classification system was found to be the most widely applied, current technique for directly estimating the volume and type of cases treated by a hospital.

(4) Patient origin-destination methodologies are valuable techniques for quantifying patient care-seeking behaviours from a geographic (service area) and a demographic (service population) perspective. Notable progress was achieved in origin-destination research with the knowledge that a hospital service population could be algebraically determined without reference to a predefined geographic area. The

most current origin-destination studies have incorporated population-based per capita measures from both a community and a provider perspective to facilitate meaningful interpretations of utilization rates.

CHAPTER III

RESEARCH METHODOLOGY

The purpose of this study was to explore the utilization patterns of cardiovascular patients in Alberta acute care hospitals over a period of 13 years. The research process which was conducted to achieve that purpose and associated objectives encompassed three phases: (1) development of a research strategy; (2) formulation of relevant data files; and (3) implementation of appropriate data analysis strategies. These three phases are discussed in the following sections.

3.1 Research Strategy

The selected research strategy incorporated an exploratory, descriptive, retrospective, longitudinal approach for the following reasons: (1) The objectives of the study, which are directed to identifying trends and variations in geographic patterns of acute care hospital utilization by patients with cardiovascular disease, are primarily descriptive in nature; (2) the intent of the study was to examine all episodes of cardiovascular hospital admissions in Alberta over a 13-year period rather than a sample of admissions. This precluded the need to draw inferences regarding the population based on sample statistics; (3) the literature review revealed no theoretical foundation for the development of hypotheses required for a confirmatory approach; (4) since the identification of trends was a major objective of this study, a meaningful information base should encompass variation patterns over an extended period of time. A longitudinal, retrospective design, involving the collection of data from 1971 to 1983/84, facilitated the achievement of that objective; and (5) in contrast to a prospective approach which would have mandated substantial time and funds, the availability of past utilization data rendered the retrospective approach more feasible with respect to cost-effectiveness and logistic implications.

The research methodology also incorporated population-based per capita measures of resource provision and consumption. A community-based (CB) method, based on the population of defined geographic areas, was used to compute the per capita utilization measures. This population-based research approach permitted analysis and comparability of hospital utilization variations among geographic districts and regions in Alberta. In view of patient movement across "hospital boundaries," the population-based approach more accurately described the population of a particular district, enhancing comparability of utilization rates (Bay & Nestman, 1984).

Resource consumption and allocation were analysed from community-based and provider-based perspectives. The community-based approach elucidated district and regional utilization rate variations, and the provider-based methodology enhanced examination of utilization patterns with respect to specific hospitals. A combined application of these two approaches produced patient origin-destination matrices to assess patient flow patterns.

In summary, the overall research strategy for this study incorporated a longitudinal, retrospective, exploratory design. Diagnostic-specific utilization rates, based on population-based per capita measures, identified historical trends and facilitated comparability of geographic variations in cardiovascular service utilization. Patient origin-destination analysis was employed to examine the patient care-seeking behaviours throughout the province. The analytic sequence which was followed in this study is delineated in Figure 1.

3.2 Data Sources

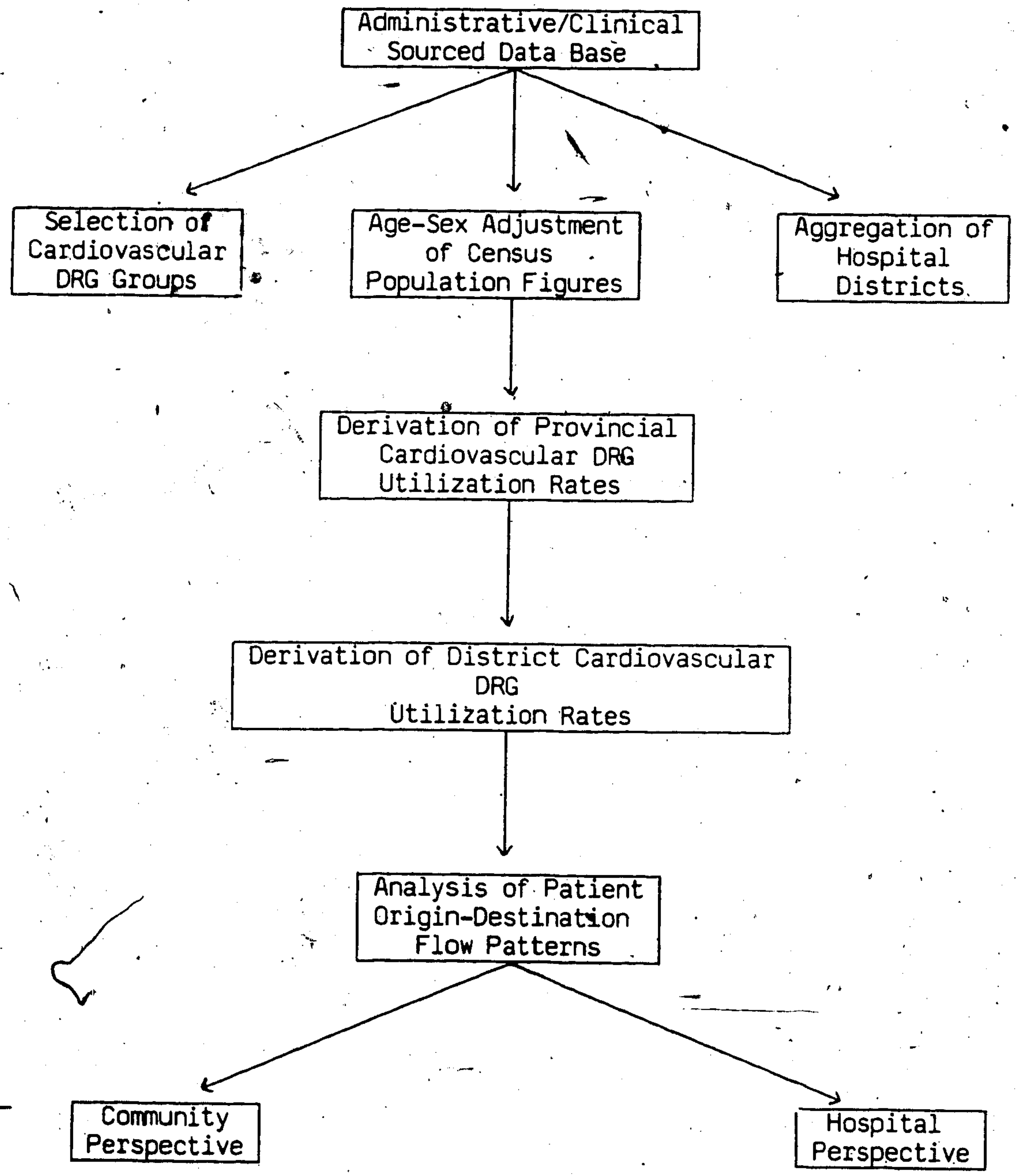
The data required to operationalize the research strategy emanated primarily from three administrative/clinical sources: (1) Professional Activity Study (PAS) separation abstracts; (2) Statistics Canada census figures; and (3) Provincial Government annual reports. These data sources are reviewed in the following sections.

3.2.1 PAS Abstracts

The derivation of utilization rates requires accurate utilization measures for the numerator. For this study, PAS files for Alberta residents discharged from acute care hospitals with selected cardiovascular diagnoses between January 1971 and March 1984 were examined. Computation of per capita measures were restricted to the census years of 1971, 1976, and 1981, in view of the inherent inaccuracies attributable to population figure extrapolation. PAS

FIGURE 1

Analytic Sequence of Research Methodology



abstracts were available from provincial government computer tapes, representing the most comprehensive hospital utilization data available on a provincial-wide basis. Variables from the abstracts relevant to this study included: (1) age of patient on admission; (2) gender of patient; (3) year of separation from the hospital; (4) discharge medical diagnoses; (5) operative procedures; (6) duration of hospital stay; (7) discharge status (alive or dead); (8) code of the admitting hospital; and (9) hospital district corresponding to the patient's residence.

The data for PAS separation abstracts are collected routinely by all acute care hospitals in Alberta. Reliability and validity of the data are maintained through the criteria established by, and quality control checks of, the Commission on Professional and Hospital Activities (CPHA).

Use of the hospital separation episode as a unit of analysis has some inherent disadvantages. Hospital utilization rates tend to be higher than individual patient hospitalization episodes since a discharge abstract is required for **each** hospital admission and transfer. Thus, the utilization rates are sensitive to patients who are frequently admitted with the same diagnosis, and/or transferred from one hospital to another during the same illness episode. To partially alleviate this problem, the analyses also incorporated patient-days (PDAYS) and weighted separations. Although the PDAY is considered more accurate in terms of resources used, potential bias may occur since the separation of a patient is coded in the year in which the separation occurred, regardless of the year of admission. It is assumed however, that this limitation is minimal since potential distortions occur at both the beginning and the end of each year, resulting in a cancelling-out effect in the data recording.

The PAS data were lacking three months of data during 1979. To compensate for this constraint, the calendar year was adjusted, commencing in April 1972, to extend from April to March of the following year.

3.2.1.1 Diagnostic Classification Unit

Diagnostic selection was based on the DRG classification system. Since this study is directed toward planning and policy formulation in the area of resource allocation, it seemed appropriate to select a case mix methodology which encompassed both clinical and resource consumption criteria. Furthermore, the DRG system has been relatively well tested in the United States, and the DRGs are defined with variables which can be readily extracted from the PAS separation abstracts.

Within the major diagnostic category (MDC) of relevance to this study ("Diseases and Disorders of the Circulatory System") are 18 surgical DRGs and 25 medical DRGs. Appendix A.1 contains the tree diagram describing the DRG structure for the circulatory system MDC (MDC 05) with respect to the different types of decisions made when DRG assignment was determined.

This study was designed to reflect **general** patterns and trends of cardiovascular utilization behaviour. Some DRGs, as they are currently defined, contain diseases and procedures which lay outside the major range of circulatory system disorders. For example, DRG

126 lists the rare condition of candidal endocarditis with the ICD-9-CM coding rubric 112.81 as one of its medical diagnoses. Consequently, it was decided that the selection of medical diagnoses and operations within the DRGs would be primarily restricted to the major ranges of circulatory system diseases and operations on the cardiovascular system as classified by the ICD nosology.

Since this study spanned a 13-year period, it was necessary to construct similar DRG groups for the years of 1971 to 1983/84. From 1971 to 1973, the first edition of H-ICDA coding was used for all hospital discharge abstracts in Alberta; from 1974 to 1978, the second edition of H-ICDA coding (H-ICDA-2) was in effect; and from 1979 to the present, the revised ICD-9-CM coding methodology is used. Consequently, there were inherent coding difficulties in matching each cardiovascular disease and procedure over the 13 years to derive perfectly comparable DRGs. Using the revised ICD-9-CM DRGs as the basic reference (and incorporating the aforementioned restriction of diagnoses to the major ICD ranges of circulatory system disorders), DRG definitions were approximated for the time periods of 1971 to 1973 and from 1974 to 1978. Appendix A.2 contains definitions of the DRGs for: (1) 1971 to 1973, predicated on the H-ICDA coding rubrics; (2) 1974 to 1978, based on the H-ICDA-2 coding scheme; and (3) 1979 to 1983/84, based on the revised ICD-9-CM coding structure.

During the course of estimating these three sets of DRG definitions, it became apparent that coding changes precluded the achievement of reasonable comparability for all DRGs over the 13 years, in particular for some of the surgical DRGs. Consequently, it was necessary to aggregate those DRG groups which could not be reasonably compared on an individual DRG basis. The process of DRG aggregation resulted in the following combined DRG groups, each of which is similar from a clinical and resource use perspective: (1) DRGs 104-5 (cardiac valve procedures), (2) DRGs 106-7 (coronary bypass procedures), and (3) DRGs 108-12 (cardiothoracic and vascular procedures). Appendix A.2 outlines the sequential process used and the problems encountered in approximating the three sets of cardiovascular DRG definitions.

3.2.1.2 Geographic Classification Unit

To compare utilization rates and assess patient flow patterns, the province must be divided into mutually exclusive and exhaustive geographic units. Prior utilization studies in Alberta have considered the "hospital district" to be the most appropriate geographic unit of analysis. The primary reasons for selection of this unit included: (1) PAS separation abstracts record the hospital district as the patient's origin; (2) of the 101 hospital districts, 95 include only one hospital; (3) Canadian census enumeration areas (EAs) can be grouped to approximate hospital district boundaries; and (4) hospital districts are of sufficient size to achieve data reduction and yet not obscure significant differences in utilization patterns.

3.2.2 Census Data

The denominator for the computation of per capita measures requires an accurate record of the number of persons in each geographic unit. Census data were available for the years 1971, 1976, and 1981, released by Statistics Canada according to enumeration areas (EAs). The Department of Hospitals and Medical Care (DHMC) had tabulated these data by five-year age categories, sex, and general hospital district. In order to achieve unbiased comparisons of utilization rates, it was necessary to delete the confounding factor related to the age-sex composition of the population. The indirect method was selected to achieve population age-sex adjustment, since this method obviated the complex data manipulation required by the direct method of population age-sex adjustment. Further, the indirect method employed the more stable rates of the larger provincial population as the standard of comparison for the smaller, district populations. The weighted-sum approach of Bay and Nestman (1980), in conjunction with the cardiovascular DRG weighted values (USWE), were used to adjust the crude district population figures for 1971, 1976, and 1981. Thus, the service population of a particular area was equivalent to the age-sex adjusted census population of that defined geographic area with respect to the quantity and nature of cardiovascular resources consumed by residents.

3.2.3 Provincial Government Reports

Annual Reports and associated supplements of the DHMC provided data concerning the number of acute care hospitals, and the associated bed complement of each acute care hospital. From 1971 to 1977, the Alberta Hospital Services Commission was the governing body for provincial hospitals. Annual Reports issued by the Commission ranged from 1971 to 1976. The Commission was replaced by the DHMC in 1977, and during this transition period, the 1977-78 Annual Report encompassed 15 months (January 1, 1977 to March 21, 1978) in order to implement a fiscal year rather than the prior calendar year reporting system.

3.3 Data Analysis Strategies

The analyses of cardiovascular services utilization in Alberta were conducted in three steps: (1) provincial analysis; (2) district analysis; and (3) patient origin-destination analysis. These data analysis strategies are outlined in the following sections.

3.3.1 Provincial Analysis

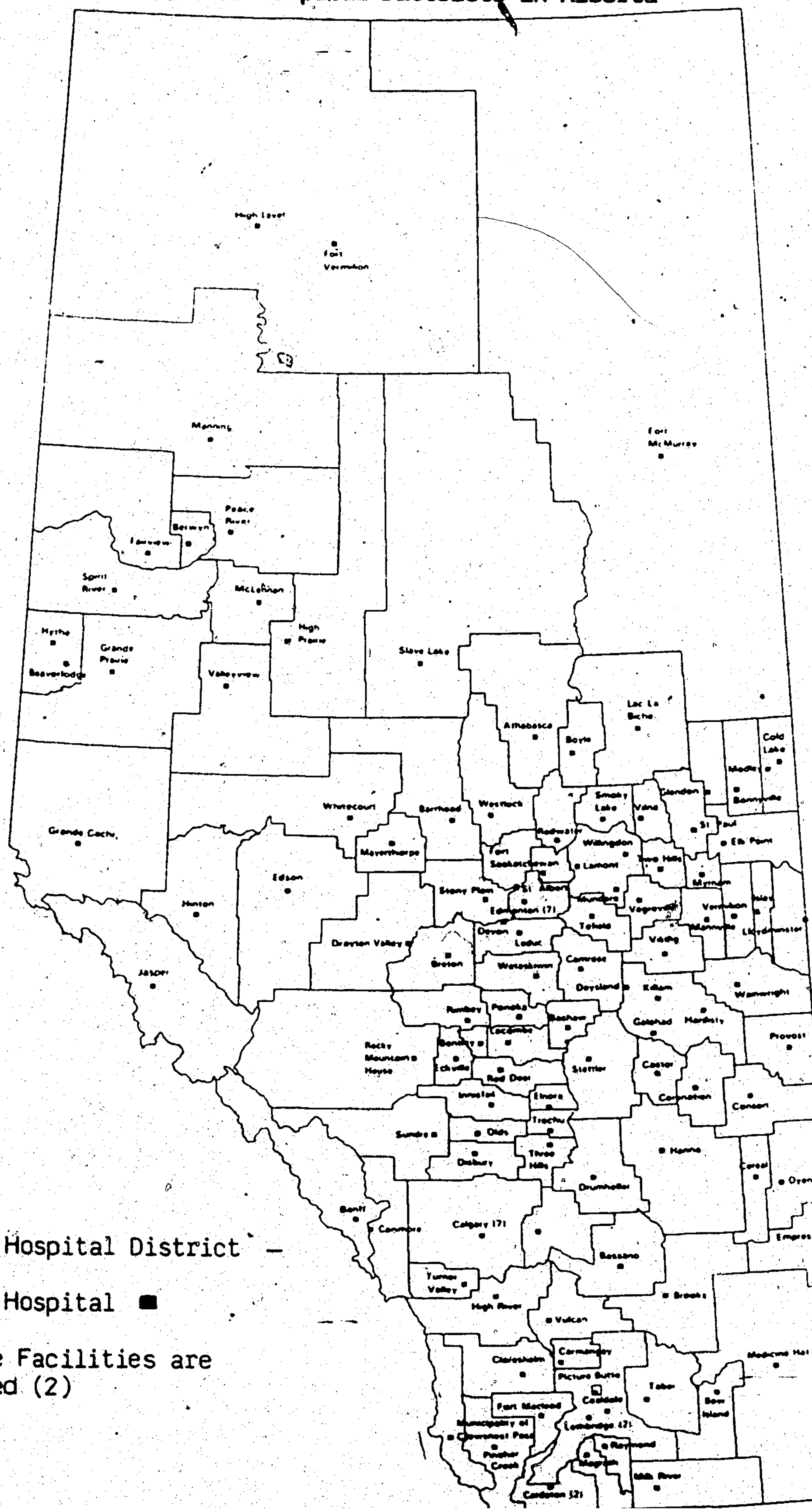
To provide a broad perspective of cardiovascular services utilization in Alberta, provincial analysis initially involved the aggregation of utilization data (total SEPS, total PDAYS, and ALOS) over all hospitals and hospital districts in the province for the years 1971 to 1983/84 inclusive. Utilization measures were provided for the major cardiovascular surgical DRGs, all cardiovascular surgical DRGs combined, the major cardiovascular medical DRGs, all cardiovascular medical DRGs combined, and all cardiovascular surgical and medical DRGs combined. The second phase of provincial analysis examined the USRE and USWE values for the previously identified cardiovascular DRG categories for each of the study years and for all the study years combined. Finally, cardiovascular DRG specific population-based utilization rates were computed for the census years of 1971, 1976, and 1981 to achieve more meaningful comparisons of resource consumption. The denominator of these utilization rates were annual service population figures, and the numerator included SEPS, weighted SEPS (USWE), and charges (USRE).

3.3.2 District Analysis

To achieve interdistrict comparisons, data analyses involved the calculation of utilization rates for all cardiovascular DRGs combined for each general hospital district for the census years of 1971, 1976, and 1981 combined. Figure 2 illustrates the GHD boundaries for the province of Alberta. (See Appendix B.1 and B.3 for a list of hospital and district names and codes.) The utilization indicators of SEPS, PDAYS, USRE, and USWE for each hospital district were used in the utilization rate numerator; district service population figures were included in the rate denominator. Geographic variation was explored by means of a relative scale which divided the per capita utilization rate distributions into mutually exclusive categories, each based on a percentage variation from the provincial rate.

Figure 2

General Hospital Districts in Alberta



General Hospital District —

General Hospital ■

Multiple Facilities are indicated (2)

District variability was also examined according to the nature of cardiovascular separations generated in Alberta GHDs by incorporating three per case utilization indicators (ALOS, AUSRE, and AUSWE) for 1971, 1976, and 1981 combined.

3.3.3 Patient Origin-Destination Analysis

Origin-destination studies provided information concerning patient flow patterns from both a community perspective and a hospital (or provider) perspective. While information from the community perspective was primarily directed toward province-wide planning, information gained from the provider perspective was intended to enhance resource allocation and planning endeavours within a particular district or region.

To construct the cross-tabulated matrices, a computer program based on the Statistical Package for the Social Sciences (SPSSX) was used, whereby the patient's residence and the hospital of service delivery served as the patient origin variable and the patient destination variable, respectively. Patient origin-destination matrices were based on USRE values as the measure of resource utilization for all cardiovascular DRGs combined over the 13-year study period. The patient flow measures determined from the matrices included relevance indices (which measured the likelihood of patients to use a particular hospital or group of hospitals), and commitment indices (which measured the likelihood of a specific hospital to serve patients from specific geographic areas).

From the community perspective, relevance indices were presented according to the level of hospital care available and the influence of geographic region on patient flow patterns. From the provider perspective, commitment indices of resource allocation were given within the context of levels of hospital care, regional hospital aggregates, and major urban Metro-Calgary and Metro-Edmonton hospitals.

The levels of hospital care were established by aggregating all districts into metropolitan, regional or rural clusters. Although not mutually exclusive with respect to the levels of care provided, tertiary, secondary, and primary care are available in the metropolitan areas, primary and secondary care are provided in the regional areas, and primary care is available in the rural areas. In conjunction with varying levels of care, other dissimilar characteristics were noted among these three geographic divisions including: (1) differences in socioeconomic and demographic factors; (2) levels of urbanization; (3) physician specialty and supply; (4) accessibility to, and availability of, health delivery facilities; and (5) hospital size and case mix. For this study, the metropolitan cluster included the Metro-Calgary and Metro-Edmonton hospital districts, the regional aggregation was composed of Grande Prairie, Lethbridge, Medicine Hat, and Red Deer hospital districts, while all remaining hospital districts in Alberta formed the rural cluster.

The impact of geographic region on patient flow patterns was facilitated by dividing the province into six areas, including Edmonton, Grande Prairie, and Red Deer hospital districts in the northern part of the province, and Calgary, Lethbridge, and Medicine

Hat districts in the southern part of the province. Each area contains a regional referral centre, although the areas vary regarding time and distance to these centres. Appendix B.2 and B.4 present the districts and hospitals, respectively, which were included in the metropolitan/regional/rural cluster and the six region aggregate.

3.4 Chapter Summary

The overall research strategy for this investigation adopted an exploratory and descriptive approach in conjunction with retrospective, longitudinal hospital utilization data. The diagnostic classification unit included the MDC of the DRG system entitled "Diseases and Disorders of the Circulatory System"; three sets of DRG definitions were approximated for the coding time periods of 1971 to 1973, 1974 to 1978, and 1979 to 1983/84. The data analyses were conducted in three major stages to correspond with the study objectives: (1) provincial utilization patterns and trends in relation to DRG specific length of stay, DRG specific USRE and USWE, and DRG specific population-based utilization rates; (2) district variation in terms of overall cardiovascular utilization rates; and (3) the care-seeking patterns of patients with cardiovascular disease through origin-destination analyses.

CHAPTER IV

RESULTS

The research findings of this investigation are presented in terms of three analytic strategies: (1) provincial cardiovascular utilization trends; (2) interdistrict comparisons of cardiovascular utilization rates; and (3) patient origin-destination analyses of the care-seeking behaviours of cardiovascular patients. In keeping with the purpose, objectives, and research strategies of this study, the results are primarily descriptive. Furthermore, the findings are discussed within the context of selected aspects of the Alberta hospital system to enhance a more meaningful presentation of results.

4.1 Alberta Profile

This section is designed to provide relevant information regarding overall Alberta demographic and health care system characteristics which could influence utilization of acute care hospital services by cardiovascular patients. Aspects of the Alberta system which are reviewed include both structural and dynamic factors such as census data, hospitals, hospital districts, service populations, and relevant utilization statistics.

4.1.1 Alberta Hospital System

Prior to 1978, the Alberta Hospital Services Commission had the responsibility for the administration of Alberta's hospital system. This administrative responsibility was transferred to the Department of Hospitals and Medical Care in January, 1978; however, the impact of that change was considered neglible on the findings of this study. The Department of Hospitals and Medical Care is responsible for the planning, construction, and operation of all active treatment and auxiliary hospitals in Alberta. The planning, building, and operation of these institutions are monitored by the Department to determine compliance with legislation and to ensure the effective expenditure of funds.

The Alberta hospital system is divided into 101 mutually exclusive and exhaustive administrative districts. These general hospital districts (GHDs) vary significantly with respect to geographic size, population attributes and size, climactic conditions, and type, size, and location of acute care hospitals. Hospital districts in the northern area of the province typically have large land areas with sparse populations, while those hospital districts in the southern part of the province have relatively small surface areas with higher population densities. The uneven distribution of population and geographic size among hospital districts could impact the utilization of acute care hospitals in two major ways: (1) Since distance and time factors are recognized as important determinants of utilization, variability in utilization rates may be partially attributed to dissimilar travel and time factors among hospital districts; and (2) differences in population densities may impact the type, number, and location of available health care resources, potentially leading to disparate utilization patterns. Consequently, direct comparisons of utilization rates among hospital districts should be made in recognition of these dissimilarities.

A hospital (or small group of hospitals) is governed by a board of trustees which is responsible for the enactment of general bylaws governing the organization, management, and operation of the hospital, and is accountable for the use of public funds and the financial viability of the hospital. Hospitals may be owned by the government, district boards (majority), municipalities or religious orders; there are no privately owned, for-profit hospitals in Alberta (although one rural hospital is managed by a private firm as of April 1, 1986). Active treatment hospitals include: (a) "general" hospitals which provide for the diagnosis, treatment, and care of a wide range of conditions to people of all age and sex groups; and (b) "allied special" hospitals which provide for the treatment of a limited range of conditions and/or restrict admissions to a particular age group (for example, Cross Cancer Institute; Alberta Children's Hospital). Hospitals have a relatively even distribution among hospital districts, usually with one hospital per district. Nine districts (two metropolitan, one regional, and six rural) contain more than one hospital, while two rural districts have no hospital.

The total number of active treatment hospitals in Alberta remained relatively constant between 1971 and 1983/84 at 125. In 1971, active treatment hospitals accounted for a total rated bed capacity of 11,976 adult and paediatric beds; in 1984, there were 125 acute care hospitals with an approved bed complement of 12,700 adult and paediatric beds. While the total rated bed capacity increased by 723 (6.0 percent) between 1971 and 1983/84, the per capita supply of acute care beds declined from 7.37 beds per 1,000 persons in 1971 to 5.4 beds per 1,000 persons in 1984. Furthermore, as expected from dissimilar population densities, the number of hospital beds has not been evenly distributed throughout the province. In 1971, 17.0 percent of acute care hospital beds were distributed among 76 hospitals, each of which had fewer than 50 beds. Nine metropolitan hospitals accounted for 53.0 percent of all active treatment beds in Alberta. This distribution of hospital beds remained relatively similar over the 13-year study period. For the year ended March 31, 1984, 75 small hospitals contained 17.0 percent of acute care hospital beds, while 11 major hospitals accounted for 55.0 percent of all active treatment beds.

4.1.2 Population Trends

The population of Alberta grew from 1.63 million in 1971 to 2.24 million in 1981, an increase of 37.5 percent. The rate of population growth was higher for the intercensal years of 1976 to 1981 (21.7 percent) than for the period of 1971 to 1976 (12.9 percent). The population of Canada rose from 21.57 million in 1971 to 22.99 million in 1976 (6.6 percent increase) and to 24.34 million in 1981 (5.9 percent increase). The overall increase in the Canadian population between 1971 and 1981 was 12.9 percent. Thus, it is evident that Alberta experienced a significantly higher rate of growth between 1971 and 1981 than the corresponding growth rate of the Canadian population (Statistics Canada, 1971; 1976; 1981). With respect to the sex ratio, there was a slightly higher proportion of males than females in the Alberta population, in contrast to the distribution of males and females for the population of Canada.

Table 1 indicates population trends for Alberta and Canada between 1971 and 1976, and between 1976 and 1981, by six age groups. The 25-44 year age category represented the greatest change in the Alberta population (68.7 percent increase), whereas the 65-74 year age group demonstrated the highest rate of growth (37.2 percent) for the population of Canada. Between 1971 and 1981, the Alberta 0-14 and 15-24 populations increased by 5.3 percent and 57.9 percent, respectively; these two age categories demonstrated a decrease of 14.1 percent and an increase of 16.4 percent, respectively, for the population of Canada. The 45-64 age category rose by 28.4 percent and 15.8 percent in Alberta and Canada, respectively. With respect to the two eldest age groups, the rates of growth between 1971 and 1981 were similar for both Alberta and Canada, although the relative proportion of persons over 65 years was greater for the population of Canada as a whole. In summary, Alberta could be considered a relatively young province between 1971 and 1981, during which time the 15-24 and 25-44 year age groups experienced the most dramatic rates of growth.

In view of the large variation among age-sex categories with respect to the utilization of health care resources and the changes in population over time, it was necessary to adjust the crude population figures for each hospital district. Such adjustment yielded service populations (age-sex adjusted number of residents within each

Table 1

Population Trends for Census Years 1971, 1976, and 1981

Age Group (Years)	Alberta Population by Census Year 1971 (%)	1976 (%)	1981 (%)	Percentage Change 1971–1976	1976–1981	1971–1981
0–14	514,510 (31.6)	503,130 (27.4)	541,670 (24.2)	- 2.2	7.7	5.3
15–24	303,150 (18.6)	379,220 (20.6)	478,760 (21.4)	25.1	26.2	57.9
25–44	411,825 (25.3)	499,820 (27.2)	694,880 (31.1)	21.4	39.0	68.7
45–64	279,645 (17.2)	317,945 (17.3)	359,035 (16.0)	13.7	12.9	28.4
65–74	72,110 (4.4)	85,525 (4.7)	100,550 (4.5)	18.6	17.6	39.4
75+	46,635 (2.9)	52,400 (2.9)	62,845 (2.8)	12.4	19.9	34.8
Total Population	**1,627,875 (100)**	**1,838,035 (100)**	**2,237,725 (100)**	**12.9**	**21.7**	**37.5**

Age Group (Years)	Canadian Population by Census Year 1971 (%)	1976 (%)	1981 (%)	Percentage Change 1971–1976	1976–1981	1971–1981
0–14	6,380,895 (29.6)	5,896,180 (25.6)	5,481,110 (22.5)	- 7.6	- 7.0	-14.1
15–24	4,003,750 (18.6)	4,479,060 (19.5)	4,658,695 (19.1)	11.9	4.0	16.4
25–44	5,415,940 (25.1)	6,217,555 (27.0)	7,184,340 (29.5)	14.8	15.5	32.7
45–64	4,023,315 (18.7)	4,397,460 (19.1)	4,658,065 (19.1)	9.3	5.9	15.8
65–74	1,077,340 (5.0)	1,254,540 (5.5)	1,477,745 (6.1)	16.4	17.8	37.2
75+	667,070 (3.1)	747,805 (3.3)	883,230 (3.6)	12.1	18.1	32.4
Total Population	**21,568,310 (100)**	**22,992,605 (100)**	**24,343,180 (100)**	**6.6**	**5.9**	**12.9**

district) which would achieve unbiased comparisons of utilization rates. Although various health utilization indicators could have been used to describe the utilization behaviours of each age-sex category (for example, number of patient-days or separations), the weighting factors applied to the crude population figures of each age-sex group for this study were the DRG USWE values which estimate relative resource requirements for each DRG. Assuming that the quantity and nature of the resources consumed by patients within a DRG are similar, yet different across DRGs, the application of DRG separation weights (rather than unweighted SEP or PDAY measures) more accurately related the various age-sex categories to the type and amount of cardiovascular acute care resources used. Furthermore, application of the DRG USWE values avoided the problem of deviant lengths of stay since the DRG system assumes that all cases within a particular DRG group are treated similarly. By incorporating the weighted-sum approach as described by Bay and Nestman (1980), the DRG based age-sex adjusting weights were applied to the crude population figures for 1971, 1976, and 1981, thereby rendering the district service populations longitudinally comparable.

Examination of census to service population ratios (Table 2) indicated the substantial age-sex differences which existed among district populations between 1971 and 1981. If the service population were larger than the census population (a ratio of more than 1.0), a relatively "older" population was suggested, and conversely, if the service population were smaller than the census population (a ratio of less than 1.0), a relatively "younger" population was assumed to exist. Over the ten-year period, the distribution of the number of

Table 2

Ratios of District Service Populations to District Census Populations: 1971, 1976, 1981

Ratio Range	1971		1976		1981	
	# Dist.[1]	**SP**[2] **(%)**[3]	**# Dist.**	**SP (%)**	**# Dist.**	**SP (%)**
Under 0.85	14	114 (7.0)	13	157 (8.6)	14	257 (11.5)
0.85 - 0.95	6	914 (56.1)	6	570 (31.0)	11	802 (35.9)
0.95 - 1.05	13	139 (8.5)	13	624 (34.0)	5	615 (27.5)
1.05 - 1.15	11	58 (3.6)	10	61 (3.3)	15	130 (5.8)
1.15 or More	57	404 (24.8)	59	425 (23.1)	56	433 (19.4)
Total	**101**	**1,629 (100)**	**101**	**1,837 (100)**	**101**	**2,237 (100)**

1 Number of hospital districts.

2 Age-sex adjusted service population, expressed in thousands.

3 Percentage of the total provincial service population.

hospital districts within each ratio category, varied, and the proportion of the service population attributed to these districts changed significantly, reinforcing the importance of applying age-sex adjustments to crude population figures for the purpose of utilization rate comparisons.

4.1.3 Relevant Utilization Statistics

To provide background information with respect to hospital utilization trends in Alberta and Canadian hospitals, broad comparative analyses were performed. Table 3 presents Alberta's status, relative to the other provinces, according to the number of separations per 1,000 person-years (SEPRATE), the number of patient-days per 1,000 person-years (PDAYRATE), and the number of patient-days per separation (ALOS) for the three census years. It should be noted that the utilization trends in Table 3 are based on data from acute care and extended care hospitals. From 1971 to 1981, most provinces experienced a decline in the SEPRATE. Between 1971 and 1976, a decrease of the PDAYRATE was noted in all provinces except British Columbia and Prince Edward Island; conversely, six out of ten provinces indicated a higher PDAYRATE between 1976 and 1981, increasing the national PDAYRATE over this five-year period. Alberta had the second highest number of separations per 1,000 person-years in 1971, and the third highest SEPRATE in 1976 and 1981; the province's PDAYRATE was ranked second highest, highest, and third highest in 1971, 1976, and 1981, respectively. The ALOS indicated a pattern similar to that of the PDAYRATE. The ALOS decreased in the majority

Table 3

Utilization Trends[1] for Canada and the Provinces: 1971, 1976, 1981

Utilization Measure	Canada	B.C.	Alta.	Sask.	Man.	Ont.	Que.	N.B.	N.S.	P.E.I.	Nfld.
SEPRATE[2]											
1971	166	175	222	235	186	164	134	177	170	175	159
1976	158	160	202	214	165	166	119	177	162	235	164
1981	148	156	171	207	154	151	116	166	171	209	163
PDAYRATE[3]											
1971	1,916	1,792	2,225	2,275	1,945	1,956	1,802	2,001	1,794	1,627	1,556
1976	1,726	1,827	2,141	2,005	1,762	1,726	1,550	1,764	1,604	1,771	1,453
1981	1,771	1,946	1,867	2,090	1,813	1,723	1,722	1,790	1,658	1,508	1,413
ALOS[4]											
1971	11.6	10.3	10.2	9.7	10.4	11.9	13.4	11.3	10.6	9.3	9.8
1976	10.9	11.4	10.6	9.4	10.8	10.4	13.1	10.0	9.9	7.6	8.9
1981	12.0	12.5	10.9	10.1	11.8	11.4	14.9	10.8	9.7	7.2	8.7

DATA SOURCE: Statistics Canada, Catalogue #82-206, 1971, 1976, 1980/81.

1 Utilization data were extracted from acute care and extended care hospitals combined.

2 Number of separations per 1,000 person-years.

3 Number of patient-days per 1,000 person-years.

4 Number of patient-days per separation.

of provinces between 1971 and 1976, including the highest populated provinces of Ontario and Quebec; however, an opposite trend emerged over the next five years, resulting in a Canadian ALOS increase of 10.1 percent. The ALOS in Alberta hospitals gradually increased from 10.2 days in 1971 to 10.9 days in 1981. In summary, for each of the three census years, the Alberta SEPRATEs and PDAYRATEs were higher than the corresponding national indices while the ALOS was below the overall Canadian ALOS value.

The data in Table 4 illustrate comparative utilization trends associated with selected cardiovascular separations for Alberta and Canadian hospitals in 1971 and 1980/81. The comparisons were limited in view of the fact that statistics were extracted from all types of hospitals including extended care facilities such as auxiliary hospitals, potentially inflating PDAYRATEs and ALOS values for those cases which were managed in long-term care facilities. The SEPRATEs for all four cardiovascular diagnoses decreased between 1971 and 1981 in Alberta and Canada. Similarly, the PDAYRATEs declined for three of the diagnostic categories; however, the PDAYRATEs for arteriosclerosis in both Alberta and Canadian hospitals increased substantially. With respect to Alberta and Canadian ALOS values, decreases were noted for acute myocardial infarction and all other ischaemic heart diseases. The Canadian ALOS declined for hypertension but increased for Alberta patients, while the ALOS for arteriosclerosis increased significantly between 1971 and 1981 in Alberta and Canada. In summary, comparisons of Alberta and Canadian utilization rates revealed overall similarities among the SEPRATEs for the four cardiovascular diagnostic categories. The most pronounced differences were attributed to the

Table 4

Comparison of Alberta and Canadian Hospital Utilization[1] for Selected Cardiovascular Diseases: 1971, 1980/81

Utilization Measure	Acute Myocardial Infarction Alberta	Acute Myocardial Infarction Canada	All Other Ischaemic Alberta	All Other Ischaemic Canada	Hypertension Alberta	Hypertension Canada	Arteriosclerosis Alberta	Arteriosclerosis Canada	Total[5] Alberta	Total[5] Canada
SEPRATE[2]										
1971	1.77	2.09	3.79	3.84	1.63	1.08	.51	.36	7.70	7.37
1980/81	1.56	2.02	2.52	3.81	.88	.81	.31	.36	5.27	7.00
PDAYRATE[3]										
1971	36.87	45.93	65.45	89.23	19.7[illegible]	[illegible]7.69	22.11	22.57	144.18	175.42
1980/81	28.84	33.93	42.19	63.14	17.68	[illegible]2.08	42.84	32.69	131.55	141.84
ALOS[4]										
1971	20.8	22.0	17.3	23.2	12.1	16.4	43.4	62.7	18.7	23.8
1980/81	18.5	16.8	16.7	16.6	20.1	14.9	138.2	90.8	25.0	20.3

DATA SOURCE: Statistics Canada, Catalogue #82-206, 1971, 1980/81.

1 Utilization data were extracted from acute care and extended care hospitals combined.

2 Number of separations per 1,000 person-years.

3 Number of patient-days per 1,000 person-years.

4 Number of patient-days per separation.

5 Includes acute myocardial infarction, all other ischaemic heart diseases, hypetension, and arteriosclerosis, combined.

higher Alberta PDAYRATEs for hypertension and arteriosclerosis, resulting in notably longer Alberta ALOS values for these two diagnoses as compared to the corresponding Canadian indices.

4.1.4 Summary

The foregoing discussion of selected aspects of the Alberta health care system revealed that:

(1) Alberta contains 101 mutually exclusive and exhaustive general hospital districts which differ with respect to geographic size, population characteristics and size, climactic conditions, and type, size, and location of acute care hospitals. Thus, direct comparisons of utilization rates must be made in recognition of these dissimilarities, particularly with regard to time and distance disparities, and population density variances.

(2) The total number of active treatment hospitals in Alberta remained relatively constant between 1971 and 1983/84; however, the per capita supply of acute care beds declined by 1.97 beds per 1,000 persons over this 13-year period.

(3) The Alberta population experienced a substantially higher rate of growth (37.5 percent) between 1971 and 1981 than the growth rate of the Canadian population (12.9 percent). During that time period, Alberta was a relatively young province; those age groups between 15 and 45 years indicated the most dramatic rates of growth.

(4) The crude population figures for each hospital district were adjusted by applying the DRG USWE values for cardiovascular separations. Such adjustment yielded service populations which were

age-sex adjusted with respect to the quantity and nature of cardiovascular resources consumed by residents of Alberta.

(5) Between 1971 and 1981, most Canadian provinces experienced a decline in the SEPRATE. A similar decline was noted between 1971 and 1976 regarding the PDAYRATE; however, substantial increases in the PDAYRATEs were noted for the majority of provinces between 1976 and 1981. The Alberta SEPRATEs and PDAYRATEs ranked higher than the corresponding national indices in 1971, 1976, and 1981, while the Alberta ALOS for each census year was shorter than the Canadian ALOS figures.

(6) The SEPRATEs for four major cardiovascular diagnostic categories declined between 1971 and 1981 in Alberta and Canada. The PDAYRATEs also declined for acute myocardial infarction, all other ischaemic heart diseases, and hypertension, but increased significantly for arteriosclerosis in both Alberta and Canada. Alberta displayed much higher PDAYRATEs for hypertension and arteriosclerosis, resulting in substantially longer ALOSs for these two diagnostic categories relative to the corresponding national figures.

4.2 Provincial Cardiovascular Utilization Trends

The utilization of acute care hospital resources by patients with cardiovascular disease was examined from three perspectives: (1) DRG specific length of stay; (2) DRG specific charges and relative resource requirements; and (3) DRG specific population-based utilization rates. The cardiovascular DRG specific length of stay was measured in terms of the traditional indicators of resource consumption by hospital patients including separations (SEPS), patient-days (PDAYS), and average length of stay (ALOS).

Recognizing that the number of SEPS and PDAYS yields only the volume of cases treated and time spent in the hospital (with no regard for disparate resource consumption among various disease categories), the DRG classification system afforded two additional measures of resource consumption: charges and weighted SEPS. For the purpose of this study, charges rendered for cardiovascular services are referred to as the USRE (United States Reimbursement Equivalent), and DRG specific relative resource requirements are indicated as the USWE (United States Weight Equivalent). The presumption is made that the quantity and nature of the resources consumed by patients within a DRG are similar, yet different across DRGs. It is further assumed for this study that the Canadian and United States hospital systems have similar resource requirements for similar cases.

With respect to the USRE, a standardized cost per DRG was calculated by adjusting each cost per case (based on a large volume of U.S. data) according to the number of days spent in a regular hospital room, the number of days spent in a special care unit, and the ancillary charges for services to patients. As a result, the DRG system assumes that it should cost the same amount, on average, to care for all patients assigned to the same DRG group regardless of the hospital setting. Application of the appropriate U.S. standardized DRG costs to cardiovascular separations generated in Alberta during the study period estimates the amount (in constant 1986 U.S. dollars) that would have been incurred for cardiovascular services if the

Alberta hospital system had adopted the DRG classification and reimbursement system over this time period.

The USWE is an index which represents the average resource requirements for cases in a particular DRG group relative to the national average resources consumed by the average U.S. separation (the average of all separations including cardiovascular and non-cardiovascular separations in the U.S.) in the average U.S. acute care hospital. The USWE was calculated by dividing the DRG specific U.S. average standardized cost by the overall U.S. average standardized cost. Thus, a separation which has been assigned a USWE of 2.0 requires, on average, twice as many resources as the average U.S. case. If the assumption is made that Canadian and U.S. hospital resource requirements are similar, on average, the total number of separations generated in Alberta, weighted by the appropriate USWE values, would approximate the utilization/resource needs in Alberta acute care hospitals. Consequently, the USRE and USWE were incorporated in this study to provide a more sensitive indication of hospital utilization by examining resource consumption according to the type and frequency of cardiovascular separations.

Per capita resource consumption rates were employed to compensate for the methodological limitations of raw utilization data, thus effecting a more accurate analysis and comparison of variations in utilization behaviour. Utilization rates were calculated by including the USRE, the USWE, or the number of SEPS in the numerator, and appropriate age-sex adjusted population figures in the denominator.

The following results of this provincial perspective are intended to provide a general overview of utilization trends, and the relative consumption of hospital resources by patients with cardiovascular disease, according to the aforementioned utilization measures.

4.2.1 Cardiovascular DRG Specific Length of Stay

Table 5 illustrates the number of SEPS, the number of PDAYS, and the ALOS for the major cardiovascular surgical DRGs, all cardiovascular surgical DRGs combined, the major cardiovascular medical DRGs, all cardiovascular medical DRGs combined, and all cardiovascular surgical and medical DRGs combined; utilization values are given for each of the 13 study years and for all study years combined. Each 1971 utilization measure reflects a base value to which the corresponding values of all other years are compared in terms of percentages. The selection of major surgical and major medical DRGs was determined on the basis of a significant contribution of SEPS and/or charges relative to all cardiovascular DRGs.

Specific surgical DRGs were merged in view of the difficulties associated with ICD coding congruency over the study period. These newly formed DRG groups (104-5, 106-7, and 108-12) experienced dramatic increases between 1971 and 1983/84 in terms of SEPS and PDAYS. DRGs 106-7 (coronary bypass procedures) demonstrated an increase of 355.0 percent SEPS and 162.7 percent PDAYS between 1971 and 1983/84, succeeded by DRGs 104-5 (cardiac valve procedures) which had an increase of 114.7 percent SEPS and 50.5 percent PDAYS, and DRGs 108-12 (cardiothoracic and vascular procedures) which experienced an overall increase of 100.9 percent SEPS and 52.5 percent PDAYS. The ALOS for these three major surgical DRG groups exhibited decreasing

Table 5

Cardiovascular DRG Specific Length of Stay

DRG Codes	DRG Description	Utilization Measure	1971[1]	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	1981/82	1982/83	1983/84	1971-83/84	U.S./1984[2]
Major Surgical																	
104-5	Cardiac Valve Procedures	SEPS	109	105	100	126	153	140	125	167	147	207	189	206	234	2008	
		(%)	(100.0)	(96.3)	(91.7)	(115.6)	(140.4)	(128.4)	(114.7)	(153.2)	(134.9)	(189.9)	(173.4)	(189.0)	(214.7)		
		PDAYS	2618	2672	2476	2583	3230	2604	2300	2885	2475	3557	3330	3531	3940	38201	
		(%)	(100.0)	(102.1)	(94.6)	(98.7)	(123.4)	(99.5)	(87.9)	(110.2)	(94.5)	(135.9)	(127.2)	(134.9)	(150.5)		
		ALOS	24.0	25.5	24.8	20.5	21.1	18.6	18.4	17.3	16.8	17.2	17.6	17.1	16.8	19.0	-
		(%)	(100.0)	(106.3)	(103.3)	(85.4)	(87.9)	(77.5)	(76.7)	(72.1)	(70.0)	(71.7)	(73.3)	(71.3)	(70.0)		
106-7	Coronary Bypass Procedures	SEPS	111	154	190	175	205	294	318	368	473	459	514	474	505	4240	
		(%)	(100.0)	(138.7)	(171.2)	(157.7)	(184.7)	(264.9)	(286.5)	(331.5)	(426.1)	(413.5)	(463.1)	(427.0)	(455.0)		
		PDAYS	2825	3098	3568	3396	3607	5123	4812	5982	7019	6665	7504	7215	7422	68236	
		(%)	(100.0)	(109.7)	(126.3)	(120.2)	(127.7)	(181.3)	(170.3)	(211.8)	(748.5)	(235.9)	(265.6)	(255.4)	(262.7)		
		ALOS	25.5	20.1	18.8	19.4	17.6	17.4	15.1	16.3	14.8	14.5	14.6	15.2	14.7	16.1	-
		(%)	(100.0)	(78.8)	(73.7)	(76.1)	(69.0)	(68.2)	(59.2)	(63.9)	(58.0)	(56.9)	(57.3)	(59.6)	(57.6)		
108-12	Cardiothoracic and Vascular Procedures	SEPS	1143	1274	1438	1332	1450	1643	1734	1951	1805	1838	1750	2133	2296	21787	
		(%)	(100.0)	(111.5)	(125.8)	(116.5)	(126.9)	(143.7)	(151.7)	(170.7)	(157.9)	(160.8)	(153.1)	(186.6)	(200.9)		
		PDAYS	24240	25824	28460	26309	27450	30381	29078	34653	31205	32050	30252	34746	36961	391609	
		(%)	(100.0)	(106.5)	(117.4)	(108.5)	(113.2)	(125.3)	(120.0)	(143.0)	(128.7)	(132.2)	(124.8)	(143.3)	(152.5)		
		ALOS	21.2	20.3	19.8	19.8	18.9	18.5	16.8	17.8	17.3	17.4	17.3	16.3	16.1	18.0	-
		(%)	(100.0)	(95.8)	(93.4)	(93.4)	(89.2)	(87.3)	(79.2)	(84.0)	(81.6)	(82.1)	(81.6)	(76.9)	(75.9)		
114	Upper Limb and Toe Amputation	SEPS	529	566	497	535	483	538	506	532	451	431	387	358	334	6147	
		(%)	(100.0)	(107.0)	(94.0)	(101.1)	(91.3)	(101.7)	(95.7)	(100.6)	(85.3)	(81.5)	(73.2)	(67.7)	(63.1)		
		PDAYS	5202	6207	5091	6001	4269	4310	4601	5259	5028	4543	4769	5121	4261	64662	
		(%)	(100.0)	(119.3)	(97.9)	(115.4)	(82.1)	(82.9)	(88.4)	(101.1)	(96.7)	(87.3)	(91.7)	(98.4)	(81.9)		
		ALOS	9.8	11.0	10.2	11.2	8.8	8.0	9.1	9.9	11.2	10.5	12.3	14.3	12.8	10.5	17.2
		(%)	(100.0)	(112.2)	(104.1)	(114.3)	(89.8)	(81.6)	(92.9)	(101.0)	(114.3)	(107.1)	(125.5)	(145.9)	(130.6)		

1 Each 1971 utilization measure reflects a base value (%) to which the corresponding values of all other years are compared in terms of percentages.

2 Number of patient-days per cardiovascular separation based on 1984 United States medicare data. Insufficient data were available to compute ALOS values for the combined DRG groups.

Table 5
(Continued)

DRG Codes	DRG Description	Utilization Measure	1971[1]	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	1981/82	1982/83	1983/84	1971-83/84	U.S./1984[2]
119	Vein Ligation	SEPS	1908	1970	1619	1481	1486	1353	1250	1086	1142	1012	958	1107	1090	17462	
	and Stripping	(%)	(100.0)	(103.2)	(84.9)	(77.6)	(77.9)	(70.9)	(65.5)	(56.9)	(59.9)	(53.0)	(50.2)	(58.0)	(57.1)		
		PDAYS	15086	15487	11868	10610	10271	9071	7455	6867	7841	6169	5734	6979	6491	119929	
		(%)	(100.0)	(102.7)	(78.7)	(70.3)	(68.1)	(60.1)	(49.4)	(45.5)	(52.0)	(40.9)	(38.0)	(46.3)	(43.0)		
		ALOS	7.9	7.9	7.3	7.2	6.9	6.7	6.0	6.3	6.9	6.1	6.0	6.3	6.0	6.9	7.7
		(%)	(100.0)	(100.0)	(92.4)	(91.1)	(87.3)	(84.8)	(75.9)	(79.7)	(87.3)	(77.2)	(75.9)	(79.7)	(75.9)		
All Surgical 104-119		SEPS	4298	4640	4467	4234	4398	4639	4622	4822	4810	4697	4610	5001	5181	60419	
		(%)	(100.0)	(108.0)	(103.9)	(98.5)	(102.3)	(107.9)	(107.5)	(112.2)	(111.9)	(109.3)	(107.3)	(116.4)	(120.5)		
		PDAYS	60937	66536	65481	61685	62335	65456	61746	70789	69752	67896	67246	71991	73236	865086	
		(%)	(100.0)	(109.2)	(107.5)	(101.2)	(102.3)	(107.4)	(101.3)	(116.2)	(114.5)	(111.4)	(110.4)	(118.1)	(120.2)		
		ALOS	14.2	14.3	14.7	14.6	14.2	14.1	13.4	14.7	14.5	14.5	14.6	14.4	14.1	14.3	-
		(%)	(100.0)	(100.7)	(103.5)	(102.8)	(100.0)	(99.3)	(94.4)	(103.5)	(102.1)	(102.1)	(102.8)	(101.4)	(99.3)		
Major Medical 122	Circulatory	SEPS	1666	1713	1830	1962	1878	1963	1941	1930	2262	2174	2197	2252	2319	26087	
	Disorders with	(%)	(100.0)	(102.8)	(109.8)	(117.8)	(112.7)	(117.8)	116.5)	(115.8)	(135.8)	(130.5)	(131.9)	(135.2)	(139.2)		
	AMI and without	PDAYS	35864	34839	35692	35863	33450	33612	30118	28805	31950	28820	28398	28745	27476	413632	
	Cardiovascular	(%)	(100.0)	(97.1)	(99.5)	(100.0)	(93.3)	(93.7)	(84.0)	(80.3)	(89.1)	(80.4)	(79.2)	(80.2)	(76.6)		
	Complication,	ALOS	21.5	20.3	19.5	18.3	17.8	17.1	15.5	14.9	14.1	13.3	12.9	12.8	11.9	15.9	10.6
	Discharged Alive	(%)	(100.0)	(94.4)	(90.7)	(85.1)	(82.8)	(79.5)	(72.1)	(69.3)	(65.6)	(61.9)	(60.0)	(59.5)	(55.3)		

1 Each 1971 utilization measure reflects a base value (%) to which the corresponding values of all other years are compared in terms of percentages.

2 Number of patient-days per cardiovascular separation based on 1984 United States medicare data. Insufficient data were available to compute ALOS values for the combined DRG groups.

Table 5
(Continued)

DRG Codes	DRG Description	Utilization Measure	1971[1]	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	1981/82	1982/83	1983/84	1971-83/84	U.S./1984[2]
125	Circulatory Disorders except AMI, with Cardiac Cath and without Complex Diagnosis	SEPS	643	787	844	956	1324	1443	1537	1515	1409	1477	1758	2404	2562	18659	
		(%)	(100.0)	(122.4)	(131.3)	(148.7)	(205.9)	(224.4)	(239.0)	(235.6)	(219.1)	(229.7)	(273.4)	(373.9)	(398.4)		
		PDAYS	4271	5044	4425	4615	6669	7248	6846	7795	7538	7355	7940	9237	10316	89299	
		(%)	(100.0)	(118.1)	(103.6)	(108.1)	(156.1)	(169.7)	(160.3)	(182.5)	(176.5)	(172.2)	(185.9)	(216.3)	(241.5)		
		ALOS	6.6	6.4	5.2	4.8	5.0	5.0	4.5	5.2	5.4	5.0	4.5	3.8	4.0	4.8	3.8
		(%)	(100.0)	(97.0)	(78.8)	(72.7)	(75.8)	(75.8)	(68.2)	(78.8)	(81.8)	(75.8)	(68.2)	(57.6)	(60.6)		
127	Heart Failure	SEPS	2688	2912	2951	2938	2972	3234	3345	3351	3442	3312	3420	3370	3481	41416	
		(%)	(100.0)	(108.3)	(109.8)	(109.3)	(110.6)	(120.3)	(124.4)	(124.7)	(128.1)	(123.2)	(127.2)	(125.4)	(129.5)		
		PDAYS	41378	45091	41283	40955	41145	43296	43012	45059	46243	42838	43425	44465	43993	562183	
		(%)	(100.0)	(109.0)	(99.8)	(99.0)	(99.4)	(104.6)	(103.9)	(108.9)	(111.8)	(103.5)	(104.9)	(107.5)	(106.3)		
		ALOS	15.4	15.5	14.0	13.9	13.8	13.4	12.9	13.5	13.4	12.9	12.7	13.2	12.6	13.6	8.8
		(%)	(100.0)	(100.6)	(90.9)	(90.3)	(89.6)	(87.0)	(83.8)	(87.7)	(87.0)	(83.8)	(82.5)	(85.7)	(81.8)		
130	Peripheral Vascular Disorders, Age ≥ 70 and/or CC[3]	SEPS	1397	1431	1497	1567	1593	1437	1479	1539	1515	1434	1433	1469	1600	19391	
		(%)	(100.0)	(102.4)	(107.2)	(112.2)	(114.0)	(102.9)	(105.9)	(110.2)	(108.4)	(102.6)	(102.6)	(105.2)	(114.5)		
		PDAYS	23109	23440	23380	22391	23709	21153	21248	22595	21948	19767	19401	19299	21246	282686	
		(%)	(100.0)	(101.4)	(101.2)	(96.9)	(102.6)	(91.5)	(91.9)	(97.8)	(95.0)	(85.5)	(84.0)	(83.5)	(91.9)		
		ALOS	16.5	16.4	15.6	14.3	14.9	14.7	14.4	14.7	14.5	13.8	13.5	13.1	13.3	14.6	8.3
		(%)	(100.0)	(99.4)	(94.5)	(86.7)	(90.3)	(89.1)	(87.3)	(89.1)	(87.9)	(83.6)	(81.8)	(79.4)	(80.6)		
132	Atherosclerosis, Age ≥ 70 and/or CC	SEPS	3680	4165	2729	2780	2579	2393	2306	1910	1983	1799	1790	1929	1761	31804	
		(%)	(100.0)	(113.2)	(74.2)	(75.5)	(70.1)	(65.0)	(62.7)	(51.9)	(53.9)	(48.9)	(48.6)	(52.4)	(47.9)		
		PDAYS	53511	61989	36283	36342	33033	28786	26421	20442	21982	18832	18270	18949	17840	392680	
		(%)	(100.0)	(115.8)	(67.8)	(67.9)	(61.7)	(53.8)	(49.4)	(38.2)	(41.1)	(35.2)	(34.1)	(35.4)	(33.3)		
		ALOS	14.5	14.9	13.3	13.1	12.8	12.0	11.5	10.7	11.1	10.5	10.2	9.8	10.1	12.4	7.0
		(%)	(100.0)	(102.8)	(91.7)	(90.3)	(88.3)	(82.8)	(79.3)	(73.8)	(76.6)	(72.4)	(70.3)	(67.6)	(69.7)		

[1] Each 1971 utilization measure reflects a base value (%) to which the corresponding values of all other years are compared in terms of percentages.

[2] Number of patient-days per cardiovascular separation based on 1984 United States medicare data. Insufficient data were available to compute ALOS values for the combined DRG groups.

[3] "Complication or comorbidity" refers to separation abstracts listing more than one discharge diagnosis, provided that the principal diagnosis is a cardiovascular disorder.

Table 5
(Continued)

DRG Codes	DRG Description	Utilization Measure	1971[1]	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	1981/82-	1982/83	1983/84	1971-83/84	U.S./1984[2]
134	Hypertension	SEPS	2490	3021	2129	2172	2232	2162	1941	1909	1718	1525	1573	1751	1789	26412	
		(%)	(100.0)	(121.3)	(85.5)	(87.2)	(89.6)	(86.8)	(78.0)	(76.7)	(69.0)	(61.2)	(63.2)	(70.3)	(71.8)		
		PDAYS	27288	32941	20669	20836	20773	19158	17674	16683	14122	12846	12518	13676	13651	242835	
		(%)	(100.0)	(120.7)	(75.7)	(76.4)	(76.1)	(70.2)	(64.8)	(61.1)	(51.8)	(47.1)	(45.9)	(50.1)	(50.0)		
		ALOS	11.0	10.9	9.7	9.6	9.3	8.9	9.1	8.7	8.2	8.4	8.0	7.8	7.6	9.2	6.6
		(%)	(100.0)	(99.0)	(88.2)	(87.3)	(84.5)	(80.9)	(82.7)	(79.1)	(74.5)	(76.4)	(72.7)	(70.9)	(69.1)		
138	Cardiac	SEPS	747	937	1121	1196	1253	1488	1670	1839	1681	1774	1772	1838	2063	19379	
	Arrhythmia and	(%)	(100.0)	(125.4)	[illegible]	(160.1)	(167.7)	(199.2)	(223.6)	(246.2)	(225.0)	(237.5)	(237.2)	(246.1)	(276.2)		
	Conduction	PDAYS	8126	11479	[illegible]243	12020	11344	12665	12930	14773	12778	13494	13467	14102	15560	164981	
	Disorders, Age	(%)	(100.0)	(141.3)	(150.7)	(147.9)	(139.6)	(155.9)	(159.1)	(181.8)	(157.2)	(166.1)	(165.7)	(173.5)	(191.5)		
	≥ 70 and/or	ALOS	10.9	12.3	10.9	10.1	9.1	8.5	7.7	8.0	7.6	7.6	7.6	7.7	7.5	8.5	6.5
	CC[3]	(%)	(100.0)	(112.8)	(100.0)	(92.7)	(83.5)	(78.0)	(70.6)	(73.4)	(69.7)	(69.7)	(69.7)	(70.6)	(68.8)		
140	Angina Pectoris	SEPS	1503	1452	1298	1413	1374	1563	1746	1811	1917	1975	2105	2281	2596	23034	
		(%)	(100.0)	(96.6)	(86.4)	(94.0)	(91.4)	(104.0)	(116.2)	(120.5)	(127.5)	(131.4)	(140.1)	(151.8)	(172.7)		
		PDAYS	16647	15974	11953	12493	11942	13019	13705	14303	14920	15020	15557	16101	17915	189549	
		(%)	(100.0)	(96.0)	(71.8)	(75.0)	(71.7)	(78.2)	(82.3)	(85.9)	(89.6)	(90.2)	(93.5)	(96.7)	(107.6)		
		ALOS	11.1	11.0	9.2	8.8	8.7	8.3	7.9	7.9	7.8	7.6	7.4	7.1	6.9	8.2	5.7
		(%)	(100.0)	(99.1)	(82.9)	(79.3)	(78.4)	(74.8)	(71.2)	(71.2)	(70.3)	(68.5)	(66.7)	(64.0)	(62.2)		
All Medical 121-145		SEPS	18707	20360	18656	19045	19197	19792	19948	19850	19825	19460	20027	21474	22463	258804	
		(%)	(100.0)	(108.8)	(99.7)	(101.8)	(102.6)	(105.8)	(106.6)	(106.1)	(106.0)	(104.0)	(107.1)	(114.8)	(120.1)		
		PDAYS	256760	277180	234104	229945	226546	224963	213873	211505	211726	197790	198980	205288	209871	2898531	
		(%)	(100.0)	(108.0)	(91.2)	(89.6)	(88.2)	(87.6)	(83.3)	(82.4)	(82.5)	(77.0)	(77.5)	(80.0)	(81.7)		
		ALOS	13.7	13.6	12.6	12.1	11.8	11.4	10.7	10.7	10.7	10.2	9.9	9.7	9.3	11.2	-
		(%)	(100.0)	(99.3)	(92.0)	(88.3)	(86.1)	(83.2)	(78.1)	(78.1)	(78.1)	(74.5)	(72.3)	(70.1)	(67.9)		

1 Each 1971 utilization measure reflects a base value (%) to which the corresponding values of all other years are compared in terms of percentages.

2 Number of patient-days per cardiovascular separation based on 1984 United States medicare data. Insufficient data were available to compute ALOS values for the combined DRG groups.

3 "Complication or comorbidity" refers to separation abstracts listing more than one discharge diagnosis, provided that the principal diagnosis is a cardiovascular disorder.

Table 5
(Continued)

DRG Codes	DRG Description	Utilization Measure	1971[1]	1972	1973	1974	1975	1976	1977	1978	1979/80	[illegible]	[illegible]/82	1982/83	1983/84	1971-83/84	U.S./1984[2]
All Surgical and Medical 104-145		SEPS	23005	25000	23123	23279	23595	24431	24570	24672	24635	24157	24637	26475	27644	319223	
		(%)	(100.0)	(108.7)	(100.5)	(101.2)	(102.6)	(106.2)	(106.8)	(107.2)	(107.1)	(105.0)	(107.1)	(115.1)	(120.2)		
		PDAYS	317697	343716	299585	291630	288881	290419	275619	282294	281478	265686	266226	277279	283107	3763617	
		(%)	(100.0)	(108.2)	(94.3)	(91.8)	(90.9)	(91.4)	(86.8)	(88.9)	(88.6)	(83.6)	(83.8)	(87.3)	(89.1)		
		ALOS	13.8	13.8	13.0	12.5	12.2	11.9	11.2	11.4	11.4	11.0	10.8	10.5	10.2	11.8	-
		(%)	(100.0)	(100.0)	(94.2)	(90.6)	(88.4)	(86.2)	(81.2)	(82.6)	(82.6)	(79.7)	(78.3)	(76.1)	(73.9)		

1 Each 1971 utilization measure reflects a base value (%) to which the corresponding values of all other years are compared in terms of percentages.

2 Number of patient-days per cardiovascular separation based on 1984 United States medicare data. Insufficient data were available to compute ALOS values for the combined DRG groups.

trends, with the most pronounced overall decline by DRGs 106-7 (a decrease of 42.4 percent between 1971 and 1983/84). The two remaining major cardiovascular surgical DRGs demonstrated a decline in the number of SEPS and PDAYS; DRG 114 (upper limb and toe amputation) exhibited an overall decrease of 36.9 percent SEPS and 18.1 percent PDAYS, while DRG 119 (vein ligation and stripping) had an overall decrease of 42.9 percent SEPS and 57.0 percent PDAYS. While DRG 119 exhibited a consistently declining ALOS, the ALOS associated with DRG 114 fluctuated throughout the study period, demonstrating an overall increase of 30.6 percent. (It should be noted that DRG 114 was not restricted to the presence of circulatory system disorders only.)

When the cardiovascular surgical DRGs were combined (including the major surgical DRGs and all other surgical DRGs), the number of SEPS and PDAYS gradually increased between 1971 and 1983/84 (20.5 percent SEPS overall and 20.2 percent PDAYS overall). The ALOS for all cardiovascular surgical DRGs combined remained relatively constant throughout the study period, with an overall ALOS of 14.3 patient-days per cardiovascular surgical separation.

With respect to the medical cardiovascular DRGs, eight major DRG groups were identified. Of those eight DRGs, four groups experienced an increase in the number of SEPS and PDAYS. DRG 125 [circulatory disorders except acute myocardial infarction (AMI), with a cardiac catheterization and without a complex diagnosis] demonstrated the most dramatic growth, with an increase of 298.4 percent SEPS overall and 141.5 percent PDAYS overall. DRG 138 [cardiac arrhythmia and conduction disorders, age ≥ 70 years and/or a complication or comorbidity (CC)] exhibited an overall increase of 176.2 percent SEPS and 91.5 percent PDAYS, followed by DRG 140 (angina pectoris) which demonstrated an overall increase of 72.7 percent SEPS and 7.6 percent PDAYS, and DRG 127 (heart failure) which had an overall increase of 29.5 percent SEPS and 6.3 percent PDAYS.

Two major cardiovascular medical DRGs had an increase in the number of SEPS and a decrease in the number of PDAYS. DRG 122 (circulatory disorders with AMI and without a cardiovascular complication, discharged alive) and DRG 130 (peripheral vascular disorders, age ≥ 70 years and/or a CC) demonstrated overall increases of 39.2 percent SEPS and 14.5 percent SEPS, respectively, and overall decreases of 23.4 percent PDAYS and 8.1 percent PDAYS, respectively. The two remaining major cardiovascular medical DRGs exhibited declining trends in the number of SEPS and PDAYS. DRG 132 (atherosclerosis, age ≥ 70 years and/or a CC) indicated an overall decrease of 52.1 percent SEPS and 66.7 percent PDAYS, while DRG 134 (hypertension) experienced an overall decrease of 28.2 percent SEPS and 50.0 percent PDAYS. The eight major cardiovascular medical DRGs exhibited declining trends in the ALOS, with overall rates of decline ranging from 18.2 percent (DRG 127) to 44.7 percent (DRG 122).

The combination of the major cardiovascular medical DRGs with all other cardiovascular medical DRGs revealed a gradual overall increase in the number of SEPS (20.1 percent), which closely approximated the SEP trend demonstrated by the cardiovascular surgical DRGs combined. In contrast to the surgical DRGs, however, the number of PDAYS and the ALOS for all cardiovascular medical DRGs combined exhibited gradual declines over the study period, with the number of PDAYS and the ALOS decreasing by 18.3 percent and 32.1 percent, respectively.

The number of SEPS for all cardiovascular surgical and medical DRGs combined demonstrated an increase of 6.2 percent between 1971 and 1976, and an increase of 13.2 percent between 1976 and 1983/84, with an overall increase of 20.2 percent. The number of PDAYS for all cardiovascular DRGs combined, however, demonstrated a decline of 10.9 percent between 1971 and 1983/84; the ALOS also exhibited a gradually decreasing trend, declining from 13.8 patient-days per cardiovascular separation in 1971 to 10.2 patient-days per cardiovascular separation in 1983/84 (26.1 percent).

Table 5 also presents an overall ALOS value for selected DRG groups based on 1984 U.S. medicare data. (There were insufficient data available to compute an ALOS for the combined DRG categories.) The U.S. ALOS values were lower than the corresponding Alberta ALOS values for all major DRG groups except DRG 114 (upper limb and toe amputation) and DRG 119 (vein ligation and stripping).

4.2.2 Cardiovascular DRG Specific USRE and USWE

Table 6 depicts the number of SEPS, the USRE, and the USWE for the major cardiovascular surgical DRGs, all cardiovascular surgical DRGs combined, the major cardiovascular medical DRGs, all medical cardiovascular DRGs combined, and all cardiovascular DRGs combined; utilization values are given for each of the study years and for all study years combined. The total number of SEPS were weighted by the U.S. DRG standardized costs [average USRE (AUSRE)] to yield the total USRE (TUSRE), which represents the total amount in constant 1986 U.S. dollars which would have been incurred by the Alberta hospital system

Table 6

Cardiovascular DRG Specific USRE and USWE

DRG Codes	DRG Description	Utilization Measure	1971	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	1981/82	1982/83	1983/84	1971–83/84
Major Surgical																
104-5	Cardiac Valve Procedures	SEPS	109	105	100	126	153	140	125	167	147	207	189	206	234	2008
		(%)[1]	(100.0)	(96.3)	(91.7)	(115.6)	(140.4)	(128.4)	(114.7)	(153.2)	(134.9)	(189.9)	(173.4)	(189.0)	(214.7)	
		TUSRE[2]	3159	3038	2893	3687	4477	4105	3658	4892	4244	5973	5453	5944	6752	58273
		TUSWE[3]	696	669	637	817	992	911	811	1085	933	1312	1198	1306	1484	12852
106-7	Coronary Bypass Procedures	SEPS	111	154	190	175	205	294	316	368	473	459	514	474	505	4240
		(%)	(100.0)	(138.7)	(171.2)	(157.7)	(184.7)	(264.9)	(286.5)	(331.5)	(426.1)	(413.5)	(463.1)	(427.0)	(455.0)	
		TUSRE	2318	3217	3964	3689	4320	6207	6755	7791	9844	9552	10697	9864	10510	88727
		TUSWE	521	723	890	835	977	1406	1537	1768	2205	2140	2396	2210	2354	19961
108-12	Cardiothoracic and Vascular Procedures	SEPS	1143	1274	1438	1332	1450	1643	1734	1951	1805	1838	1750	2133	2296	21787
		(%)	(100.0)	(111.5)	(125.8)	(116.5)	(126.9)	(143.7)	(151.7)	(170.7)	(157.9)	(160.8)	(153.1)	(186.6)	(200.9)	
		TUSRE	13257	14199	16110	16507	18061	20274	21343	24497	21734	22649	21245	26516	28806	265199
		TUSWE	3109	3341	3787	3889	4253	4777	5032	5774	5109	5305	4986	6205	6737	62303
114	Upper Limb and Toe Amputation	SEPS	529	566	497	535	483	538	506	532	451	431	387	358	334	6147
		(%)	(100.0)	(107.0)	(94.0)	(101.1)	(91.3)	(101.7)	(95.7)	(100.6)	(85.3)	(81.5)	(73.2)	(67.7)	(63.1)	
		TUSRE	4167	4459	3915	4215	3805	4238	3986	4191	3553	3395	3049	2820	2631	48426
		TUSWE	1002	1072	942	1014	915	1019	959	1008	854	817	733	678	633	11646
119	Vein Ligation and Stripping	SEPS	1908	1970	1619	1481	1486	1353	1250	1086	1142	1012	958	1107	1090	17462
		(%)	(100.0)	(103.2)	(84.9)	(77.6)	(77.9)	(70.9)	(65.5)	(56.9)	(59.9)	(53.0)	(50.2)	(58.0)	(57.1)	
		TUSRE	7157	7389	6073	5555	5574	5075	4689	4074	4284	3796	3593	4152	4089	65500
		TUSWE	1749	1806	1484	1357	1362	1240	1146	995	1047	927	878	1015	999	16004

1 Each 1971 SEP measure reflects a base value (%) to which the corresponding SEP values of all other years are compared in terms of percentages.

2 The "Total United States Reimbursement Equivalent" represents the total amount of charges expended for all separations, expressed in 1000's of constant 1986 U.S. dollars.

3 The "Total United States Weight Equivalent" reflects the total number of separations weighted by the respective U.S. DRG standardized resource need index.

Table 6
(Continued)

DRG Codes	DRG Description	Utilization Measure	1971	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	1981/82	1982/83	1983/84	1971-83/84
All Surgical 104-119		SEPS	4298	4640	4467	4234	4398	4639	4622	4822	4810	4697	4610	5001	5181	60419
		(%)[1]	(100.0)	(108.0)	(103.9)	(98.5)	(102.3)	(107.9)	(107.5)	(112.2)	(111.9)	(109.3)	(107.3)	(116.4)	(120.5)	
		TUSRE[2]	35769	38831	39652	39966	42516	46636	47205	52420	51455	53001	52495	57259	60582	617787
		(AUSRE)[4]	(8.3)	(8.4)	(8.9)	(9.4)	(9.7)	(10.1)	(10.2)	(10.9)	(10.7)	(11.3)	(11.4)	(11.4)	(11.7)	(10.2)
		TUSWE[3]	8479	9214	9383	9462	10039	11005	11145	12340	12059	12375	12268	13371	14122	145263
		(AUSWE)[5]	(2.0)	(2.0)	(2.1)	(2.2)	(2.3)	(2.4)	(2.4)	(2.6)	(2.5)	(2.6)	(2.7)	(2.7)	(2.7)	(2.4)
Major Medical 122	Circulatory	SEPS	1666	1713	1830	1962	1878	1963	1941	1930	2262	2174	2197	2252	2319	26087
	Disorders with	(%)	(100.0)	(102.8)	(109.8)	(117.8)	(112.7)	[illegible]	(116.5)	(115.8)	(135.8)	(130.5)	(131.9)	(135.2)	(139.2)	
	AMI and without	TUSRE	8996	9250	9882	10595	10141	10600	10481	10422	[illegible]	11740	11864	12161	12523	140870
	Cardiovascular	TUSWE	2211	2273	2428	2604	2492	2605	2576	2561	3002	2885	2915	2988	3077	34617
	Complication,															
	Discharged Alive															
125	Circulatory	SEPS	643	787	844	956	1324	1443	1537	1515	1409	1477	1758	2404	2562	18659
	Disorders ex-	(%)	(100.0)	(122.4)	(131.3)	(148.7)	(205.9)	(224.4)	(239.0)	(235.6)	(219.1)	(229.7)	(273.4)	(373.9)	(398.4)	
	cept AMI, with	TUSRE	1953	2391	2564	2904	4022	4384	4669	4603	4281	4487	5341	7303	7783	56686
	Cardiac Cath	TUSWE	467	572	613	695	962	1048	1117	1101	1024	1073	1277	1747	1862	13558
	and without Com-															
	plex Diagnosis															
127	Heart Failure	SEPS	2688	2912	2951	2938	2972	3234	3345	3351	3442	3312	3420	3370	3481	41416
		(%)	(100.0)	(108.3)	(109.8)	(109.3)	(110.6)	(120.3)	(124.4)	(124.7)	(128.1)	(123.2)	(127.2)	(125.4)	(129.5)	
		TUSRE	11053	11974	12135	12081	[illegible]	13298	13755	13779	14154	13619	14063	13857	14314	170303
		TUSWE	2715	2941	2981	2967	3002	3266	3378	3385	3476	3345	3454	3404	3516	41830

1 Each 1971 SEP measure reflects a base value (%) to which the corresponding SEP values of all other years are compared in terms of percentages.

2 The "Total United States Reimbursement Equivalent" represents the total amount of charges expended for all separations, expressed in 1000's of constant 1986 U.S. dollars.

3 The "Total United States Weight Equivalent" reflects the total number of separations weighted by the respective U.S. DRG standardized resource need index.

4 The "Average United States Reimbursement Equivalent" represents the standardized DRG charge per separation, expressed in 1000's of constant 1986 U.S. dollars.

5 The "Average United States Weight Equivalent" represents the resource requirements per cardiovascular separation relative to the resource needs of an average separation in an average U.S. acute care hospital.

Table 6
(Continued)

DRG Codes	DRG Description	Utilization Measure	1971	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	1981/82	1982/83	1983/84	1971-83/84
130	Peripheral Vascular Disorders, Age ≥ 70 and/or CC[6]	SEPS	1397	1431	1497	1567	1593	1437	1479	1539	1515	1434	1433	1469	1600	19391
		(%)[1]	(100.0)	(102.4)	(107.2)	(112.2)	(114.0)	(102.9)	(105.9)	(110.2)	(108.4)	(102.6)	(102.6)	(105.2)	(114.5)	
		TUSRE[2]	4722	4837	5060	5296	5384	4857	4999	5202	5121	4847	4844	4965	5408	65542
		TUSWE[3]	1153	1181	1236	1293	1315	1186	1221	1270	1250	1184	1183	1213	1321	16005
132	Atherosclerosis, Age ≥ 70 and/or CC	SEPS	3680	4165	2729	2780	2579	2393	2306	1910	1983	1799	1790	1929	1761	31804
		(%)	(100.0)	(113.2)	(74.2)	(75.5)	(70.1)	(65.0)	(62.7)	(51.9)	(53.9)	(48.9)	(48.6)	(52.4)	(47.9)	
		TUSRE	11739	13286	8706	8868	8227	7634	7356	6093	6326	5739	5710	6154	5618	101455
		TUSWE	2959	3349	2194	2235	2074	1924	1854	1536	1594	1446	1439	1551	1416	25570
134	Hypertension	SEPS	2490	3021	2129	2172	2232	2162	1941	1909	1718	1525	1573	1751	1789	26412
		(%)	(100.0)	(121.3)	(85.5)	(87.2)	(89.6)	(86.8)	(78.0)	(76.7)	(69.0)	(61.2)	(63.2)	(70.3)	(71.8)	
		TUSRE	6364	7722	5442	5552	5705	5526	4961	4879	4391	3898	4021	4476	4573	67509
		TUSWE	1585	1923	1355	1382	1421	1376	1235	1215	1094	971	1001	1115	1139	16811
138	Cardiac Arrhythmia and Conduction Disorders, Age ≥ 70 and/or CC	SEPS	747	937	1121	1196	1253	1488	1670	1839	1681	1774	1772	1838	2063	19379
		(%)	(100.0)	(125.4)	(150.1)	(160.1)	(167.7)	(199.2)	(223.6)	(246.2)	(225.0)	(237.5)	(237.2)	(246.1)	(276.2)	
		TUSRE	2483	3115	3726	3976	4165	4946	5551	6113	5588	5897	5890	6110	6857	64416
		TUSWE	608	763	912	973	1020	1211	1359	1497	1368	1444	1442	1496	1679	15771
140	Angina Pectoris	SEPS	1503	1452	1298	1413	1374	1563	1746	1811	1917	1975	2105	2281	2596	23034
		(%)	(100.0)	(96.6)	(86.4)	(94.0)	(91.4)	(104.0)	(116.2)	(120.5)	(127.5)	(131.4)	(140.1)	(151.8)	(172.7)	
		TUSRE	4187	4045	3616	3937	3828	4355	4864	5045	5341	5502	5865	6355	7232	64173
		TUSWE	1036	1001	895	974	947	1078	1204	1249	1322	1362	1451	1573	1790	15882

1 Each 1971 SEP measure reflects a base value (%) to which the corresponding SEP values of all other years are compared in terms of percentages.

2 The "Total United States Reimbursement Equivalent" represents the total amount of charges expended for all separations, expressed in 1000's of constant 1986 U.S. dollars.

3 The "Total United States Weight Equivalent" reflects the total number of separations weighted by the respective U.S. DRG standardized resource need index.

6 "Complication or comorbidity" refers to separation abstracts listing more than one discharge diagnosis, provided that the principal diagnosis is a cardiovascular disorder.

Table 6
(Continued)

DRG Codes	DRG Description	Utilization Measure	1971	1972	1973	1974	1975	1976	1977	1978	1979/80	1980/81	1981/82	1982/83	1983/84	1971-83/84
All Medical 121-145		SEPS	18707	20360	18656	19045	19197	19792	19948	19850	19825	19460	20027	21474	22463	258804
		(%)[1]	(100.0)	(108.8)	(99.7)	(101.8)	(102.6)	(105.8)	(106.6)	(106.1)	(106.0)	(104.0)	(107.1)	(114.8)	(120.1)	
		TUSRE[2]	68199	73572	69205	70402	70662	73339	73993	74321	75144	74081	75934	80483	84070	963404
		(AUSRE)[4]	(3.6)	(3.6)	(3.7)	(3.7)	(3.7)	(3.7)	(3.7)	(3.7)	(3.8)	(3.8)	(3.8)	(3.7)	(3.7)	(3.7)
		TUSWE[3]	16806	18138	17024	17317	17376	18030	18185	18262	18465	18195	18641	19747	20622	236807
		(AUSWE)[5]	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)
All Surgical and Medical 104-145		SEPS	23005	25000	23123	23279	23595	24431	24570	24672	24635	24157	24637	26475	27644	319223
		(%)	(100.0)	(108.7)	(100.5)	(101.2)	(102.6)	(106.2)	(106.8)	(107.2)	(107.1)	(105.0)	(107.1)	(115.1)	(120.2)	
		TUSRE	103968	112403	108857	110368	113178	119975	121197	126741	126599	127082	128429	137743	144652	1581191
		(AUSRE)	(4.5)	(4.5)	(4.7)	(4.7)	(4.8)	(4.9)	(4.9)	(5.1)	(5.1)	(5.3)	(5.2)	(5.2)	(5.2)	(5.0)
		TUSWE	25286	27352	26407	26778	27415	29035	29330	30602	30524	30570	30909	33118	34744	382070
		(AUSWE)	(1.1)	(1.1)	(1.1)	(1.2)	(1.2)	(1.2)	(1.2)	(1.2)	([illegible].2)	(1.3)	(1.3)	(1.3)	(1.3)	(1.2)

1 Each 1971 SEP measure reflects a base value (%) to which the corresponding SEP values of all other years are compared in terms of percentages.

2 The "Total United States Reimbursement Equivalent" represents the total amount of charges expended for all separations, expressed in 1000's of constant 1986 U.S. dollars.

3 The "Total United States Weight Equivalent" reflects the total number of separations weighted by the respective U.S. DRG standardized resource need index.

4 The "Average United States Reimbursement Equivalent" represents the standardized DRG charge per separation, expressed in 1000's of constant 1986 U.S. dollars.

5 The "Average United States Weight Equivalent" represents the resource requirements per cardiovascular separation relative to the resource needs of an average separation in an average U.S. acute care hospital.

if the DRG reimbursement system had been operative in Alberta during the study period. The total number of SEPS were weighted by the U.S. DRG standardized resource need indices [average USWE (AUSWE)] to provide the total USWE (TUSWE), which represents the total resource needs in weighted SEPS. For each DRG as a separate entity, the AUSRE and the AUSWE are constants; however, the values of these two indices fluctuate when the DRGs are combined into major groups (all surgical, all medical, or all surgical and medical), and as such, are designated accordingly in Table 6. In view of the fact that the TUSRE and the TUSWE represent a constant multiplied by the number of SEPS (with the exception of the three major combinations of cardiovascular DRGs), the rates of increase or decrease for the TUSRE and the TUSWE parallel the magnitude and direction of the changes associated with the corresponding number of SEPS.

For the major cardiovascular surgical DRGs, DRGs 106-7 (coronary bypass procedures) demonstrated the most dramatic increase in the TUSRE and TUSWE (consistent with the significant increase of 355.0 percent SEPS between 1971 and 1983/84), succeeded by DRGs 104-5 (cardiac valve procedures), and DRGs 108-12 (cardiothoracic and vascular procedures). Although DRGs 108-12 generated 5.1 times as many SEPS as DRGs 106-7, and 10.9 times as many SEPS as DRGs 104-5, the relatively high AUSRE and AUSWE attributed to DRGs 106-7 [AUSRE of $20,900 (U.S.) and AUSWE of 4.7] and to DRGs 104-5 [AUSRE of $29,000 (U.S.) and AUSWE of 6.4] substantially impacted the amount of cardiovascular resources consumed by these two DRG groups. Similar to the declining numbers of SEPS generated during the study period, DRG 114 (upper limb and toe amputation) and DRG 119 (vein ligation and stripping) indicated decreasing trends in the TUSRE (and TUSWE) of 36.9 percent overall for DRG 114 and 42.9 percent overall for DRG 119.

Although the number of SEPS produced by all cardiovascular surgical DRGs combined increased by 20.5 percent overall, the TUSRE and the TUSWE increased dramatically by 69.4 percent and 66.6 percent, respectively. Table 6 indicates that the average cost per cardiovascular surgical separation (AUSRE) increased from $8,300 (U.S.) to $11,700 (U.S.), representing an overall increase of 41.0 percent. Thus, between 1971 and 1983/84, a consistently higher proportion of more complex cardiovascular surgical cases were being generated. This finding was substantiated by the gradually increasing resource need index of the average cardiovascular surgical separation (AUSWE), which increased from 2.0 in 1971 to 2.7 in 1983/84 (35.0 percent increase).

Consistent with the magnitude and direction of the changes in SEP values during the study period, the TUSRE and the TUSWE of the major cardiovascular medical DRGs similarly increased most dramatically for DRG 125 (circulatory disorders except AMI, with a cardiac catheterization and without a complex diagnosis), followed by DRG 138 (cardiac arrhythmia and conduction disorders, age ≥ 70 years and/or a CC), DRG 140 (angina pectoris), DRG 127 (heart failure), DRG 122 (circulatory disorders with AMI and without a cardiovascular complication, discharged alive), and DRG 130 (peripheral vascular disorders, age ≥ 70 years and/or a CC). Of the two remaining major cardiovascular medical DRGs, DRG 132 (atherosclerosis, age ≥ 70 years and/or a CC) and DRG 134 (hypertension) experienced declines in the TUSRE and TUSWE. The total amount over the 13-year study period which would have been incurred if the patients had been treated in U.S. acute care hospitals was highest for DRG 127 (heart failure) at $170.3 million (U.S.), succeeded by DRG 122 (circulatory disorders with AMI and without a cardiovascular complication, discharged alive) at $140.9 million (U.S.), and DRG 132 (atherosclerosis, age ≥ 70 years and/or a CC) at $101.5 million (U.S.). No cardiovascular medical DRG approached the significant charges of $265.2 million (U.S.), however, which would have been incurred by patients in the surgical DRGs 108-12 (cardiothoracic and vascular procedures).

Whereas there was a pronounced difference between the increase in the number of combined cardiovascular surgical SEPS and the corresponding combined surgical TUSRE and TUSWE, the rates of increase in the number of SEPS, the TUSRE, and the TUSWE for all cardiovascular medical DRGs combined were similar at 20.1 percent, 23.3 percent, and 22.7 percent, respectively, between 1971 and 1983/84. The average cost per cardiovascular medical separation (AUSRE) varied slightly over the study period between $3,600 (U.S.) and $3,800 (U.S.), and the corresponding average resource need index (AUSWE) was constant at 0.9. Thus, in contrast to the increasing resources required by the average cardiovascular surgical separation, the average cardiovascular medical separation consumed virtually the same amount of resources throughout the 13-year study period.

For all cardiovascular DRGs combined, the TUSRE increased from $104.0 million (U.S.) in 1971 to $144.7 million (U.S.) in 1983/84, with a total amount for all 13 years of $1.6 billion (U.S.). While the total proportion of cardiovascular surgical and medical separations was 18.9 percent and 81.1 percent, respectively, the contribution of the surgical separations to the TUSRE was 39.1 percent, while the contribution of the cardiovascular medical separations to the TUSRE was 60.9 percent. The AUSRE for all cardiovascular DRGs combined gradually increased from $4,500 (U.S.) in 1971 to $5,200 (U.S.) in 1983/84, representing an overall increase in the average charge per cardiovascular case of 15.6 percent. Thus, although there were 4.3 times as many cardiovascular medical separations as cardiovascular surgical separations overall, the higher cost-weighted surgical DRGs significantly influenced the consumption of acute care hospital resources. The significant impact of the cardiovascular surgical DRGs on resource utilization was further underscored by the gradually increasing AUSWE for all cardiovascular DRGs combined, which rose from 1.1 in 1971 to 1.3 in 1983/84.

4.2.3 Cardiovascular DRG Specific Utilization Rates

To achieve more meaningful comparisons of resource consumption, population-based utilization rates were calculated and compared among individual DRG categories and combinations thereof. Table 7 illustrates the SEPRATE, USRERATE, and USWERATE for 1971, 1976, and 1981/82; utilization rates are given for the major cardiovascular surgical DRGs, all cardiovascular surgical DRGs combined, the major cardiovascular medical DRGs, all cardiovascular medical DRGs combined, and all cardiovascular surgical and medical DRGs combined. Since the USRERATE and the USWERATE are a function of the number of SEPS multiplied by a constant and then divided by the age-sex adjusted service population, the rates of increase or decrease are generally

Table 7

Cardiovascular DRG Specific Utilization Rates

DRG Codes	DRG Description	Utilization Measure	1971[1]	1976	1981/82
Major Surgical					
104-5	Cardiac Valve Procedures	SEPRATE[2]	0.07	0.08	0.08
		(%)	(100.0)	(114.3)	(114.3)
		USRERATE[3]	1.94	2.23	2.44
		(%)	(100.0)	([illegible]4.9)	(125.8)
		USWERATE[4]	0.43	[illegible].50	0.54
		(%)	(100.0)	([illegible]16.3)	(125.6)
106-7	Coronary Bypass Procedures	SEPRATE	0.07	0.16	0.23
		(%)	(100.0)	(228.6)	(328.6)
		USRERATE	1.42	3.38	4.78
		(%)	(100.0)	(238.0)	(336.6)
		USWERATE	0.32	0.76	1.07
		(%)	(100.0)	(237.5)	(334.4)
108-12	Cardiothoracic and Vascular Procedures	SEPRATE	0.70	0.89	0.78
		(%)	(100.0)	(127.1)	(111.4)
		USRERATE	8.14	11.03	9.50
		(%)	(100.0)	(135.5)	(116.7)
		USWERATE	1.91	2.60	2.23
		(%)	(100.0)	(136.1)	(116.8)
114	Upper Limb and Toe Amputation	SEPRATE	0.32	0.29	0.17
		(%)	(100.0)	(90.6)	(53.1)
		USRERATE	2.56	2.31	1.36
		(%)	(100.0)	(90.2)	(53.1)
		USWERATE	0.62	0.55	0.33
		(%)	(100.0)	(88.7)	(53.2)

1 Each 1971 utilization measure reflects a base value (%) to which the corresponding measures of 1976 and 1981/82 are compared in terms of percentages.

2 Number of separations per 1,000 person-years.

3 Amount of constant 1986 U.S. dollars per capita-year.

4 Number of weighted separations (total SEPS weighted by the appropriate U.S. DRG standardized resource need index) per 1,000 person-years.

Table 7
(Continued)

DRG Codes	DRG Description	Utilization Measure	1971[1]	1976	1981/82
119	Vein Ligation and Stripping	SEPRATE[2]	1.17	0.74	0.43
		(%)	(100.0)	(63.2)	(36.8)
		USRERATE[3]	4.40	2.76	1.61
		(%)	(100.0)	(62.7)	(36.6)
		USWERATE[4]	1.07	0.67	0.39
		(%)	(100.0)	(62.6)	(36.4)
All Surgical 104-119		SEPRATE	2.64	2.52	2.06
		(%)	(100.0)	(95.5)	(78.0)
		USRERATE	21.97	25.37	23.47
		(%)	(100.0)	(115.5)	(106.8)
		USWERATE	5.21	5.99	5.48
		(%)	(100.0)	(115.0)	(105.2)
Major Medical 122	Circulatory Disorders with AMI and without Cardiovascular Complication, Discharged Alive	SEPRATE	1.02	1.07	0.98
		(%)	(100.0)	(104.9)	(96.1)
		USRERATE	5.53	5.77	5.30
		(%)	(100.0)	(104.3)	(95.8)
		USWERATE	1.36	1.42	1.30
		(%)	(100.0)	(104.4)	(95.6)
125	Circulatory Disorders except AMI, with Cardiac Cath and without Complex Diagnosis	SEPRATE	0.39	0.79	0.79
		(%)	(100.0)	(202.6)	(202.6)
		USRERATE	1.20	2.39	2.39
		(%)	(100.0)	(199.2)	(199.2)
		USWERATE	0.29	0.57	0.57
		(%)	(100.0)	(196.6)	(196.6)

1 Each 1971 utilization measure reflects a base value (%) to which the corresponding measures of 1976 and 1981/82 are compared in terms of percentages.

2 Number of separations per 1,000 person-years.

3 Amount of constant 1986 U.S. dollars per capita-year.

4 Number of weighted separations (total SEPS weighted by the appropriate U.S. DRG standardized resource need index) per 1,000

Table 7
(Continued)

DRG Codes	DRG Description	Utilization Measure	1971[1]	1976	1981/82
127	Heart Failure	SEPRATE[2]	1.65	1.76	1.53
		(%)	(100.0)	(106.7)	(92.7)
		USRERATE[3]	6.79	7.24	6.29
		(%)	(100.0)	(106.6)	(92.6)
		USWERATE[4]	1.67	1.78	1.54
		(%)	(100.0)	(106.6)	(92.2)
130	Peripheral Vascular Disorders, Age ≥ 70 and/or CC[5]	SEPRATE	0.86	0.78	0.64
		(%)	(100.0)	(90.7)	[illegible].4)
		USRERATE	2.90	2.64	2.17
		(%)	(100.0)	(91.0)	(74.8)
		USWERATE	0.[illegible]1	0.65	0.53
		(%)	(100.0)	(91.5)	(74.6)
132	Atherosclerosis, Age ≥ 70 and/or CC	SEPRATE	2.26	1.30	0.80
		(%)	(100.0)	(57.7)	(35.4)
		USRERATE	7.21	4.15	2.55
		(%)	(100.0)	(57.6)	(35.4)
		USWERATE	1.82	1.05	0.64
		(%)	(100.0)	(57.7)	(35.2)
134	Hypertension	SEPRATE	1.53	1.18	0.70
		(%)	(100.0)	(77.1)	(45.8)
		USRERATE	3.91	3.01	1.80
		(%)	(100.0)	(77.0)	(46.0)
		USWERATE	0.97	0.75	0.45
		(%)	(100.0)	(77.3)	(46.6)

1 Each 1971 utilization measure reflects a base value (%) to which the corresponding measures of 1976 and 1981/82 are compared in terms of percentages.

2 Number of separations per 1,000 person-years.

3 Amount of constant 1986 U.S. dollars per capita-year.

4 Number of weighted separations (total SEPS weighted by the appropriate U.S. DRG standardized resource need index) per 1,000 person-years.

5 "Complication or comorbidity" refers to separation abstracts listing more than one discharge diagnosis, provided that the principal diagnosis is a cardiovascular disorder.

Table 7
(Continued)

DRG Codes	DRG Description	Utilization Measure	1971[1]	1976	1981/82
138	Cardiac Arrhythmia and Conduction Disorders, Age ≥ 70 and/or CC[5]	SEPRATE[2]	0.46	0.81	0.79
		(%)	(100.0)	(176.1)	(171.7)
		USRERATE[3]	1.53	2.69	2.63
		(%)	(100.0)	(175.8)	(171.9)
		USWERATE[4]	0.37	0.66	0.64
		(%)	(100.0)	(178.4)	(173.0)
140	Angina Pectoris	SEPRATE	0.92	0.85	0.94
		(%)	(100.0)	(92.4)	(102.2)
		USRERATE	2.57	2.37	2.62
		(%)	(100.0)	(92.2)	(101.9)
		USWERATE	0.64	0.59	0.65
		(%)	(100.0)	(92.2)	(101.6)
All Medical 121-145		SEPRATE	11.49	10.77	8.95
		(%)	(100.0)	(93.7)	(77.9)
		USRERATE	41.89	39.90	33.94
		(%)	(100.0)	(95.2)	(81.0)
		USWERATE	10.32	9.81	8.33
		(%)	(100.0)	(95.1)	(80.7)

1 Each 1971 utilization measure reflects a base value (%) to which the corresponding measures of 1976 and 1981/82 are compared in terms of percentages.

2 Number of separations per 1,000 person-years.

3 Amount of constant 1986 U.S. dollars per capita-year.

4 Number of weighted separations (total SEPS weighted by the appropriate U.S. DRG standardized resource need index) per 1,000 person-years.

5 "Complication or comorbidity" refers to separation abstracts listing more than one discharge diagnosis, provided that the principal diagnosis is a cardiovascular disorder.

Table 7
(Continued)

DRG Codes	DRG Description	Utilization Measure	1971[1]	1976	1981/82
All Surgical and Medical 104-145		SEPRATE[2]	14.13	13.29	11.01
		(%)	(100.0)	(94.1)	(77.9)
		USRERATE[3]	63.86	65.27	57.41
		(%)	(100.0)	(102.2)	(89.9)
		USWERATE[4]	15.53	15.80	13.82
		(%)	(100.0)	(101.7)	(89.0)
Alberta Population			1.63 Million (100.0)	1.84 Million (112.9)	2.24 Million (137.4)

1 Each 1971 utilization measure reflects a base value (%) to which the corresponding measures of 1976 and 1981/82 are compared in terms of percentages.

2 Number of separations per 1,000 person-years.

3 Amount of constant 1986 U.S. dollars per capita-year.

4 Number of weighted separations (total SEPS weighted by the appropriate U.S. DRG standardized resource need index) per 1,000 person-years.

similar among the three utilization indicators for individual DRG categories; these rates differ however, when the DRGs are merged into larger categories.

With respect to the major cardiovascular surgical DRGs, DRGs 106-7 (coronary bypass procedures) exhibited the most dramatic and consistent increases in the SEPRATE, USRERATE, and USWERATE between 1971 and 1983/84. There were 0.07 separations per 1,000 person-years in 1971, which increased to 0.23 separations per 1,000 person-years in 1981/82, representing an overall increase of 228.6 percent. Similarly, the USRERATE increased markedly from $1.42 (U.S.) per capita in 1971 to $4.78 (U.S.) per capita in 1981/82, while the USWERATE for DRGs 106-7 rose from 0.32 weighted separations per 1,000 person-years in 1971 to 1.07 weighted separations per 1,000 person-years in 1981/82. DRGs 104-5 (cardiac valve procedures) demonstrated a marked increase in the actual number of separations (114.7 percent overall); the corresponding SEPRATE however, increased by only 14.3 percent between 1971 and 1976, and remained constant between 1976 and 1981/82. In contrast, the USRERATE and USWERATE for DRGs 104-5 consistently increased between 1971 and 1981/82. The utilization rates for DRGs 108-12 (cardiothoracic and vascular procedures) demonstrated moderate increases between 1971 and 1976, followed by a decrease in the SEPRATE, USRERATE, and USWERATE between 1976 and 1981/82. Consequently, during this latter five-year time frame, the rate of population growth exceeded the rates of increase regarding the resource consumption by patients in DRGs 108-12. Consistent with the declining number of separations, TUSRE values and TUSWE values of DRG 114 (upper limb and toe amputation) and DRG 119 (vein ligation and stripping), the SEPRATEs, USRERATEs, and USWERATEs of these two DRGs indicated even more pronounced rates of decline between 1971 and 1981/82.

Although the actual number of SEPS for all cardiovascular surgical DRGs combined increased by 20.5 percent, the cardiovascular surgical SEPRATE decreased from 2.64 separations per 1,000 person-years in 1971 to 2.52 separations per 1,000 person-years in 1976 (4.5 percent), and further declined to 2.06 separations per 1,000 person-years in 1981/82 (18.3 percent), representing an overall decrease of 22.0 percent. The TUSRE and TUSWE increased by approximately 68 percent overall; however, the USRERATE and USWERATE for all cardiovascular surgical DRGs combined increased by only 15.5 percent and 15.0 percent, respectively, between 1971 and 1976, and demonstrated decreases of 7.5 percent and 8.5 percent, respectively, between 1976 and 1981/82. The USRERATE for all cardiovascular surgical DRGs combined increased from $21.97 (U.S.) per capita in 1971 to $23.47 (U.S.) per capita in 1981/82, representing an overall increase of 6.8 percent. The corresponding USWERATE increased slightly from 5.21 weighted separations per 1,000 person-years in 1971 to 5.48 weighted separations per 1,000 person-years in 1981/82, reflecting an overall increase of 5.2 percent.

In terms of the four major cardiovascular medical DRGs which had experienced an overall increase in the number of SEPS and PDAYS, each of these DRGs [except DRG 127 (heart failure)] demonstrated an increased overall SEPRATE, USRERATE, and USWERATE, although the intercensal year patterns varied. DRG 125 (circulatory disorders except AMI, with a cardiac catheterization and without a complex diagnosis) experienced the highest overall SEPRATE increase of 102.6 percent between 1971 and 1976; between 1976 and 1981/82 however, the SEPRATE, USRERATE, and USWERATE remained unchanged. DRG 127 (heart failure) and DRG 138 (cardiac arrhythmia and conduction disorders, age ≥ 70 years and/or a CC) demonstrated SEPRATE increases of 6.7 percent and 76.1 percent, respectively, between 1971 and 1976, and subsequent decreases of 13.1 percent and 2.5 percent, respectively, between 1976 and 1981/82. In contrast, DRG 140 (angina pectoris) had a SEPRATE decrease of 7.6 percent between 1971 and 1976, and an increase in the SEPRATE of 10.6 percent between 1976 and 1981/82.

Of the major cardiovascular medical DRGs which demonstrated an increase in the number of SEPS and a decrease in the number of PDAYS, DRG 122 (circulatory disorders with AMI and without a cardiovascular complication, discharged alive) had an increased SEPRATE of 4.9 percent between 1971 and 1976, and a decreased SEPRATE of 8.4 percent between 1976 and 1981, with an overall decline of 3.9 percent. DRG 130 (peripheral vascular disorders, age ≥ 70 years and/or a CC) experienced a consistently declining SEPRATE of 9.3 percent and 17.9 percent between 1971 and 1976, and between 1976 and 1981/82, respectively, with an overall decreased SEPRATE of 25.6 percent. The major cardiovascular medical DRGs which indicated an overall decline in the number of SEPS and PDAYS demonstrated greater rates of decline with respect to the SEPRATE, USRERATE, and USWERATE. DRG 132 (atherosclerosis, age ≥ 70 years and/or a CC) had a dramatic overall SEPRATE decrease of 64.6 percent, while DRG 134 (hypertension) exhibited an overall SEPRATE decrease of 54.2 percent. The declining SEPRATES of DRGs 122, 132, and 134 approximated the Alberta and

Canadian trends with respect to the selected cardiovascular diagnoses illustrated in Table 4.

For all cardiovascular medical DRGs combined, the increased number of SEPS (20.1 percent) over the 13-year study period was accompanied by an overall decrease in the SEPRATE of 22.1 percent, a pattern which paralleled that demonstrated by the cardiovascular surgical DRGs combined. In contrast to the cardiovascular surgical DRGs however, the USRERATE and USWERATE for the cardiovascular medical DRGs combined consistently decreased. The USRERATE declined from $41.89 (U.S.) per capita in 1971 to $33.94 (U.S.) per capita in 1981/82, reflecting a decrease of 19.0 percent. The USWERATE for all cardiovascular medical DRGs combined similarly declined from 10.32 weighted SEPS per 1,000 person-years in 1971 to 8.33 weighted SEPS per 1,000 person-years in 1981/82, demonstrating an overall decrease of 19.3 percent.

When all cardiovascular DRGs were combined, the SEPRATE decreased by 5.9 percent between 1971 and 1976, and further decreased by 17.2 percent between 1976 and 1981/82, yielding an overall decline of 22.1 percent. The USRERATE however, increased from $63.86 (U.S.) per capita in 1971 to $65.27 (U.S.) per capita in 1976 (2.2 percent increase), but declined to $57.41 (U.S.) per capita in 1981/82 (12.0 percent decrease), reflecting an overall USRERATE decrease of 10.1 percent. Similarly, the USWERATE increased slightly between 1971 and 1976 (1.7 percent), and decreased more markedly between 1976 and 1981/82 (12.5 percent), emphasizing the greater impact of the population growth rate as compared to the increase in cardiovascular SEPS and charges.

4.2.4 Summary

Descriptive analyses of provincial utilization by cardiovascular patients discharged from Alberta acute care hospitals between 1971 and 1983/84 revealed that:

(1) The number of SEPS for all cardiovascular DRGs combined increased from 23,005 in 1971 to 27,644 in 1983/84, the number of PDAYS decreased from 317,697 in 1971 to 283,107 in 1983/84, and the ALOS declined from 13.8 patient-days per cardiovascular separation in 1971 to 10.2 patient-days per cardiovascular separation in 1983/84. The number of SEPS increased at a similar rate for the cardiovascular surgical DRGs combined and the cardiovascular medical DRGs combined; however, the number of PDAYS gradually increased for the cardiovascular surgical DRGs combined but declined for the cardiovascular medical DRGs combined. The ALOS for the cardiovascular surgical DRGs combined remained relatively constant throughout the study period at approximately 14.3 patient-days per cardiovascular separation, while the ALOS for the cardiovascular medical DRGs combined decreased consistently from 13.7 patient-days in 1971 to 9.3 patient-days per cardiovascular separation in 1983/84. While the major cardiovascular medical DRG 127 (heart failure) generated the highest number of SEPS and PDAYS between 1971 [illegible], the major cardiovascular surgical DRGs 106-7 (corona[illegible] procedures) experienced the most pronounced increase in [illegible] number of SEPS and PDAYS generated during the study period.

(2) For all cardiovascular DRGs combined, the TUSRE increased from $104.0 million (U.S.) in 1971 to $144.7 million (U.S.) in 1983/84.

While the TUSRE and TUSWE increased dramatically by 69.4 percent and 66.6 percent, respectively, for all cardiovascular surgical DRGs combined, the corresponding rates of increase were 23.3 percent and 22.7 percent, respectively, for all cardiovascular medical DRGs combined. The average cost per cardiovascular surgical separation (AUSRE) increased from $8,300 (U.S.) in 1971 to $11,700 (U.S.) in 1983/84; the resource need index for the average cardiovascular surgical separation (AUSWE) increased from 2.0 in 1971 to 2.7 in 1983/84. The average cost per cardiovascular medical separation fluctuated slightly between $3,600 (U.S.) and $3,800, while the corresponding resource need index remained constant at 0.9. Hence, the significant impact of the surgical DRGs on the consumption of hospital resources was demonstrated by the consistently increasing average cost [$4,500 (U.S.) in 1971 to $5,200 (U.S.) in 1983/84] and resource need index (1.1 in 1971 to 1.3 in 1983/84) for the overall average cardiovascular separation. This trend of increasing average costs and resource requirements per cardiovascular case indicated that the ratio of more resource-intensive DRGs to less resource-intensive DRGs increased during the study period, a phenomenon which may have been attributed to the occurrence of a more selective hospital admissions procedure. Although the surgical DRGs 108-12 (cardiothoracic and vascular procedures) would have generated the greatest amount of charges [$265.2 million (U.S.)] over the 13-year period, the surgical DRGs 106-7 (coronary bypass procedures) and the medical DRG 125 (circulatory disorders except AMI, with a cardiac catheterization and without a complex diagnosis) would have experienced the greatest rates of increase with respect to the total charges generated.

(3) While the actual number of SEPS increased for all cardiovascular DRGs combined, the overall SEPRATE declined from 14.13 separations per 1,000 person-years in 1971 to 11.01 separations per 1,000 person-years in 1981/82, emphasizing the greater impact of the Alberta population growth rate. The SEPRATE for all cardiovascular surgical DRGs decreased from 2.64 separations per 1,000 person-years in 1971 to 2.06 separations per 1,000 person-years in 1981/82, while the SEPRATE for all cardiovascular medical DRGs declined from 11.49 separations per 1,000 person-years in 1971 to 8.95 separations per 1,000 person-years in 1981/82.

(4) The USRERATE for all cardiovascular DRGs combined increased from $63.86 (U.S.) per capita in 1971 to $65.27 (U.S.) per capita in 1976, and then decreased to $57.41 (U.S.) per capita in 1981/82. Following a similar pattern, the cardiovascular surgical USRERATE increased from $21.97 (U.S.) per capita in 1971 to $25.37 (U.S.) per capita in 1976, and declined to $23.47 (U.S.) per capita in 1981/82; however, the USRERATE decreased consistently for the cardiovascular medical DRGs combined, declining from $41.89 (U.S.) per capita in 1971 to $33.94 (U.S.) per capita in 1981/82. For each census year, DRGs 108-12 (cardiothoracic and vascular procedures) indicated the highest USRERATEs and USWERATEs. DRGs 106-7 (coronary bypass procedures) and DRG 125 (circulatory disorders except AMI, with a cardiac catheterization and without a complex diagnosis) demonstrated the greatest rates of increase with respect to the SEPRATE, USRERATE, and USWERATE.

In summary, the overall declining trends in the cardiovascular SEPRATE, USRERATE, and USWERATE indicated a per capita reduction of hospital resource consumption by patients with cardiovascular disease, a phenomenon which may be explained by decreasing cardiovascular morbidity, improved medical care, more rigid hospital admissions criteria, or a combination thereof.

4.3 District Cardiovascular Utilization

To examine the variability of district utilization patterns of cardiovascular services, utilization rates for all cardiovascular DRGs combined were calculated for each GHD for the census years of 1971, 1976, and 1981 combined. Table 8 displays the number of hospital districts and associated service population proportions for selected indicators of hospital utilization including the SEPRATE, PDAYRATE, USRERATE, and USWERATE. The geographic variation of these indicators was examined by means of a relative scale which divided the rate distribution into four categories, each based on a percentage variation from the provincial rate: (1) low rate (more than 20 percent below the provincial rate); (2) moderate rate (within plus or minus 20 percent of the provincial rate); (3) high rate (20 percent to 50 percent above the provincial rate); and (4) very high rate (more than 50 percent above the provincial rate). The geographic distribution of utilization rates was also evaluated by considering the service population of each GHD in order to take into account the variation in population size among districts. It should be noted that the denominators used for rate derivation were age-sex adjusted

Table 8

Distribution of District Utilization Rates and Service Populations: 1971, 1976, 1981/82 Combined

Utilization Measure	Category	Range	Number of Districts	% of Service Population
SEPRATE[1]	Low	Less than 10.17	3	27.8
	Moderate	10.17 - 15.26	38	51.1
	High	15.27 - 19.08	30	12.0
	Very High	More than 19.08	30	9.1
PDAYRATE[2]	Low	Less than 123.30	5	3.4
	Moderate	123.30 - 184.95	48	81.5
	High	184.96 - 231.19	26	7.8
	Very High	More than 231.19	22	7.3
USRERATE[3]	Low	Less than 49.43	1	0.1
	Moderate	49.43 - 74.14	57	85.2
	High	74.15 - 92.67	28	10.5
	Very High	More than 92.67	15	4.2
USWERATE[4]	Low	Less than 12.00	1	0.1
	Moderate	12.00 - 17.99	57	84.7
	High	18.00 - 22.49	27	10.7
	Very High	More than 22.49	16	4.5

1 Number of cardiovascular separations per 1,000 person-years.

2 Number of cardiovascular patient-days per 1,000 person-years.

3 Amount of constant 1986 U.S. dollars per person-year.

4 Number of cardiovascular weighted separations (total SEPS weighted by the appropriate U.S. DRG standardized resource need index) per 1,000 person-years.

service population figures; thus, these rates do not reflect disparities with respect to the age-sex composition of the population.

The cardiovascular SEPRATE ranged from 9.4 to 27.7 separations per 1,000 person-years, with a provincial rate of 12.7. Although 60 districts exhibited high and very high SEPRATEs, these districts represented only 21.1 percent of the provincial service population. The major contributor to the low SEPRATE was Calgary, which had a SEPRATE of 9.9 separations per 1,000 person-years and a representative service population of 25.0 percent. Thirty-eight hospital districts displayed a moderate SEPRATE, primarily influenced by Edmonton which had a SEPRATE of 10.4 separations per 1,000 person-years and a representative service population of 25.5 percent.

Those districts with high and very high cardiovascular SEPRATEs were generally located in the northern part of the province, and south of Calgary proximate to the borders. These areas may be characterized by smaller population densities and a lower availability of alternative health care facilities such as outpatient services and home care. There was a cluster of districts with high SEPRATEs immediately surrounding Red Deer, although Red Deer itself had a moderate rate. Both Calgary and Edmonton had SEPRATEs below the provincial rate, which may be attributed to their highly developed health delivery systems. The other two districts with low SEPRATEs were located within close proximity of Edmonton.

The district PDAYRATEs exhibited less overall variability than the SEPRATEs, with 81.5 percent of the total service population reflecting moderate rates. Edmonton and Calgary contributed 50.5 percent of this service population proportion, and both districts had

PDAYRATEs slightly below the provincial rate of 154.1 patient-days per 1,000 person-years. (Edmonton and Calgary had PDAYRATEs of 129.5 and 136.0 patient-days per 1,000 person-years, respectively.) Four districts (Myrnam, Cereal, Boyle, and Lamont) had extremely high PDAYRATEs of more than 300 patient-days per 1,000 person-years. Again, districts with high and very high PDAYRATEs tended to be located around the perimeter of the province, accounting for 15.1 percent of the total service population. Only five districts--Stony Plain and Sturgeon (very close to Edmonton), Elnora and Eckville (immediately adjacent to Red Deer), and Hinton--experienced low PDAYRATEs.

The USRERATE distribution (amount of constant 1986 ~~U.S.~~ dollars per person-year) exhibited less variability than either the SEPRATE or PDAYRATE distribution. Fifty-seven districts (with a representative service population of 85.2 percent) had moderate USRERATE values. Calgary and Edmonton were included in this category, demonstrating USRERATEs of $53 (U.S.) per capita and $57 (U.S.) per capita, respectively, both of which were below the provincial USRERATE of $62 (U.S.) per person-year. Elnora experienced the lowest USRERATE of $39 (U.S.) per person-year, coinciding with a moderate SEPRATE and low PDAYRATE. In contrast, the district of Boyle had the highest USRERATE of $114 (U.S.) per capita, which coincided with a very high SEPRATE and PDAYRATE. Although 43 districts experienced high or very high USRERATEs, they were relatively sparsely-populated rural areas, accounting for only 14.7 percent of the total provincial service population.

The USWERATE distribution (total resource needs measured in weighted SEPS per 1,000 person-years) approximated that of the

USRERATE distribution. Calgary and Edmonton were included among the 57 districts with moderate USWERATEs, demonstrating rates of 12.8 and 13.8 weighted SEPS per 1,000 person-years, respectively. Both metropolitan centres again demonstrated values which were below the provincial USWERATE of 15.0 weighted SEPS per 1,000 person-years. Elnora was the only district with a comparatively low USWERATE of 9.6 weighted SEPS per 1,000 person-years. The 43 rural districts with high or very high USRERATEs similarly experienced high or very high USWERATEs, emphasizing the large per capita consumption of acute care hospital resources for patients with cardiovascular disease in these areas.

To explore district variability according to the nature of cardiovascular separations generated in Alberta hospital districts, three per case utilization indicators were calculated: (1) ALOS (average number of patient-days per cardiovascular separation); (2) AUSRE (average amount of U.S. dollars per cardiovascular separation); and (3) AUSWE (average resource need index per cardiovascular separation). It should be noted that per case utilization measures are less sensitive indicators than per capita measures of hospital utilization in view of the diluting or inflation effect of the referral movement of patients. This effect is caused by the fact that separation abstracts are submitted for each hospital admission and transfer; thus, for referred patients, more than one separation abstract would be generated for a single patient illness episode, biasing utilization rates toward an over-representation of the actual number of patients treated.

Table 9 displays the number of hospital districts and associated service population proportions for the ALOS, AUSRE, and AUSWE for 1971, 1976, and 1981/82 combined. The geographic variation of these indicators was examined by means of a relative scale which divided the rate distribution into five categories, each based on a percentage variation from the provincial rate: (1) very low rate (more than 10 percent below the provincial rate); (2) low rate (5 percent to 10 percent below the provincial rate); (3) moderate rate (within plus or minus 5 percent of the provincial rate); (4) high rate (5 percent to 10 percent above the provincial rate); and (5) very high rate (more than 10 percent above the provincial rate).

The ALOS distribution ranged from a low of 7.0 patient-days per cardiovascular separation in Castor to a high ALOS of 19.7 patient-days per cardiovascular separation in Myrnam. In contrast to the SEPRATE, PDAYRATE, USRERATE, and USWERATE trends of Calgary and Edmonton, their ALOS values were above the provincial figure of 12.1 patient-days per cardiovascular separation, with ALOSs of 13.8 patient-days and 12.4 patient-days per cardiovascular separation for Calgary and Edmonton, respectively. While there were only 16 districts with high or very high ALOSs, they represented a relatively high proportion of the service population, primarily accounted for by the service population proportion of Calgary (25.0 percent). Fifty-four small rural districts with a representative service population of 22.1 percent had low or very low ALOSs; these low ALOS values, in conjunction with relatively high SEPRATEs, PDAYRATEs, USRERATEs, and USWERATEs, suggested that a process of repetitive cardiovascular admissions of a relatively low resource intensive nature was operating

Table 9

Distribution of District Utilization and Service Populations for the Average Cardiovascular Separation: 1971, 1976, 1981/82 Combined

Utilization Measure	Category	Range	Number of Districts	% of Service Population
ALOS[1]	Very Low	Less than 10.91	41	15.1
	Low	10.91 - 11.51	13	7.0
	Moderate	11.52 - 12.73	31	45.0
	High	12.74 - 13.33	7	5.8
	Very High	More than 13.33	9	27.1
AUSRE[2]	Very Low	Less than 4373	48	14.2
	Low	4374 - 4615	23	10.6
	Moderate	4616 - 5101	25	21.6
	High	5102 - 5344	3	3.0
	Very High	More than 5344	2	50.6
AUSWE[3]	Very Low	Less than 1.06	46	12.6
	Low	1.06 - 1.12	24	11.9
	Moderate	1.13 - 1.24	26	22.0
	High	1.25 - 1.30	4	28.0
	Very High	More than 1.30	1	25.5

1 Average number of patient-days per cardiovascular separation.

2 Amount of constant 1986 U.S. dollars per average cardiovascular separation.

3 Average resource need index per cardiovascular separation.

in these centres. Furthermore, it is submitted that the rural areas were admitting patients with complex cardiovascular disorders who were then transferred promptly to metropolitan hospitals.

The research findings with respect to the AUSRE and AUSWE further supported the finding that rural districts generally had relatively low rates of resource utilization on a per case basis, while metropolitan districts had high rates of per case resource consumption. Only five districts had high or very high AUSREs and AUSWEs: Calgary, Edmonton, Stony Plain, Sturgeon, and Whitecourt. Calgary and Edmonton had the highest overall AUSREs of $5,350 (U.S.) and $5,479 (U.S.), respectively, and the highest overall AUSWEs of 1.29 and 1.32, respectively. Consequently, the cardiovascular case mix of the metropolitan districts was oriented toward more complex cases. The suburban-populated districts demonstrated moderate AUSRE and AUSWE values: Grande Prairie [$4,804 (U.S.), 1.16]; Lethbridge [$4,814 (U.S.), 1.17]; Medicine Hat [$4,717 (U.S.), 1.15]; and Red Deer [$4,867 (U.S.), 1.18]. Approximately 70 rural districts experienced AUSRE and AUSWE ~~values which~~ were significantly lower than the provincial AUSRE of $4,858 (U.S.) and the provincial AUSWE of 1.18; the majority of these districts had demonstrated high or very high SEPRATEs, PDAYRATEs, USRERATEs, and USWERATEs. Thus, the highest per capita consumption of hospital resources was reflected primarily by sparsely-populated rural areas, while the highest per case consumption of acute care resources was exhibited predominantly by the major urban centres.

In summary, the research findings associated with district variation in acute care hospital utilization by patients with cardiovascular disease revealed that:

(1) The provincial cardiovascular SEPRATE, PDAYRATE, USRERATE, and USWERATE for the three census years combined were 12.7 separations per 1,000 person-years, 154.1 patient-days per 1,000 person-years, $62 (U.S.) per person-year, and 15.0 weighted separations per 1,000 person-years, respectively.

(2) The SEPRATE and PDAYRATE distributions exhibited wide variability, while the USRERATE and USWERATE distributions indicated somewhat less variation. High and very high SEPRATEs and PDAYRATEs were reflected by 60 districts and 48 districts, respectively; 43 districts demonstrated high or very high USRERATEs and USWERATEs. Districts with high or very high utilization rates tended to be geographically located around the borders and northern area of the province, and accounted for a relatively small proportion of the total provincial service population. The major urban centres of Calgary and Edmonton consistently experienced SEPRATEs, PDAYRATEs, USRERATEs, and USWERATEs below the corresponding provincial rates.

(3) In contrast to the relatively low per capita consumption of acute care resources by metropolitan residents, the average cardiovascular separation generated in Calgary and Edmonton exhibited the highest average cost and resource need index. Furthermore, the ALOS values for these two districts were longer than the provincial ALOS figure of 12.1 patient-days per cardiovascular separation.

(4) Whereas a large number of sparsely-populated districts exhibited SEPRATEs, PDAYRATEs, USRERATEs, and USWERATEs at the high end of the

scale, the consumption of hospital resources according to the average cardiovascular separation generated in these districts was generally located at the low end of the scale, exhibiting values below the provincial AUSRE of $4,858 (U.S.) and the provincial AUSWE of 1.18.

(5) In general, the relatively high per capita resource utilization rates of numerous rural districts, in conjunction with a relatively low per case resource need index, would suggest a high use of acute care hospital beds for less complex cardiovascular diseases; in contrast, the relatively low per capita utilization rates by the major urban districts, in association with comparatively high per case resource needs, would suggest more stringent control of acute care beds oriented toward a more complex cardiovascular case mix.

4.4 Patient Origin-Destination Analyses

An investigation of the care-seeking behaviours of patients with cardiovascular disease in Alberta was conducted from two perspectives: (1) the district of patient residence (community-based); and (2) the hospital in which the patient received care (provider-based). The patient origin-destination analyses involved the aggregation of all cardiovascular DRGs, and was performed for the years 1971, 1976, 1983/84, and for the three years combined. In recent hospital utilization studies conducted in Alberta, the traditional indicators of SEPS and PDAYS were used as the measures of resource consumption. For this study, patient origin-destination analyses employed the DRG-based USRE (United States Reimbursement Equivalent) utilization indicator to more directly assess the resource consumption patterns of patients with cardiovascular disease. Thus, the interpretation of origin-destination analyses for this investigation is more directly associated with resource dependency and allocation patterns rather than with the movement of patients between districts of residence and hospital destinations. The research findings according to the two investigational strategies are presented in the following sections.

4.4.1 [illegible]ty Perspective

Relevance indices (RIs) were calculated to estimate the extent to which cardiovascular patients of a given geographic area depended on (or consumed the resources of) a particular hospital or hospital group. Accordingly, hospital districts in Alberta were aggregated to reflect: (1) the level of hospital care available, as depicted by metropolitan, regional, and rural divisions; and (2) the influence of geographic region on patient resource consumption, as represented by six regional divisions of the province.

Table 10 presents the RIs for the metropolitan, regional, and rural divisions by patient origin and destination. The RIs for the three areas indicated that the majority of patients with cardiovascular disease depended on the resources of hospitals within their own districts of residence for treatment. This finding supported the significance of distance minimization with respect to patient care-seeking behaviour. The tendency to consume resources in hospitals beyond the patients' resident districts was lowest for metropolitan residents and highest for rural residents. This was an expected finding as the availability of all levels of care in the

Table 10

Relevance Indices[1] for Metropolitan, Regional, and Rural Divisions: 1971, 1976, 1983/84

Utilization Measure	Patient Destination	Patient Origin Metropolitan Districts	Regional Districts	Rural Districts
USRE %	Metropolitan Hospitals			
	1971	98.1	20.6	25.7
	1976	98.6	28.1	34.4
	1983/84	98.8	32.3	42.7
	1971; 76; 83/84	98.5	28.1	35.0
	Regional Hospitals			
	1971	0.2	71.9	2.0
	1976	0.1	65.3	2.4
	1983/84	0.2	64.0	3.9
	1971; 76; 83/84	0.2	66.4	2.8
	Rural Hospitals			
	1971	1.7	7.5	72.4
	1976	1.3	6.5	63.2
	1983/84	1.1	3.7	53.4
	1971; 76; 83/84	1.3	5.6	62.2

1 Indices are calculated as percentages for cardiovascular charges ("United States Reimbursement Equivalent"). Theoretically, the sum of RIs over all hospitals for a given patient origin district and year is 100 percent.

metropolitan areas would minimize the need to seek care elsewhere, and conversely, the availability of only primary level care in the rural areas would stimulate the need to seek more complex levels of care.

A significantly high proportion of cardiovascular rural patients consumed resources in metropolitan hospitals (35.0 percent USRE overall); rural patients demonstrated a greater resource dependency on metropolitan rather than regional hospitals for cardiac care. Similarly, cardiovascular regional patients had a relatively high cardiovascular resource dependency on metropolitan hospitals (28.1 percent USRE overall). It is suggested that the "rural to metropolitan" and "regional to metropolitan" resource patterns in care-seeking behaviours for cardiovascular patients were influenced by the significant growth of cardiovascular medical technology, compelling patients to utilize the higher levels of care available in metropolitan hospitals.

An examination of trends between 1971 and 1983/84 revealed an increasing tendency for rural patients to consume cardiovascular resources in metropolitan hospitals, notably increasing from 25.7 percent USRE in 1971 to 42.7 percent USRE in 1983/84. (There was a concomitant decreasing trend for rural patients to depend on cardiovascular resources in hospitals within their own area, declining from 72.4 percent USRE to 53.4 percent USRE in 1971 and 1983/84, respectively.) Regional data also indicated an increasing tendency for cardiovascular patients from regional areas to consume resources in metropolitan areas, rising from 20.6 percent USRE in 1971 to 32.3 percent USRE in 1983/84. It is suggested that the effect of this increasing burden on metropolitan hospitals would have significant implications for resource allocation planning and decision-making.

Table 11 presents the RIs for six regional divisions by patient origin and destination. These six areas included Edmonton, Grande Prairie, and Red Deer in the northern part of the province, and Calgary, Lethbridge, and Medicine Hat in the southern part of the province. Each area contains a regional referral centre, although the areas vary regarding travel time and distance to these centres.

A high proportion of Grande Prairie and Red Deer residents depended on Edmonton cardiovascular acute care hospital resources, increasing from 19.8 percent USRE in 1971 to 37.6 percent USRE in 1983/84 for Grande Prairie residents, but decreasing slightly from 21.0 percent USRE in 1971 to 19.6 percent USRE in 1983/84 for Red Deer patients. Lethbridge, Medicine Hat, and Red Deer residents indicated an increasing resource dependency on Calgary hospitals for cardiovascular care; the RIs increased from 13.8 percent USRE in 1971 to 24.0 percent USRE in 1983/84 for Lethbridge patients, from 12.5 percent USRE in 1971 to 36.5 percent USRE in 1983/84 for Medicine Hat residents, and from 4.9 percent USRE in 1971 to 17.0 percent USRE in 1983/84 for Red Deer patients. The remaining RIs with regard to resource consumption in hospitals beyond patients' home regions were relatively small, implying chance occurrences of cardiovascular illness.

The proportion of cardiovascular resources consumed within local hospitals declined over time for all regions except Calgary and Edmonton. Both Calgary and Edmonton residents maintained a relatively

Table 11

Relevance Indices[1] for Six Regional Divisions: 1971, 1976, 1983/84

Utilization Measure	Patient Destination-Hospitals	Patient Origin-Districts: Calgary	Edmonton	Grande Prairie	Lethbridge	Medicine Hat	Red Deer
USRE %	Calgary						
	1971	96.1	0.4	1.0	13.8	12.5	4.9
	1976	97.3	0.4	0.1	19.1	23.8	6.3
	1983/84	97.2	2.0	1.5	24.0	36.5	17.0
	1971; 76; 83/84	96.9	1.0	0.9	19.6	26.2	10.0
	Edmonton						
	1971	3.1	98.3	19.8	7.0	6.2	21.0
	1976	1.6	98.6	34.4	4.4	5.1	24.6
	1983/84	1.9	97.1	37.6	1.5	2.9	19.6
	1971; 76; 83/84	2.2	97.9	31.6	4.0	4.4	21.6
	Grande Prairie[2]						
	1971	-	0.3	79.1	-	-	-
	1976	0.1	0.2	65.3	0.0	[illegible]	0.2
	1983/84	0.0	0.1	60.8	-	0.[illegible]	0.0
	1971; 76; 83/84	0.0	0.2	67.4	0.0	0.[illegible]	0.1
	Lethbridge[2]						
	1971	0.3	0.0	-	79.0	1.8	0.2
	1976	0.4	0.0	0.1	76.1	2.6	0.0
	1983/84	0.4	0.1	0.1	74.3	2.5	0.0
	1971; 76; 83/84	0.4	0.0	0.0	76.2	2.3	0.1
	Medicine Hat[2]						
	1971	0.1	0.0	-	0.0	79.5	0.0
	1976	0.2	0.0	-	0.0	68.6	-
	1983/84	0.0	0.0	-	0.1	58.2	-
	1971; 76; 83/84	0.1	0.0	-	0.0	67.1	0.0
	Red Deer[2]						
	1971	0.4	1.0	0.2	0.1	-	73.9
	1976	0.4	0.7	0.2	0.4	-	68.8
	1983/84	0.4	0.7	-	0.1	-	63.4
	1971; 76; 83/84	0.4	0.8	0.1	0.2	-	68.3

1 Indices are calculated as percentages for cardiovascular charges ("United States Reimbursement Equivalent"). Theoretically, the sum of RIs over all hospitals for a given patient origin district and year is 100 percent.

2 The complete absence of the utilization measure is denoted by "-". The relatively low frequency of the utilization measure is denoted by "0.0".

high resource dependency on hospitals within their respective districts.

4.4.2 Provider Perspective

Commitment indices (CIs) were calculated to estimate the extent to which selected groups of hospitals allocated cardiovascular resources to particular districts. Accordingly, acute care hospitals in Alberta were aggregated to reflect: (1) the commitment of metropolitan, regional, and rural hospitals; (2) the service commitment of hospitals located in the six regional divisions of the province; and (3) the commitment of Metro-Calgary and Metro-Edmonton hospitals to patients within selected districts.

Table 12 presents the CIs for the metropolitan, regional, and rural hospital groups by patient origin and destinatin. An inverse relationship was revealed between the level of care available within a hospital group and the commitment of that group to patients within their home district. Accordingly, metropolitan hospitals exhibited the lowest resource commitment (70.8 percent USRE overall) to cardiovascular patients from metropolitan districts, while rural hospitals demonstrated the highest resource commitment (96.0 percent USRE overall) for cardiovascular patients of rural districts. Regional hospitals, which typically offer primary and secondary levels of care, had a service commitment to regional patients ranging between the CIs of metropolitan and rural hospitals. Over time, the resource commitment of metropolitan and regional hospitals to their respective districts indicated consistently decreasing trends, while the

Table 12

Commitment Indices[1] for Metropolitan, Regional, and Rural Divisions: 1971, 1976, 1983/84

Utilization Measure	Patient Origin	Patient Destination: Metropolitan Hospitals	Patient Destination: Regional Hospitals	Patient Destination: Rural Hospitals
USRE %	Metropolitan Districts			
	1971	76.1	1.0	2.2
	1976	70.7	0.7	2.0
	1983/84	67.6	0.9	2.1
	1971; 76; 83/84	70.8	0.9	2.1
	Regional Districts			
	1971	3.1	86.4	1.8
	1976	4.5	85.3	2.2
	1983/84	5.2	79.8	1.7
	1971; 76; 83/84	4.4	83.2	1.9
	Rural Districts			
	1971	20.8	12.7	96.0
	1976	24.8	14.0	95.9
	1983/84	27.3	19.3	96.3
	1971; 76; 83/84	24.8	15.9	96.0

[1] Indices are calculated as percentages for cardiovascular charges ("United States Reimbursement Equivalent"). Theoretically, the sum of CIs over all districts for a given hospital [illegible] and year [illegible] 100 percent.

commitment of rural hospitals to rural districts remained stable during the 13-year period.

Origin-destination matrices also revealed the commitment of metropolitan, regional, and rural hospitals to cardiovascular patients residing outside their home districts. Of significance was the increasing allocation of metropolitan hospital resources to rural residents, rising from 20.8 percent USRE in 1971 to 27.3 percent USRE in 1983/84. To a lesser extent, the allocation of regional hospital resources to rural patients also increased during the study period, increasing from 12.7 percent USRE in 1971 to 19.3 percent USRE in 1983/84. Thus, between 1971 and 1983/84, metropolitan and regional hospitals devoted decreasing amounts of cardiovascular resources to residents within their respective areas, and concurrently, demonstrated a marked increased commitment of resources to cardiovascular patients from rural districts.

Commitment indices were also calculated to estimate the commitment of the six regional hospital groups to cardiovascular patients within and outside of their respective districts (Table 13). The allocation of cardiovascular resources by the Grande Prairie, Medicine Hat, and Red Deer hospitals to residents within their own regions slightly increased between 1971 and 1983/84, while the resource commitments by the Calgary, Edmonton, and Lethbridge hospital groups to their respective residents declined over time.

With regard to the resource commitment of hospital groups to patients residing outside of their respective regions, the Calgary hospitals consistently increased their proportion of cardiovascular resources to patients from the Lethbridge, Medicine Hat, and Red Deer

Table 13

Commitment Indices[1] for Six Regional Divisions: 1971, 1976, 1983/84

Utilization Measure	Patient Origin-Districts	Patient Destination-Hospitals: Calgary	Edmonton	Grande Prairie[2]	Lethbridge[2]	Medicine Hat[2]	Red Deer[2]
USRE %	Calgary						
	1971	92.7	1.6	-	1.1	1.4	1.7
	1976	89.9	0.8	0.9	1.6	2.2	1.8
	1983/84	83.6	1.1	0.1	1.8	0.4	2.4
	1971; 76; 83/84	87.9	1.2	0.3	1.5	1.3	2.0
	Edmonton						
	1971	0.7	91.7	2.8	0.2	0.6	7.3
	1976	0.7	90.8	2.3	0.3	0.1	6.1
	1983/84	2.9	91.5	1.9	0.4	0.4	6.5
	1971; 76; 83/84	1.6	91.3	2.3	0.3	0.4	6.6
	Grande Prairie						
	1971	0.2	2.1	97.2	-	-	0.1
	1976	0.0	3.8	96.4	0.1	-	0.2
	1983/84	0.3	4.1	97.9	0.0	-	-
	1971; 76; 83/84	0.2	3.4	97.2	0.0	-	0.1
	Lethbridge						
	1971	3.9	1.1	-	97.8	0.1	0.1
	1976	5.5	0.7	0.1	97.0	0.1	0.6
	1983/84	6.2	0.3	-	96.6	0.2	0.1
	1971; 76; 83/84	5.4	0.6	0.0	97.1	0.2	0.3
	Medicine Hat						
	1971	1.2	0.3	-	0.8	97.7	-
	1976	2.2	0.3	-	[illegible]	97.5	-
	1983/84	3.4	0.2	0.1	1.2	99.0	-
	1971; 76; 83/84	2.4	0.2	0.0	1.0	98.1	-
	Red Deer						
	1971	1.4	3.2	-	0.2	0.1	90.8
	1976	1.7	3.6	0.4	0.0	-	91.3
	1983/84	3.8	2.9	0.1	0.0	-	90.9
	1971; 76; 83/84	2.5	3.2	0.2	0.1	0.0	91.0

1 Indices are calculated as percentages for cardiovascular charges ("United States Reimbursement Equivalent"). Theoretically, the sum of CIs over all districts for a given hospital group and year is 100 percent.

2 The complete absence of the utilization measure is denoted by "-". The relatively low frequency of the utilization measure is denoted by "0.0".

Hospital Code	Hospital Name	Hospital Code	Hospital Name
81	Mary Immaculate (Mundare)	105	Two Hills Municipal
82	Myrnam Municipal	106	Valleyview General
83	Olds Municipal	107	St. Joseph's (Vegreville)
84	Big Country (Oyen)	108	Vermilion Municipal
85	Peace River Municipal	109	Viking Municipal
86	Picture Butte Municipal	110	Our Lady's (Vilna)
87	St. Vincent's (Pincher Creek)	111	Vulcan Municipal
88	Ponoka General	112	Wainwright General
89	Provost Municipal	113	Immaculata (Westlock)
90	St. Joseph's (Radway)	114	Wetaskiwin Municipal
91	Raymond Municipal	115	Mary Immaculate (Willingdon)
92	Red Deer General	116	Whitecourt General
93	Rimbey General	117	Fort McMurray
94	Rocky Mountain House General	118	Slave Lake General
95	George McDougall (Smoky Lake)	119	Sundre General
96	Holy Cross (Spirit River)	120	Sturgeon General (St. Albert)
97	Stettler Municipal	121	Grande Cache General
98	Stony Plain Municipal	122	Redwater General
99	St. Therese (St. Paul)	123	High Level Community
100	Taber General	125	Charles Camsell (Edmonton)
101	Three Hills Municipal	126	Colonel Belcher (Calgary)
102	Tofield Municipal	301	Blood Indian (Cardston)
103	St. Mary's (Trochu)	302	Medley (CFB Cold Lake)
104	Turner Valley Municipal		

B.4 HOSPITAL AGGREGATES

Hospital Divisions	Hospital Codes
Metropolitan	15, 16, 17, 18, 19, 20, 38, 39, 40, 41, 43, 44, 125, 126
Regional	56, 71, 72, 79, 92
Rural	All other hospitals
Calgary	2, 5, 14, 15, 16, 17, 18, 19, 20, 22, 26, 34, 36, 57, 60, 83, 84, 101, 103, 104, 111, 119, 126
Edmonton	1, 3, 10, 12, 13, 21, 29, 32, 33, 35, 38, 39, 40, 41, 43, 44, 45, 46, 52, 55, 58, 61, 64, 65, 66, 67, 69, 70, 77, 78, 81, 82, 89, 90, 95, 98, 99, 102, 105, 107, 108, 109, 110, 112, 113, 114, 115, 116, 117, 118, 120, 121, 122, 125, 302
Grande Prairie	6, 8, 49, 53, 56, 59, 62, 74, 76, 85, 96, 106, 123
Lethbridge	9, 23, 24, 27, 28, 50, 71, 72, 75, 80, 86, 87, 91, 100, 301
Medicine Hat	11, 48, 79
Red Deer	4, 7, 25, 30, 31, 37, 47, 54, 63, 68, 88, 92, 93, 94, 97