# THE HOSPITAL CHOICE OF AGED RURAL MEDICARE BENEFICIARIES: THE INFLUENCE OF PATIENT ATTRIBUTES, HOSPITAL ATTRIBUTES, AND SPATIAL ACCESS

A Dissertation Presented

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## ABSTRACT

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June 2000

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Although studies of hospital choice by non-elderly rural residents suggest that rural hospitals have been increasingly bypassed, the hospital bypass behavior of the rural elderly is a response to the need for specialized care. In addition, previous research has confirmed that desirable hospital attributes, some demographic characteristics (e.g., age and socioeconomic status), and increased distance also affect hospital choice, however, these studies are primarily on a regional basis. The current study adds to the existing literature by not only drawing data from a national sample of the elderly population but also examining extensive individual attributes including socioeconomic and functional status, satisfaction with and access to primary care, and prior hospitalization in the study of hospital choice of rural Medicare beneficiaries. Finally, gender difference in hospital choice behavior, which has not been the focus of the previous studies, will be extensively examined here.

## DEDICATION

**To**

**My Parents**

For the opportunities they have provided me for education

And

**My Husband, Rick**

For his continuous love and support

## ACKNOWLEDGMENTS

It is quite impossible to thank to all the people who have made this work possible individually. These people include faculty members, colleagues, staff, and friends. For them, I am always grateful for what they have done for me. Some individuals must be singled out for especial thanks. To my chair, Professor Frank Porell, for his continuous efforts in guiding me through during my entire time in the program and especially during the final parts of this process. Without his guidance on methodology and statistics, criticisms, and editing comments, this study would have been quite impossible. To Professor Francis Caro, for his encouragement, enthusiasm, and optimism all the time I have known him. His continuous efforts on policy issues kept my focus in the proper direction. To Professor Kathleen Adams, for assisting me with various methodology and data issues. Her expertise and past work on rural hospital choice really provided me valuable insights on various aspects of the study. Grateful thanks to Professor Gail Russell, for her genuine criticisms, suggestions, and editorial comments. My colleagues Michael Vaughan have my gratitude for having read and critiqued the entire manuscript. Sincerely thanks are also given to the Health Care Financing Administration for the fellowship support for my dissertation.

To the ones who not only made it possible, but also worthwhile: my family members. Thanks for their support and continuous encouragement throughout this process. Finally, I would like to thank my dearest husband, Rick. He has been patient listener, programming support, and critic, but most of all, the source of love that made me get through all these years.

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# CHAPTER I

# INTRODUCTION

## *1.1. Problem Statement*

On many dimensions of health, the rural elderly, as a group, are perceived to be disadvantaged in contrast with elderly residing in urban areas (Lessey & Lessey 1985, Dwyer et al. 1990). Some of the differences are attributed to lifelong income and education differentials between rural and urban elderly; a lower standard of living in rural areas; less availability and accessibility of quality health care in rural areas; and the greater distance involved in obtaining health care (Dwyer et al. 1990). For example, rural elderly often have to travel relatively far from home, or face more transportation problems to obtain medical care (Buczko 1992, Adams et al. 1991). Thus there are financial and other disincentives associated with medical service use. As a consequence, the rural elderly tend to use less health care and have somewhat more severe health problems than do urban elderly (Lessey & Lessey 1985, Dwyer et al. 1990).

Although some researchers found that rates of hospitalization are unrelated to either rural or urban residential location (McConnel et al. 1993), rural elderly who need more sophisticated and/or intensive hospital care may face more barriers to obtain needed services locally.

Because the most comprehensive and specialized treatment centers are largely located in urban centers --- where the most highly trained and specialized physicians are also concentrated (Hickey 1980).

Also, rural hospitals have traditionally practiced a less intensive style of care than urban hospitals. As a result, rural residents who require specialized care are often referred to urban hospitals that engage in more sophisticated care (Cromwell et al. 1987).

Effect of hospital bypassing or outmigration for hospital care can harm rural hospitals especially when they are the major employers or economic resources of the community. "Bypassing" or "outmigration" can be defined as shopping or using for services outside the local trade area. "Hospital bypassing" occurs when people choose to use a more distant hospital for medical services that are available at hospitals closer to their home (Bronstein and Morrisey 1991). With an increase in the use of capital intensive technology, health care costs in general, and public expectations for higher quality care, providers and payers have began to wonder if rural residents were increasing their outmigration to urban areas for the care that is available locally. Hospital bypassing creates two potential problems in rural hospital markets. First, local hospitals in rural areas are perceived as inferior to their urban counterparts and patients' bypassing may result in financial problems for rural hospitals. Second, if the above is true, rural residents who do not have economic, social, and physical and health resources to travel may experience access problems in obtaining needed health care.

Finally, it is greatly recognized that the problems of old age in America are largely the problems of women. Women 65 years and over outnumber their male

counterparts. This sex imbalance in the older population reflects higher male mortality at every age and is evident in each residence category. In addition, the sex imbalance among the aged has a very significant influence on the marital status and living arrangements of the elderly (Clifford et al. 1985). Because of longer distances involved in obtaining inpatient care in rural areas, it may pose serious access problems for rural women who survive longer as opposed to their male counterparts. Understanding gender differences in hospital choice behavior is essential because we can then determine whether older women encounter problems while accessing hospital care.

*1.2. Historical Perspectives of Rural Hospitals*

For the 20 percent of Americans who live in rural areas, the rural hospital is an essential source of health care (AHA 1997). In addition to being important to individual health security, the health care system interacts with every other important component of rural development such as agriculture, employment, transportation, education, social security, and other spheres (Roemer 1976). The rural hospital, as the center of the rural health care system, plays a significant role in the community—functionally, symbolically, and economically. The hospital ranks with the church and the school as the most important elements of rural society (Rosenblatt & Moscovice 1982).

In 1995, 42 percent of all community hospitals in the United States were rural hospitals (AHA 1997). Most rural hospitals are smaller in terms of beds set up and staffed for use. Rural hospitals are more likely to be government owned than urban hospitals although nearly half of the rural hospitals in the United States were owned by

private, nonprofit entities (AHA 1997). According to the AHA report, the number of rural community hospitals decreased by 57 between 1991 and 1995, and 52 of the 57 hospitals were government owned. These hospitals were not necessarily closed; some may have converted into outpatient or non-acute care facilities.

In the 1980s, hospitals generally experienced sharp reductions in inpatient volumes that may have been driven by advances in medical technology and changes in payment systems. These changes stabilized in the 1990s. The introduction of Medicare Prospective Payment System (PPS) pricing and the growth of managed care organizations encouraged the shifts of care to outpatient settings. In general, rural hospitals serve disproportionately more patients in categories affected by the introduction of the PPS, including indigents and elderly, and often receive lower reimbursements than urban hospitals for the same procedures due to urban/rural payment differentials (Moscovice 1989a). The declines in inpatient care were especially dramatic for rural hospitals: between 1980 and 1990, rural hospitals' admissions fell 37 percent and inpatient days dropped 31 percent (AHA 1997).

Hospitals, in general, have responded to the PPS by shortening lengths of stay and treating less severe cases on an outpatient basis (Prospective Payment System Commission 1990). Rural hospitals have a less severe case mix, practice less intensive care, and shift a greater percentage of their patients to outpatient status than urban hospitals (Prospective Payment System Commission 1990). Both volume and case-mix intensity are key factors affecting the financial survival of a hospital.

With diminishing inpatient volumes, rural hospitals have been unable to financially justify the adoption of new specialized services and advanced technologies (Hogan 1988). Lack of specialized services has further diminished the desirability of rural hospitals in the eyes of patients who seek quality inpatient care (Buczko 1994). At least one study suggests that both patients and physicians tend to choose more "modern" urban hospitals over less sophisticated rural hospitals (U.S. General Accounting Office 1990). The decrease of patients in rural areas leads to decrease in technology purchase, which further decreases the desirability of rural hospitals.

In the 1990s, many rural hospitals face increasing pressure from managed care or similar payment arrangements that force them to bear financial risks from capitation. By shortening length of stay, referring patients to lower-cost outpatient or long-term care settings, and matching staff levels to patient volumes, rural hospitals have successfully controlled hospital expenses (AHA 1997). Despite these successful cost containment efforts, rural hospitals heavily rely on government sources of revenue, and this dependence has increased since 1991. Medicare represents the single largest payer of rural hospitals, indicating the relatively high concentrations of elderly residents in rural areas (AHA 1997).

Generally speaking, the declines in the rural population in general, rural Medicare beneficiaries, and the rural economy (Prospective Payment System Commission 1990) have contributed to severe financial problems in rural hospitals that are less confronted in urban hospitals (Buczko 1992). The financial situations of rural hospitals have been a public concern since closures; reductions in service capacity, and fiscal instability may

increase the percentage of rural residents treated in urban hospitals (Buczko 1992). Lack of more sophisticated care among rural hospitals is especially important for older beneficiaries, who may have more difficulties than younger ones in traveling long distances for medical services. The financial difficulties of some rural hospitals also affect health care financing of the elderly population. In addition to access to care, the costs of health care for the rural elderly borne by Medicare will rise due to geographical variation in reimbursement under PPS, especially given the much higher payment rates for urban teaching hospitals.

Given the reasons discussed, rural hospitals' profitability, competitive power, and quality are uncertain. When patients bypass the less-equipped rural hospitals for more "modern" urban hospitals, the patient volume and case-mix intensity of the rural hospitals diminish. This in turn results in financial problems and sometimes the closure of these hospitals. Rural patients must travel farther to receive inpatient care. The associated increase of time for travel ("time-price") should reduce access to health care and utilization.

### *1.3. Recent Federal Initiatives*

Limited-service hospitals have been used to maintain health care services in rural communities with full-service hospitals at risk of closure. The Essential Access Community Hospital (EACH) program under OBRA 1989 legislation was an attempt to develop rural health networks consisting of Rural Primary Care Hospitals (RPCHs) and EACHs. RPCHs are limited-service rural hospitals that provide outpatient and short-term

inpatient hospital care on an urgent or emergency basis, then release patients or transfer them to an EACH or other full-service hospital. Hospitals to be designated as RPCHs had to meet certain criteria, including requirements that they not have more than six inpatient beds for acute care and maintain an average inpatient length of stay of no more than 72 hours. The program used cost-based reimbursement and relaxed regulatory requirements to help low-volume rural hospitals shift emphasis from acute care to primary care and emergency services.

A small number of rural hospitals had converted to the RPCH status since the program entered the implementation stage in late 1993. It was uncertain for rural hospitals regarding the financial impact of RPCH conversion and concerns with certain requirements. A preliminary analysis of the impact of statewide implementation of the EACH program in Iowa suggests that about 60% of rural hospital beds and about 28% of all hospital beds would be eliminated (Hilsenrath et al. 1991).

A similar 1997 federal Critical Access Hospital (CAH) legislation is the most recent nationwide alternative for maintaining health care in rural communities. The new legislation replaces the seven-state EACH/RPCH program with a new Medicare Rural Hospital Flexibility Program (MRHFP) under which limited-service hospitals known as critical access hospitals (CAHs) would be designated. To be a designated CAH, a facility must be located in a State that has established a MRHFP. Furthermore, it must be located more than a 35-mile drive from any other hospital or CAH with a bed-size limit of 15 beds, or is certified by the State as being a necessary provider of health care services to residents in the area. A rural health network is defined an organization consisting of at

least one CAH and at least one full-service hospital, the members of which have entered into certain agreements regarding referral and transfer, communications, and patient transportation.

Twenty-one states were moving formally toward involvement in the program. It was estimated that between 183 and 227 hospitals would convert to CAHs in the next one to two years (Reif and Ricketts 1999). While the CAH program shows some promise for successful implementation (Reif and Ricketts 1999), the impacts of rural hospital conversion to CAHs on hospital choice especially for rural elderly should be carefully scrutinized.

*1.4. The Health Status of Rural Elderly and Their Utilization of Health Care*

In general, data in the 1980s indicated that the proportion of the population 65 years and older in urban and rural areas was 11.4 percent and 10.9 percent, respectively. This reflected a shift from previous decades when the elderly population in rural areas constituted a smaller percentage relative to urban areas (Coward and Lee 1985). This trend continues into 1990s. In 1990, persons older than age 65 made up 17.7 percent of the population in the communities fewer than 1,000 persons compared to 12.6 percent for the United States (Bureau of Census 1992). Moreover, the rural elderly are not evenly distributed in all parts of the United States (Dwyer et al. 1990).

In terms of population statistics in the 1980s, studies have concluded that rural elderly were less likely to be the "oldest-old", more likely to be married, and more likely

to be white than their urban counterparts. The rural elderly were also more likely to be in poverty than were the urban elderly (Dwyer et al. 1990).

Elderly rural residents experience the same kind of chronic health problems as the general elderly population including difficulties with: arthritis, blood pressure, respiratory system, heart, digestive track, sight, and hearing (Krout 1995). In the study of health status among elderly population, Krout (1985) concluded that no empirical evidence exists on rural disadvantage. Whereas many studies concluded that rural elders, nevertheless, as a group, still appear to be relatively disadvantaged on many dimensions including health status and access to health care services (McCoy and Brown 1978, Dwyer et al.1990).

In many ways, health status is better measured by assessing the functional status of individuals, either reflected in their own appraisal of their health conditions or by measuring the number of days in which they are restricted from performing usual activities (Rosenblatt and Moscovice 1982). Recent studies using data from a nationally representative data set concluded that the functional status of the elderly does not conform to a rural-urban continuum. The relationship between residence and health disappeared after controlling for various characteristics of elders such as age, gender, education, and living arrangement (Cutler and Coward 1988). However, some data shows that an interrelationship exists between economic status and disability. McCoy and Brown (1978) found that there is a rural-urban difference, with rural elderly rating themselves lower with respect to physical activity limitations even after taking economic conditions into consideration.

The literature in the 1980s, in general, confirmed that rural elders were disadvantaged relative to their urban counterparts in the availability and accessibility of both community-based and institutional health services (Cutler and Coward 1988, Dwyer et al.1990). However, a more recent study revealed that the utilization patterns of hospitals, nursing homes, and physicians were unrelated to either rural or urban location (McConnel and Zetzman 1993). In terms of inpatient utilization, studies have not confirmed the rural differential in service use (Coward and Lee 1985, McConnel and Zetzman 1993). Although quality and service capacities of hospitals are highly variable, the most comprehensive and specialized treatment centers are largely located in urban centers.

In general, previous studies have found no consistent findings on differences in health status and health care utilization between rural and urban elderly. In terms of social interactions, rural elders are even better off as opposed to their urban counterparts. They are more likely to be married and live with others as opposed to their urban counterparts (Dwyer et al. 1990). They have a lower mortality risk and are less likely to be the oldest-old compared with urban elderly (Smith et al.1995). Therefore, in the study of hospital choice behavior, we have to acknowledge that rural elderly, as a very diverse group, do not experience better or worse health conditions and health care access as opposed to urban elderly. In some dimensions, they compare favorably to urban elderly.

*1.5. Old, Female, and Rural*

When compared to their urban counterparts, rural elderly women are often portrayed as economically and health disadvantaged (McCulloach 1998). They are less likely to be educated and are more likely to experience life-long histories of limited employment opportunities (Lingg et al. 1993, McLaughlin and Holden 1993). Porter (1989) noted that the economic disadvantage of rural elderly women is compounded by the large percentage of rural female-headed households (39%).

Since women tend to outlive men, and as women age, they are far more likely to live alone and experience chronic health problems than to men. These factors further complicate the disadvantages of rural older females in accessing health services. The access and utilization pattern of inpatient care is of interest because of the proximity issues involved in accessing health care in rural areas. It would be especially difficult to access care necessary for oldest-old women with difficulties in physical functioning. On the other hand, if older women were more likely to visit their physicians than men, holding other factors constant, they may be more likely to visit physician regularly and/or be hospitalized in facilities closer to their homes than men.

In a study of Johnson County, TN, researchers did find that women perceived financial barriers to health care significantly more than men did, even when living in the same household (Beck et al.1996). This highlights the importance of assessing gender differences in the hospital choice behavior of older women in rural areas.

Gender differences in various socioeconomic characteristics, health status, and health services utilization may have also influence hospital choice. Women live longer;

therefore they are more likely to suffer from chronic diseases and functional impairment in old age. Although gender difference in the frequency of doctor visits has been well established in the literature, studies on hospital utilization have not drawn a firm conclusion regarding gender differences. Women's higher doctor visits and closer tie with their primary physicians can possibly lead to different hospital choice behavior from men. Understanding gender differences in hospital choice behavior is essential because we can then determine whether older women who are more likely to live alone, stay unmarried, and have functional limitations encounter problems while accessing hospital care. For instance, if the coefficient of ADL limitations was negatively associated with choice of urban teaching hospital over the closest rural hospital for women but not for men, holding everything constant, it maybe an indication of access barriers for older women living in rural areas.

*1.6. Limitations of Previous Research*

Over the past two decades, health care research has made important contributions toward understanding the process of hospital choice among rural elderly populations. These studies used claims data on specific geographic areas and had the following shortcomings. First, they have limited information on individual attributes other than basic demographics and diagnostics. Second, their use of data on regional market areas raises a question on the studies' generalizability. Finally, previous studies did not only investigate gender differences in hospital choice behavior. The current study will not draw data from a national sample of the elderly population but also examine extensive

individual attributes including socioeconomic and functional status, satisfaction with and access to primary care, and prior hospitalization in the study of hospital choice of rural Medicare beneficiaries. Also, gender difference in hospital choice behavior, which has not been the focus of the previous studies, will be extensively examined here. More detailed discussions on how the current study is going to address limitations from previous literature will be presented in the Chapter 3.

*1.7. Policy Concerns*

In general, there are four major policy concerns regarding rural hospitals from the perspectives of government, hospital providers, and rural patients. First, the questions about the extent to which rural hospitals should remain open, be consolidated, or converted into outpatient clinics. Second, the questions about the extent to which stronger relationships should be developed among hospitals so that rural hospitals can remain open but their patients have access to the more specialized care available elsewhere when they need it. Third, questions about what the rural hospital can do to strengthen their facilities and services so that they are more competitive. Fourth, questions about what the rural hospital can do to improve the effectiveness of their marketing to physicians and patients.

The study of hospital bypass behavior by aged rural Medicare beneficiaries will provide information about the consumers' preferences for various hospital attributes. This information can be used by hospitals to assess how sensitive patient volume may be

to the expansion of existing or new services. Hospitals then could expand new or existing services to attract patients.

In addition, the specification of more individual patient attributes than previous studies should help to better distinguish sub-populations who need specialized care but are restricted to utilizing them in urban areas. It has been suggested that the oldest-old are less likely to bypass rural hospitals and seek care in urban hospitals (Adams et al. 1991). Given that most studies of hospital choice use claims data, there is relatively little information about population subgroups that might also have limited spatial access to hospital care. For example, functionally impaired elderly may be less likely than other rural Medicare beneficiaries with the same illnesses to access more sophisticated care in urban facilities and may require targeted programs to enhance their access to adequate care.

Hospital choice models can also be employed in the planning and analysis of policy impact (Porell & Adams 1995). Nearly all levels of government are concerned with the factors that influence a patient's choice of hospital. By knowing the probability that individuals with given characteristics will choose one type of hospital over another, the impact of hospital closure, adding or removing beds, and down-scaling of services (e.g., CAH) can be estimated.

### *1.8. Purpose of the Study*

The main purpose of this study is to identify empirically both individual and hospital factors associated with hospital choice behavior among aged rural Medicare

beneficiaries. Unlike earlier studies which either employed regional data to estimate aggregate hospital choice models or employed regional claims data to estimate disaggregate hospital choice models, this study will estimate a disaggregate hospital choice model from a national sample of aged rural Medicare beneficiaries. The analytic version of the MCBS, which contains zip code, county and state identifiers, will be used. The use of rich MCBS data will permit analyses of the influence of numerous patient attributes on hospital choice (e.g., functional status, provider satisfaction) not available in hospital claims. Furthermore, the use of a national sample of rural Medicare beneficiaries will enhance the ability to generalize study findings to the nation's rural elders that is not available in hospital claims data.

This study attempts to answer the following questions:

1) To what extent do aged rural Medicare beneficiaries bypass the closest rural facility when in seeking inpatient care?

2) What are the individual and hospital attributes that determine whether or not an aged rural Medicare beneficiary bypasses the closest rural hospital and travels to other types of hospitals for inpatient care?

3) To what extent does gender influence hospital choice for aged rural Medicare beneficiaries?

### *1.9. Overview of the Study*

Chapter 2 contains an introduction to the hospital choice models and definitions of hospital market areas. It also reviews the current body of literature on hospital choice

and hospital bypassing behavior. The literature review involves comparison of empirical findings across different studies. Chapter 3 focuses on the data sources, the analytical designs, and most importantly, the construction of hospital market areas. Chapter 4 presents both descriptive statistics for the study sample and bivariate relationship between characteristics of the study sample and hospital choice behavior. Chapter 5 contains empirical findings from the conditional logit analyses on hospital choice. Discussion, conclusions, policy implications, and suggestions for future research are presented in chapter 6. An appendix contains detailed descriptions of various variables and data constructions that are mentioned in the body of the dissertation.

# CHAPTER II

# LITERATURE REVIEW

## *2.1. Hospital Choice Models*

### 2.1.1. Definitions of the Hospital Choice Model

Since the term "choice model" may differ among various academic disciplines, it is appropriate to define the term for the study. In their review article, Porell and Adams (1995) define hospital choice model as

> "A statistical model where discrete admissions to specific hospitals or types of hospitals are specified to be a function of the attributes that characterize patients, and/or the set of hospitals among which people can choose."

As they also state, these definitions contain no explicit assumptions about the actual choice processes. In the most widely used health services use model, Andersen (1968) theorized that health services use is determined by three broad sets of factors: (1) medical need factors; (2) predisposing factors such as age, gender, or race; and 3) enabling factors, such as income. The actual decision-making process, however, is so complex that it takes many steps to produce the final observation: a patient's admission to a particular hospital.

Besides, it is not clear to what extent the hospital choice is affected by patients versus their physicians. Therefore, under the general definition of the hospital choice model, it is not who chooses the hospital or how the hospital gets chosen that really matter. More importantly, patients' or physicians' preferences for hospitals can be reasonably expressed in terms of attributes that admission choices are based upon. For example, if patients or physicians prefer admissions to more sophisticated hospitals over less sophisticated ones, urban hospitals over rural ones, and older patients prefer closer hospitals to more distant ones, and these attributes should be reflected in a systematic way when all other factors are controlled for. In other words, the statistical models for identifying the preferences of patients and/or physicians for individual hospitals or hospital types are considered hospital choice models.

### 2.1.2. Gravity Model

The earliest multivariate hospital choice models were applications of the social gravity model of spatial interaction (Porell and Adams 1995). The social gravity model hypotheses that a greater level of spatial interaction is expected at two population masses at those points, and the lesser is expected at the spatial distance between them (Stewart 1948). In the context of hospital choice, the number of patients from the community admitted to the particular hospital is positively determined by total population size of the community and its composition, and the capacity and service mix of the hospital, while it is inversely determined by distance and intervening opportunities. For example, Morrill and Earickson (1970) incorporated the aggregate number of hospital beds in all hospitals

closer to a given community as the "intervening hospital opportunity" that affects admissions to a particular hospital. However, the implicit choice process underlying early gravity models is limited (Porell and Adams 1995).

2.1.3. Aggregate Hospital Choice Model

Recently, researchers have used aggregate hospital choice model to study hospital choice behavior. The model specifies that expected market shares of a community's total hospital admissions are distributed among hospital alternatives in proportion to how attractive hospitals are to the patients and/or physicians, and in inverse proportion to how distant hospitals are to the community (Porell & Adams 1995). The expected market shares sum to one unity. These facility-level models were estimated by geometric means linearized through logarithmic transformation (Buczko 1994).

Studies have used this model with aggregated patient-origin data to estimate the effects of hospital attributes on the probability of choosing one hospital over another (Earickson & Finkler 1985; Folland 1983; Cohen & Lee 1985; Garnick et al. 1989; Luft et al. 1990; Burns & Wholey 1992; Phibbs et al. 1993; Porell 1986). One major limitation of using aggregate choice model is that patient attributes could not be incorporated in assessing hospital choice. The homogeneity of patient preferences is often assumed and incorporated in this type of the model (Porell & Adams 1995).

Studies using aggregate hospital choice models vary with the definitions of dependent variables and market areas, the set of hospital characteristics used, the econometric methods applied, and primarily estimated separate equations of patient-level

information for sub-groups. These studies are important in the sense that they tested all-inclusive other than only intervening alternatives and a wider range of hospital attributes (Porell and Adams, 1995).

2.1.4. Disaggregate Hospital Choice Model

Based on the conditional logit model developed by McFadden (McFadden 1974), studies on hospital choice have applied disaggregate conditional choice models in the study of hospital choice behavior (Adams et al. 1991; Bronstein & Morrisey 1991; Dranove et al. 1989; Kim 1990; Buczko 1992; 1994). These models are estimated by maximum likelihood methods and include binary (two alternatives) or multinomial (more than two alternatives) models.

Conditional upon a choice being made, the factors explaining the relative probabilities of selecting certain alternatives could be estimated (Porell and Adams 1995). The probability of choosing one hospital (i.e., teaching, urban) over another (i.e. non-teaching, non-urban) is a linear function of characteristics of individuals (e.g., age, gender, etc.) and characteristics of hospitals attributes (e.g., beds, service capacity, etc.).

Although conditional choice models allow incorporating patient attributes for estimation, the estimated coefficients for patient attributes must be alternative specific to be incorporated into the models. While many patient attributes and hospital alternatives exist, the number of positive parameters to include in the model increase as well. Therefore, most disaggregate choice model have been estimated with choice sets defined

in terms of typologies of hospitals (e.g., rural versus urban, different types of hospitals) rather than individual hospitals (Adams et al. 1991, Kim 1990).

Disaggregate choice models incorporate patient attributes but are more sensitive to bias when irrelevant alternatives are specified (Buczko 1994). However, grouping similar hospitals into hospital types reduces the bias associated with the incorporation of irrelevant alternatives (Adams et al. 1991).

### *2.2. Defining Hospital Market Areas*

Earlier studies of hospital choice generally assume that the market area coincides with an existing geographic or jurisdictional entity. For rural hospitals, the county is usually assumed to be the appropriate unit for the analysis of hospital choice. On the other hand, the Metropolitan Statistical Area (MSA) is typically the unit for urban hospitals in the study of hospital choice (Folland 1983; Erickson and Finkler 1985; Hogan 1988). When examining these hospital market area definitions, several other researchers have concluded that it is unlikely that hospital markets conveniently coincide with these geographic boundaries (Garnick et al. 1987; Morrisey, Sloan; Valvona, 1988; Wright & Marlor 1990). For rural areas, the county may be narrow in many situations, while MSA is too large to represent to true hospital market area (Goody 1993). In addition, this definition does not consider the basic economic principles: demand of consumers and supply of providers (Porell and Adams, 1995).

Furthermore, hospital market area can be defined from either the patient's or the hospital's perspectives (Luft et al. 1990). The patient, or physicians acting as their

agents, may consider only a few of the available alternatives in the hospital market area as "relevant alternatives". The number of "relevant alternatives" may be limited by the patient or physician's willingness to travel. Relevant attraction can also be determined by the severity of type of illness the patient has. The maximum distance patient or physician is willing to travel for defining hospital market area has not empirically established. This may be due to the availability of relevant data sets on patients, physicians, and hospitals' information and the complexity of linking them together if they are available. However, empirical studies have confirmed the importance of distance on hospital choice (Goody 1993).

Therefore, some researchers have used the hospitals' perspective to delineate market areas by estimating radii around a hospital or hospitals (Garnick et al. 1987). The assumption about the distance patients and their physicians are willing to travel does vary depending the geographic characteristics of the areas. In addition, this method ignores barriers that may be encountered by patients and their physicians. It is often assumed that hospitals are located at the center of market area, assumption that is not always true (Goody 1993).

Hospital markets definition from patients' perspective is very prevalent in recent hospital choice literature (Porell and Adams 1995). The use of patient origin information does implicitly reflect travel distances of patients in the face of existing alternatives and geographic barriers.

The market areas are comprised of a group of zip codes within which patients share similar patterns of hospital choice. The contribution of zip codes to total (hospital

or area) discharges and patients flows in or out of the "market area" was often used as criteria for clustering zip codes. Studies often use patient origin information to create the baseline catchment areas for hospitals although these studies used various cutoff percentages of a hospital's discharges to determine where the market starts and stops. The cutoff points have ranged from 50 to 90 percent (Goody 1993). Zwanziger, Melnick, and Mann (1990) found measures of market concentration to be robust across various cut-off points. After the baseline catchment areas are determined, patient origin information is then used to determine where patients go to get care. If a hospital is a majority provider in an area, the zip code is added to the baseline catchment area.

For example, Adams et al. (1991) used the travel patterns of residents surrounding three hospitals located in Fergus Falls, Breckenridge, and Alexandria in Minnesota to delineate the hospital market area. They first examined zip codes in Minnesota, North Dakota, and South Dakota to determine if they had Medicare discharges from any of these three hospitals. All zip codes with at least three Medicare discharges were identified. Then, any other hospitals that served at least three discharges from this set of zip codes were included in the market area.

Studies on hospital choice to some extent must explain the derivation of hospital market areas. Although most recent studies used patient flows to draw market areas for hospitals, the debates on different merits of alternative definitions, focal points of the market, and the decision rules on inclusion or exclusion of hospitals have been well documented (Porell and Adams 1995). Failure to include hospitals that compete with

each other and to exclude non-competing ones can affect the parameter estimates in empirical models of hospital choice behavior (Goody 1993).

Since the purpose of the study is the bypassing behavior of inpatient care of a random sample of the nation's Medicare beneficiaries, the focal point of the market area is the patient's residence. Although none of the hospitals in the nation would be technically excluded since distance to beneficiaries' residence and capacity of a hospital can be determined to group alternatives, a cutoff point is still chosen to exclude outlier cases. A more detailed description of hospital market area delineation will be presented in the methodology section.

### *2.3. Previous Empirical Findings on Hospital Choice Behavior*

#### 2.3.1. Hospital Bypassing Behavior for Inpatient Care by Rural Residents

Hospital choice behavior is studied in both rural and urban areas. Since rural hospitals are often perceived to be inferior to urban ones, and urban residents seldom use hospitals in the rural areas, the study of hospital bypassing behavior has concentrated on patients living in rural areas.

Does hospital bypassing in rural America frequently happen? The prevalence of hospital bypassing the rural or closest facilities varies among studies conducted in different parts of the country. In Alabama, about 40 percent of rural women did not use their geographically nearest obstetrics hospital to deliver their babies because of the lack of technologically advanced obstetrics units in these hospitals (Bronstein and Morrisey 1991). Local hospital bypassing was very common in Iowa (Mowery 1992). In contrast,

over 70 percent of all hospitalizations of rural patients took place in their county of residence in New York State (Hogan 1988). Similarly, about 82 percent of elderly rural Medicare beneficiaries in Delaware with a hospital in their ZIP code area were hospitalized locally (Buczko 1994). Of the 12,266 Medicare discharges, 40 percent of rural Medicare beneficiaries in the states of Minnesota, North Dakota and South Dakota hospital bypassed their closest hospitals (Adams et al. 1991). The percentage increases up to 79 percent if the closest hospital was a large facility. The only study using national data to examine the hospital bypassing behavior found that 30 percent of rural Medicare beneficiaries were hospitalized in urban areas in 1989. This percentage has been stable since 1984 (Buczko 1992).

Where are rural residents who did not use their local hospitals hospitalized? Again, the answer varies geographically. Of those rural patients who crossed county borders in New York for hospitalization, almost two-thirds of them traveled to urban facilities (Hogan 1988). About half of rural Medicare beneficiaries in Delaware who did not use their local hospitals were still treated in another nearby rural hospital (Buczko 1994). Of those aged rural Medicare beneficiaries who used a facility other than the closest hospital, less than half (43 percent) used other rural facilities (Adams and Wright 1991).

Furthermore, the extent to which hospital bypassing behavior occurs and the choice among alternatives appear to depend upon the type of care the patient is seeking, patient's characteristics, and geographic location under study. The percentage of those who used other rural facilities over their closest rural hospital went down to only nine

percent when the closest hospital is a larger facility (Adams and Wright 1994). Also, the rate of hospital bypassing is suggested to be lower among the "old-old" which could be a result of frailty or functional limitations (Adams et al. 1991). Again, the percent of hospital bypassing to urban facilities among rural Medicare beneficiaries varies by case mix of patients. For example, about 47 percent of rural Medicare beneficiaries used urban facilities for major joint or limb reattachment procedures while only 16 percent used them for simple pneumonia and pleurisy (Buczko 1992).

Recent research on obstetrics care have also found that about 40 percent of the women did not utilize their nearest obstetrics hospital to deliver their babies in Alabama maybe because of the lag of technologically advanced obstetrics units of these hospitals (Bronstein and Morrisey 1991). However, it is also indicated that the use of non-local hospitals varies according to pregnancy risk level of the patients as well (Phibbs et al. 1993). Compared to other types of medical care, the rate of hospital bypassing to urban hospitals among rural women for obstetric care seems to be higher.

Even though studies indicated that some rural residents have abandoned nearby rural facilities to seek medical services in urban hospitals, the majority of rural patients stayed in their neighborhoods (Buczko 1992, 1994; Adams and Wright 1991; Adams et al. 1991; Bronstein & Morrisey 1990, 1991; Codman Research Group Inc. 1990). Even when the elderly bypassed their closest hospitals, many rural elderly were still treated in other nearby rural facilities (Buczko 1994). The decision to bypass their closest hospitals or the decision to choose urban over other rural facilities after hospital bypassing depends upon various individual and facility factors. Since most studies of bypassing rural

hospitals have used data restricted to a region, State, or geographic areas the findings cannot be generalized to the nation.

### 2.3.2. Importance of Distance and Its Relation to Other Individual and Hospital Characteristics on Hospital Choice

The earliest empirical research on hospital choices focused the influence of distance on hospital choice. The research consistently showed that patients have a strong tendency to be admitted to the closest hospital to their homes (Morrill and Earickson 1968). That is, as distance increases, the number of persons using particular providers declines (Porell & Adams 1995). The literature also found that hospital admissions are negative exponential functions of distance (Morrill and Earickson 1968, Bashshur, Shannon, and Metzner 1971).

Even controlling for individual and hospital attributes, increase in *distance* has been found to have a significant deterrent effect on hospital choice, especially for older patients (Adams et al. 1991; Cohen & Lee 1983; Erickson & Finkler 1985; Folland 1983; Garnick et al. 1989; Luft et al. 1990; Burns & Wholey 1992; Phibbs et al. 1993; Porell 1986). A significant negative association between distance or travel time and choice of a hospital has been uniformly found in the past research. Rural Medicare beneficiaries strongly prefer to travel shorter distances to obtain inpatient care, holding everything else constant.

In addition, the importance of distance on hospital choice varies on the characteristics of patients, admitting hospitals, and the availability of other neighborhood

hospitals. For example, in the presence of a *teaching hospital* in an adjacent urban area, or when an urban hospital with *larger scopes of services* is accessible, patients tend to overcome the deterrent of distance on hospital choice (Adams et al. 1991). The importance of travel distance to hospitals also varies with patient attributes such as race, religion, and income (Morrill, Earickson, and Rees 1970).

Furthermore, mean travel times to the hospital vary across *diagnoses* (Mayer 1983; Kane, et al. 1978) and *ages* (Adams et al. 1991). For instance, psychiatry and pediatrics patients were less sensitive to travel time (Cohen and Lee 1985). More severely ill patients tend to travel farther for medical care (Folland 1983). "Old-old" tended to be treated locally instead of traveling longer distances regardless of the complexity of the illness (Adams et al. 1991). Although those over 85 exhibited preferences for a greater scope of service, they tended to choose smaller rural facilities and sought surgical services closer to home. On the contrary, those under 75 preferred a higher scope of service and size and were more likely to bypass small rural hospitals.

Later studies found that the influence of distance varies with both the type of hospital admission and type of hospital (Porell and Adams 1995). For instance, Mayor (1984) found that patient sensitivity to distance is higher for common diagnoses or procedures (e.g., pneumonia) than for more specialized care (e.g., heart operations).

It is worth noticing that it is not only the distance to the admitting hospital that matters but also the distance to other hospitals in the market area. For example, the distance to the closest hospital was found to be positively associated with the probability of hospital bypassing the nearest facilities for obstetric care. But the distance to the next

closest and metropolitan hospital was negatively associated with the probability of bypassing the nearest facilities (Bronstein and Morrisey 1990; 1991).

2.3.3. The Relationship of Hospital Attributes on Hospital Choice Behavior

Several indicators were used to identify the characteristics of a hospital. Patients, in general, prefer bigger hospitals than smaller ones and teaching hospitals than non-teaching ones. They also tend to choose hospitals with a large scope of service, holding other factors constant.

The *number of acute care beds* has generally been found to be positively associated with choice of a hospital (Folland 1993; Cohen and Lee 1985; Porell, 1986; Bronstein and Morrisey 1990; Adams et al. 1991; and Buczko 1991). For instance, the availability of acute care beds in metropolitan area was positively associated with probability of bypassing local facilities for obstetric care (Bronstein and Morrisey 1990). Adams et al. (1991) found that an increase in size of ten beds increased the odds of choosing a hospital by 1.7 percent. Patients view *teaching* hospitals more favorable than non-teaching ones (Luft et al. 1990; Burns and Wholey 1992; Phibbs et al. 1993; and Adams et al. 1991).

The more extensive *service capacity* a hospital has, the more likely it will attract patients. The Guttman Scale is based on the principle of cumulative scaling, which takes advantages of the tendency of hospitals to acquire service capabilities in a predictable (from the most common to the least common) sequence. Each hospital is scored by its highest-ranking (least-common) service (Adams et al. 1991). Guttman scale of service

capacity was found to be positively associated with choice of such hospital (Adams et al. 1991). Studies that used other measures of service capacity also found its positive influence on choice on the choice of a hospital (Cohen and Lee 1985; Erickson and Finkler 1985; Porell 1986; Burns and Wholey 1992; and Phibbs et al. 1993). For example, hospitals with high-level newborn intensive care were preferred over the ones with lower levels (Phibbs et al. 1993).

Patients prefer hospitals with better *clinical outcomes*. Several studies have used "better than expected" outcomes on mortality and complications on the probability of hospital choice (Garnick et al. 1989; Luft et al. 1990; Phibbs et al. 1993; and Burns and Wholey 1992). Better outcomes, measured by the risk-adjusted Z score for prenatal mortality increased the probability that a mother would choose to deliver at a particular hospital (Phibbs et al. 1993).

Patient and payer mix volumes are found to be associated with the probability of hospital choice. Garnick et al. (1989) found that the aggregate volume of patients transferred in from other facilities had a positive effect on admission probabilities while the volume transferred out had a negative effect. Local hospital Medicare caseload was negatively associated with choice of bypassing local hospitals to non-local ones while Medicare caseload of the treating hospital had a positive effect (Buczko 1994). Bronstein and Morrisey (1991) found that birth volume of the closest hospital was negatively associated the decision to not use that hospital.

Hospital ownership also influences hospital choice, however, the empirical results are not conclusive. Garnick, et al. (1989a) found that patients were more likely to go to

public hospitals over proprietary ones. Luft, et al.(1990) also found that patients were more attracted to both public and proprietary hospitals than voluntary hospitals. Also, Phibbs et al. (1993) found that Catholic and public hospitals were more attractive than proprietary and district hospitals. Finally, women were less likely to bypass their closest facilities when the nearest hospitals were public whereas they were more likely to bypass the closest facilities when the second hospital was public (Bronstein and Morrisey 1991).

The attributes of alternative hospital in a market area are important in determining the choices of patients. The probability of bypassing for obstetric care was negatively associated with the number of beds in the closest hospital. On the other hand, it was positively associated with the number of beds of the next closest and the closest metropolitan hospital (Bronstein and Morrisey 1990, 1991).

2.3.4. Physician Influence on Hospital Choice Behavior for Inpatient Care:

Both patients and physicians contribute to the decision on where the patients will be hospitalized. Although it is not obvious to what degree physicians exercise power on hospital choice of their patients (Porell & Adams 1995), a number of decision-making processes are suggested by previous studies (Luft et al. 1990, Garnick et al. 1987).

First, it is suggested that physicians act as the patients' agents and are assumed to be the primary decision-maker in hospital choice (Luft et al. 1990 and Garnick et al. 1987). Under this model, treating physicians, not patients, decide where patients are hospitalized. Although physicians take the patients' preferences into account, once patients choose their physicians, the choice is restricted to hospitals where the physician

has admitting privileges. Therefore, hospital choice depends upon the admitting privileges and referral patterns of physicians.

Physicians affiliate with particular hospitals for various reasons such as proximity, exposure during medical training, and the hospital affiliation of group (Earickson 1970). In metropolitan Chicago, 30 to 68 percent of physicians were affiliated with the closest hospital to their offices (Earickson 1970). These physicians were also just as likely to be affiliated with a hospital beyond the one closest to his office as he was to the closest hospital. Therefore, the chance of a patient going to the closest hospital is reduced. The proportion of physicians affiliated with their closest hospital was higher in the suburban areas (Earickson 1970). This pattern may suggest a higher proportion of physicians who will affiliate with their closest hospitals in rural areas. When physician referral patterns dominate hospital choice, the chances that rural patients will go to their closest hospital should be much higher.

Other researchers suggested that patients play a more active role in choosing a hospital (Morrisey et al. 1988, McGuirk & Porell 1984). A patient's choice of the physician-hospital bundle is suggested in the hospital choice model in these studies. That is, patients consider physician's affiliation with specific hospitals in their choice of physicians. Therefore, the patients' choice of physicians is influenced by preferences for particular hospitals (Porell & Adams 1995).

Patient surveys report that patients play a significant role in the choice of hospitals. Several patient surveys revealed that general quality, range of services, and staff quality were among the most important factors influencing hospital choice, while

physician recommendation ranked among the lowest factors (Jackson & Jensen 1984; Berkowitz & Flexner 1981; Boscarino & Steiber 1982). Furthermore, in at least two surveys, 16 and 26 percent of respondents respectively reported that they chose the hospitals themselves (Jackson & Jensen 1984, Berkowitz & Flexner 1981). Over a half of those respondents reported that choice of the hospital was a result of active collaboration with physicians. About 75 percent of respondents indicated a specific hospital for future use.

Physician influence was specified as a hospital attribute in many studies (Folland 1983; Cohen and Lee 1985; Erickson and Finkler 1985; Porell 1986). The number of physicians with affiliated admission privilege and the physician per bed ratio were found to have a positive influence on hospital choice. The results indicated an increased probability of hospital choice (Porell and Adams 1995).

2.3.5. The Impact of Individual Attributes on Hospital Choice Behavior

Individual characteristics were incorporated in both aggregate and disaggregate hospital choice models. The difference between aggregate and disaggregate models is that individual attributes were indirectly incorporated by stratification of patients into groups in the aggregate hospital choice model. The following summarizes the influence of individual attributes on hospital choice or hospital bypass behavior in the previous studies.

Important patterns by *age* on hospital choice or bypassing were found. The older a rural patient is, the stronger his or her preference for rural over urban hospitals, holding

distance and other factors constant (Adams et al. 1991, Buczko 1992). Adams et al. (1991) found that older Medicare beneficiaries tended to choose a small rural hospital or a nearby large rural hospital over other more distant hospitals. Although their analyses suggested that those over 85 exhibited preferences for a greater scope of service, they tended to choose smaller, rural facilities and seek surgical services closer to home. On the contrary, those under 75 preferred a higher scope of service and size. Other studies have also found the importance of age on hospital choice; however, the study populations were very different from the study population in this research (i.e., pregnant women or children). Therefore, the results of these studies are not discussed here.

Socioeconomic status also affects hospital choice. Women with more *resources* were less likely to use a local facility to obtain obstetrical services (Bronstein and Morrisey 1991). *Income* per-capita was positively associated with bypassing behavior for obstetric care (Bronstein and Morrisey 1990, 1991). However, percentage of residents on Aid to Family with Dependent Children (AFDC) was also positively associated with hospital bypassing the nearest facility or bypassing to a metropolitan facility for obstetric care in 1988 (Bronstein and Morrisey 1991).

Those who were on *Medicaid* were more likely than private pay patients to be admitted to public hospitals, higher charge hospitals, and hospitals with worse prenatal outcomes for obstetrical care, presumably as a result of choice restrictions (Phibbs et. al. 1993). Cohen and Lee (1985) also found that the role of physician was insignificant for those who were in *poverty*. Finally, individuals of high *educational status* tended to concentrate their admissions in hospitals that primarily serve individuals with good

insurance coverage (Phibbs et al. 1993). In Korea, individuals with cars and higher standards of living were more likely to use the facilities with more service offerings (Kim 1990).

Some variation in choice of a hospital by *race* was also found. Hispanics use hospitals serving disproportionately more Medicaid patients for obstetrical services (Bronstein and Morrisey 1991). White pregnant women were more likely to bypass local rural facilities (Bronstein and Morrisey 1990, 1991).

Like utilization of health services, bypassing the closest or local rural hospitals is often predicted by the need of specialized care among rural Medicare beneficiaries (Buczko 1992, 1994; Codman Research Group Inc. 1990, Adams and Wright 1991; Adams et al.1991). More *severely ill* rural Medicare beneficiaries were more likely to choose urban over rural hospitals than less severely ill patients were, controlling for other individual and hospital characteristics (Adams et al. 1991). In general, severity of illness were measured by diagnostic categories, in-hospital process measures, and other more sophisticated instruments and has been found to influence hospital choice or bypassing.

The use of urban hospitals by rural elderly usually involved *surgical treatment* of cardiovascular conditions at large urban teaching hospitals (Adams et al. 1991; Adams & Wright 1991; & Buczko 1994). *Surgical* and *general* medicine patients were more likely to be admitted to bigger hospitals or hospitals with better outcomes (Luft et al. 1990, Cohen and Lee 1985). Elderly persons with *psychiatric diagnoses* were more likely than individuals with medical diagnoses to choose urban over rural hospitals (Adams et al. 1991). Cohen and Lee (1985) also found that psychiatry condition was positively

associated with travel time. Since *complexity of illness* and *diagnostic category* tend to be highly correlated, one study found that the complexity was no longer significant in the odds of choosing a larger rural hospital over a smaller one for Medicare beneficiaries once the nature of treatment was accounted for (Adams et al. 1991).

Several in-hospital process variables were also used to measure severity of illness of patients including length of stay, number of Intensive Care Unit (ICU) days, number of Coronary Care Unit (CCU) days, Diagnostic Related Group (DRG) weights, number of procedures, and specific DRG categories. Length of stay was found to be positively associated with hospital bypassing, so were the number of ICU, CCU days, and procedures performed (Buczko 1992, 1994). The higher the DRG weight of principal diagnosis (case mix index), the more likely the rural elderly were hospitalized in urban areas (Buczko 1992, 1994). Those with cardiovascular conditions were also more likely to be treated in more sophisticated urban hospitals. Procedures positively associated with hospital bypassing behavior include hysterectomy, radiotherapy, chemotherapy, craniotomy and spinal procedures, splenectomy and other operating room procedures for blood forming organs, major head and neck procedures, ear, nose, and throat procedures, kidney procedures, neoplasm, and injury procedures (Buczko 1992, 1994). With one exception, number of diagnoses was negatively associated with use of urban facilities (Buczko 1992).

Disease Staging Methodology (reflects both the severity of the DRG and the severity of the cases within DRG) was found to be associated with use of more sophisticated facilities (Adams et al. 1991). Furthermore, deliveries were classified as on

the basis of the American Academy of Pediatrics / American College of Obstetrics and Gynecology Guidelines for Prenatal Care (1988). High-risk deliveries were identified with presence of at least one of the guideline conditions (Phibbs et al. 1993). High-risk women had stronger preferences for hospitals with better quality measures (lower risk-adjusted mortality rates, teaching status, and hospitals with level III NICU), and were more willing to travel longer distance. Women with high-risk deliveries were also more likely to go to public hospitals and more likely to avoid proprietary hospitals, than those in the low-risk group.

2.3.6. Gender Differences in Health Services Utilization and Hospital Choice Behavior

Over the past two decades, in social/behavior literature, academic interest in the lives of older rural residents has increased. Although only a few studies have reported gender differences in hospital choice behavior (Cohen and Lee 1985, Buczko 1992), gender differences in the use of health services are frequently reported (Nelson 1995). One of the most consistent findings in the literature is that females are more likely than males to visit the doctor even in the elderly population (Roos and Shapiro 1981; Marcus and Siegel 1982; Wolinsky 1978; Saameno 1995; & Bertakis et al. 2000). One study even concluded that gender differences exist in the effect of social supports on elderly individuals' use of health services although these differences were not consistent across the various measures of health services utilization (Nelson 1995). However, no gender difference was found for mean hospitalizations and hospital charges (Bertakis 2000).

Furthermore, gender differences exist in diseases and health problems over the life course and into old age that may contribute to the need for different types and amount of inpatient care. Women who are more likely to experience chronic diseases partly because of a longer life span maybe need no sophisticated inpatient care for their functional limitations. However, men who are more likely to experience heart and cardiovascular diseases may benefit from care at specialized but distant hospitals.

The effect of *gender* on hospital choice or bypassing behavior has not been strong; however, it appears that women prefer staying in local areas for health care. Cohen and Lee (1985) found that women used non-teaching hospitals relatively more than men do. Females were significantly more likely to use rural hospitals (Buczko 1992, Hogan 1988).

2.3.7. Other Factors That Influence Hospital Choice Behavior for Inpatient Care

Community Attributes: Several studies used county boundaries as their definition of hospital market areas, the various community attributes based on this politically defined geographic unit were used to test their influence on hospital choice behavior. For example, Folland (1983) found that the sales tax revenue from the city was positively associated with hospital choice. Porell (1986) found that median family income, percent of families on welfare, and percent of population 65 years of age or older positively affect which hospital is chosen. While percent of residents who were 25 years or older with college degree and percent of black population had a negative effect on hospital choice.

At least one study suggested that bypassing might not necessarily reflect the need or desire for a more technically sophisticated hospital or a more specialized service. Some rural Medicare beneficiaries who bypassed local rural hospitals were hospitalized at facilities that appear to be little different from their local ones (Buczko 1994). These hospitalizations could reflect preference or availability of specific physicians, proximity of family, prior use, or other factors that were not specified in the previous research.

2.3.8. Summary

Regarding hospital attributes, in general, patients use closer, larger, teaching facilities, and those with greater service scope were more favorably (Porell and Adams 1995). With regard to patient characteristics, older rural residents were less likely to travel farther distances (Adams et al. 1991). Women with more resources were more likely to bypass local facility to obtain obstetrical services (Bronstein and Morrisey 1991), and individuals of higher socioeconomic status in Korea were more likely to use the higher services facilities (Kim 1990). With regard to race, Hispanic women tended to use hospitals serving disproportionately more Medicaid patients for obstetrical services (Bronstein and Morrisey 1991). In general, a surgical diagnosis (or psychiatric versus medical DRG) has a positive relationship of admitting to a more specialized hospital.

Table 1 presents a summary and comparison of previous studies on hospital choice behavior.

## Table 1. Comparison of Selected Previous Studies on Hospital Choices

| Study | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| **Dependent Variable** | Market share | Actual patient flows from community to each hospital | Market share | Admission per capita from communities to hospitals | Market share |
| **Market Definition / Choice Set** | 54 counties in South Dakota | 186 census tracks in Rhode Island | 5 counties in southern Pennsylvania | Allegheny County in Pennsylvania | Zip code clusters in California |
| *Year* | 1977 | 1980 | 1979 | 1975 | 1983 |
| *Patient Attributes* | | | | | |
| ***-Demographic Characteristics*** | | | | | |
| Woman * teaching | | - | | | |
| ***-Social Structural Characteristics*** | | | | | |
| Socioeconomic status * bed | | - | | | |
| Socioeconomic status * physician | | + | | | |
| ***-Health, Functional Status, & Diagnostic Category*** | | | | | |
| Psychiatric or pediatric * travel time | | - | | | |
| General medicine * size/scope of service | | + | | | |
| Surgery * size/scope of service | | + | | | |
| ***-Physician Influence*** | | | | | |
| Number of physicians with admission privilege | + | + | + | | |
| Percent physicians affiliated only with one hospital | | | + | | |
| Physician per bed | | | | + | |
| **Hospital Attributes** | | | | | |
| Bed size | + | + | | + | |
| Service capacity | | + | + | + | |
| Urban/small town | | - | | | |
| Price/cost | | | | - | - |
| Presence of outpatient department in the hospital | | | | - | |
| Quality | | | | + | |
| Adjusted mortality/worse outcomes | | | | | - |
| Public (proprietary) ownership | | | | | - |
| Volumes patients transferred in | | | | | + |
| Volumes of open heart surgery | | | | | + |
| **Distance / Travel Time** | | | | | |
| Distance to hospital | - | - | - | - | - |
| **Community Characteristics** | | | | | |
| Median family income | | | | + | |
| Percent of family with public assistance income | | | | + | |
| Percent of population 65 years of age or older | | | | + | |
| Percent 25 years or older with college degree | | | | - | |
| Percent of black population | | | | - | |
| Sales tax revenue from city | + | | | | |

**Table References:**


1. Folland, (1983).
2. Cohen & Lee, (1985).
3. Erickson & Finkler, (1985).
4. Porell, (1986).
5. Garnick et al., (1989).

## Table 1. Comparison of Selected Previous Studies on Hospital Choices (continued)

| Study | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|
| **Dependent Variable** | Actual patient flows | Actual patient flows | Patient flows from communities to hospitals | Individual hospitals' admissions | Hospital type (lower vs. tertiary facilities) |
| **Market Definition / Choice Set** | Zip code clusters in California | Zip code clusters in Arizona | Zip code clusters in California | 7 rural MSAs in California | One province in Korea |
| *Year* | 1983 | 1989 | 1985 | 1985 | 1988 |
| *Patient Attributes* | | | | | |
| ***-Demographic Characteristics*** | | | | | |
| Age * rural | | | | | - |
| ***-Social Structural Characteristics*** | | | | | |
| Whites | | | | + | |
| Medicaid | | | | + | |
| Medicaid (vs. private insurance) * NICU / C section / birth center / bridge or tunnel / outcomes | | | - | | |
| Medicaid (vs. private insurance) * Medicaid contract / charges / public | | | + | | |
| Education / Education * private insurance | | | + | | + |
| Education * Medicaid | | | | - | |
| Access to automobile / higher standard of living | | | | | + |
| Educational level / access to auto * rural location | | | | | + |
| ***-Health, Functional Status, & Diagnostic Category*** | | | | | |
| Severity of illness * public / C-section | | | + | | |
| Psychiatric or medical DRG * proprietary | | | - | | |
| High (vs. low) delivery risk * hospital quality / distance / public hospital / teaching /service capacity | | | + | | |
| High (vs. low) delivery risk * proprietary | | | - | | |
| Delivery / elective | | | | + | |
| **Hospital Attributes** | | | | | |
| Teaching status | + | + | + | | |
| Adjusted mortality rates/worse outcomes | - | - | - | | |
| Cost/charge | | - | - | | |
| Use by out of state residents | | + | + | | |
| Service capacity | | | + | | |
| Public/proprietary (voluntary) ownership | - | | | | |
| Public/catholic ownership (proprietary and district) | | | + | | |
| Same zip * Hispanics / income | | | | + | |
| Government ownership * Medicaid / Hispanics | | | | + | |
| Government ownership * private insurance | | | | - | |
| Private ownership * teaching | | | | + | |
| Cesarean section rate | - | | + | | |
| **Distance / Travel Time** | | | | | |
| Distance to hospital (to the closest hospital) | - | - | - | - | |
| Same zip / near zip | | | | + | |

**Table References:**


6. Luft et al., (1990).
7. Burns & Wholey, (1992).
8. Phibbs et al., (1993).
9. Dranove, White, & Wu, (1989).
10. Kim, (1990).

**Table 1. Comparison of Selected Previous Studies on Hospital Choices (continued)**

| Study | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|
| **Dependent Variable** | Bypass a nearest hospital (or not) | Bypass to a metropolitan hospital (or not) | Seven hospital types (large metro versus closest rural) | % inflow from other states | % outflow to other states |
| **Market Definition / Choice Set** | Non-MSA counties in Alabama | Non-MSA counties in Alabama | Three zip code clusters of 53 hospitals in Minnesota | National sample of Medicare discharges | National sample of Medicare discharges |
| *Year* | 1983 & 1988 | 1983 & 1988 | 1986 | 1987 | 1987 |
| *Patient Attributes* | | | | | |
| ***-Demographic Characteristics*** | | | | | |
| Age | + | | - | | |
| ***-Social Structural Characteristics*** | | | | | |
| White | + | | | | |
| Income | + | + | | | |
| Percent of household on AFDC | + | + | | | |
| ***-Health, Functional Status, & Diagnostic Category*** | | | | | |
| Clinically needy patients (more severe case intensity) | | | + | | |
| Surgical DRG (vs. medical) | | | + | | |
| Psychiatric DRG | | | + | | |
| **Hospital Attributes** | | | | | |
| Supply of physicians | | | | + | |
| Beds per capita / Beds | | | + | + | - |
| Occupancy rate | | | | - | |
| Local hospitals Medicare caseload | | | | | |
| Teaching status | | | + | | |
| Service capacity | | | + | | |
| Metropolitan has a public hospital or NICU | | + | | | |
| Number of births in the past year at next hospital | | - | | | |
| Volumes (of the nearest hospitals) | - | | | | |
| Public ownership of the nearest hospital | - | | | | |
| Public ownership of the next hospital | + | | | | |
| **Distance / Travel Time** | | | | | |
| Distance to hospital ( to the closest hospital) | + | + | - | | |
| Distance to next or metropolitan area | - | - | | | |
| **Market Attributes** | | | | | |
| Percent of rural residents | | | | | + |
| Percent of Arizona migrants | | | | | + |

**Table References:**


11. Bronstein & Morrisey, (1991).
12. Bronstein & Morrisey, (1991).
13. Adams et al., (1991).
14. Buczko, (1991).
15. Buczko, (1991).

**Table 1. Comparison of Selected Previous Studies on Hospital Choices (continued)**

| Study | 16 | 17 | 18 |
|---|---|---|---|
| **Dependent Variable** | Non-MSA (MSA) | Non-local (local) hospitals | Urban, non-local, and (local) hospitals |
| **Market Definition / Choice Set** | 20% of MEDPAR in the nation | National sample of Medicare discharges within 120 miles of patients' residence in Delaware | National sample of Medicare discharges within 120 miles of patients' residence in Delaware |
| *Year* | 1987 | 1987 | 1987 |
| *Patient Attributes* | | | |
| ***-Demographic Characteristics*** | | | |
| Age | + | | |
| Female | + | | |
| ***-Social Structural Characteristics*** | | | |
| N/A | | | |
| ***-Health, Functional Status, & Diagnostic Category*** | | | |
| Clinically needy patients (more severe case intensity) | - | | |
| Transferred patients | - | | |
| Disabled | + | | |
| Chronic renal disease | - | | |
| Surgical DRG | - | | |
| Psychiatric DRG | | | |
| DRG weight | - | | |
| Cardiovascular conditions | - | | |
| More sophisticated treatments (e.g. Chemotherapy) | - | | |
| Number of diagnoses | + | | |
| Number of procedures | - | | + |
| Coronary care unit days | | + | + |
| **Hospital Attributes** | | | |
| Beds per capita / Beds | | | |
| Local hospitals Medicare caseload | | - | - |
| Treating hospital Medicare caseload | | + | + |
| **Distance / Travel Time** | | | |
| Distance to hospital | | | |

**Table References:**
16. Buczko, (1992).
17. Buczko, (1994).
18. Buczko, (1994).

# CHAPTER III

# METHODOLOGY

This chapter contains discussion about data sources and study methods. First, four major data sources are discussed: the Medicare Current Beneficiary Survey (MCBS), the Medicare Provider of Service File (POS), the Hospital Service Area File (HSA), and the AHA Survey of Hospitals (AHA). Data collection and sample selection are briefly discussed. The method used to delineate choice alternative is discussed next. A detailed description of the conceptual model and hypotheses will then presented. These will be followed by the presentation of the file construction and the study variables used in model specification. Finally, steps for data analyses will be presented at the close of the chapter.

## *3.1. Data Sources*

### 3.1.1. Medicare Current Beneficiary Survey

Data for the study is compiled from multiple sources. The main source is the Medicare Current Beneficiary Survey (MCBS). The MCBS is a continuous panel survey of Medicare beneficiaries in the U.S. (Eppig and Edwards 1996). The first round of the survey was initiated in the fall of 1991. Today, sixteen rounds of the survey are available for public use.

The sampling design of the survey is completed in two stages. In the first stage, a sample of geographic *Primary Sampling Units* (PSUs) is obtained. Next, a systematic random sampling within age groups is performed on the selected PSUs. Each year, the survey is completed for about 12,000 beneficiaries living in the community or in institutions (Adler 1994). Participants in the survey who relocate during any of the rounds remain in the sample and are interviewed at their new residence. Samples for the surveys are drawn from the Medicare enrollment file with an over-sampling from the group of beneficiaries under the age of 65 and over the age of 85 years. Information about beneficiaries who refuse to participate in the survey was also collected for comparison purposes (Adler 1994).

The average interview for community residents lasts about one hour. Interviewers use the *Computer Assisted Personal Interviewing* (CAPI) technique, which incorporates a computerized questionnaire on a small portable computer. This technique enhances the quality of the data since it eliminates transcription errors and incorporates quality checks on the data as it is entered (Adler 1994). For beneficiaries residing in institutions, the survey is shorter and is completed by interviewing a staff member at the institution. Interviews are conducted three times a year with each round of interviews ending by December, April, or August.

The two primary focuses of the MCBS are on economic and beneficiary issues, in particular, health care use, expenditures and factors that affect use of care and the beneficiary's ability to pay. The survey collects information on demographic characteristics, health status and functioning, satisfaction with and access to care,

insurance coverage, financial resources, and potential family support. The longitudinal feature of the MCBS also allows analysis of the effects of the changes on utilization over time.

The MCBS is prepared for linkage to Medicare fee-for-service claims on covered services and other administrative files (Adler 1994, Eppig & Edwards 1996). Availability of claims data is important to gain precise estimates of health services utilization and expenditures. Because they are defined by dates, claims can be used to construct episodes of care for any length of time. Claims for different services (e.g., hospitalization, home health, and outpatient) can be linked to show patterns of health care utilization over time. The hospital claims contain diagnostic and reimbursement information as well as a hospital Medicare Provider Number. The availability of the claims allows researchers to study patterns of health care utilization over time and greatly enhances analytic power of the survey alone. In this study, the choice of a specific hospital alternative of a rural elder can be determined through these inpatient claims. With multiple years of hospital utilization records for each beneficiary, it is also possible to assess the potential influence of prior hospitalization (use) on hospital choice.

MCBS response rates have varied between 85 to 95 percent. Kasper, Campbell, and Gutierez-Mohamed (1994) studied the patterns of non-response and retention since the first four rounds of the MCBS. The preliminary analysis presented by the authors identified refusals and death as the major sources of non-response. They indicated that beneficiaries who dropped out were somewhat older, were more likely to be women, were more likely to live in certain areas of the country, and were more likely not to report

income information. Furthermore, prior year utilization appeared to be associated with attrition at Rounds 2-4.

According to the same study, the non-respondents in the first four rounds of the MCBS were also more likely to be older and to be females than were respondents. Authors concluded that there was no indication of worse self-reported health status at Round 1 for those who refused to participate as compared to respondents (Kasper et al. 1994). In addition, prior year utilization was not related to non-response at Round 1 (Kasper et al. 1994). On the contrary, Hijjazi (1998) found that health services utilization was significantly higher among respondents relative to non-respondents in the Round 3 and Round 4 of the MCBS.

Only one study published to date used a national sample of the elderly to study rural hospital choice. Buczko (1992) used Medicare provider analysis record (MEDPAR) data to study bypass behavior for inpatient care in rural areas. Patients' attributes were restricted to information contained on the claims.

The current study incorporates a rich set of individual characteristics from the MCBS including demographic characteristics, functional levels, economic and family resources, availability of regular source of care and level of satisfaction with primary care, and information about previous hospitalization in modeling hospital choice behavior of rural Medicare beneficiaries. For example, Adams et al. (1991) found that age was an important predictor in the choice of hospital among rural Medicare beneficiaries. It is plausible that it is the functional status or mobility level of the elderly, rather than age,

that is responsible for the limited bypassing of rural hospitals by the oldest-old. The MCBS data will permit investigation of these issues.

Another important factor that has been rarely studied is the physician's influence on hospital choice. Previous studies suggested that physicians influence patients' choice of hospital. A positive association was found between the number of physicians with admitting privileges to the hospital within proximity of the hospital or the patient's residence and hospital choice (Folland 1983; Cohen and Lee 1985, and Burns and Wholey 1992). Burns and Wholey (1992) even specified the distance between admitting physician-to-admitting hospital in addition to patient-to-hospital distance and found that both physician and patient access to a hospital strongly influenced admission choices. However, these studies used an aggregate choice model so individuals' attributes were not specified in the models.

Consumer satisfaction with medical services was a major influence of rural health care out-shopping behavior (Andrus & Kohout 1985). Since the MCBS provides detailed information on individuals' primary care physician and their satisfaction with medical services, it is possible to test whether beneficiaries with stronger ties to local physicians are less likely to bypass rural hospitals for inpatient care.

In this study, the 1994 and 1995 MCBS will be used. Permission was granted to use the analytic version of MCBS, which contains personal identifying information (i.e., zip code of the residences).

3.1.2. Provider of Service File

The Medicare POS file is a compilation of data about health care providers that is routinely collected by HCFA. Data about providers is extracted from HCFA *Online Survey and Certification and Reporting System* (OSCAR) database. The file is released annually and is available for the calendar years 1991 through 1997. The file contains an individual record for each Medicare-approved provider. Provider information is updated quarterly. The file contains detailed information about a variety of health care providers, including name, address, Medicare participation, staff, and type of ownership. Of interest to the study are the provider's size, teaching status, and location. Since providers may change, they will be matched with their reported bed size, teaching status, and rural versus urban location during the year in which services were rendered. The data are collected through the HCFA regional offices. Since 1994 and 1995 MCBS were included for this study, the same years were selected for the POS file.

3.1.3. Hospital Service Area File

The Hospital Service Area (HSA) File is a summary file derived from individual inpatient claims data over a calendar year. The records contain the number of discharges, length of stay, and total discharges summarized by Medicare provider for each residence zip code of all Medicare beneficiaries. The HSA file has been created for the years of 1986 to 1997. When the file is sorted by zip code and by Medicare providers, a list of providers serving Medicare beneficiaries in a zip code area can be determined. The market share of a provider for each residence zip code can be determined through

dividing its number of hospital discharges by the total Medicare discharges for the same zip code.

This file was used to delineate hospital market areas of rural Medicare beneficiaries by their zip code of residence. Like other files used in this study, 1994 and 1995 data were selected from the HSA file as well.

### 3.1.4. AHA Survey of Hospitals

The American Hospital Association's Annual Survey of Hospitals has been conducted annually since 1946. It contains hospital-specific data elements on more than 6,000 hospitals and health care systems including utilization, organizational structure, personnel, hospital services, and finances. The following information is available:

- Facilities and services;
- Utilization: including the number of beds and inpatient days, discharges, emergency visits, and inpatient and outpatient visits;
- Personnel;
- Long-term care beds;
- Hospital expenses;

Since the Provider of Service file contains only limited information for measuring the capacity of hospitals, the AHA data supplements the POS file. Again, 1994 and 1995 data were selected from the AHA data.

*3.2. Study Sample*

The study population was restricted to the MCBS respondents who resided in a non-MSA county and who had at least one hospitalization during the years of 1994 and 1995. In order to increase the statistical power of the analysis, two years of hospital discharge data were used. The sample was restricted to non-institutionalized beneficiaries who were at least sixty-five years old, entitled to Medicare under Old Age Survival Insurance (OASI). Since the unit of analysis is a hospitalization associated with an individual, an elderly beneficiary could have multiple records in one year. In this case, the same individual patient attributes were specified for multiple hospitalizations in the same year. Hospitalizations for the same individual in different calendar years were also treated as two separate observations. Individuals patient attributes associated with the hospitalizations were specified from MCBS survey for the respective year.

The study sample includes 849 respondents from Round 10 and 853 respondents from Round 13. The sample only includes Medicare beneficiaries who:

- were entitled for Medicare under OASI[1] at the time of the survey,
- were not enrolled in Health Maintenance Organization (HMO) or managed care plans during the year following the survey[2],
- did not reside in a Metropolitan Statistical Area (MSA),
- whose closest hospital was not located in an MSA,

[1] Because beneficiaries entitled under Disability or End Stage Renal Disease (ESRD) program may have different health needs from the general aged Medicare population, they were excluded from the study sample.

[2] HCFA does not usually receive Medicare claims for beneficiaries who enroll in a managed care plan during their enrollment period. Also, the general model of hospital choice may be different for the elderly

- were not institutionalized at the time of the survey, and
- had one or more hospital discharges.

Respondents with missing critical data elements (i.e., education or income) were also excluded. Table 2 presents a summary of these cases excluded by application of sample selection criteria for both Round 10 and Round 13.

**Table 2. Sample Selection Criteria from MCBS Rounds 10 and 13**

| Criteria | Round 10 | Round 13 |
|---|---|---|
| | N | N |
| **All MCBS Respondents** | 16119 | 15590 |
| **Exclusion Criteria**[3] | | |
| Aged with ESRD | 36 | 36 |
| Disabled beneficiaries under 65 years old | 2709 | 2597 |
| Enrolled in HMO during year of survey | 1253 | 1506 |
| Residing in a MSA | 11760 | 11254 |
| Institutionalized at time of survey | 1377 | 1355 |
| No inpatient utilization | 3019 | 3003 |
| Cases with missing data | 2 | 17 |
| Closest hospital located in a MSA | 55 | 56 |
| **Final Sample** | 849 | 853 |

enrolled in a managed care plan. Therefore, these Medicare beneficiaries were excluded from the study sample.

[3] Members can meet more than one of following exclusion criteria. Therefore, the total of MCBS respondents minus the sum of all exclusion criteria does not equal to the final sample for both years.

*3.3. Conceptual Model*

3.3.1. McFadden Conditional Choice Model

To avoid unstable coefficients from linearlization methods, this study used the conditional logit model by McFadden (1974). The McFadden's model, or known as the conditional logit model, provided a framework in many fields of study to link between utility maximization and discrete consumer choice (Porell and Adams 1995). Conditional upon a choice being made, the model attempts to estimate factors explaining the relative probabilities of choosing certain alternatives. The premise underlying the conditional model of hospital choice is that individuals, or their physicians acting as agents, choose hospitals on the basis of a vector of hospital attractiveness (prices, size, scope of service, teaching status, etc.), given their needs (diagnosis) and personal characteristics (income, gender, functional status, access to health care, etc.).

When the utility maximization of individuals choosing from a set of hospital alternatives is incorporated in the conceptual model for the study, characteristics of the choice itself are modeled as well as characteristics of the individuals who choose (Adams et al. 1991). Individuals maximize utility based on (1) the attributes of that choice (chosen hospitals versus alternative hospitals), and (2) their own individual characteristics.

Patients, or their physicians acting as agents, are assumed to prefer hospitals that can be specified in terms of a vector of attributes characterizing hospitals and access to them from their community (Porell and Adams 1995) or $\underline{H}$ and a vector of their own characteristics, or $\underline{X}$. The original McFadden model assumed that the utility

maximization for hospital choice is comprised of two components: a non-stochastic component and a stochastic component. The non-stochastic V ($\underline{X}$, $\underline{H}$) component reflects general population preferences. The stochastic component $\varepsilon$ ($\underline{X}$, $\underline{H}$) represents idiosyncratic factors varied by individuals that are unobserved by the researcher. The utility is for the jth hospital alternative is defined as follows:

$$U(\underline{X}, \underline{H}_j) = V(\underline{X}, \underline{H}_j) + \varepsilon(\underline{X}, \underline{H}_j) \qquad [1]$$

where $\underline{H}_j$ is a vector of attributes characterizing hospital alternative j and the access (e.g., distance or travel time) of the patient to that hospital and X is a vector of attributes characterizing patients. Hospital alternatives have been defined as either individual hospitals in a local market area (Dranove et al. 1988) or typologies of hospital alternatives comprised of individual hospitals (Adams et al. 1991, Buczko 1992; Kim 1990).

In the process of utility maximization, the patient will choose a specific hospital alternative j if its utility, or U ($\underline{X}$, $\underline{H}_j$), exceeds the utility of all other hospital alternatives. Since the stochastic component of the utility function cannot be observed, only probabilistic statements on hospital choice can be made. The probability of a patient is admitted to hospital alternative j should be presented as the probability that utility is highest for alternative j. That is,

$$Pr_i(j) = Pr\{V(\underline{X}_i, \underline{H}_j) + \varepsilon(\underline{X}_i, \underline{H}_j) > V(\underline{X}_i, \underline{H}_k) + \varepsilon(\underline{X}_i, \underline{H}_k)\} \qquad [2]$$

$$k = 1,\ldots, K, j \neq k,$$

where $Pr_i(j)$ is defined to be the probability that individual i is admitted to hospital alternative j.

In addition, McFadden (1982) assumed that the idiosyncratic factors affecting choice are independent distributed with a reciprocal exponential or Weibull distribution, or $Pr\{\varepsilon(\underline{X}_i, \underline{H}_k) >= \varepsilon^*\} = \exp(-\exp^{-\varepsilon^*})$, leads to following structure for the conditional logit choice model:

$$Pr_i(j) = \frac{\exp\{V(\underline{X}_i,\underline{H}_j)\}}{\sum_j \exp\{V(\underline{X}_i,\underline{H}_j\})} \qquad [3]$$

$V(\underline{X},\underline{H})$ has been commonly postulated as a linear function of the characteristics of both hospitals and individuals as follows:

$$V(\underline{X}_i, \underline{H}_j) = \alpha j + \sum_m \alpha_{jm} x_{im} + \sum_n \beta_n h_{jn}, \qquad [4]$$

where the $x_{im}, m = 1,\ldots, M$ represent individual attributes (e.g., age, gender, income, number of children, etc) and the $h_{jn}, n = 1,\ldots, N$, represent hospital attributes (e.g., beds, service capacity, etc) of alternative j.

Both alternative- specific parameters and parameters that are invariant with regard to the choice set of alternatives are included in [4]. The alternative-specific parameters reflect systematic differences of any unspecified attributes of alternative j affecting patients' propensity to choose hospital alternative j. And these systematic effects under [4] are postulated to vary with the vector of specified patient attributes $\underline{X}$. This unique feature of conditional logit model where specification of alternative-specific parameters is permitted allows patient characteristics to affect the choice probabilities. For example, possible preferences for urban over rural hospitals by high-income elderly should be reflected in larger positive estimated coefficients for the high-income dummy variable for urban hospitals. Unfortunately, the number of model parameters to be estimated increases rapidly when numerous patient attributes and hospital alternatives are estimated.

The direct elasticity of preference for alternative j with respect to a desirable hospital attribute x can be defined as the percentage increase in the probability of choosing alternative j associated with a marginal increase in the level of the desirable hospital attribute such as bed size. The greater the existing likelihood of choosing hospital k, the greater the level and utility weight are for the desirable bed size attribute.

### 3.3.2. Definition of Hospital Alternatives

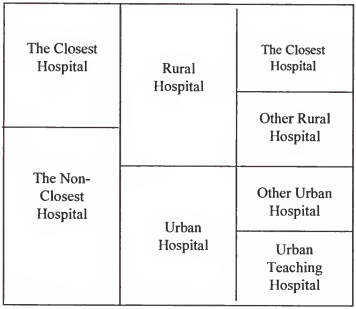
As mentioned earlier, one of the most important elements in studying hospital choice is to properly classify the choice set of relevant alternatives (Porell and Adams 1995). Even if relevant alternatives are difficult to determine, consumers must be aware

of the relevant alternatives and consider their feasibility (Porell and Adams 1995). Either the exclusion of relevant alternatives or the inclusion of irrelevant alternatives would bias the choice probabilities and then limit its use for predicting effects of hospital closures or openings (Porell & Adams 1995), or for estimating the effects of individual and hospital attributes on hospital choice.

Previous hospital choice research has employed hospital typologies as choice alternative. For instance, Adams and Wright (1991) examined the travel patterns of Medicare beneficiaries residing in three rural areas by categorizing the admitting hospital based on whether it was urban or rural, its size, and whether it was the closest. Other studies examined the patient and hospital attributes associated with binary choice to bypass the closest local hospital among rural residents (Bronstein and Morrisey 1991, Buczko 1994). A model with a dichotomous dependent variable, indicating choice of the closest rural hospital (versus non-closest), examines why some Medicare beneficiaries with a hospital "in their neighborhood" use other hospitals. However, this typology may be too simplistic because it fails to distinguish the differences among alternatives other than the closest hospital (Type 1 in the Figure 1).

Since previous studies found that about 20 to 30 percent of Medicare beneficiaries residing in rural market areas went to an urban hospital, the event of rural Medicare beneficiaries going to an urban hospital was the primary interest of some research (Buczko et al. 1992). A model with a dichotomous dependent variable, indicating choice of an urban hospital versus a rural hospital, allows an examination of factors influencing such a choice.

**Figure 1. Comparison of Alternative Hospital Choice Models**




However, this approach overlooks the heterogeneity among rural alternatives (Type 2 in the Figure 1). Categorizing hospital choice alternatives either as rural versus urban location types, or closest versus more distant hospital types for rural patients are likely to overlook important variations among within these dichotomous alternatives.

Some studies have examined hospital choice or bypassing behavior through a typology of alternative hospitals (Adams et al. 1990, Buczko 1994). Adams et al. (1991) categorized hospital choices into a typology of seven hospital types based on location and hospital bed size. These categories, ranging from small rural hospital to all distant large urban hospitals (as a single group) accounted for more than 97 percent of Medicare

discharge in the market area. This kind of typology was appropriate to model hospital choice behavior of rural residents in a single geographic market because the choice to bypass all rural hospitals along with the choice of one rural hospital over another could be encompassed with a single virtually exhaustive choice typology. However, since the study only focused on a single small rural market area in the mid-west part of the country, its applicability to other rural health markets in the nation is unclear.

Since the number of model parameters to be estimated increases rapidly if there are numerous patients attributes and local hospital alternatives (Porell and Adams 1995). The hospital typology should be simple and general enough that it is applicable to all rural hospital markets in the nation. For example, since it was found that the majority of rural elderly were hospitalized in the closest rural hospital, the closest rural hospital type and other rural hospital type are distinguished to be consistent with previous literature. The hospital typology should also be detailed enough that the heterogeneity of hospital type could be distinguished. For example, scope of service and bed size may not fully account for patients' preferences about the "attractiveness of teaching hospitals" due to perceptions about quality and prestige. So an urban teaching hospital type is included.

This study focuses on the influence of various individual patient and hospital characteristics on choice of one type of hospital over another by aged rural Medicare beneficiaries. Instead of focusing solely on either the choice between urban and rural location, or the choice between the closest hospital versus a more distant hospital, in this study the two most commonly used binary hospital choice are combined together into a broader typology. First, the rural hospital category is split into two categories: the closest

rural hospital and other rural hospital. Second, the urban hospital category is split into two categories to distinguish urban hospitals with higher service scopes (i.e. teaching hospitals) and other non-teaching hospitals.

The following typology and choice set was developed in the study:

Type 1= urban teaching hospital in Metropolitan Statistical Areas.

Type 2= other urban non-teaching hospital.

Type 3= other rural hospital.

Type 4= the closest rural hospital.

For each residential zip code, potential hospital market in rural areas (in miles) and the hospital typology fitting each of these categories were determined. A Type 1 hospital was determined by its location in any MSA county and its teaching status. A Type 2 hospital was categorized through its location in a MSA county within the hospital market area from a patient's residence. A Type 3 hospital included any other rural hospitals in the hospital market area except the closest rural hospital to a patient's residence. A Type 4 hospital was the closest rural hospital from a beneficiary's residence. One or more hospitals will comprise each choice alternative. Although Type four hospital is often comprised of only one closest rural hospital, few exceptions do exist. Since the measure of straight-line distance was "miles" from the centroid of the Medicare beneficiary's zip code of residence to those of hospitals' zip codes in the market area[4], the distance between a Medicare beneficiary's residence to two hospitals in the same zip code should be identical.

[4] The following is the formula to measure distance between two points (A1 and A2).

Since there is no limit on the number of hospitals comprising each of typologies, it was necessary to impose a limit based on conceptual reasoning of feasible alternatives. The idea of feasible choices is based on actual choices of all Medicare beneficiaries residing in same zip code areas as sample population. This will be described in details in the section later in this chapter.

### 3.3.3. Hypotheses

Based on the utility maximization theory, patients have derived utility for hospital services that can be specified in terms of hospital and individual patient attributes. The major hypotheses concerning the effect of individual characteristics, hospital attributes, and spatial access on hospital choices are:

*(1) Distance affects hospital choice. Since cost is not heavily borne by elderly Medicare beneficiaries for selecting different hospitals, money prices should not be the major concern of these Medicare beneficiaries in the models. Time price, however, should become especially important for frail rural Medicare beneficiaries who may find it difficult to travel for inpatient services. That is, an increased of distance, or time price should deter aged rural Medicare beneficiaries from choosing a hospital from alternatives.*

*(2) Desirable hospital attributes should be positively associated with choice of a hospital alternative. That is, a better a hospital type is (in terms of bed size, service capacity, number of hospitals in the choice alternative), a more likely an aged rural Medicare beneficiary will choose it.*

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DISTANCE=3959*ATAN (SQRT(1-(A*A))/A);

A = A1 + A2;
A1 = SIN (H_Lat/57.3) * SIN (P_LAT/57.3);
A2 = COS (H_Lat/57.3) * COS (P_LAT/57.3) * COS (P_LONG/57.3 -H_LONG/57.3);

Where H_LAT and H_LONG are the longitude and latitude coordinate of A1 and P_LAT and P_LONG are the longitude and latitude coordinate of A2.

*(3) Individual patient attribute such as age, socioeconomic status, complexity and diagnosis of disease, functional status, and the satisfaction with and access to medical care should affect hospital choice behavior of aged rural Medicare beneficiaries. In general, individuals with younger ages, a higher SES, a lower level of functional limitation, a more severe illness, a lack of regular source of care, a shorter tie with physician, and a dissatisfaction with availability and quality of care were expected to be more likely to bypass the closest rural hospital.*

*(4) Although previous studies were not conclusive regarding gender differences on hospital choice, differences in various socioeconomic status, functional status, diagnostic conditions, and access or satisfaction with health care were found between older men and older women residing in rural areas. These differences may lead to variations in hospital choice behavior. For instance, relative to men, a lower SES and higher long-term disability among older women may contribute to a very low probability of them bypassing the closest rural hospital.*

3.3.4. File Construction

After the sample respondents and their hospitalizations were selected, the MCBS records and their associated inpatient discharges were linked to the POS files in the corresponding years to obtain hospital attributes and zip codes information of the chosen alternative. This linkage used the Medicare Provider Number that is contained on Medicare hospital claims. The POS files contain information about hospitals serving Medicare beneficiaries in the nation including name and address, zip code, teaching status, and various services that are offered.

The hospital choice admission patterns of all Medicare beneficiaries who resided in the same zip codes as beneficiaries in the study sample were used to derive hospital market areas for the sample population. Hospital market area used here simply indicates a cluster of hospitals to which the aged rural Medicare beneficiaries in a zip code were

admitted. That is, observed patient choice by all Medicare beneficiaries was used to define feasible choice sets faced by patients in the sample. The HSA file was used to operationalize this definition.

The Provider-Beneficiary ZIP Hierarchical File of the HSA file was sorted by beneficiary-zip code and then by hospital provider so that for each zip code, one summary record was generated for each hospital. Hospitals with a market share (% of total discharges for the zip code area) less than one percent in a rural aged Medicare beneficiary's zip code of residence were excluded from the set of feasible choice sets to exclude extraneous travel patterns. An example of such is admissions to hospitals in very distant states, which most likely to occur while these Medicare beneficiaries were traveling away from their homes.

A national zip code data file from the Census Geographic Information Coding Scheme (GICS), containing information about the longitudes and latitudes of all 5-digit zip codes in the nation, was merged to zip codes of the sample population, and to zip codes of individual hospitals in the market areas. Using the centroid longitude and latitude of the zip codes as end points, the straight-line distances were calculated in miles between the residential zip codes of each sample person and the zip codes of all hospitals included in the market area of the residence zip code. This allowed the determination of the closest hospital based on relative distance.

Since the inclusion of beneficiaries whose closest providers were urban hospitals may cloud the interpretations of empirical findings based on the choice typology discussed earlier, the sample was further restricted to individuals whose closest hospital

providers were located in non-MSA areas. Hospital choice sets, as defined earlier in this chapter were then derived from the information about each hospital's urban/rural locations, its distance from each sample person, and the teaching status of the hospital.

Data on hospital characteristics of the feasible alternatives (e.g., number of beds, number of hospitals in the choice alternative, and hospital service capacity) were obtained from the POS files and augmented by the AHA Survey of Hospitals for the relevant years. The AHA data contains a richer set of information (i.e., service complexity) than the POS for constructing a Guttman scale of hospital service capacity that will be explained in details later in this chapter. Since there was no common identifier available to link the POS and AHA data, the file information was matched manually by hospital names.

Several independent variables of hospital attributes were also constructed through summaries of individual hospital attributes (i.e., bed size, number of hospital, and the Guttman hospital service capacity) within each choice alternative for sample persons. The file that contains the dependent variable and attributes of hospitals in the market areas were finally linked to beneficiary level MCBS survey and claim data to distinguish the chosen alternative from all other feasible alternatives.

Figure 2 displays the matching structure of the files for this study. Note that there was not a single common geographic or provider number available to link all the files. However, for each pair of files, there was a common identifier to permit data matching. The following steps were taken in file matching.

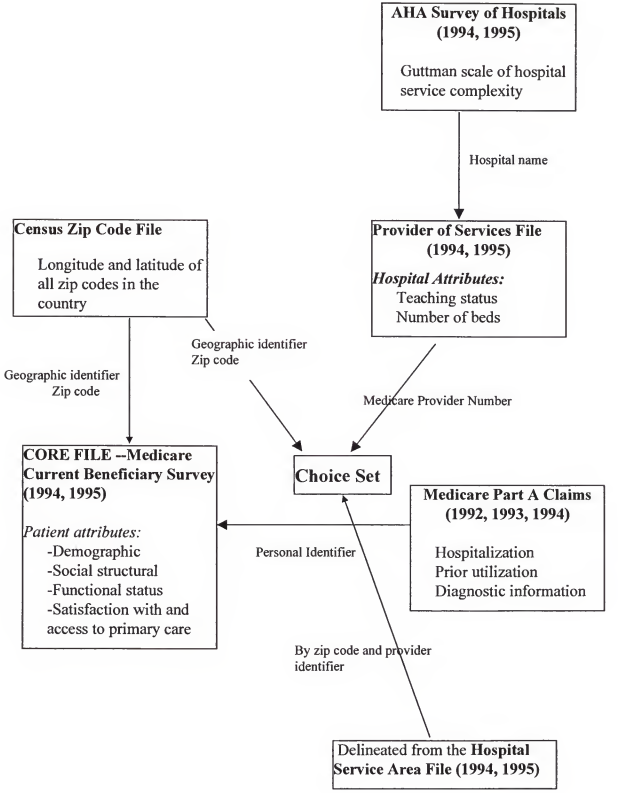
1. Medicare claims data for hospitalizations were merged via person identifier to the Medicare Current Beneficiary Survey so that the hospitalization information for rural Medicare beneficiaries in the study sample could be linked with their individual attributes.

2. The AHA hospital data was linked to Medicare POS file by hospital name, thereby creating a hospital-level file with selected hospital attributes.

3. The HSA file was used to delineate the hospital choice set. The HSA was first sorted by beneficiary-zip code and then by hospital provider so that for each zip code, one summary record was generated for each hospital. Hospitals with a market share (% of total discharges for the zip code area) less than 1 percent in a rural aged Medicare beneficiary's zip code of residence were excluded from the set of feasible hospital choices.

4. This file was then matched with POS by Medicare provider ID to obtain hospital attributes and matched with the Census zip codes file by zip code to get distances of all feasible hospital choices for each sample person's zip code residence. The choice set that is comprised of four alternatives was then derived from the information about each hospital's urban/rural locations, its distance from each sample person, and the teaching status of the hospital. Aggregate hospital attributes for feasible alternatives were then determined

**Figure 2. File Structure of the Study**



5. Feasible choice sets were then matched to MCBS and claims file by zip code and by provider code to determine the chosen alternative from all feasible alternatives and its hospital attributes for sample respondents.

*3.4. Model Specification*

Table 3 displays the coding algorithms of independent and dependent variables that were specified in the choice models. The expected sign for the association of each independent variable on the probability of choosing one alternative over another is also hypothesized. The 1st comparison is with respect to the choice of other rural hospital over the closest rural hospital specification. The 2nd comparison refers to the choice of other urban hospital over the closest rural hospital specification. The 3rd comparison is with respect to the choice of urban teaching hospital over the closest rural hospital specification. However, all three comparisons belong to one single multinomial logit model.

For those variables not tested in the previous research and are to be explored in the study, question marks will be presented in the table for the expected signs. Since gender differences in the effect of individual patients attributes on hospital choice behavior may exist, expected signs of some of the estimated independent variables for the male model could be different from those of females. A positive sign indicates an increase in likelihood and a negative indicates a decrease in likelihood in choosing the hospital alternative.

**Table 3. Coding Algorithm, and Expected Signs of Dependent and Independent Variables**

| Variables | Descriptions | Source | Expected Sign | | |
|---|---|---|---|---|---|
| | | | 1st | 2nd | 3rd |
| **DEPENDENT VARIABLE** | | | | | |
| Hospital choice | Choice of a typology of hospital classified based on location or type of the hospital (Reference: the closest rural hospital)<br>1= Other rural hospital<br>2= Urban non-teaching urban hospital type<br>3= Urban teaching hospital type | MCBS<br>HSA | | | |
| **INDEPENDENT VARIABLES** | | | | | |
| **Patient Attributes** | | | | | |
| *-Demographic Characteristics* | | | | | |
| Age75-84 | Sample person is between 75-84 years old, 1=Yes, 0=Otherwise | MCBS | - | - | - |
| Age 85 and over | Sample person is greater than or equal to 85 years old, 1=Yes, 0=Otherwise | MCBS | - | - | - |
| Male | 1=Male, 0=Female | MCBS | ? | ? | - |
| Married | 1=Yes, 0=Otherwise | MCBS | + | + | + |
| *-Social Structural Characteristics* | | | | | |
| College | Sample person has 16 or more years of education, 1=Yes, 0=Otherwise | MCBS | + | + | + |
| White | Sample person reports to be of white race, 1=White, 0=Otherwise | MCBS | + | + | + |
| Income more than $25,000 | 1=Income is more than $25k, 0=Otherwise | MCBS | + | + | + |
| Medicaid | Sample person self-reported to be Medicaid eligible, 1=Yes, 0=Otherwise | MCBS | ? | ? | ? |
| Number of Children | Number of children of sample respondent | MCBS | + | + | + |

**Table 3. Coding Algorithm, and Expected Signs of Dependent and Independent Variables, Continued**

| Variables | Descriptions | Source | Expected Sign | | |
|---|---|---|---|---|---|
| | | | 1st | 2nd | 3rd |
| **INDEPENDENT VARIABLES** | | | | | |
| *-Health and Functional Status* | | | | | |
| ADLs | Sum of reported difficulty in performing any of the following six activities: bathing, getting in/out of a chair, dressing, eating, toileting, and/or walking | MCBS | - | - | - |
| Bedridden | 1=Yes, 0=Otherwise | MCBS | - | - | - |
| Poor Health | 1=Reported perceived health as poor, 0=Otherwise | MCBS | + | + | + |
| Surgical DRG | 1=Yes, 0=Otherwise | MCBS | + | + | + |
| Psychiatric Diagnosis | 1=Yes, 0=Otherwise | | + | + | + |
| Cardiovascular procedure | 1=Hospitalization for DRG 103-112, 117, 124, 125, 0=Otherwise | MCBS | + | + | + |
| Technical intensive conditions | 1=Hospitalization for DRG 5, 106, 107, 112, 214, 410, 0=Otherwise | MCBS | + | + | + |
| Number of surgical procedures | Number of surgical procedure performed in the hospital stay | MCBS | + | + | + |
| *-Satisfaction with and Access to Medical Care* | | | | | |
| Regular source of care | 1= Sample person has a regular source of care, 0=otherwise | MCBS | - | - | - |
| Longer Physician-Patient tie | Sample person has seen his/her regular physician for one year or more, 1=yes, 0=Otherwise | MCBS | - | - | - |
| Less Accessible to Physician | Sample person is 30 minutes or more away from physician's office 1=Yes, 0=Otherwise | MCBS | + | + | + |
| Dissatisfaction with the availability of health care | 1 = dissatisfied/very dissatisfied about service availability or there was trouble getting care because unavailable, or not see doctor because of access, 0= otherwise | MCBS | + | + | + |
| Dissatisfaction with the quality of physician | 1= dissatisfaction on questions regarding overall quality of physician care, regarding physician's technical competence, or with physician practice style, 0=otherwise | MCBS | + | + | + |

**Table 3. Coding Algorithm, and Expected Signs of Dependent and Independent Variables, Continued**

| Variables | Descriptions | Source | Expected Sign | | |
|---|---|---|---|---|---|
| | | | 1st | 2nd | 3rd |
| **INDEPENDENT VARIABLES** | | | | | |
| *-Prior Use* | | | | | |
| Bypass in 12 month | 1=Sample person utilized a hospital other than the closest rural hospital in the past 12 months 0=Otherwise | MCBS | + | + | + |
| Hospitalized in 12 month | 1=Sample person was hospitalized in the past 12 months, 0=Otherwise | MCBS | ? | ? | ? |
| **Hospital Attributes** | | | | | |
| Bed size | Average number of acute care beds of the aggregate choice alternative | POS | | + | |
| Guttman Scale of Hospital Service Capacity[5] | Average of the Guttman Scale of service complexity of the aggregate choice alternative | AHA | | + | |
| Number of hospitals | Total number of hospitals of the aggregated choice alternative | POS | | + | |
| **Distance** | | | | | |
| Distance to hospital | Average distance between sample person and the hospital alternative | MCBS<br>POS<br>GIS | | - | |

[5] The delineation of this scale is based on the method proposed by Adams, Wright, and Robbins (1989). It is based on a principle of cumulative scaling, assuming that hospitals have the tendency to acquire service capabilities in a predictable sequence. A list of significant services and specialized units will be sequenced, and each hospital is scored by its highest-ranking (least common) service.

Since it is very likely that there is more than one hospital among the 1st, 2nd, and 3rd alternative in the choice set, the technique of aggregation of alternatives will be applied (Ben-Akiva & Lerman 1985). The systematic utility of aggregate alternative can be expressed as the sum of a) the average utility of the elemental alternatives in aggregate alternative, b) the measure of the size of the alternative, and c) the measure of the variability of the utilities of the elemental alternatives in aggregate alternative. The hospital attributes used to describe the aggregate alternatives here are the summaries of elemental alternatives[6].

Elemental alternatives are defined as the actual alternatives that decision-makers choose. They are by definition mutually exclusive and collectively exhaustive. The choice probability of an aggregate alternative is equal to the probability that the decision-maker chooses one of its elemental alternatives. The utility term for the variability of attributes among elemental alternatives may be omitted if the aggregate alternatives are defined to have equal variance. However, the variance effect may be very influential when aggregate alternatives are heterogeneous (Lerman 1975). The equal variances of aggregate alternatives cannot be strictly assumed here although they should be similar for the 2nd, 3rd, and 4th choice alternatives. Since no variance exists for most 1st choice alternatives (where only one hospital constitutes the alternative), variance cannot be measured for all alternatives. Hence variance terms are not specified as attributes of the alternatives.

[6] An average was used for distance, bed size, and Guttman scale of hospital service capacity while a sum

3.4.1. Dependent Variables

The dependent variable was constructed from admission patterns of all Medicare beneficiaries to represent hospital choice alternatives. A rural aged Medicare beneficiary's choice of a hospital was categorized into either one of these four alternatives based on location (the distance and rural/urban location) of the hospital and its teaching/non-teaching status. These four alternatives were mutually exclusive and they are the "closest rural hospital", "other rural hospital", "other urban hospital", and "urban teaching hospital" alternatives.

3.4.2. Independent Variables

There were three sets of independent variables: patient attributes that do not vary across hospitals, hospital attributes that do not vary across patients, and the distance variable that varies with both individuals and hospitals. The patient attributes included demographic variables, socioeconomic variables, health and functional status, satisfaction with and access to medical care, and prior use. Hospital attributes were aggregate hospital characteristics for the choice alternatives of the dependent variable. Distance was calculated by averaging the distances between the sample person and all hospitals in each choice alternative of the dependent variable.

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was used for the number of hospitals in the alternative.

*Patient attributes:*

Demographic Variables: Three demographic variables were extracted from the MCBS files. They included age in years, gender, and marital status. Because of high association between age and level of frailty, older respondents should be less likely to bypass their closest rural hospital for inpatient care. AGE7584 and AGE85 were two age variables constructed from original age variable measured in years to test for a possible non-linear relationship between age and hospital choice. Both AGE7484 and AGE85 were specified as dichotomous variables equal to one for "yes" and zero "otherwise".

Gender has not been found to be a very consistent predictor of hospital choice. For example, females were more likely to be hospitalized locally (Buczko 1992, Hogan 1988, Buczko 1994). They were also more likely to be hospitalized in non-teaching facilities (Cohen and Lee 1985). However, no separate models for females and males were tested for gender differences in hospital choice in past research. The expected impacts of gender and its association with other independent variables on hospital choice are uncertain. Gender was specified as a dichotomous variable, MALE, equal to one for males and zero for females.

Since women were less likely to be married in later life as opposed to men, the effect of marital status on hospital choice may vary by gender. As a source of family support from marriage, married men were expected to bypass the closest rural hospital. An interaction term between marital status and gender was created to indicate MARRIED MALE. Marital status has not been found to be a significant predictor of hospital choice in previous research. However, it is plausible that respondents who were not married

may be more likely to lack informal support. Such individuals may be less likely to have informal help needed to obtain more sophisticated care in a distant hospital, if necessary. MARITAL STATUS was specified as a dichotomous variable with a value of one for married individuals and zero otherwise.

Socioeconomic Variables: Five social-structural patient variables were specified including education, race, income, Medicaid, and number of children. Generally speaking, it was found that individuals with a higher socioeconomic status (SES) were more likely to bypass their local hospitals (Bronstein and Morrisey 1990, Phibbs et al. 1993; Dranove et al. 1989). A positive association between SES and continuous or intensive treatment also suggests that individuals with a lower SES may experience inequities in treatment options, or even hospital alternatives available to them (Haas et al. 1994). While a lower SES (i.e., financial assets, education, and income) was found to be associated with a worse health throughout adulthood and old age (Robert and House 1996), this may suggest a potential access problem for individual with lower socioeconomic resources.

At theoretical level, higher educational attainment should be associated with a better knowledge about hospital quality and urban and rural hospital alternatives. This knowledge should facilitate the choice of more sophisticated but distant hospitals. The original education variable was measured in terms of years of formal schooling. A dummy educational variable, COLLEGE, was constructed with a value of one for individuals with at least 16 years of education, and zero otherwise. Individuals with at

least a college degree were expected to choose more sophisticated but distant hospitals as opposed to the closest rural hospital.

Race was only found to be significant in the choice of hospital for obstetrical care in past research. Bronstein and Morrisey (1990) found that white pregnant women were more likely to bypass local rural facilities and used more distant hospitals. There is literature on racial differences in treatment suggesting that blacks were less likely to receive sophisticated intervention (Bach 2000; Klabunde et al. 1998; Williams 1995; Polednak and Flannery 1992). Therefore, the physician practice style of referring patients to hospitals could also vary by race. That is, non-Whites were expected to use smaller or less sophisticated hospitals in rural areas. Due to the small number of respondents within most of the non-white racial groups reported in the MCBS, race had to be specified as a simple dichotomous variable WHITE equal to one for individuals who reported to be of white race, and zero otherwise.

While aged rural Medicare beneficiaries do face co-payments and deductibles for inpatient care, the out-of-pocket treatment costs should influence their hospital choice. Income reflected SES and was expected to influence their ability of bypassing the closest rural hospital. Individuals with higher income were expected to have a higher probability of hospital bypassing as opposed to lower income individuals. Income was reported in $5,000 increment, and some respondents only reported $25,000 or more or less than $25,000 in the MCBS. To maximize cases with valid responses, a dummy variable representing beneficiaries with income below $25,000 from those with income equal to or over $25,000 was constructed.

Medicaid was only found to be associated with hospital choice of non-Medicare beneficiaries in past research. Those who were on Medicaid were more likely than private pay patients to be admitted to public hospitals, higher charge hospitals, and hospitals with worse prenatal outcomes for obstetrical care, presumably as a result of choice restrictions (Phibbs et al. 1993). The effect of Medicaid on hospital choice among rural aged Medicare beneficiaries has not been examined. Having Medicaid can be an indication of a lower SES that may deter patients from hospital bypassing. However, elderly patients with Medicaid coverage might reflect the availability of broader and better insurance than other elderly that may result in a higher likelihood of hospital bypassing. Therefore, the effect of Medicaid on hospital choice can go either way. A self-reported MEDICAID status was specified as a dichotomous variable with a value of one for Medicaid eligibility and zero otherwise.

Similar to marital status, more children could also be an indication for the availability of informal care or support. Those who had more children may be more likely to choose distant hospitals because of the potential help on driving or driving a long distance. NUMBER OF CHILDREN was specified as a count variable reported by the MCBS respondent. The more children an aged rural Medicare beneficiary had, the more likely he or she was expected to bypass the closest rural hospital.

Health and Functional Status Variables: Three types of patient health functional status variables were included in the model: self-reported health status, functional status level, and the medical condition treated in the hospital. General health perception indicates how a person perceives his or her health status. Overall, older people's self

assessed general and physical health were predictive of functional decline and mortality (Lee 2000). Functional status measures focus on an individual's ability to perform daily living activities. Chronic illness may also important in studying hospital choice of patients.

The self-reported health status measure contains five responses ranging from poor to excellent and was re-coded as a single dummy variable, POOR HEALTH, to distinguish individuals in the poorest health from all others. Patients in poor health are expected to choose more sophisticated hospitals.

To evaluate Activity of Daily Living (ADLs), respondents were asked if they experienced difficulty in performing each of the following six tasks: bathing, getting in/out of a chair, dressing, eating, toileting, and/or walking. According to the conventional definition of disability in the literature (Verbrugge and Jette 1994), respondents who had reported difficulty in performing an activity were considered disabled. The variable, NUMBER of ADLs, summarizes responses to indicate a patient's level of functional disability. The variable ranges from 0 to 6. Unlike being in poor health, a higher level of functional disability is expected to decrease the probability of hospital bypassing for aged rural Medicare beneficiaries.

Another variable was specified to distinguish patients with severe functional impairment using the same set of ADL questions in the MCBS. Medicare beneficiaries were asked whether they were bedridden in terms of their ability to perform following tasks: bathing, getting in/out of a chair, dressing, eating, toileting, and/or walking. A dummy variable BEDRIDDEN was created from these six ADL questions to indicate

whether or not a person was bedridden, with a score of one indicating "yes" and a score of zero indicating "otherwise". In general, functional impairments reflect a beneficiary's level of disability. Individuals who were bedridden were those with the most severe functional status limitations. Bedridden patients should be less likely to be admitted to a more distant hospital because of their extreme mobility limitations.

Certain kinds of medical conditions were found to be associated with hospital bypassing in the past research. A surgical DRG or a psychiatric diagnosis, a higher DRG case-mix index, a higher numbers of procedure performed, and a cardiovascular or technical intensive diagnosis were found to be associated with the use of more sophisticated hospitals or choice of urban over rural facilities (Adams e al 1991, Buczko 1992).

Patients with medical conditions treated through surgical interventions may require hospitals with increased service capacity, and were expected to be associated with urban teaching hospitals' admissions. Psychological DRG tend to be positively correlated with hospital bypassing for privacy reasons (Adams et al. 1991, Phibbs et al. 1993). Therefore, the presence of a psychiatric condition is also expected to be associated with hospitalization in more distant hospitals. The SURGICAL and PSYCHOLOGICAL DRG were included in the study, with a value of one for "yes" and zero "otherwise".

Diagnostic information from MEDPAR claims were used to distinguish high technology hospitalizations, based on categories proposed by Codman Research Group Inc., (1990). Principle diagnoses were classified into groups based on the ICD-9-CM

classification of diseases (Codman Research Group 1990). Two dummy variables were constructed to distinguish respondents with different potential needs for more sophisticated hospital services. The two groups of diagnoses were defined with respect to 3-digit ICD-9 codes as follows:

1. Cardiovascular procedures (103-112, 117, 124, & 125).
2. Technically intensive conditions (5, 106, 107, 112, 214, & 410).

Finally, both the CMI and number of procedures were both found to be positively associated with hospital bypassing (Buczko 1992). The CMI and NUMER OF PROCEDURES performed during the hospital stay were also specified as a patient attribute since patients with more severe CMI or more procedures performed during the hospital stay should be those with more severe cases that require hospitals with increased service capacity. Therefore, the case-mix index and number of procedures performed are both expected to be positively associated with bypassing the closest rural hospital for more sophisticated but distant hospitals.

Satisfaction with and Access to Medical Care Variables: Although previous studies suggested that hospital choice is strongly influenced by the patients' physician, individuals can accept or reject physicians' decisions based on their own knowledge or preference (Adams et al. 1991). Distance between the office of primary care physician with admitting privilege and the hospital, physician preferences, and physicians' assessment of patients' needs all affect hospital choice of patients.

The influence of primary care physician on choice of a particular hospital for inpatient care could not be directly measured here. However, having a regular source of care in the community and higher levels of satisfaction with primary care may reduce the probability of rural elderly bypassing the closest rural hospital for inpatient care. Therefore, these factors were hypothesized to have negative effects on hospital bypassing behavior. That is, the elderly who have a regular source of care or have a higher level of satisfaction with their primary care physician should be less likely to bypass local hospitals and hospitalized in an urban hospital.

Five variables were specified to indicate the satisfaction with and access to medical care. In general, patients who had a regular source of care, a longer tie with the physician, a higher level of satisfaction with availability of care or quality of physicians, and a better access to physician were expected to have a higher probability of using locally provided health care.

The regular source of care was based on a self-reported question in the MCBS regarding whether a respondent had a regular source of care. Individuals without a regular source of care include those who did not have a regular doctor because they were never sick. The variable, REGULAR SOURCE OF CARE, equals one if the sample persons had a regular source care.

For those who had a regular physician, MCBS respondents were asked how long they were seeing their physicians. The patient and physician relationship was coded as the followings: 1 = "less than or equal to one year", 2 = "one to three years", 3 = "three to five years", 4 = "five to ten years", and 5 = "ten years or more". A dummy variable

indicating a LONGER PATIENT-PHYSICIAN TIE was created. Those who saw their primary physicians for more than one year were coded one for this dummy variable and zero otherwise.

In general, persons with a regular doctor or a longer patient-physician tie may receive a higher quality of care because of a greater familiarity of doctors with medical history and a greater continuity of care. Thus worse health outcomes that require sophisticated care in more distant urban hospitals were less likely to be expected for such individuals. Furthermore, distance from the physician's office to the hospital exerts the strongest negative and most consistent effects on referral patterns for hospital care (Burns and Wholey 1989). Therefore, patients may prefer closer hospitals where local primary physicians most likely to have admitting privileges.

An aged rural Medicare beneficiary's spatial access to doctor's office for medical care may contribute to the understanding of hospital choice behavior. If an aged rural Medicare beneficiary's local physician is more accessible, he or she may be more likely to receive inpatient care at the closest hospital where the physician is most likely to practice (Burns and Wholey 1989). The LESS ACCESSIBLE TO PHYSICIAN indicated whether or not a sample person must spend 30 minutes or more in travel to the doctor's office.

The followings two scales measured different dimensions of patient satisfaction with availability of health care and with quality of physician.

DISSATISFACTION WITH THE AVAILABILITY OF HEALTH CARE equals one if one of three conditions were satisfied. First, a respondent reported having trouble receiving care due to physician availability. Second, a respondent reported dissatisfaction with the ease of getting to the doctor, or ability to get care at the same location. Third, a respondent reported dissatisfaction or suggested improvements in waiting time, paper work, or location of the doctor's office in an open-ended question.

DISSATISFACTION WITH QUALITY OF PHYSICIAN equals to one if one of three conditions were satisfied. First, a respondent reported one or more dissatisfaction on questions regarding overall quality of physician care. Second, a respondent reported one or more dissatisfaction regarding physician's technical competence. Third, a respondent reported one or more dissatisfaction with physician practice style. A detailed description on individual questions included for this variable is included in the Appendix A.

Beneficiaries were interviewed in the last three months of the calendar year and hospitalizations could occur much sooner. The most obvious solution is to use physician satisfaction data from the previous year for those beneficiaries who were MCBS respondents in the previous year. The problem with this approach is that some MCBS respondents in one year drop out of the survey in the following year due to non-response or deaths and new respondents were added every year. This would suggest that no previous data on satisfaction with health care could be found for these individuals. As a compromise, current year data for new respondents and previous year data for continuing respondents were used to construct variables on satisfaction variables discussed above.

Prior Use for Inpatient Care: The effect of prior use on hospital choice was not specified in past research. However, it is plausible to assume that previous hospital choice behavior should have a positive effect on current hospital choice behavior. That is, those who bypassed their "closest rural hospital" alternative before were expected to be more likely to bypass it again. Medicare inpatient claims between the years of 1993 and 1995 were used to identify previous hospitalizations. Since some beneficiaries did not have any hospitalization in the past 12 months, these individuals and individuals had at least one hospitalization but did not bypass the closest rural hospital were both assigned zero on this variable. Previous BYPASSING equals one if a person utilized the non-closest rural hospitals in the past 12 months, and zero otherwise. Another variable, PRIOR HOSPITALIZATION, equals to one if a sample person had a least one hospitalization in the past 12 months, zero otherwise. Then previous bypassing variable means that the effect of a prior hospitalization on choice varies depending upon whether a person bypassed or not. In other words, bypassing in the past becomes an interaction term with prior hospitalization. Individuals with previous hospitalization may be an indication of higher or frequent users. Higher or frequent users in need of more sophisticated care may choose better but more distant hospitals. On the other hand, higher or frequent users in need of frequent inpatient care may decide to stay in hospitals in a closer proximity for the convenience reason.

*Hospital attributes:*

Three hospital attributes were specified including the bed size, Guttman scale of hospital service capacity, and the size of the choice alternative that the aged rural Medicare beneficiary resided. Since hospital choice may be influenced by patient preferences for hospital characteristics, independent variables measuring hospital scale and capacity (i.e., beds and services provided) were included to differentiate the hospitals.

Previous literature found hospital bed size to be positively associated with choice of a hospital (Adams et al. 1991, Buczko 1994). The hospital bed size can reflect both patient volumes and hospital capacity. It can be a simple measure of scale and complexity of service offering. Therefore, it was hypothesized that the greater number of hospital beds of a choice alternative, the more likely a sample person would perceive that alternative with a better capacity, and in turn, chooses that alternative. The AVERAGE BED SIZE was the average number of acute care beds of all hospitals in the choice alternative.

In addition, it was found that the scope of services of hospitals positively affects a patient's choice of hospitals (Adams et al. 1991). A simple count of services cannot distinguish more complex service offering from less complex ones. The Guttman scale was based on the principle of cumulative scaling, which accounts for the tendency of hospitals to acquire services capabilities in a predictable sequence: from less complex to more complex services (Adams et al. 1991). For example, hospitals typically offer some general and less technology intensive services (e.g., emergency services) before more technology intensive services (e.g., neonatal intensive care unit). That is, it is expected

that hospitals with a neonatal intensive care unit already have an emergency care department.

The Guttman scale lists significant services or specialized units. The process is then followed by the searches of those items that occur in a consistent sequence, eliminating items that always occur jointly (Adams et al. 1991). Each hospital is scored by its highest–ranking (least common) service.

However, a small number of AHA cases could not be matched to the Medicare POS file. The sample means of several hospital characteristics for the unmatched POS hospitals and the ones matched to AHA hospitals were compared to ascertain any bias. The comparison revealed no systematic differences in teaching status and total number of certified beds between matched and unmatched cases, although fewer of the unmatched hospitals were located in rural areas. The unmatched cases were kept in the sample to maintain corresponding statistical power. Predicted Guttman scales for POS hospitals without AHA data were estimated from the data of matched hospitals by relating their hospital attributes including bed size, teaching status, and rural/urban location to their Guttman scores. The following simple linear model was used to predict Guttman scores for the unmatched hospitals.

The predicted Guttman Score = $a + b$ * bed size + $c$ * teaching status + $d$ * rural/urban location.

A scale of 17 specific items was used for the hospitals in our sample persons' market areas. Details are presented in Appendix B. The scales were developed iteratively, using a SAS program to include and exclude items with the goal of capturing diversified frequency of occurrences as well as internal consistency.

The 1994 and 1995 AHA data were used to derive this scale. Services prevalence ranges from emergency services (over 81 percent) to specialized pediatric intensive care units (only 6 percent). The AVERAGE GUTTMAN SCALE of hospital service capacity of choice alternatives was constructed by averaging the Guttman scores of all hospitals in the choice alternative.

NUMBER OF HOSPITALS of the choice alternative was not specified in past research. One may hypothesize that the more hospitals around a rural Medicare beneficiary's residence to choose from, the more likely that the beneficiary would receive treatment in the local area due to availability. The total number of hospitals was the total number of hospitals of the choice alternative.

*Distance:*

Earlier studies suggested that distance is a major deterrent for the choice of more distant hospitals for inpatient care in rural areas (Adams et al. 1991, Adams & Wright 1991). Previous literature measured distance (spatial access) in different forms, however, the studies all found that the closer a patient's residence to a hospital, the more likely that the patient will choose the hospital, holding other variables constant (Adams et al. 1991, Adams and Wright 1991). With reduced roles of money costs of hospital care and

opportunity cost of local travel, distance must reflect a broader array of less tangible social, psychic, and informational cost barriers (Porell and Adams 1995). Distance represents spatial access in the hospital choice behavior especially for aged rural Medicare beneficiaries who need to travel much farther than most elderly persons in urban areas. Therefore, the distance was hypothesized to be a strong deterrent on the choice of a type of hospital among alternatives.

The measure of distance used here was miles as "the crow flies" from the centroid of each zip code of residence to that of the hospital. Again, since the dependent variable is the hospital alternative instead of the choice of individual hospitals, the DISTANCE to hospital used here is the average distance of hospitals within the choice alternative to a beneficiary's residence. Although travel time might be a more desirable measure, the required data were not available. Road distance might even been preferred; however, it does not account for traffic congestion or other barriers to travel (Adams et al. 1991). McGuirk and Porell (1984) found little differences between using travel time and linear distance measures in estimating spatial access barriers to choice of hospital. This significant finding provides a theoretical basis for using the straight-line distance measure to specify spatial access when the travel time data are not available.

*3.5. Data Analysis*

In addressing the research questions, data analysis was completed in four stages. The first stage described the sample persons, dependent and independent variables. The second stage explored bivariate relationships between patient characteristics and hospital

attributes with hospital choice. The third stage of analysis involved in identifying patient, hospital, and distance variables associated with hospital choice of aged rural Medicare beneficiaries. The fourth stage examined gender differences in hospital choice by estimating separate models for men and for women.

# CHAPTER IV

# DESCRIPTIVE AND BIVARIATE ANALYSES

This chapter presents descriptive statistics and bivariate relationships between several key independent variables and the dependent variable for the study sample. The first section presents basic descriptive statistics of the study sample and their hospital choice. The bivariate analysis demonstrates the association between hospital choice and several key independent variables such as size of the closest rural hospital, age, gender, severity of illness, income, and the patient's access to health care. Descriptive and bivariate analyses include aged rural Medicare beneficiaries from rounds 10 and 13 of the MCBS who met the study sample selection criteria outlined in Chapter 3.

## *4.1. Descriptive Statistics*

### 4.1.1. Descriptive Statistics of the Hospital Choice Alternatives

Table 4 presents the descriptive statistics of the dependent variable, hospital choice, for the study sample. The dependent variable was composed of four categories: "closest rural hospital", "other rural hospital", "other urban hospital", and "urban teaching hospital" alternatives.

**Table 4. Descriptive Statistics of Hospital Choice Alternatives, 1994 & 1995**

| Hospital Choice Alternative | N | % |
|---|---|---|
| Closest rural hospital | 956 | 56.2 |
| Other Rural Hospital | 217 | 12.7 |
| Other Urban Hospital | 227 | 13.3 |
| Urban Teaching Hospital | 302 | 17.7 |

The majority of the aged rural Medicare beneficiaries were hospitalized in the "closest rural hospital" alternative" (56%), almost 13 percent in the "other rural hospital" alternative, another 13 percent in the "other urban hospital" alternative, and almost 18 percent in the "urban teaching hospital" alternative.

4.1.2. Demographic and Social Structural Characteristics

Table 5 presents sample means for patient characteristics including demographic, social structural, health and diagnostic information, satisfaction with and access to health care, and prior hospital use of the sample respondents. The average age for the study sample was 78.1 years old. Around 45 percent of the study sample were between the age of 75 and 84 years old, while 20 percent were 85 years of age or older. Since all study sample members were hospitalized at least once, it is not surprising they are older on average than the total aged Medicare beneficiary population. Sample respondents were more likely to be White (89%), while they were less likely to be male (43%), and married (48%).

**Table 5. Descriptive Statistics for Individual Characteristics among Aged Rural Medicare Beneficiaries, 1994 & 1995**

| Variables | N=1702 | | | |
|---|---|---|---|---|
| | Mean or % | SD | Min | Max |
| **Demographic Characteristics** | | | | |
| Age*[7] | 78.104 | 7.351 | 65 | 103 |
| Age 75-84 (%) | 0.452 | 0.498 | 0 | 1 |
| Age 85+ (%) | 0.200 | 0.400 | 0 | 1 |
| Male (%) | 0.425 | 0.494 | 0 | 1 |
| Married (%) | 0.479 | 0.500 | 0 | 1 |
| **Social Structural Characteristics** | | | | |
| White (%) | 0.890 | 0.313 | 0 | 1 |
| College degree (%) | 0.168 | 0.374 | 0 | 1 |
| Medicaid Eligibility (%) | 0.199 | 0.399 | 0 | 1 |
| Income more than $25,000 (%) | 0.157 | 0.364 | 0 | 1 |
| Number of Children | 3.250 | 2.596 | 0 | 14 |
| One or more Children* | 0.883 | 0.321 | 0 | 1 |
| **Health, Functional Status, and Diagnostic Category** | | | | |
| ADL Impairments | 1.647 | 1.934 | 0 | 6 |
| Bedridden (%) | 0.066 | 0.249 | 0 | 1 |
| Poor Health (%) | 0.214 | 0.410 | 0 | 1 |
| Surgical DRG (%) | 0.295 | 0.456 | 0 | 1 |
| Psychiatric Diagnosis (%) | 0.011 | 0.102 | 0 | 1 |
| Cardiovascular Procedure (%) | 0.079 | 0.269 | 0 | 1 |
| Technical Intensive Condition (%) | 0.042 | 0.201 | 0 | 1 |
| Case Mix Index | 1.394 | 1.045 | 0.418 | 16.986 |
| Number of Procedure | 1.144 | 1.573 | 0 | 6 |
| **Satisfaction With and Access to Medical Care** | | | | |
| Regular Source of Care (%) | 0.981 | 0.136 | 0 | 1 |
| Longer Patient-Physician Tie (%) | 0.860 | 0.347 | 0 | 1 |
| Less Accessible to Physician (%) | 0.136 | 0.343 | 0 | 1 |
| Dissatisfaction with the Availability of Health Care (%) | 0.223 | 0.417 | 0 | 1 |
| Dissatisfaction with the Quality of Physician | 0.375 | 0.484 | 0 | 1 |
| **Prior Use** | | | | |
| Hospitalized in the Past 12 Months (%) | 0.405 | 0.491 | 0 | 1 |
| Bypassed the Closest Hospital in the Past 12 Months (%) | 0.174 | 0.379 | 0 | 1 |

[7] These variables were not specified in the multivariate model.

Nearly 17 percent of the sample persons were college educated with 16 years of education or more. Almost 20 percent were on Medicaid at the time of the survey and well over three-quarters reported an annual income below $25,000 (84%). Almost 89 percent of the study sample had one or more children and the average number of children for the study sample was 3.3 children.

4.1.3. Health, Functional Status, and Diagnostic Category Characteristics

The average number of ADLs for the study sample was 1.65. A little more than six percent of the study sample was bedridden. When asked to rate their general health, less than one-quarter (21%) of the sample respondents reported poor health. Diagnostic information associated with their hospitalization shows that almost 30 percent presented with a surgical DRG, one percent with a psychiatric diagnosis, almost eight percent with a cardiovascular procedure, and four percent with a technical intensive condition upon admission. The average case mix index for the study sample was almost 1.4, ranging from 0.42 to 16.99. The average number of surgical procedures performed during a hospital stay was 1.14, ranging from zero to six for the study sample.

4.1.4. Satisfaction with and Access to Medical Care

More than 98 percent of the study sample possessed a regular source of care. Most respondents in the study sample (86%) had seen their regular physicians for more than one year. Only 14 percent of the sample respondents were thirty minutes or more away from their regular physician's office. Over 22 percent of the sample respondents

reported access barriers related to service availability (i.e., dissatisfied or very dissatisfied about service availability or experienced difficulties receiving care because it was unavailable, or could not see the doctor because of barriers to access). Almost 38 percent of the study respondents reported dissatisfaction with at least one of 17 aspects of physician quality (i.e., dissatisfied or very dissatisfied with regular physician, physician competence, or physician practice style).

4.1.5. Prior Hospital Use

A little over 40 percent of the study sample was hospitalized at least once in the past twelve months. Seventeen percent of the sample respondents were hospitalized and did not choose their closest rural hospital in the past 12 months.

4.1.6. Characteristics of Hospital Type

Table 6 presents the descriptive statistics of hospital attributes of four choice alternatives faced by aged rural Medicare beneficiaries in the sample. Since not every sample persons had all four choice alternatives in their hospital market areas, zeros were assigned when the hospital market area of a sample person did not contain a feasible choice alternative[8]. Analyses of variance for all hospital attributes indicated significant differences among four choice alternatives.

[8] These incidences will not be included in the multivariate analyses to avoid misspecifications of hospital attributes.

**Table 6. Descriptive Statistics of Hospital Characteristics in the Aged Rural Medicare Beneficiaries' Market Areas by Hospital Type, 1994 & 1995**

| Variables | Hospital Type (N=1702) | | | |
|---|---|---|---|---|
| | Closest Rural[9] | Other Rural | Other Urban | Urban Teaching |
| **Hospital Attributes** | | | | |
| Bed Size*[10] | 105.14 | 133.69 | 243.90 | 585.86 |
| | (89.80) | (96.83) | (138.10) | (187.28) |
| Guttman Scale of Hospital Service Capacity* | 5.91 | 6.24 | 7.30 | 10.68 |
| | (2.94) | (2.92) | (3.61) | (3.06) |
| Number of Hospitals* | 1.06 | 2.95 | 3.55 | 4.31 |
| | (0.24) | (2.10) | (3.26) | (2.79) |
| **Distance in Miles** | | | | |
| Distance to Hospital* | 5.56 | 96.14 | 211.42 | 172.70 |
| | (6.62) | (175.14) | (292.29) | (201.35) |

The average bed size of the "closest rural hospital" alternative was 105 as opposed to 133 beds for the "other rural hospital" alternative, 244 beds for the "other urban hospital" alternative and 586 beds for the "urban teaching hospital" alternative. The average Guttman scale of hospital service capacity of the "closest rural hospital" alternative was 5.91 as opposed to 6.24 for the "other rural hospital" alternative, 7.30 for the "other urban hospital" alternative and 10.68 for the "urban teaching hospital" alternative.

The higher the Guttman score, the greater scope of service is provided by a hospital. Finally, the average distance of the "closest rural hospital" alternative was 5.56 miles as opposed to 96.14 miles for the "other rural hospital" alternative, 211.42 miles for the "other urban hospital" alternative and 172.70 miles for the "urban teaching hospital"

[9] Standard deviations are reported in parentheses.

alternative. It should be noted that the median distance of each alternative should be lower than the mean. This may be due to the 1 percent cutoff point applied in the market area definition discussed in Chapter 3 that still results in inclusion of some admissions with extraneous travel patterns. Various cutoff points for the hospital market area definition should be used in the future to test the sensitivity of estimated coefficients in the conditional hospital choice models.

*4.2. Bivariate Analyses*

Bivariate analyses examine the relationship between independent variables and hospital choice. By controlling for the "size of the closest rural hospital", it also allows us to describe travel patterns that could be influenced by the alternative to which most rural elderly were admitted. The bivariate analyses examine the association between hospital choice and each independent variable on a one-to-one basis. Treating "the closest rural hospital" alternative as the reference category, independent sample "t" tests were used to examine whether differences were significant for each independent variable between the choice of the "closest rural hospital" alternative and other hospital choice alternatives. Since gender difference in hospital choice is of interest in the study, gender differences in the association between hospital choice and each independent variable were also examined with independent sample "t" tests for the study sample.

[10] * Significantly different at 1% level: test for differences by group with ANOVA.

4.2.1. Individual Attributes by Hospital Choice Alternative

Table 7 presents sample means for the personal attributes of patients using different hospital alternatives. Particularly, the differences of individual attributes in hospital choice behavior were also examined.

Closest rural vs. other rural: Comparing sample means of those using the closest rural hospital with those using the "other rural hospital" alternative, patients who used a rural hospital other than the closest to their residence were less likely to be among the oldest-old (85 years or older), Medicaid eligible, and had lower ADL scores than those admitted to their closest rural hospital. They were also less likely to have a regular source of care as opposed to those hospitalized in the "closest rural hospital" alternative.

As opposed to those who were hospitalized in their "closest rural hospital", patients who were hospitalized in an "other rural hospital" alternative were more likely to be White, hospitalized for a surgical DRG, a cardiovascular procedure, or a technical intensive condition. They were also more likely to have hospitalized and to have bypassed their closest hospital in the past year, than patients admitted to their closest rural hospital. Patients hospitalized in the "other rural hospital" alternative also had more children, a more severe case mix, and a higher number of surgical procedures performed during their hospital stay than patients admitted to their closest rural hospital.

**Table 7. Sample Means of Individual Attributes by Chosen Hospital Choice Alternative[11]**

| Variables | Closest Rural[12] | Other Rural | | Other Urban | | Urban Teaching | |
|---|---|---|---|---|---|---|---|
| | Mean or % | Mean or % | Sig. | Mean or % | Sig. | Mean or % | Sig. |
| | *(N=956)* | *(N=217)* | | *(N=227)* | | *(N=302)* | |
| **Demographic Characteristics** | | | | | | | |
| Age 75-84 (%) | 0.45 | 0.48 | | 0.47 | | 0.44 | |
| Age 85+ (%) | 0.27 | 0.17 | ***[13] | 0.13 | *** | 0.07 | *** |
| Married (%) | 0.38 | 0.42 | | 0.49 | *** | 0.51 | *** |
| Male | 0.43 | 0.47 | | 0.53 | *** | 0.61 | *** |
| **Social Structural Characteristics** | | | | | | | |
| White (%) | 0.87 | 0.92 | ** | 0.87 | | 0.94 | *** |
| College degree (%) | 0.15 | 0.14 | | 0.15 | | 0.27 | *** |
| Medicaid Eligibility (%) | 0.23 | 0.16 | ** | 0.19 | | 0.14 | *** |
| Income More Than $25,000 (%) | 0.13 | 0.12 | | 0.20 | *** | 0.25 | *** |
| Number of Children | 3.16 | 3.41 | * | 3.32 | | 3.36 | |
| **Health, Functional Status, and Diagnostic Category** | | | | | | | |
| ADL Impairments | 1.77 | 1.34 | *** | 1.43 | *** | 1.63 | ** |
| Bedridden (%) | 0.08 | 0.06 | | 0.03 | *** | 0.04 | |
| Poor Health (%) | 0.23 | 0.19 | | 0.20 | | 0.20 | |
| Surgical DRG (%) | 0.19 | 0.32 | *** | 0.35 | *** | 0.56 | *** |
| Psychiatric Diagnosis (%) | 0.01 | 0.02 | | 0.02 | ** | 0.01 | |
| Cardiovascular Procedure (%) | 0.02 | 0.05 | *** | 0.12 | *** | 0.27 | *** |
| Technical Intensive Condition (%) | 0.00 | 0.03 | *** | 0.07 | *** | 0.17 | *** |
| Case Mix Index | 1.19 | 1.38 | *** | 1.52 | *** | 1.97 | *** |
| Number of Procedures | 0.73 | 1.18 | *** | 1.47 | *** | 2.18 | *** |
| **Satisfaction with and access to Medical Care** | | | | | | | |
| Regular Source of Care (%) | 0.99 | 0.96 | ** | 0.99 | | 0.97 | |
| Longer Patient-Physician Tie (%) | 0.88 | 0.85 | | 0.80 | *** | 0.84 | * |
| Dissatisfaction with the Availability of Health Care (%) | 0.34 | 0.40 | | 0.37 | | 0.31 | |
| Less Accessible to Physician (%) | 0.37 | 0.39 | | 0.39 | | 0.38 | |
| Dissatisfaction with the Quality of Physician (%) | 0.37 | 0.39 | | 0.39 | | 0.37 | |
| **Prior Use** | | | | | | | |
| Hospitalized in the Past 12 Months (%) | 0.36 | 0.39 | | 0.42 | * | 0.54 | *** |
| Bypassed the Closest Hospital in the Past 12 Months (%) | 0.06 | 0.31 | *** | 0.26 | *** | 0.38 | *** |

[11] Two-tailed t-test (means) or chi-square (proportions) was performed.

[12] The "closest rural hospital" alternative is the reference category for the comparisons.

[13] * Significant at 10% level. ** Significant at 5% level. *** Significant at 1% level.

Closest rural vs. other urban: Comparing sample means of those admitted to the "closest rural hospital" with those of patients choosing the "other urban hospital" alternative, "other urban hospital" users were less likely to be in the oldest-old category and to have fewer ADLs. Different from those who were admitted to a more distant "other rural hospital" alternative, "other urban hospital" users were much more likely to be male, married, and of higher income ($25,000 or more), but less likely to be bedridden, than those admitted to their closest rural hospital.

As opposed to those who were hospitalized in the "closest rural hospital", individuals hospitalized in the "other urban hospital" alternative were more likely to be hospitalized for a surgical DRG, a psychiatric diagnosis, a cardiovascular procedure, or a technical intensive condition. They were also more likely to have bypassed their closest hospital for hospital admission in the past 12 months, than did individuals admitted to their closest rural hospital. Patients admitted to a non-teaching urban hospital had a more severe case-mix and a greater number of surgical procedures performed during their hospital stay, than patients admitted to their closet rural hospital. Unlike "other rural hospital" users, patients admitted to "other urban hospital" alternative were less likely to have a longer patient-physician tie and were more likely to have been hospitalized in the past 12 months, as opposed to those who used their closest rural hospital. Again, patients who bypassed their closest rural hospital for admission to a non-teaching urban hospital were also less frail and had more complex treatment needs than patients admitted to their closest rural hospital.

Closest rural vs. urban teaching: Comparing sample mean values of those admitted to the "closest rural hospital" with those of patients choosing the "urban teaching hospital" alternative, "urban teaching hospital" users were much less likely to be in the oldest-old age category and Medicaid recipients. However, the "urban teaching hospital" users were more likely to be male, married, White, have an income $25,000 or more, and more highly educated as opposed to patients admitted to their closest rural hospital. "Urban teaching hospital" users were less likely to have a longer patient-physician tie, as opposed to those admitted to their closest rural hospital.

As opposed to those who were admitted to their "closest rural hospital", patients choosing admission to an urban teaching hospital were more likely to be hospitalized for a surgical DRG, a cardiovascular procedure, or for a technical intensive condition. They were also more likely to have bypassed their closest hospital in the past 12 months, than did individuals admitted to their closest rural hospital. Urban teaching hospital users also had a lower level of ADL functional impairment, a more severe case-mix, and a higher number of surgical procedures performed during their hospitalization than patients admitted to their closest rural hospital.

In sum, individuals who bypassed the "closest rural hospital" alternative appeared to be less disadvantaged in terms of demographic, socioeconomic, and functional limitations. However, they seemed to bypass their closest rural hospital for more complex treatment needs than patients admitted to their closest rural hospital. They were also more likely to lack a regular source of care and to have a shorter patient-physician relationship.

4.2.2. Gender Differences in Individual Patient Attributes

Table 8 presents sample means for patient attributes by gender. Among individuals in the study sample, males were less likely than females to be among the "oldest-old" and Medicaid. However, male patients were more likely to be married, White, have an income $25,000 or more, and to have more children, than their female patient counterparts.

Males were also more likely to be hospitalized for a cardiovascular procedure or a technical intensive condition, to have a more severe case-mix, and to have a greater number of surgical procedures performed during their hospital stay than females. Compared to females, male patients were slightly more likely to have a regular source of care, to live 30 minutes or more away from their physician's office, to be dissatisfied with quality of physician, and to have bypassed their closest rural hospital in the past 12 months.

**Table 8. Gender Differences in Individual Patient Attributes among Aged Rural Medicare Beneficiaries, 1994 & 1995[14]**

| Variables | Female (n=979) | | | | Male (n=723) | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean or % | SD | Min | Max | Mean or % | SD | Min | Max |
| **Demographic Characteristics** | | | | | | | | |
| Age 75-84 (%) | 0.46 | 0.50 | 0 | 1 | 0.45 | 0.50 | 0 | 1 |
| Age 85+ (%) | 0.25 | 0.43 | 0 | 1 | 0.13***[15] | 0.34 | 0 | 1 |
| Married (%) | 0.30 | 0.46 | 0 | 1 | 0.73*** | 0.45 | 0 | 1 |
| **Social Structural Characteristics** | | | | | | | | |
| White (%) | 0.87 | 0.34 | 0 | 1 | 0.92*** | 0.27 | 0 | 1 |
| College degree (%) | 0.17 | 0.38 | 0 | 1 | 0.16 | 0.37 | 0 | 1 |
| Medicaid Eligibility (%) | 0.26 | 0.44 | 0 | 1 | 0.12*** | 0.33 | 0 | 1 |
| Income More Than $25,000 (%) | 0.11 | 0.32 | 0 | 1 | 0.22*** | 0.41 | 0 | 1 |
| Number of Children | 3.13 | 2.47 | 0 | 13 | 3.41*** | 2.75 | 0 | 14 |
| **Health, Functional Status, and Diagnostic Category** | | | | | | | | |
| ADL Impairments | 1.83 | 1.93 | 0 | 6 | 1.40 | 1.91 | 0 | 6 |
| Bedridden (%) | 0.08 | 0.26 | 0 | 1 | 0.06 | 0.23 | 0 | 1 |
| Poor Health (%) | 0.22 | 0.42 | 0 | 1 | 0.20 | 0.40 | 0 | 1 |
| Surgical DRG (%) | 0.28 | 0.45 | 0 | 1 | 0.31 | 0.46 | 0 | 1 |
| Psychiatric Diagnosis (%) | 0.00 | 0.12 | 0 | 1 | 0.01 | 0.08 | 0 | 1 |
| Cardiovascular Procedure (%) | 0.06 | 0.23 | 0 | 1 | 0.11*** | 0.31 | 0 | 1 |
| Technical Intensive Condition (%) | 0.02 | 0.14 | 0 | 1 | 0.07*** | 0.26 | 0 | 1 |
| Case Mix Index | 1.32 | 0.89 | 0.42 | 7.66 | 1.50*** | 1.22 | 0.422 | 16.99 |
| Number of Procedures | 1.01 | 1.42 | 0 | 6 | 1.32*** | 1.74 | 0 | 6 |
| **Satisfaction with and access to Medical Care** | | | | | | | | |
| Regular Source of Care (%) | 0.98 | 0.15 | 0 | 1 | 0.99* | 0.11 | 0 | 1 |
| Longer Patient-Physician Tie (%) | 0.87 | 0.34 | 0 | 1 | 0.85 | 0.35 | 0 | 1 |
| Dissatisfaction with the Availability of Health Care (%) | 0.22 | 0.42 | 0 | 1 | 0.22 | 0.42 | 0 | 1 |
| Less Accessible to Physician (%) | 0.12 | 0.33 | 0 | 1 | 0.16** | 0.36 | 0 | 1 |
| Dissatisfaction with the quality of Physician (%) | 0.36 | 0.48 | 0 | 1 | 0.40* | 0.49 | 0 | 1 |
| **Prior Use** | | | | | | | | |
| Hospitalized in the Past 12 Months (%) | 0.39 | 0.49 | 0 | 1 | 0.42 | 0.49 | 0 | 1 |
| Bypassed the Closest Hospital in the Past 12 Months (%) | 0.16 | 0.36 | 0 | 1 | 0.20** | 0.40 | 0 | 1 |

[14] 2-tailed t-test (means) or chi-square (proportions) was performed.

[15] * Significant at 10% level. ** Significant at 5% level. *** Significant at 1% level.

4.2.3. Gender Difference in Hospital Choice

Table 9 presents data about gender difference in hospital choice among aged rural Medicare beneficiaries in the sample population. As opposed to females, males were less likely to choose their admission to the closest rural hospital, and they were more likely to be hospitalized in an urban teaching hospital. The chi-square test indicated that the hospital choice of women was different from men.

**Table 9. Gender Difference in Hospital Choice among Aged Rural Medicare Beneficiaries, 1994 & 1995***[16]

| Dependent Variable | Female | | Male | |
|---|---|---|---|---|
| | N | % | N | % |
| Closest rural hospital | 589 | 60.2 | 367 | 50.8 |
| Other Rural Hospital | 126 | 12.9 | 91 | 12.6 |
| Other Urban Hospital | 116 | 11.9 | 111 | 15.4 |
| Urban Teaching Hospital | 148 | 15.1 | 154 | 21.3 |
| **Total** | 979 | 100 | 723 | 100 |

[16] * Significant at 1% with Chi-square test.

4.2.4. Distribution of Admission and Mean Distance Traveled by Chosen Hospital Alternative

This section examines the relationship between the bed size of the "closest rural hospital" alternative and hospital choice. Table 10 presents distribution of admissions and means of distance traveled among hospital choice alternatives by the size of the closest rural hospital. The majority of the aged Medicare beneficiaries used their closest hospital regardless its size. As shown earlier in Table 3 and in Table 9 below, 56.2 percent of the study respondents were admitted to their closest rural hospital. Overall, among the 44 percent of the sample respondents who bypassed their closest hospital, over 70 percent were admitted to an urban hospital. Among beneficiaries whose closest rural hospital had 100 beds or more, the choice patterns were markedly different from those whose closest rural hospital was smaller. Almost 37 percent of the beneficiaries traveling past their closest rural hospital with fewer than 100 beds used an urban teaching facility. In contrast, about 55 percent of those who bypassed their closest larger rural hospital (100+ beds) used urban teaching facilities.

On average, elderly beneficiaries traveled only 3.9 miles to their closest rural hospital. Beneficiaries obtained inpatient care at facilities other than their closest rural hospital traveled an average of 143.7 miles to the alternative hospital[17].

[17] Note this does not reflect the actual average distance traveled by individual patients to their specific hospital of choice. Rather patients are assigned to the average distance to all hospitals in the chosen alternative.

**Table 10. Number and Mean Distance Traveled by Chosen Hospital Alternative: Rural Medicare Beneficiaries All Ages, 1994-1995**

| | Those Patients Whose Closest Hospital is a | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | All Patients | | | Small Rural (<100 beds) | | | Large Rural (100+ beds) | | |
| | Number | % | Distance (in miles) | Number | % | Distance (in miles) | Number | % | Distance (in miles) |
| **Admitted to the Closest Hospital** | 956 | 56.2 | 3.9 | 527 | 47.1 | 4.3 | 429 | 73.5 | 3.4 |
| **Admitted to More Distant Hospital** | 746 | 43.8 | 143.7*[18] | 591 | 52.9+[19] | 149.7* | 155 | 26.5 | 120.7* |
| **Total** | 1702 | 100.0 | 65.2 | 1118 | 65.7 | 81.2 | 584 | 34.3 | 34.5 |
| | **Among Those Using an Alternative Hospital, the Patients Used:** | | | | | | | | |
| **Other Rural Hospital** | 217 | 29.0 | 100.5 | 176 | 29.8+ | 109.9 | 41 | 26.5 | 60.1 |
| **Other Urban Hospital** | 227 | 30.3 | 159.6**[20] | 198 | 33.5 | 165.2** | 29 | 18.7 | 121.5** |
| **Urban Teaching Hospital** | 305 | 40.7 | 162.8 | 217 | 36.7 | 168.0 | 85 | 54.8 | 149.6** |
| **Total** | 746 | 100.0 | 143.7 | 591 | 79.2 | 149.7 | 155 | 20.8 | 120.7 |

[18] * Significantly different from those who used the closest hospital, two-tailed t-test (p=0.01).

[19] + Proportion is significantly different from those closest rural hospital was large, chi-square test (p=0.01).

[20] ** Significantly different from those who used a distant other rural hospital, two tailed t-test (0.05).

Similarly, bypassers whose closest rural hospital was larger (100+ beds) tended to travel shorter distances (120.7 miles) than bypassers whose closest rural hospital was smaller (149.7 miles). On average, they traveled 60 miles, 122 miles, and 150 miles to their "other rural hospital", "other urban hospital", and "urban teaching hospital" alternatives, respectively as opposed to 110 miles, 165 miles, and 168 miles traveled, on average, by those lived closer to smaller facilities. Overall, these data reveal a systematic relationship suggesting bed size of the closest rural hospital is an important factor affecting bypassing behavior.

4.2.5. Differences in Severity of Illness by Chosen Hospital Alternative

Table 11 displays sample means for case-mix by hospital admission choice, and further, by bed size of the closest rural hospital. The data show that, in general, patients with more complex cases traveled farther. Patients admitted to their closest rural hospital were less severe as measured by the CMI of their admission. Overall, the relative mean severity of cases is uniformly higher among patients bypassing their closest rural hospital, ranging from 1.38 for patients admitted to an "other rural hospital", to 1.97 for patients admitted to an "urban teaching hospital". These patterns hold regardless of whether elderly beneficiaries' closest rural hospital was smaller or larger, but the overall mean level of case-mix severity, again, was greater among bypassing patients whose closest rural hospital had 100 beds or more.

**Table 11. Difference in Case-Mix Severity of Illness by Chosen Hospital Alternative and Bed Size of the Closest Rural Hospital: Rural Medicare Beneficiaries All Ages, 1994-1995**

| | Those Patients Whose Closest Hospital Is a | | |
|---|---|---|---|
| | **All Patients** | **Small Rural (<100 Beds)** | **Large Rural (100+ Beds)** |
| | CMI | CMI | CMI |
| **Admitted to the Closest Hospital** | 1.19 | 1.10 | 1.30 |
| **Admitted to More Distant Hospital** | 1.66*[21] | 1.59* | 1.90* |
| **Total** | 1.39 | 1.36 | 1.46 |
| | **Among Those Using an Alternative Hospital, the Patients Used:** | | |
| **Other Rural Hospital** | 1.38 | 1.32 | 1.63 |
| **Other Urban Hospital** | 1.52**[22] | 1.48** | 1.78** |
| **Urban Teaching Hospital** | 1.97** | 1.92** | 2.08** |
| **Total** | 1.66 | 1.59 | 1.90 |

4.2.6. Mean Severity of Illness by Chosen Hospital Alternative and Age Category

Table 12 contains sample means for case-mix severity of illness by hospital choice for three patient age categories of less than 75 year, 75-84 years, and 85 years and older. The data suggest that age plays an important role in either the beneficiaries' willingness to travel or their physicians' tendency to refer them to hospitals that required travel. Overall, the propensity for elderly patient to bypass their closest rural hospital appears to decline with age.

[21] * Significantly different from those who used the closest hospital, two-tailed t-test (p=0.01).
[22] ** Significantly different from those who used a distant other rural hospital, two tailed t-test (0.10).

**Table 12. Difference in Number and Severity of Illness by Chosen Hospital Alternative: Rural Medicare Beneficiaries by Age Group, 1994 and 1995**

| | Age of Patient | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | <75 Year | | | 75-84 Year | | | 85+ Year | | |
| | Number | % | CMI | Number | % | CMI | Number | % | CMI |
| **Admitted to the Closest Hospital** | 278 | 46.9 | 1.24 | 425 | 55.3 | 1.20 | 253 | 74.4 | 1.11 |
| **Admitted to More Distant Hospital** | 315 | 53.1[+23] | 1.77*[24] | 344 | 44.7 | 1.59* | 87 | 25.6 | 1.52* |
| **Total** | 593 | 100.0 | 1.52 | 769 | 100.0 | 1.38 | 340 | 100.0 | 1.22 |
| | **Among Those Using an Alternative Hospital, the Patients Used:** | | | | | | | | |
| **Other Rural Hospital** | 77 | 24.4[+] | 1.38 | 104 | 30.2 | 1.40 | 36 | 41.4 | 1.31 |
| **Other Urban Hospital** | 92 | 29.2 | 1.76**[25] | 106 | 30.8 | 1.31 | 29 | 33.3 | 1.49 |
| **Urban Teaching Hospital** | 146 | 46.3 | 1.98** | 134 | 39.0 | 1.96** | 22 | 25.3 | 1.91** |
| **Total** | 315 | 100.0 | 1.77 | 344 | 100.0 | 1.59 | 87 | 100.0 | 1.52 |

[23] + Proportion is significantly different from those who used the closest rural hospital, chi-square test (p=0.01).

[24] *Significantly different from those who use the closest rural hospital, two tailed t-test (p=0.01).

[25] ** Significantly different from those who used a distant other rural hospital, two tailed t-test (010).

For example, whereas about 47 percent of patients less than 75 years old were admitted to their "closest rural hospital", 55 percent of patients in the 75-84 age group and 74 percent of patients in the 85 years or older group were admitted to their closest rural hospital. Moreover, among bypassers more than 41 percent of patients in the oldest-old group were still admitted to an "other rural hospital" versus 24 percent of bypassing patients younger than age 75. The tendency for admission to an urban teaching hospital was much lower among older patients than for the younger patients regardless of admission choice.

Severity case-mix measures were similar among younger patients and older patients. In sum, patients with more complex cases were more likely to bypass the closest rural hospital and to be admitted in an urban teaching hospital regardless of age.

4.2.7. DRG Group by Chosen Hospital Alternative

Table 13 contains information about the bypassing propensities for patients distinguished by whether the hospital DRG was classified as medical, surgical, or psychiatric. Of those who were admitted to the closest rural hospital, almost 81 percent were admitted with a medical DRG and a much smaller percentage of patients were admitted with a surgical DRG (19.3%). The pattern by bed size of the closest rural hospital was similar with previous findings. Again, the size of the closest rural hospital was influential in patients' utilization patterns.

**Table 13. Percentages of Rural Elderly Beneficiaries Who Were Admitted to Their Closest Rural Hospital by Medical, Surgical, or Psychiatric Diagnosis by Size of the Closest Hospital, 1994 and 1995**

| Of Patients admitted to the Closest Rural Hospital | Those Patients Whose Closest Hospital Is a | | | | | |
|---|---|---|---|---|---|---|
| | All Patients | | Small Rural (<100 Beds) | | Large Rural (100+ Beds) | |
| | N | % | N | % | N | % |
| **Medical** | 772 | 80.8+[26] | 446 | 84.6 | 326 | 76.0 |
| **Surgical** | 184 | 19.3+ | 81 | 15.4 | 103 | 24.0 |
| **Psychiatric** | 7 | 0.7 | 3 | 0.6 | 4 | 0.9 |

For example, of those who were admitted to a closest rural hospital with 100 beds or more, 24 percent of patients were admitted with a surgical DRG. However, of those who were admitted to a closest rural hospital with less than 100 beds, only 15 percent patients were admitted with a surgical DRG. Overall these data suggest patients with surgical DRG or a psychiatric diagnosis were more likely to bypass their closest rural hospital than medical DRGs and bypassing is more likely when the closest rural hospital is small.

4.2.8. Age Group Differences in Case-Mix Severity of Illness by Chosen Hospital Alternative and Size of the Closest Rural Hospital

Sample means for case-mix severity of illness by chosen hospital alternative for patients of different age groups are presented in Table 14A and Table 14B for subgroups of patients distinguished by the bed size of their closest rural hospital.

[26] + Proportion is significantly different from those who were not admitted to the closest rural hospital, chi-square test (p=0.01).

**Table 14A. Differences in Severity of Illness by Chosen Hospital Alternative and Age Group among Rural Medicare Beneficiaries Whose Closest Rural Hospital is a Small Rural Hospital (Less Than 100 Beds): 1994 and 1995**

| | Patients Whose Closest Rural Hospital Is a Small (<100 Beds) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | <75 Year | | | 75-84 Year | | | 85+ Year | | |
| | N | % | CMI | N | % | CMI | N | % | CMI |
| **Admitted to the Closest Hospital** | 160 | 41.3 | 1.17 | 216 | 41.8 | 1.06 | 151 | 70.6 | 1.06 |
| **Admitted to More Distant Hospital** | 227 | 58.7+[27] | 1.72*[28] | 301 | 58.2 | 1.55* | 63 | 29.4 | 1.36* |
| **Total** | 387 | 34.6 | 1.49 | 517 | 46.2 | 1.35 | 214 | 19.1 | 1.15 |
| | **Among Bypassers of the Closest Rural Hospital:** | | | | | | | | |
| **Other Rural Hospital** | 55 | 24.2++[29] | 1.27 | 94 | 31.2 | 1.36 | 27 | 42.9 | 1.30 |
| **Other Urban Hospital** | 80 | 35.2 | 1.75**[30] | 94 | 31.2 | 1.29** | 24 | 38.1 | 1.30 |
| **Urban Teaching Hospital** | 92 | 40.5 | 1.95** | 113 | 37.5 | 1.93** | 12 | 19.0 | 1.60 |
| **Total** | 227 | 38.4 | 1.72 | 301 | 50.9 | 1.55 | 63 | 10.7 | 1.36 |

[27] + Proportion is significantly different from those who used the closest rural hospital, chi-square test (p=0.01).

[28] * Significantly different from those who used the closest rural hospital, two-tailed t-test (p=0.01).

[29] ++ Proportion is significantly different from those who used a distant other rural hospital, chi-square test (p=0.01).

[30] ** Significantly different from those used a distant other rural hospital, two-tailed t-test (p=0.10).

**Table 14B. Differences in Severity of Illness by Chosen Hospital Alternative and Age Group among Rural Medicare Beneficiaries Whose Closest Rural Hospital is a Large Rural Hospital (100 Beds or more): 1994 and 1995**

| | Patients Whose Closest Rural Hospital Is Large (100+ Beds) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | <75 Year | | | 75-84 Year | | | 85+ Year | | |
| | N | % | CMI | N | % | CMI | N | % | CMI |
| **Admitted to the Closest Hospital** | 118 | 57.3 | 1.33 | 209 | 82.9 | 1.34 | 102 | 81.0 | 1.19 |
| **Admitted to More Distant Hospital** | 88 | 42.7+[31] | 1.90*[32] | 43 | 17.1 | 1.87* | 24 | 19.0 | 1.96* |
| **Total** | 206 | 35.3 | 1.58 | 252 | 43.2 | 1.43 | 126 | 21.6 | 1.33 |
| | **Among Bypassers of the Closest Rural Hospital:** | | | | | | | | |
| **Other Rural Hospital** | 22 | 25.0 | 1.66 | 10 | 23.3 | 1.81 | 9 | 37.5 | 1.35 |
| **Other Urban Hospital** | 12 | 13.6 | 1.83 | 12 | 27.9 | 1.48 | 5 | 20.8 | 2.38 |
| **Urban Teaching Hospital** | 54 | 61.4 | 2.02**[33] | 21 | 48.8 | 2.13 | 10 | 41.7 | 2.29 |
| **Total** | 88 | 56.8 | 1.90 | 43 | 27.7 | 1.87 | 24 | 15.5 | 1.96 |

[31] + Proportion is significantly different from those who used the closest rural hospital, chi-square test (p=0.01).

[32] * Significantly different from those who used the closest rural hospital, two-tailed t-test (p=0.01).

[33] ** Significantly different from those who used a distant other rural hospital, two-tailed t-test (p=0.10).

Patterns of hospital choice and mean levels of case-mix severity of illness among different age groups appear to vary depending upon the bed size of the closest rural hospital.

The mean case-mix severity of illness was higher for patients who bypassed their closest rural hospital relative to that of patients admitted to their closest rural hospital regardless the bed size of the "closest rural hospital" and age of the respondents. That is, influence of severity of illness appears to prevail over age in choice of hospital among the rural elderly. However, for younger aged rural Medicare beneficiaries, the decision to choose urban versus "other rural hospital" alternative among bypassers depends on the severity of illness when the closest rural hospital had less than 100 beds.

The data also highlight the importance of the rural hospital network for the oldest-old. Whereas 24 percent of bypassing patients younger than 75 years old whose closest rural hospital was small used an "other rural hospital" alternative, 43 percent of the oldest old were admitted to the "other rural hospital". This pattern held for those whose "closest rural hospital" alternative was large (100 or more beds) as well. Here age effects prevailed over the size of the closest rural hospital in influencing in the choice of hospital by the rural elderly.

Bypassing patients whose "closest rural hospital" was small (< 100 beds) were less likely to be admitted to an urban teaching hospital than patients whose closest rural hospital was large across all age groups. A much greater percentage of those whose closest rural hospital was large and who bypassed their closest hospital were admitted to an urban teaching hospital regardless of age. In contrast, individuals with a small closest

rural hospital who bypassed that facility were equally more likely to choose "other rural hospital" or "other urban hospital" over the "closest rural hospital" alternative.

### 4.2.9. Gender Differences in Distribution of Admission by Chosen Hospital Alternative among Rural Medicare Beneficiaries

Since gender differences were shown in various individual attributes and hospital choice patterns earlier, bivariate relationships between certain attributes that were shown to vary by gender and hospital choice were examined further. Table 15 presents distribution of admissions among hospital choice alternatives by gender. Females (39.8%) were less likely to bypass their "closest rural hospital" than were men (49.2%). However, no gender difference was found regarding admission choices of those who bypassed their closest rural hospital.

**Table 15. Distribution of Admission by Chosen Hospital Alternative: Rural Medicare Beneficiaries by Gender, 1994 and 1995**

| | Female | | Male | |
|---|---|---|---|---|
| | Number | % | Number | % |
| **Admitted to the Closest Hospital** | 589 | 60.2 | 367 | 50.8 |
| **Admitted to More Distant Hospital** | 390 | 39.8*[34] | 356 | 49.2 |
| **Total** | 979 | 100.0 | 723 | 100.0 |
| | **Among Those Using an Alternative Hospital, the Patients Used:** | | | |
| **Other Rural Hospital** | 126 | 32.3 | 91 | 25.6 |
| **Other Urban Hospital** | 116 | 29.7 | 111 | 31.2 |
| **Urban Teaching Hospital** | 148 | 37.9 | 154 | 43.3 |
| **Total** | 390 | 100.0 | 356 | 100.0 |

[34] * Proportion is significantly different from those who used the closest rural hospital, chi-square test (p=0.01).

4.2.10. Gender Differences in Income by Chosen Hospital Alternative among Rural Medicare Beneficiaries

Table 16 presents the gender difference in income by chosen hospital alternative among aged rural Medicare beneficiaries. A gender difference was found between the high-income dummy variable and hospital choice. A higher percent of male patients who bypassed their closest rural hospital had annual incomes exceeding $25,000 (28.1%) as opposed to males who were admitted to their closest rural hospital (15.3%). No significant difference in income was found for females.

A gender difference was also found in annual income among those who bypassed their closest rural hospital. Males who bypassed their closest rural hospital and used their "other urban hospital" (29.7%) or the "urban teaching hospital" (33.8%) alternative were more likely to have an annual income exceed $25,000 than males who bypassed and were admitted to an "other rural hospital" alternative (16.5%). This pattern did not hold for females in the study sample.

In general, men were more likely to have a higher income than females regardless of hospital choice. However, higher income was associated with a greater likelihood of admissions to urban hospitals for men but not for women. This may have implications toward access barriers among women.

**Table 16. Difference in Income by Chosen Hospital Alternative: Rural Medicare Beneficiaries by Gender, 1994 and 1995**

| | Income More than $25,000 (Yes) | | | |
|---|---|---|---|---|
| | Female | | Male | |
| | Number | % | Number | % |
| **Admitted to the Closest Hospital** | 64 | 10.9 | 56 | 15.3 |
| **Admitted to More Distant Hospital** | 48 | 12.3 | 100 | 28.1*[35] |
| **Total** | 112 | 11.4 | 156 | 21.6 |
| | **Among Those Using an Alternative Hospital, the Patients Used:** | | | |
| **Other Rural Hospital** | 12 | 9.5 | 15 | 16.5 |
| **Other Urban Hospital** | 13 | 11.2 | 33 | 29.7**[36] |
| **Urban Teaching Hospital** | 23 | 15.5 | 52 | 33.8** |
| **Total** | 48 | 12.3 | 100 | 28.1 |

[35] * Significantly different from those who used the closest rural hospital, chi-square test (p=0.01).

[36] ** Significantly different from those who used a distant other rural hospital, chi-square test (p=0.05).

4.2.11. Gender Differences in Patient-Physician Relationship and Problems with Health Care by Chosen Hospital Alternative among Age Rural Medicare Beneficiaries

Table 17 presents information about gender differences in patient-physician relationships and health care access indicators by chosen hospital alternative among aged rural Medicare beneficiaries. A lower percentage of males (97.8%) who bypassed their closest rural hospital had a regular source of care relative to males who were admitted to their closest rural hospital (99.7%). No significant difference was found between women who bypassed and those who did not. However, a lower percentage of females (82.6%) who bypassed their closest rural hospital had a longer patient-physician tie than women admitted to their closest rural hospital (89.1%). No significant difference was found for male patients.

With respect to satisfaction with the availability of health care, a higher percentage of patients who bypassed the closest rural hospital were dissatisfied with the availability of health care compared to those admitted to their closest rural hospital regardless of gender. However, a gender difference was found in concerns about the availability of health care among those who bypassed their closest rural hospital. Males who bypassed their closest rural hospital and were admitted to an "other urban hospital" (21.6%) or an "urban teaching hospital" (22.1%) alternative were less likely to be dissatisfied with the availability of health care, as opposed to bypassing males who were admitted to "other rural hospital" (34.1%). This unexpected pattern did not hold true for females in the study sample.

**Table 17. Differences in Patient-Physician Relationship and Access by Hospital Alternative Used: Rural Medicare Beneficiaries, by Gender, 1994 and 1995**

| | Female | | Male | |
|---|---|---|---|---|
| | **Usual Source of Care (Yes)** | | | |
| | Number | % | Number | % |
| **Admitted to the Closest Hospital** | 379 | 97.2 | 348 | 99.7 |
| **Admitted to More Distant Hospital** | 577 | 98.0 | 366 | 97.8*[37] |
| **Total** | 956 | 97.7 | 714 | 98.8 |
| | **Longer Patient-Physician Tie (Yes)** | | | |
| | Number | % | Number | % |
| **Admitted to the Closest Hospital** | 525 | 89.1 | 318 | 86.7 |
| **Admitted to More Distant Hospital** | 322 | 82.6* | 299 | 84.0 |
| **Total** | 847 | 86.5 | 617 | 85.3 |
| | **Dissatisfaction with Availability of Health Care (Yes)** | | | |
| | Number | % | Number | % |
| **Admitted to the Closest Hospital** | 110 | 18.7 | 72 | 19.6 |
| **Admitted to More Distant Hospital** | 109 | 28.0* | 89 | 25.0#[38] |
| **Total** | 219 | 22.4 | 161 | 22.3 |
| | **Among These Using an Alternative Hospital, the Patients Used:** | | | |
| **Other Rural Hospital** | 37 | 29.4 | 31 | 34.1 |
| **Other Urban Hospital** | 33 | 28.5 | 24 | 21.6**[39] |
| **Urban Teaching Hospital** | 39 | 26.4 | 34 | 22.1** |
| **Total** | 109 | 28.0 | 89 | 25.0 |

[37] *Significantly different from those who used the closest rural hospital, chi-square test (p=0.01).

[38] # Significantly different from those who used the closest rural hospital, chi-square test (p=0. 10).

[39] ** Significantly different from those who used a distant other rural hospital, chi-square test (p=0.05).

*4.3. Summary*

The following section summarizes univariate and bivariate analyses on aged rural Medicare beneficiaries in the study sample and their hospital choice behavior.

4.3.1. Prevalence of hospital bypassing behavior

The univariate analysis was consistent with previous research on the hospital choices of aged rural residents. The majority of aged rural Medicare beneficiaries in the study sample were admitted to their closest rural hospital. Among those who bypassed their closest rural hospital, almost three-quarters were admitted to an urban hospital.

4.3.2. Bypassers of the Closest Rural Hospital

Findings from the bivariate analysis suggested that patients who bypassed their closest rural hospital appeared to be less disadvantaged in terms of demographic, socioeconomic, and functional limitations. However, they seemed to bypass their closest rural hospital for more complex treatment needs than patients admitted to their closest rural hospital.

Individuals without a regular source of care usually bypassed their closest rural hospital to use the "other rural hospital" alternative while absence of a long patient-physician relationship was associated with the choice of urban hospitals. A presence of a psychiatric diagnosis was only associated with the choice of an "other rural hospital" alternative over the closest rural hospital. Socioeconomic attributes were mildly associated with the choice between the "closest rural hospital" and the "other rural

hospital" alternative but strongly influenced the choice between the "closest rural hospital" and "urban teaching hospital" alternative. Finally, bypassers were more likely to have hospitalized or have bypassed the closest rural hospital in the past 12 months than the non-bypassers.

4.3.3. Attributes of Hospital Choices in Study Sample's Hospital Markets

The closest rural hospital in sample persons' hospital market areas was often smaller and ranked lower in service capacity compared with other choice alternatives. The "other urban hospital" and the "urban teaching hospital" alternatives were more likely to be larger, ranked higher in service capacity, and farther away from an elder's residence as opposed to the "closest rural hospital" and "other rural hospital" alternatives.

4.3.4. Gender Differences in Hospital Choice and Individual Patient Attributes

In terms of hospital choice, females were less likely to bypass their closest rural hospital compared to men. Female patients were found to be more disadvantaged than males in terms of demographic and socioeconomic characteristics and functional disability. However, women were less likely to be hospitalized for a surgical DRG, a psychiatric diagnosis, a cardiovascular procedure, a technical intensive condition, or a severe case-mix than men. Fewer surgical procedures were performed during women's hospital stays as opposed to men's.

Females were less likely to have a regular source of care, to live thirty or more minutes away from their physician's office, to be dissatisfied with the quality of their physician, and to have bypassed their closest rural hospital in the past year.

4.3.5. The Effect of Age, Diagnostic Category, and Hospital Size in Hospital Choice

The bivariate findings indicated that the size of the closest rural hospital and severity of illness were related to hospital bypassing behavior. When one's closest rural hospital was larger, patients were less likely to bypass it for inpatient hospital treatment elsewhere.

The size of the closest rural hospital also mattered among those who bypassed their closest rural hospital. The bigger the aged rural Medicare beneficiaries' closest rural hospital was, the less likely patients were to be admitted to a distant urban teaching hospital, the shorter distance traveled for the hospitalization, and the more likely patients traveled farther for severe case-mix conditions.

The average case-mix severity of illness was greater among patients who bypassed their closest rural hospital relative to patients who did not bypass regardless of the size of the closest rural hospital and patient age. That is, severity of illness appears to prevail over age in affecting the choice of hospitals for rural elderly.

The findings indicated that the influence of age, given the severity of illness, was also related to "hospital bypassing behavior." Individuals in older age categories were less likely to bypass the "closest rural hospital" alternative than were younger patients.

Among patients who bypassed, individuals in older age categories were more likely to visit an "other rural hospital" than were younger patients.

In sum, aged rural Medicare beneficiaries preferred to use the closest rural hospital for inpatient care. If they bypassed the closest rural hospital, they bypassed for more severe case-mix, a surgical DRG, or a technical intensive condition. Furthermore, hospital bypassing of aged rural Medicare beneficiaries was related to the size of their closest rural hospital. A lower propensity to travel by the most vulnerable oldest-old patients raised the question regarding the role of rural hospitals in ensuring access to care presumably result from, their increased difficulty in traveling, lack of resources, and reluctance to leave the community.

### 4.3.6. The Effect of Gender, Income and, Access to, and Satisfaction with Health Care in Hospital Choice

Females, in general, were less likely to bypass their "closest rural hospital" alternative than males. Among patients who bypassed their closest rural hospital, no gender difference in admission choices was found.

Unlike women, men with higher income, without regular source of care, and with a lower satisfaction with the availability of health care were more likely to bypass the closest rural hospital. Women with a shorter patient-physician relationship were more likely to bypass their closest rural hospital.

These bivariate findings will only be subjected to further scrutiny in the next chapter, where multivariate analysis will be used to identify significant factors affecting

hospital choice, while controlling for both individual and hospital attributes which bivariate analyses were unable to do.

# CHAPTER V

## CONDITIONAL LOGIT ANALYSES OF HOSPITAL CHOICE BEHAVIOR

The main research question of this study was to identify both individual and hospital attributes which contribute to variations in hospital choice. In chapter 4, bivariate analysis revealed significant associations between hospital choice and selected individual attributes. This chapter contains multivariate empirical results. A maximum-likelihood conditional logit technique was used to identify both individual and hospital attributes contributing to variations in hospital choice among aged rural Medicare beneficiaries. Since some gender differences were found in the bivariate analyses, separate multinomial logit models were estimated for men and for women.

While a single coefficient is estimated for each attribute describing the choice alternatives, in a conditional logit model, multiple coefficients are estimated for each attribute of the decision-maker, or patient, in this application. Denoting N as the number of choice alternatives, N-1 sets of individual patient attributes are estimated, with one alternative serving as a reference category. In this application, estimated coefficients for the "other rural hospital", "other urban hospital", and "urban teaching hospital" alternatives will be reported with the "closest rural hospital" alternative as the reference category.

The estimated multinomial logit model coefficients reflect marginal effects on the log odds of the three hospital choices ("other rural hospital", "other urban hospital", and "urban teaching hospital") relative to the choice of the "closest rural hospital" alternative. Since these coefficients are not easily interpreted in this form, risk or odds ratios are also reported to facilitate interpretation of the findings. The significant model chi-square statistic is reported to indicate if the joint association of all independent variables in the model with the dependent variables is significant. The pseudo R-square of the model is indicative of a fairly good model fit.

Finally, choice-specific constants reflect systematic effects of unspecified (unobserved) attributes of alternatives affecting patients' propensity to choose an alternative. If only hospital attributes are included in the conditional logit model with a four-alternative choice set, the choice-specific constants reflect relative preferences for three other choice alternatives relative to the reference category when these hospital attributes are held constant. Since not only hospital attributes but also individual patient attributes were included in the model, the values of these constants indicate relative preferences for each alternative relative to the reference category after controlling for any preferences not already specified in the patient attributes specified and controlling for the hospital attributes specified. A strong preference for the closest rural hospital will be reflected in negative choice-specific constants.

*5.1. Empirical Results: Multinomial Logit Model of Hospital Choice Behavior*

Table 18 contains the empirical results for a conditional hospital choice model estimated on the entire sample population of admissions for both men and women. All patients and hospital attributes have been defined earlier in Chapter 3. Overall, the model had a fairly good predictive power. The significant model chi-square statistics indicate that the joint association of all independent variables in the models with the dependent variables was significant.

Three significant choice-specific constants indicate that aged rural Medicare beneficiaries exhibited stronger preferences for the closest rural hospital. The value of the pseudo $R^2$ (0.37) was in line with that obtained in the previous studies of hospital choice ranging from 0.23 to 0.44 summarized by Adams et al. (1991). The estimated parameters for hospital attributes are discussed first. This is followed by a summary of findings for patient attributes.

5.1.1. Distance

The findings confirm a strong negative influence of distance on the choice of a hospital alternative. Holding all other variables constant, the estimated distance parameter indicates that aged rural Medicare beneficiaries were about two percent more likely to choose admission to a hospital 10 miles closer to their residence than an otherwise similar hospital.

**Table 18. Empirical Results of Conditional Hospital Choice Model: All Patients (n=1702)**

| Independent Variable | Coefficient | Wald Statistic | Odds Ratio | Coefficient | Wald Statistic | Odds Ratio | Coefficient | Wald Statistic | Odds Ratio |
|---|---|---|---|---|---|---|---|---|---|
| **Hospital Alternative Attributes** | | | | | | | | | |
| Distance | -0.002 | 27.223***[40] | 0.998 | | | | | | |
| Bed Size | 0.002 | 17.838*** | 1.002 | | | | | | |
| Guttman Scale of Hospital Service Capacity | 0.085 | 21.035*** | 1.088 | | | | | | |
| Number of Hospital | 0.172 | 82.772*** | 1.187 | | | | | | |
| **Patient Attributes** | **Other Rural/Closest Rural** | | | **Other Urban/Closest Rural** | | | **Urban Teaching/Closest Rural** | | |
| **Intercept** | -1.357 | 3.938** | 0.257 | -3.332 | 15.607*** | 0.036 | -4.903 | 42.087*** | 0.007 |
| **Demographic Characteristics** | | | | | | | | | |
| Age 75-84 | -0.166 | 0.730 | 0.847 | -0.217 | 1.274 | 0.805 | -0.445 | 5.603** | 0.641 |
| Age 85+ | -0.296 | 1.258 | 0.744 | -0.663 | 5.649** | 0.515 | -1.393 | 20.466*** | 0.248 |
| Male | 0.045 | 0.026 | 1.046 | 0.542 | 3.910** | 1.719 | 0.147 | 0.254 | 1.158 |
| Married | -0.111 | 0.175 | 0.895 | 0.200 | 0.585 | 1.221 | 0.373 | 2.145 | 1.452 |
| Married * male | -0.038 | 0.010 | 0.963 | -0.804 | 4.657** | 0.448 | -0.361 | 0.915 | 0.697 |
| **Social Structural Characteristics** | | | | | | | | | |
| White | 0.171 | 0.287 | 1.187 | -0.025 | 0.008 | 0.975 | 0.693 | 3.955** | 2.000 |
| College degree | 0.038 | 0.021 | 1.039 | -0.053 | 0.039 | 0.948 | 1.015 | 17.465*** | 2.760 |
| Medicaid Eligibility | -0.531 | 4.211** | 0.588 | -0.281 | 1.329 | 0.755 | 0.143 | 0.290 | 1.154 |
| Income More than $25,000 | -0.016 | 0.003 | 0.984 | 0.785 | 8.928*** | 2.193 | 0.358 | 2.062 | 1.431 |
| Number of Children | 0.079 | 5.352** | 1.082 | 0.021 | 0.374 | 1.021 | 0.020 | 0.351 | 1.021 |
| **Health, Functional Status, and Diagnostic Category** | | | | | | | | | |
| ADL Impairments | -0.130 | 5.445** | 0.878 | -0.010 | 0.037 | 0.990 | 0.216 | 16.978*** | 1.242 |
| Bedridden | 0.159 | 0.162 | 1.173 | -0.847 | 2.939* | 0.429 | -0.849 | 4.388** | 0.428 |
| Poor Health | -0.068 | 0.082 | 0.934 | 0.131 | 0.300 | 1.140 | -0.127 | 0.269 | 0.881 |
| Surgical DRG | 0.501 | 4.035** | 1.650 | 0.259 | 1.083 | 1.296 | 0.864 | 13.052*** | 2.372 |
| Psychiatric Diagnosis | 1.252 | 2.866* | 3.496 | 1.966 | 7.485*** | 7.139 | 0.932 | 1.133 | 2.540 |

[40] * Significant at 10% level. ** Significant at 5% level. *** Significant at 1% level.

**Table 18. Empirical Results of Conditional Hospital Choice Model: All Patients (n=1702)**

| Independent Variable | Other Rural/Closest Rural | | | Other Urban/Closest Rural | | | Urban Teaching/Closest Rural | | |
|---|---|---|---|---|---|---|---|---|---|
| | Coefficient | Wald-statistic | Odds Ratio | Coefficient | Wald-statistic | Odds Ratio | Coefficient | Wald-statistic | Odds Ratio |
| **Health, Functional Status, and Diagnostic Category** | | | | | | | | | |
| Cardiovascular Procedure | 0.925 | 3.404*[41] | 2.522 | 1.333 | 9.111*** | 3.791 | 1.832 | 21.999*** | 6.246 |
| Technical Intensive Condition | 1.508 | 2.859* | 4.517 | 2.800 | 11.068*** | 16.453 | 2.901 | 13.043*** | 18.200 |
| Case Mix Index | 0.042 | 0.130 | 1.043 | 0.041 | 0.145 | 1.042 | 0.047 | 0.235 | 1.049 |
| Number of Procedures | 0.168 | 5.408** | 1.183 | 0.267 | 14.532*** | 1.306 | 0.390 | 35.308*** | 1.477 |
| **Satisfaction with and access to Medical Care** | | | | | | | | | |
| Regular Source of Care | -1.055 | 3.148* | 0.348 | 0.940 | 1.416 | 2.561 | -0.194 | 0.093 | 0.824 |
| Longer Patient-Physician Tie | -0.113 | 0.170 | 0.893 | -0.731 | 9.416*** | 0.482 | -0.572 | 5.304** | 0.564 |
| Dissatisfaction with the Availability of Health Care | 0.507 | 6.205** | 1.660 | -0.048 | 0.049 | 0.953 | -0.202 | 0.879 | 0.817 |
| Less Access to Physician | 0.978 | 15.790*** | 2.658 | 1.607 | 46.533*** | 4.989 | 1.554 | 38.762*** | 4.733 |
| Dissatisfaction with the Quality of Physician | -0.020 | 0.012 | 0.980 | 0.103 | 0.318 | 1.109 | 0.030 | 0.027 | 1.031 |
| **Prior Use** | | | | | | | | | |
| Hospitalized in the past 12 Months | -1.258 | 19.922*** | 0.284 | -0.433 | 0.648* | 0.646 | -0.266 | 1.296 | 0.767 |
| Bypassed the Closest Hospital in the past 12 Months | 3.027 | 85.001*** | 20.642 | 2.206 | 9.082*** | 9.107 | 2.721 | 93.939 | 15.199 |
| **Chi-Square (degree of freedom)** | 1672.94(85) | | | | | | | | |
| **Pseudo $R^2$** | 0.37 | | | | | | | | |

[41] * Significant at 10% level. ** Significant at 5% level. *** Significant at 1% level.

For hospital attributes, the odds of choosing a hospital alternative A over hospital alternative B (when alternatives A & B differ only on one hospital attribute) under a conditional logit formulation can be expressed simply as $(P_A/P_B)= \exp (B (X_A-X_B))$. In this example, where $(X_A-X_B)=10$ miles and B= -0.002 then $(P_A/P_B)=0.98$. That is, they travel shorter distances for inpatient care than longer distances.

5.1.2. Hospital Attributes

All hospital attributes specified in the model were significant and positive in their effect on hospital choice. The results generally show a revealed preference for larger hospitals offering a broad scope of services over smaller hospitals among aged rural Medicare beneficiaries. The estimated parameter for hospital bed size suggests that aged rural Medicare patients were about 20 percent more likely to choose hospital with 100 more beds than an otherwise similar but smaller hospital with fewer beds. The effect of the Guttman scale of hospital service capacity on hospital choice indicate that aged rural Medicare beneficiaries prefer hospitals with a greater scope of service, holding all other factors constant. The likelihood of choosing admission to a hospital with a one point higher Guttman score over an otherwise similar hospital with fewer services were about 8.8 percent higher. Finally, choice alternatives comprised of more individual hospitals are more likely to be chosen over otherwise similar attributes with fewer hospitals. Adding a single hospital to a choice alternative increases the likelihood of admission choice by about 19 percent relative to an otherwise similar choice alternative comprised of one fewer hospitals.

5.1.3. Demographic and Socioeconomic Status

Being in the 75-84 group (relative to the 65-74 category) was negatively associated with the choice of an "urban teaching hospital" alternative over the closest rural hospital. Similarly, being in the 85+ category was negatively associated with the choice of an "other urban hospital" or "urban teaching hospital" over the "closest rural hospital" alternative. For example, the odds of choosing the "urban teaching hospital" over the "closest rural hospital" alternative were 75 percent lower among aged rural Medicare beneficiaries who were 85 years of age or older, relative to their counterparts younger than 85 years.

The effect of gender on hospital choice appeared to vary with respect to marital status and the interaction term was specified to capture gender difference. Males were more likely to choose an "other urban hospital" alternative over the closest rural hospital relative to women (OR=1.72). However, married males were less likely than others to be hospitalized in an "other urban hospital" relative to the closest rural hospital.

Being white and being more highly educated were both associated with a higher probability of choosing the "urban teaching hospital" over the "closest rural hospital" alternative. High-income aged rural Medicare beneficiaries were more likely to choose the "other urban hospital" over the "closest rural hospital" alternative. The odds of admission to an urban teaching hospital over the closest rural hospital were more than double for white patients relative to non-white patients. The odds of choosing the "urban teaching hospital" over the "closest rural hospital" alternative were almost 2.8 times higher for individuals with a college degree.

Individuals eligible for Medicaid were less likely to choose the "other rural hospital" over the "closest rural hospital" alternative. The odds of choosing the "other rural hospital" over the "closest rural hospital" alternative were 41 percent lower for patients who were Medicaid eligible relative to non-Medicaid patients. Patients with more children (an indication of potential availability of informal support) were more likely to choose the "other rural hospital" over the "closest rural hospital" alternative (OR=1.08).

5.1.4. Functional Status, Complexity of Illness, and Diagnosis

While functional disability was negatively associated with the choice of the "other rural hospital" alternative over the closest rural hospital, it was positively associated with the choice of the "urban teaching hospital" over the "closest rural hospital" alternative. That is, an increase in one ADL disability decreased the odds of choosing the "other rural hospital" over the "closest rural hospital" alternative 12 percent, while it increased the odds of choosing the "urban teaching hospital" over the "closest rural hospital" alternative by almost 24 percent. However, bedridden patients were much less likely to choose "other urban hospital" (OR=0.57) or "urban teaching hospital" (OR=0.57) alternatives over the closest rural hospital.

Hospitalization for a surgical DRG was associated with a higher probability of admission to the "other rural hospital" or the "urban teaching hospital" over the "closest rural hospital" alternative. The odds of choosing an "urban teaching hospital" over the

closest rural hospital were almost 2.4 times greater for patients hospitalized under a surgical DRG.

Hospitalization for a psychiatric diagnosis was associated with a higher probability of choosing the "other rural hospital" or "other urban hospital" over the closest rural hospital. The odds of choosing the "other urban hospital" over the "closest rural hospital" alternative were over seven times greater for patients with a psychiatric diagnosis associated with the hospitalization.

The presence of a cardiovascular procedure or a technical intensive condition was strongly associated with a higher probability of choosing admission to all alternatives other than the closest rural hospital. The odds of choosing the " urban teaching hospital" alternative were over six times greater for individuals with a cardiovascular procedure and over 18 times greater with a technical intensive condition associated with the hospitalization.

Number of surgical procedures, a proxy for complexity of illness, was positively associated with choices of "other rural hospital", "other urban hospital", and "urban teaching hospital" over the closest rural hospital. An increase in one procedure performed increased the odds of choosing the "urban teaching hospital" over the "closest rural hospital" alternative by almost 48 percent. On the other hand, no significant relationship was found between relative "cost" weights for DRGs measured by CMI and hospital choice.

5.1.5. Access to and Satisfaction with Health Care

A regular source of care was negatively associated with the choice of the "other rural hospital" over the closest rural hospital. The odds of choosing the "other rural hospital" over the "closest rural hospital" alternative were 65 percent less for patients with a regular source of care. Similarly, a longer "patient-physician tie" decreased the odds of choosing the "other urban hospital" (OR=0.48) or "urban teaching hospital" (OR=0.56) over the "closest rural hospital" alternative. The odds of choosing the "urban teaching hospital" over the closest rural hospital were 44 percent lower among patients with a longer patient-physician tie.

Dissatisfaction with the availability of health care was positively associated with the choice of the "other rural hospital" over the closest rural hospital. The odds of choosing the "other rural hospital" over the "closest rural hospital" alternative were 66 percent higher for patients who were dissatisfied with the availability of health care. Another variable measuring lack of access to physician barriers, thirty-minute travel time from one's physician's office, was also positively associated with the choice of hospital alternatives other than the closest rural hospital. The odds of choosing the "urban teaching hospital" over the "closest rural hospital" alternative were 4.7 times higher for patients who lived 30 minutes or more away from their doctor's office.

5.1.6. Prior Inpatient Hospital Use

Prior hospital use within a year was very influential in hospital choice behavior among aged rural Medicare beneficiaries. Previous bypassing of the closest rural hospital

to one's residence within one year had a very strong and positive influence on the likelihood of choosing the "other rural hospital", "other urban hospital", and "urban teaching hospital" over the "closest rural hospital" alternative. The odds of choosing the "urban teaching hospital" over the "closest rural hospital" alternative were 15 times higher when the "closest rural hospital" alternative was bypassed in the past 12 months in a previous inpatient hospitalization. However, a negative association between hospitalization in the past 12 months and hospital choice indicated that individuals who did not use inpatient hospital care at all in the past 12 months were more likely to use the "other rural hospital" or the "other urban hospital" over the closest rural hospital. The odds of choosing the "other rural hospital" over the "closest rural hospital" alternative were about 35 percent lower when a patient was hospitalized at least once in the past 12 months.

In general, the results were consistent with expectations and findings in previous research that highlighted the influence of distance, hospital attributes, age, and diseases on hospital choice. Yet they provide new insights, especially regarding the influence of socioeconomic status, satisfaction with and access to physicians and health care, and prior hospital choices upon subsequent hospital choice behavior.

### *5.2. Gender Differences in Hospital Choice*

The following section contains the empirical results from separate multinomial logit models of hospital choice for men and for women. Table 19 contains the results for the male sample and table 20 contains the results for the female sample.

**Table 19. Empirical Results of Conditional Hospital Choice Model: Male Patients (n=723)**

| Independent Variable | Coefficient | Wald-statistic | Odds Ratio | Coefficient | Wald-statistic | Odds Ratio | Coefficient | Wald-statistic | Odds Ratio |
|---|---|---|---|---|---|---|---|---|---|
| **Hospital Alternative Attributes** | | | | | | | | | |
| Distance | -0.002 | 14.941***[42] | 0.998 | | | | | | |
| Bed Size | 0.002 | 5.116** | 1.002 | | | | | | |
| Guttman Scale of Hospital Service Capacity | 0.144 | 21.085*** | 1.155 | | | | | | |
| Number of Hospital | 0.179 | 35.975*** | 1.197 | | | | | | |
| **Patient Attributes** | **Other Rural/Closest Rural** | | | **Other Urban/Closest Rural** | | | **Urban Teaching/Closest Rural** | | |
| **Intercept** | 0.934 | 0.458 | 2.544 | -1.889 | 1.617 | 0.151 | -5.280 | 12.409*** | 0.005 |
| **Demographic Characteristics** | | | | | | | | | |
| Age 75-84 | -0.278 | 0.868 | 0.757 | 0.055 | 0.036 | 1.056 | -0.669 | 5.141** | 0.512 |
| Age 85+ | 0.048 | 0.013 | 1.049 | -0.749 | 2.067 | 0.473 | -1.827 | 9.725*** | 0.161 |
| Married | -0.129 | 0.169 | 0.879 | -0.720 | 5.428** | 0.487 | -0.247 | 0.582 | 0.781 |
| **Social Structural Characteristics** | | | | | | | | | |
| White | -0.133 | 0.058 | 0.875 | 0.032 | 0.004 | 1.032 | 2.292 | 8.252*** | 9.899 |
| College degree | 0.510 | 1.498 | 1.666 | -0.325 | 0.552 | 0.723 | 1.144 | 7.121*** | 3.139 |
| Medicaid Eligibility | -0.775 | 2.162 | 0.461 | -0.596 | 1.634 | 0.551 | -0.243 | 0.214 | 0.784 |
| Income more than $25,000 | 0.044 | 0.011 | 1.045 | 1.633 | 18.237*** | 5.120 | 0.993 | 6.640** | 2.700 |
| Number of Children | 0.015 | 0.062 | 1.015 | -0.020 | 0.120 | 0.981 | 0.107 | 3.384* | 1.113 |
| **Health, Functional Status, and Diagnostic Category** | | | | | | | | | |
| ADL Impairments | -0.214 | 4.685** | 0.808 | -0.091 | 0.973 | 0.913 | 0.296 | 11.183*** | 1.344 |
| Bedridden | 0.488 | 0.666 | 1.629 | -0.316 | 0.177 | 0.729 | -0.418 | 0.418 | 0.658 |
| Poor Health | 0.352 | 0.766 | 1.422 | 0.764 | 3.467* | 2.148 | -0.355 | 0.713 | 0.701 |
| Surgical DRG | 0.430 | 1.194 | 1.537 | 0.275 | 0.482 | 1.317 | 1.191 | 10.047*** | 3.292 |
| Psychiatric Diagnosis | 1.958 | 2.063 | 7.082 | 2.543 | 3.013* | 12.724 | 2.550 | 2.710 | 12.805 |

[42] * Significant at 10% level. ** Significant at 5% level. *** Significant at 1% level.

**Table 19. Empirical Results of Conditional Hospital Choice Model: Male Patients (n=723)**

| Independent Variable | Other Rural/Closest Rural | | | Other Urban/Closest Rural | | | Urban Teaching/Closest Rural | | |
|---|---|---|---|---|---|---|---|---|---|
| | Coefficient | Wald-statistic | Odds Ratio | Coefficient | Wald-statistic | Odds Ratio | Coefficient | Wald-statistic | Odds Ratio |
| **Health, Functional Status, and Diagnostic Category** | | | | | | | | | |
| Cardiovascular Procedures | 1.373 | 3.465* | 3.948 | 1.398 | 4.537** | 4.046 | 2.426 | 16.196*** | 11.315 |
| Technical Intensive Condition | 1.923 | 2.501 | 6.843 | 3.780 | 10.259*** | 43.833 | 3.260 | 8.289*** | 26.044 |
| Case Mix Index | 0.056 | 0.192 | 1.058 | -0.043 | 0.062 | 0.958 | -0.064 | 0.176 | 0.938 |
| Number of Procedure | 0.121 | 1.216 | 1.129 | 0.244 | 5.246** | 1.276 | 0.441 | 20.761*** | 1.555 |
| **Satisfaction with and access to Medical Care** | | | | | | | | | |
| Regular Source of Care | -3.121 | 5.812** | 0.044 | -0.342 | 0.054 | 0.710 | -2.252 | 2.898* | 0.105 |
| Longer Patient-Physician Tie | -0.081 | 0.034 | 0.922 | -0.612 | 2.534 | 0.542 | -0.269 | 0.436 | 0.764 |
| Dissatisfaction with the Availability of Health Care | 0.710 | 5.078** | 2.034 | -0.446 | 1.524 | 0.640 | -0.614 | 2.956* | 0.541 |
| Less Access to Physician | 0.848 | 5.080** | 2.336 | 1.658 | 21.089*** | 5.248 | 0.985 | 5.838** | 2.678 |
| Dissatisfaction with the Quality of Physician | 0.231 | 0.615 | 1.259 | 0.418 | 2.008 | 1.519 | 0.708 | 5.530** | 2.030 |
| **Prior Use** | | | | | | | | | |
| Hospitalized in the past 12 Month | -0.932 | 5.188** | 0.394 | -0.290 | 0.631 | 0.748 | -0.037 | 0.010 | 0.964 |
| Bypassed the Closest Hospital in the past 12 Month | 2.546 | 26.233*** | 12.751 | 2.339 | 26.973*** | 10.371 | 2.844 | 42.853*** | 17.179 |
| **Chi-Square (degree of freedom)** | | | | | 738.54(79) | | | | |
| **Pseudo $R^2$** | | | | | 0.39 | | | | |

**Table 20. Empirical Results of Conditional Hospital Choice Model: Female Patients (n=979)**

| Independent Variable | Coefficient | Wald-statistic | Odds Ratio | Coefficient | Wald-statistic | Odds Ratio | Coefficient | Wald-statistic | Odds Ratio |
|---|---|---|---|---|---|---|---|---|---|
| **Hospital Alternative Attributes** | | | | | | | | | |
| Distance | -0.002 | 11.778***[43] | 0.998 | | | | | | |
| Bed Size | 0.002 | 10.191*** | 1.002 | | | | | | |
| Guttman Scale of Hospital Service Capacity | 0.062 | 6.450** | 1.064 | | | | | | |
| Number of Hospital | 0.192 | 54.067*** | 1.212 | | | | | | |
| **Patient Attributes** | **Other Rural/Closest Rural** | | | **Other Urban/Closest Rural** | | | **Urban Teaching/Closest Rural** | | |
| **Intercept** | -2.187 | 6.068* | 0.112 | -3.968 | 9.924*** | 0.019 | -5.066 | 25.942*** | 0.006 |
| **Demographic Characteristics** | | | | | | | | | |
| Age 75-84 | -0.097 | 0.128 | 0.908 | -0.464 | 2.756* | 0.629 | -0.231 | 0.733 | 0.794 |
| Age 85+ | -0.448 | 1.604 | 0.639 | -0.769 | 4.542** | 0.464 | -1.385 | 12.256*** | 0.250 |
| Married | -0.101 | 0.131 | 0.904 | 0.295 | 1.158 | 1.343 | 0.436 | 2.714 | 1.547 |
| **Social Structural Characteristics** | | | | | | | | | |
| White | 0.227 | 0.303 | 1.254 | 0.007 | 0.000 | 1.007 | 0.338 | 0.671 | 1.402 |
| College degree | -0.238 | 0.444 | 0.788 | 0.226 | 0.421 | 1.253 | 0.810 | 6.573** | 2.248 |
| Medicaid Eligibility | -0.458 | 2.211 | 0.633 | -0.178 | 0.350 | 0.837 | 0.276 | 0.726 | 1.318 |
| Income more than $25,000 | -0.108 | 0.072 | 0.898 | -0.089 | 0.046 | 0.915 | -0.212 | 0.328 | 0.809 |
| Number of Children | 0.122 | 6.974*** | 1.130 | 0.048 | 0.910 | 1.049 | -0.001 | 0.000 | 0.999 |
| **Health, Functional Status, and Diagnostic Category** | | | | | | | | | |
| ADL Impairments | -0.102 | 2.106 | 0.903 | 0.027 | 0.144 | 1.027 | 0.154 | 4.756** | 1.166 |
| Bedridden | -0.057 | 0.010 | 0.945 | -1.413 | 3.197* | 0.243 | -1.224 | 4.669** | 0.294 |
| Poor Health | -0.262 | 0.718 | 0.770 | -0.257 | 0.628 | 0.773 | -0.078 | 0.058 | 0.925 |
| Surgical DRG | 0.556 | 2.514 | 1.744 | 0.066 | 0.034 | 1.068 | 0.635 | 3.418* | 1.888 |
| Psychiatric Diagnosis | 1.172 | 1.719 | 3.227 | 2.186 | 5.756** | 8.900 | 0.489 | 0.173 | 1.631 |

[43] * Significant at 10% level. ** Significant at 5% level. *** Significant at 1% level.

**Table 20. Empirical Results of Conditional Hospital Choice Model: Female Patients (n=979)**

| Independent Variable | Other Rural/Closest Rural | | | Other Urban/Closest Rural | | | Urban Teaching/Closest Rural | | |
|---|---|---|---|---|---|---|---|---|---|
| | Coefficient | Wald-statistic | Odds Ratio | Coefficient | Wald-statistic | Odds Ratio | Coefficient | Wald-statistic | Odds Ratio |
| **Health, Functional Status, and Diagnostic Category** | | | | | | | | | |
| Cardiovascular Procedures | 0.606 | 0.707 | 1.832 | 1.333 | 4.051** | 3.794 | 1.429 | 6.554** | 4.382 |
| Technical Intensive Condition | 0.977 | 0.476 | 2.655 | 1.994 | 2.427 | 7.343 | 2.576 | 4.356** | 13.145 |
| Case Mix Index | 0.026 | 0.017 | 1.027 | 0.226 | 1.611 | 1.253 | 0.231 | 1.805 | 1.260 |
| Number of Procedure | 0.194 | 3.744* | 1.214 | 0.267 | 7.329*** | 1.306 | 0.334 | 11.720*** | 1.397 |
| **Satisfaction with and access to Medical Care** | | | | | | | | | |
| Regular Source of Care | -0.238 | 0.098 | 0.789 | 1.584 | 1.868 | 4.873 | 0.585 | 0.510 | 1.795 |
| Longer Patient-Physician Tie | -0.303 | 0.682 | 0.739 | -0.849 | 6.667*** | 0.428 | -0.753 | 5.115** | 0.471 |
| Dissatisfaction with the Availability of Health Care | 0.384 | 1.879 | 1.469 | 0.231 | 0.653 | 1.260 | 0.065 | 0.051 | 1.068 |
| Less Access to Physician | 1.236 | 12.691*** | 3.443 | 1.526 | 20.117*** | 4.599 | 2.075 | 36.489*** | 7.963 |
| Dissatisfaction with the Quality of Physician | -0.099 | 0.170 | 0.905 | -0.073 | 0.082 | 0.930 | -0.346 | 1.749 | 0.707 |
| **Prior Use** | | | | | | | | | |
| Hospitalized in the past 12 Month | -1.381 | 11.657*** | 0.251 | -0.375 | 1.388 | 0.687 | -0.171 | 0.268 | 0.843 |
| Bypassed the Closest Hospital in the past 12 Month | 3.327 | 51.701*** | 27.868 | 2.066 | 23.946*** | 7.892 | 2.505 | 38.876*** | 12.248 |
| **Chi-Square (degree of freedom)** | | | | | 1020.96(79) | | | | |
| **Pseudo $R^2$** | | | | | 0.40 | | | | |

Detailed discussions in this section are limited to variables in which gender differences were found.

In general, significant model chi-square statistics indicate that the joint association of all independent variables in the models with the dependent variables was significant for both male and female models. However, the ratio likelihood test indicated that male's hospital choice is not significantly different from females. Three significant choice-specific constants for the female model indicate that women patients exhibited stronger preferences for the closest rural hospital. However, men only exhibited a stronger preference for using the closest rural hospital relative to an "urban teaching hospital" alternative. The pseudo R-square of 0.39 for male sample and 0.40 for female sample indicated a fairly good model fits.

### 5.2.1. Distance

No gender difference was found with regard to the effect of distance on hospital choice. Male and female aged rural Medicare beneficiaries both preferred to travel shorter distances for inpatient care while holding all other factors constant.

### 5.2.2. Hospital Attributes

No significant gender difference was found with regard to the effect of hospital attributes specified in hospital choice among aged rural Medicare beneficiaries. The effect of the Guttman scale of hospital service capacity on hospital choice for both men and women indicated that rural elderly patients prefer a hospital with a greater scope of

service, holding all other factors constant. However, the odds of choosing a hospital with one point increase in Guttman scale were more than 15 percent higher for men but only 6.4 percent higher for women. That is, older women in rural areas were less responsive to service capacity measured by Guttman scale of hospital service capacity relative to older men.

5.2.3. Demographic and Socioeconomic Status

Being in the 75-84 and 85+ categories (relative to the 65-74 category) were both negatively associated with the choice of the "urban teaching hospital" over "closest rural hospital" alternative for men. For example, the odds of choosing the "urban teaching hospital" alternative over the closest rural hospital was 49 percent lower for 75-84 years old males and 84 percent lower for 85 years of age or older males.

However, being in the 85+ category was negatively associated with the choice of the "other urban hospital" or "urban teaching hospital" alternative over the closest rural hospital for women. The odds of choosing the "other urban hospital" over the "closest rural hospital" alternative were 54 percent lower and the odds of choosing the "urban teaching hospital" over the "closest rural hospital" alternative were 75 percent lower for 85 years of age or older females in the sample.

Married males were less likely to be hospitalized in the "other urban hospital" over the "closest rural hospital" alternative. The odds of choosing the "other urban hospital" over the "closest rural hospital" alternative were around 51 percent lower for

married men than for all other patients. No relationship between martial status and hospital choice was found for women.

Relative to women, men's choices of more sophisticated urban hospitals over the "closest rural hospital" alternative were more responsive to socioeconomic status. The odds of choosing the "urban teaching hospital" over "closest rural hospital" alternative were higher for whites (OR=9.90) and for individuals with higher income (OR=2.70) among men. No relationship was found between race and income and hospital choice for women.

Men with more children were also more likely to choose the "urban teaching hospital" over the closest rural hospital whereas social support influenced choice between two rural alternatives for women. With one more child, the odds of choosing the "urban teaching hospital" over the "closest rural hospital" alternative were around 11 percent higher for men. However, with an increase in one more child, the odds of choosing the "other rural hospital" over the "closest rural hospital" alternative were 13 percent higher for women.

5.2.4. Functional Status, Complexity of Illness, and Diagnosis

Men in poor health were also more likely to choose "other urban hospital" over the "closest rural hospital" alternative. The odds of choosing the "other rural hospital" over the "closest rural hospital" alternative were 2.1 times higher for men in poor health. However, women who were bedridden, an indication of severe functional disability, were less likely to choose "other urban hospital" or "urban teaching hospital" over the "closest

rural hospital" alternative. The odds of choosing the "other urban hospital" over the "closest rural hospital" were 76 percent lower and the odds of choosing the "urban teaching hospital" over the "closest rural hospital" alternative decreased 71 percent if a woman was bedridden.

The presence of a surgical diagnosis was associated with a higher probability of choosing the "urban teaching hospital" over the "closest rural hospital" alternative for both men and women. However, a presence of a surgical DRG seemed to be more influential in the choice of the "urban teaching hospital" over the "closet rural hospital" for men than for women. The odds of choosing the "urban teaching hospital" alternative over the closest rural hospital were almost 3.3 times greater for men but only 1.9 times greater for women with the presence of a surgical DRG.

Similarly, a presence of a psychiatric diagnosis seemed to be more influential in the choice of an "other urban" over the closest rural hospital for men than for women. The odds of choosing the "other urban hospital" over the "closest rural hospital" alternative were over 12 times greater for men but only 9 times greater for women with the presence of a psychiatric diagnosis.

Again, a presence of a cardiovascular procedure or a technical intensive condition seems to be more influential in hospital bypassing for men than for women. The odds of choosing the " urban teaching hospital" over the "closest rural hospital" alternative were more than 11 times greater for men but only 4 times greater for women with the presence of a cardiovascular procedure. Similarly, the odds of choosing the "urban teaching hospital" over the "closest rural hospital" alternative were over 26 times greater for men

but 13 times greater for women with the presence of a technical intensive condition. No significant gender difference was found between the number of surgical procedures performed and hospital choice.

5.2.5. Access to and Satisfaction with Health Care

The regular source of care was negatively with the choice of the "other rural hospital" or the "urban teaching hospital" over the "closest rural hospital" alternative for men. Men with a regular source of care were almost 90 percent less likely to choose the "urban teaching hospital" over the "closest rural hospital" alternative. However, no relationship between a regular source of care and hospital choice was found for women.

On the contrary, women with a longer "patient-physician tie" were less likely to be admitted to the "other urban hospital" or the "urban teaching hospital" over the "closest rural hospital" alternative. The odds of choosing the "urban teaching hospital" over the "closest rural hospital" alternative were over 53 percent lower for women with a longer patient-physician tie. However, no relationship between a longer patient-physician tie and hospital choice was found for men.

Dissatisfaction with the availability of health care was positively associated with the choice of the "other rural hospital" over the "closest rural hospital" alternative but negatively associated with the choice of the "urban teaching hospital" over the "closest rural hospital" alternative for men. The odds of choosing the "other rural hospital" over the "closest rural hospital" alternative were two times greater for men who were dissatisfied with the availability of health care while the odds of choosing the "urban

teaching hospital" over the "closest rural hospital" alternative were 46 percent lower. The negative association between dissatisfaction with the availability of health care and hospital choice may indicate a potential access problem for these men.

The odds of choosing the "urban teaching hospital" alternative over the closest rural hospital were more than two times greater for men who were dissatisfied with the quality of physician. Unlike men, no relationship was found between dissatisfaction with the availability of health care or with the quality of physician and hospital choice for women.

5.2.6. Prior Inpatient Hospital Use

No gender difference was found regarding prior inpatient use and hospital choice behavior.

5.2.7. Conditional Hospital Choice Model with Gender Interaction Terms

In order to accurately test the effect of gender on hospital choice, interaction terms of each independent variable with male gender were created. Since numerous estimated coefficients were produced, a summary of results is presented in Table 21. Although the results from this model are similar with results from the model without interaction terms (Table 17), several significant coefficients should be noted.

Relative to other aged rural Medicare beneficiaries, being married males, white males, and high-income males were more likely to be associated with hospital bypassing

while male with a regular source of care were less likely to be associated with hospital bypassing. Although patients with less access to physicians were more likely to bypass the closest rural hospital, men with less access to physician preferred to stay in the closest rural hospital. The results from male specific interaction terms, in general, indicate that men with resources exhibited strong preferences for hospital bypassing while men with a regular source of care preferred to stay in the closest rural hospital.

**Table 21. Summary of Empirical Results of Conditional Hospital Choice Model with Gender Interaction Terms: All Patients**

| Non-Bypassers | Bypassers |
|---|---|
| Age75-84 | Married |
| Age85 | College |
| More children | Married males |
| High income | White males |
| Some ADL limitation | High income males |
| Bedridden | Severe ADL limitation |
| Longer patient-physician tie | Surgical DRG |
| Males with a regular source of care | Psychiatric diagnosis |
| Males less accessible to physician | Cardiovascular diagnoses |
| Hospitalized in the past 12 months | Technical intensive conditions |
| | Higher number of surgical procedures |
| | Less accessible to physician |
| | Males dissatisfied with physician quality |
| | Bypassed in the past 12 months |

*5.3. Summary*

5.3.1. Determinants of Hospital Choice Behavior

In general, the results were consistent with findings in the previous literature that highlighted the influence of distance, hospital attributes, age, and diseases in hospital choice. Yet they provided new insights regarding the influence of socioeconomic status, satisfaction with and access to health care and physicians, and the influence of prior hospital choice decision upon subsequent hospital choice behavior. It is not prior utilization or bypassing per se that matters. Rather whether those who bypass do it again and those that don't bypass stay local again. These factors have not been given much attention in past research.

The influences of distance and hospital attributes on hospital choice behavior were in line with findings from previous literature. Generally speaking, the farther the hospital, the weaker preference the elderly patient exhibits, while the better the hospital, the stronger preference the elderly patient exhibits. In addition, similar to previous literature, the "complexity of illness", as indicated by number of surgical procedures, affects hospital choice. Complex or technical intensive conditions that require more sophisticated care often result in hospital bypassing of aged rural Medicare beneficiaries.

Even though the model controlled for diagnostic information and complexity of illness, age still exhibited a negative effect on hospital choice. That is, the older a rural patient is, the stronger is his/her preference for rural hospital over urban ones. More specifically the results indicated that those 75 years of age or older may perceive increased distance as an information or awareness barrier.

Important effects of socioeconomic status on hospital choice, especially for the choice of more sophisticated care in teaching hospitals were found. For example, being White, having a high level of education, and not being Medicaid eligible were positively related to a higher likelihood of rural elderly bypassing their closest rural hospital. Similarly, aged rural beneficiaries with better informal support (as measured by number of children) had a higher propensity to choose more distant "other rural hospital" alternative over the closest rural hospital.

The level of functional limitations significantly affected hospital choice of aged rural Medicare beneficiaries. A higher level of functional impairment such as ADL limitations or an indication of bedridden, in general, resulted in the choice of the non-closest rural hospitals. However, a positive relationship between the level of functional limitation and the choice of the "urban teaching hospital" over the "closest rural hospital" alternative was found. That is, rural elderly patients with a higher level of functional limitation preferred an "urban teaching hospital" than the closest rural hospital. This could be because patients with a higher level of functional limitation are frailer and have a higher need for sophisticated care. The decision to choose a sophisticated urban teaching hospital over the closest rural hospital among aged rural Medicare beneficiaries with a higher level of functional impairment may also indicate that more distant care is accessible for such individuals.

The CMI, weights for relative "cost" for DRG based on average inpatient standardized charges, was not significant in predicting hospital choice. It is possible that what HCFA uses to approximate relative hospital resources used associated with the

hospitalization is not a good index for patient severity of illness as it affects hospital choice and physician practice style. Adams et al. (1991) used a more sophisticated disease staging methodology which takes into account not only DRG but also the principle Disease Stage and number of unrelated comorbidities for delineation of a within- DRG index in measuring severity of illness. Even by doing that, the relative severity of a Medicare beneficiary's illness significantly decreased the odds of choosing an urban over a rural hospital but not of choosing a larger rural over a smaller rural hospital once the nature of the treatment was accounted for.

Variables that reflect physician dissatisfaction with and access barriers to health care were significant in predicting hospital choice of aged rural Medicare beneficiaries. In general, individuals without a regular source of care, without a longer patient-physician tie, reporting dissatisfaction with the availability of health care, and less accessible to physician in terms of travel time to physician's office had a higher probability in hospital bypassing.

As hypothesized, persons with a regular doctor or a longer patient-physician tie may receive a higher quality of care because of a greater familiarity of doctors with medical history and a greater continuity of care. Thus worse health outcomes that require sophisticated care in more distant urban hospitals were less likely to be expected for such individuals. Furthermore, distance from the physician's office to the hospital exerts the strongest negative and most consistent effects on referral patterns for hospital care (Burns and Wholey 1989). Therefore, if an aged rural Medicare beneficiary's local physician is

closer and more accessible, he or she may be more likely to receive inpatient care at the closest hospital where the primary physician is most likely to practice.

It should also be noted that those without a regular source of care or who had dissatisfaction with the availability of health care, even though they bypassed the closest rural hospital, preferred to stay within rural hospital market. While individuals without a longer patient-physician tie preferred to skip the entire rural hospital market and used hospitals in more distant urban areas. That is, aged rural Medicare beneficiaries consider a better "patient-physician" relationship as an important factor in deciding hospital bypassing to distant urban hospital alternatives. A longer patient-physician relationship, which is more likely to be perceived as high quality care, keeps rural hospitals from becoming "victims" of hospital bypassing.

Finally, the influence of prior utilization on hospital choice was significant. Rural elderly were very likely to use hospitals other than the closest rural hospital if these patients had bypassed a hospital in the previous year. It suggests that the likelihood of hospital bypassing increases over time because patients may seek admission to a familiar hospital used before. However, those who did not use inpatient care in the past 12 months also preferred to bypass their closest rural hospital. Rural elderly without a hospitalization in the past year were, in general, healthier than individuals with one or more hospitalization.[44] Although data on doctor visits was not examined here, one can reasonably guess that patients without any hospitalization in the past year should exhibit a lower utilization in doctor visits as well. And it could be just that these healthier lower-

use elderly were less familiar with local health system or exhibited a preference for hospitals other than the "closest rural hospital" alternative that was not controlled for in the study. Or it is because those higher or frequent users in need of frequent inpatient care decide to stay in hospitals in a closer proximity for the convenience.

5.3.2. Gender Differences in Determinants of Hospital Choice

Although gender was not significant in the ratio likelihood tests between the model with gender dummy variable and the model without gender effect, several gender differences in determinants of hospital choice should be noted. Women were most likely to choose the closest rural hospital relative to all other choice alternatives while men only exhibited a greater preference for the closest rural hospital over the "urban teaching hospital" alternative. No gender difference was found regarding the effects of hospital attributes on hospital choice.

Marital status was a deterrent for males in the choice of the "other urban hospital" over the "closest rural hospital" alternative while it was not significant for females. Men may be unwilling to travel to alternative rural hospitals than to the "closest rural hospital" alternative when the health and travel preferences of their spouses were taken into consideration. Men may be reluctant to travel back and forth between their home and the hospital daily or stay alone at a distance from home if their spouses prefer not to travel or have difficulties traveling due to functional limitations.

[44] Chi-square tests between hospitalization in the past 12 months and poor health status and between hospitalization in the past 12 months and being bedridden were examined. Individuals who were

Several socioeconomic status variables strongly influenced the choice of urban hospitals over the closest rural hospital for men but not for women. For example, being White or having income more than $25,000 increased the probability of men choosing the "urban teaching hospital" over the "closest rural hospital" alternative, although this did not hold true for females. The model with male specific interaction terms also indicates that white males, married males, and high-income males were more likely to bypass the closest rural hospital. It suggests that other subgroups of rural elderly may experience considerable socioeconomic constraints in their choice of more distant and sophisticated hospitals. Since older men are, in general, more likely to experience acute and technical intensive conditions that require care in more sophisticated facilities it may pose serious access problems especially for men without adequate socioeconomic resources.

In terms of family support, women with more children preferred to bypass the closest rural hospital and utilized the "other rural hospital" alternative while men with more children preferred the "urban teaching hospital" than the "closest rural hospital" alternative. The enabling effect of informal support from children on hospital choice for men was greater since men could go to more distant and sophisticated teaching hospitals when more children were available but women could only go to the "other rural hospital" alternative. When transportation is needed, children who can provide support and travel help to fathers and their spouses certainly make the choice of more distant urban hospitals more appealing. Since older drivers are more likely to be male (Carr et al. 1990), husbands of female married patients may drive them to hospitals when inpatient care is needed. The limited driving ability due to declining health of their husbands may deter

older women from using more distant urban hospitals. But again, it could be because men suffer from more severe conditions within the same diagnostic category that requires sophisticated care not available in rural hospitals.

Functional impairment was a deterrent for traveling beyond the closest rural hospital among aged rural Medicare beneficiaries. However, women were more responsive to severe limitations of functional status measured by whether a person was bedridden. Women who were not bedridden were more likely to use urban hospitals over the closest rural hospital. A positive relationship between poor health and the choice of the "other rural hospital" alternative over the closest rural hospital for men indicated that they may be less restricted by their health and functional limitation in the hospital bypassing.

Men and women both preferred hospitals beyond their "closest rural hospital" alternative for psychiatric treatments. Relative to women, men's decision to bypass seemed to be more responsive to the presence of a cardiovascular procedure or a technical intensive condition. This may be result from a higher percent of elderly men with a cardiovascular procedure or a technical intensive condition. Or a higher percent of men with a cardiovascular procedure or a technical intensive condition classified into a higher within-DRG severity that were not controlled for in the study.

Lack of a regular source of care increased the likelihood of men choosing the "other rural hospital" or the "urban teaching hospital" over the "closest rural hospital" alternative while a longer patient-physician tie influenced choice of urban hospitals versus rural hospitals for women. It can be that men just prefer to be admitted to

hospitals with a greater familiarity. If no regular source of care is available for men, there may be no or less local connection for men to stay local. And women may perceive a longer "patient-physician" relationship as a "better quality of care" and an important factor in deciding hospital bypassing to distant urban hospital alternatives.

Dissatisfaction with quality of physician increased the probability of men choosing the "urban teaching hospital" over the "closest rural hospital" alternative and dissatisfaction with the availability of health care decreased the probability of them choosing "urban teaching hospital" over the "closest rural hospital" alternative. The unexpected negative association between dissatisfaction with availability of health care and bypassing the closest rural hospital for the "urban teaching hospital" alternative for men is not easy to interpret. In sum, hospital bypassing of women were more related to their tie with physicians while hospital bypassing of men were more related to the availability of primary or other health care and the quality of physician or physician care. Potential access barriers may exist for men who were dissatisfied with the availability of health care and for women without a longer tie with their physicians.

# CHAPTER VI

# DISCUSSIONS AND POLICY IMPLICATIONS

The purpose of this study was to test the effect of individual attributes, hospital attributes, and spatial access on hospital choice for a national sample of aged rural Medicare beneficiaries. Unlike earlier studies which either employed regional data to estimate aggregate hospital choice models or employed regional claims data to estimate disaggregate hospital choice models, this study estimated a disaggregate hospital choice model from a national sample of aged rural Medicare beneficiaries. The use of a national sample of rural Medicare beneficiaries enhanced the ability to generalize study findings to the nation's rural elders that is not available in previous regional analyses. Furthermore, the use of rich MCBS data permitted analyses of the influence of numerous patient attributes on hospital choice (e.g., functional status, provider satisfaction) not available in hospital claims.

## *6.1. The General Findings and Impacts of Rural Hospital Closure*

General findings on determinants of hospital choice of a national sample of rural elderly are consistent with previous literature. The majority of aged rural Medicare beneficiaries in the study sample used their closest rural facilities. Of those who bypassed their closest rural hospital over 70 percent were admitted to urban hospitals.

Patients who bypass their closest rural hospital appear to be younger and more able in terms of functional disability while older and frail elders prefer to stay locally. Furthermore, patients who bypass their closest rural hospital tend to be those with more resources (i.e., income, education, family support) while patients stay locally are those with less resources. Finally, women prefer the closest rural hospital rather than other hospital choice alternatives while men only exhibit a stronger preference for the closest rural hospital over an urban teaching hospital.

Even though the model controlled for diagnostic category and relative complexity of illness, the results indicate a significant influence of age in the hospital choice behavior among aged rural Medicare beneficiaries. Distance traveled for inpatient care, in general, decreased with age. In addition, oldest-old females were most restricted in the choice of "urban" over the "closest rural hospital" alternative. As Adams et al. (1991) suggested, the implications for consumer welfare and access are greater for oldest-old rural patients when closer rural hospital is closed.

Individuals with attributes discussed above will be most likely to encounter access problems that are caused by rural hospital closure. The degree to which patients who are older or less able in terms of socioeconomic resources and functional limitations can travel for necessary health care after leaving their "closest rural hospital" alternative is a policy issue of growing importance. The oldest-old women and older men in need of sophisticated care but lack of resources are subgroups of rural elderly that are particularly in need of special attentions from policy makers.

*6.2. Patient-Physician Relationship in Hospital Bypassing and the Role of Rural Hospital Network in Hospital Choice*

Individuals with greater access to care barriers, without a regular source of care or a longer patient-physician tie, or with an experience in hospital bypassing in the past year were more likely to bypass their closest rural hospital and choose other hospital alternatives. A lack of primary physician and how patients perceive and experience their access to physicians both impact the decisions to bypass the closest rural hospital among aged rural Medicare beneficiaries.

With at least 20 percent of the population living in rural areas, less than 11 percent of the nation's physicians are practicing in rural areas (Phillips & Dunlap 1998). The current medical school environment discourages students from entering primary care specialties and from practicing in underserved areas (Phillips & Dunlap 1998). Economic issues, social adjustment, and cultural diversity are all contributing to current problems with retention of rural primary care physicians (Phillips & Dunlap 1998).

Selective medical school admission policies and several government initiatives (i.e., national health service corps, international medical graduates and J-1 visas) have been shown to increase the number of physicians serving in rural areas. Furthermore, issues such as professional fulfillment, financial remuneration, and lifestyle are often considered in the retention of physicians (Phillips & Dunlap 1998). In addition, ensuring the availability of primary care physicians in rural areas, the 1997 legislation that established criteria for the establishment of federally certified Rural Health Clinics was designed to support and encourage access to health care by rural residents. The program

helps to establish physician practice or hospital outpatient clinic in federally designated underserved areas. However, there is significant disparity in the distribution of community health centers.

One of the most common strategies that rural hospitals used to ensure a stable or even expanding physician population is to employ doctors, offering them a predictable income and shared expenses for overhead and equipment. In fact, many hospitals open clinics especially as a recruitment tool. Some hospitals have visiting specialist program, which involve regularly scheduled visits by specialists from other neighborhood counties (Ormond 2000).

If rural patients regularly bypass rural providers for primary care that is available locally due to access to care barriers, the local hospital has no chance of capturing these patients. This further affects the viability of rural hospitals where rural physicians are most likely to practice. Although it was found that a majority of Medicare patients stay in the community for primary care visits (Dunlap 1997); improved access and quality of rural physicians may provide a possible linkage between elderly patients and local hospitals in rural communities.

The results also indicate some gender differences in the relationship with primary care and hospital choice. Men's hospital choice was more responsive to the availability of a regular or other source of care while women's hospital choice was more responsive to their relationship with physicians. This could result from differences in social network, involvement with the community, and a preference for personal relationship between men and women that in turn affect hospital choice behavior such as a result of

"staying close to shore" perception in health service use of many rural women (Porter 1998). Rural elderly women prefer the location of greatest familiarity and where they have a personal history and social ties to health care utilization (Porter 1998). While rural elderly women tend to live to advanced ages, stay unmarried, live alone, and more likely to experience chronic diseases, the establishment of an accessible and closer-to-home rural physician network with the involvement of primary care providers and medical specialists are of great importance for them.

*6.3. Efforts by Rural Hospitals to Attract Patients*

The hospital attributes that attract rural elderly patients: more beds, a higher service capacity, and alternative with more hospitals. Rural hospitals can respond to patients' need by expanding new services, development of satellite clinics and the expansion of onsite outpatient capacity, and long-term care (Ormond 2000). Since it was found that choice alternatives comprised of more individual hospitals are more likely to be chosen over otherwise similar attributes with fewer hospitals. Rural hospitals can respond to this by establishing cooperative efforts with other rural providers although competition for patients and resources exists, especially for health professionals. Rural providers display a notable willingness to band together to provide a better quality of care for their residents. Cooperation with other rural providers is also a strategy to ward off encroachment by urban health care systems. These efforts include rural health alliance, sharing administrative arrangements, working with community health centers and health departments.

Formal and informal links with urban providers are perceived as necessary by many rural hospitals including help in physician recruitment or access to joint purchasing contracts or employee benefits, technical assistance, shared resources and patients, and make referrals (Ormond 2000).

The results also indicate that individuals who did not use inpatient hospital care at all in the past 12 months were more likely to bypass the closest rural hospital. Furthermore, individuals with more resources were also more likely to bypass the closest rural hospitals. Rural hospitals can also target these individuals in marketing their services.

*6.4. Competition among Rural Hospitals and their Survival*

Although the data offered evidence of travel for services not available locally, yet the movement between the "closest rural hospital" and the "other rural hospital" alternative indicate a potential competition among rural hospitals. The size as an indication of hospital service capacity of the "closest rural hospital" alternative is influential in hospital choice of aged rural Medicare beneficiaries. How do rural hospitals respond at the time when the Federal government is exploring possibilities of increased payments under the PPS for rural hospitals and offering opportunities and funds for the reconfiguration of hospital services in rural areas (e.g., CAH) is crucial for their survival. Rural hospitals, by understanding characteristics of elderly population and its diverse health care needs, can then diversify services to attract these patients, again, the key for their own survival.

*6.5. Limitations of the Study*

Although this study attempts to address the issues that were not examined in the previous research, data limitations such as physician referral pattern, the influence of religion, and market attributes on hospital choice should be noted.

6.5.1. Direct Measure of Physician Influence in Hospital Choice

Past research recognized physician's role and specified variables in their empirical work (Folland 1983; Cohen and Lee 1985; Burns and Wholey 1992; Erickson and Finkler 1985). They used counts of physicians within the proximity of the hospital, patient's community with admittance privileges to the hospital, the distance between office of the admitting physician and chosen hospital, patient-to-hospital distance, and hospitals' share of physician affiliation to specify potential physician's influence. The results suggest that both physicians and physician access influence hospital choice behavior of patients.

Although physician's admitting privilege and their spatial access to hospitals could play an important role in hospital choice of a patient, similar to other studies, the data employed here does not permit specification of a direct physician influence on hospital choice of the patient. The results from this study suggest that a lack of primary physician and how patients perceive and experience their access to physicians both impact the decisions to bypass the closest rural hospital among aged rural Medicare beneficiaries. A longer patient-physician relationship could indicate a greater likelihood that a patient routinely sees his or her physician for primary and routine care and a lesser

likelihood he or she is admitted to hospitals for unexpected, less controlled, or more severe conditions at more sophisticated hospitals with greater distances.

Although Porell & Adams (1995) suggested that it does not particularly matter who chooses the hospital as long as the preferences of patients or their physicians acting as agents are expressed in terms of attributes that are reflected in systematic patterns in hospital choice. Alternative choice structures involving a sequential decision process where patients choose physicians and then physicians choose hospitals or a single patient choice model with a treating physician and hospital bundle should provide a more direct measure of physician influence (Porell and Adams 1995).

### 6.5.2. The Influence of Religion in Hospital Choice

Religion appears to exercise some influence on patient choice of physicians and hospitals (Earickson 1970). For example, since many Jews lived in close proximity and preferred certain schools and hospitals to others, this could result in a more restricted set of hospital choice for these patients (Earickson 1970). Modest, but significant systematic hospital choice patterns were found for Roman Catholic families favoring Catholic hospitals (Earickson 1970). No further published research has addressed the potential influence of religion on hospital choice for nearly three decades. This issue could not be addressed here because the MCBS does not contain information regarding religious preferences.

6.5.3. The Influence of Market or Community Attributes in Hospital Choice Behavior

Previous studies have found that several community or market attributes play an important role in hospital choice (Folland 1983; Porell 1986; Buczko 1991). These attributes included median family income, percent of family with public assistance income, percent of population 65 years or older, percent 25 years or older with a college degree, percent of black population, percent of rural residents in a State, and sales tax revenue from the city. Data such as Areas Resources Files with county specific information regarding demographic, social structure, and hospital supply, will allow empirical tests of the influence of community or market attributes on hospital choice.

6.5.4. Quality and Hospital Choice

Finally, with an increasing public interest in hospital quality (i.e., mortality, length of stay, readmissions etc.) and volumes, patients today are more aware of the availability of this information through various sources (i.e., the Internet) and at the same time, relating these information with their decisions in hospital choice. Linking data on hospital quality/volumes in the modeling of hospital choice behavior is important not only because patients may be more and more responsive to these factors but also because patients who have barriers to travel will suffer if differences in hospital quality exist between rural and urban hospitals. The growing attentions to hospital quality can also lead to a changing relationship between patients and their physicians. How is the change in patient-physician relationship resulted from the availability of hospital quality data

that, in turn, affects hospital choice behavior of aged rural Medicare beneficiaries will be important tasks for the future research.

### *6.6. Future Research*

This study is the first to date to use a nationally representative sample of aged rural Medicare beneficiaries to test extensive hospital and individual attributes in a discrete hospital choice model of various hospital alternatives and to model the hospital choice of men and women from the same sample population. While the study yields some interesting findings, additional research is warranted to understand more about the potential impact of hospital bypassing from both providers' and patients' perspectives.

#### 6.6.1. Factors not Controlled in the Current Models

Future research should address some of the limitations of the study data most notably the inability to identify measures such as direct physician influence and individual preferences in estimating hospital choice of aged rural Medicare beneficiaries. Additional variables such as the regional differences that can be important but not specified in the previous and current research in the influence of hospital choice behavior should be examined in the future. Variables that were specified in some previous studies but not here such as the disease staging methodology (Adams et al. 1991) and quality of care (Garnick et al. 1989; Luft et al. 1990; Phibbs et al. 1993) should also be addressed in a national sample in future studies. Finally, comparisons of hospital choice models

among different subgroups (i.e., age category and regions) are also important in identifying if a particular group with special needs or access barriers exists.

### 6.6.2. Simulations of Rural Hospital Closure

The effect of rural hospital closure on patient choice can be estimated in terms of a change in admissions through simulations. Simulations can help in analyzing whether there are systematic patterns in whose choice behavior is most affected by a simulated hospital closure. By definition, a hospital closure simply involves removal of a hospital alternative from a previously estimated choice set (Porell and Adams 1995). Simulation of this kind would entail closing the closest rural hospital for each of the cases, inserting a new closest rural hospital and its attributes into the model, modify attributes for other rural hospital alternative since one hospital will be removed from this category. The predicted probabilities for each of four choice alternatives before and after the closure can be generated and compared.

The change in distribution of what proportions of sample persons choose the closest rural hospital and other hospital alternatives in the choice set will be important in estimating impacts of hospital closure. For example, if the choice probabilities for rural elderly were 56% for the closest rural hospital, 13% for "other rural hospital", 13% for "other urban hospital", and 18 % for "urban teaching hospital" and the post-closure predictions were 45%, 15%, 20%, 20%, respectively. Then it can be concluded that most of those affected would go to an "other rural hospital" alternative.

Simulations can also be conducted to see if predictions differ when new services or scales are added or existing services (e.g., number of beds) are discontinued in estimating the expected utilization impact of system reconfigurations (Porell and Adams 1995). For example, suppose a specific rural hospital was to be converted into a CAH, where involving meeting the HCFA requirement on bed size. The impact analysis would involve a generation of revised choice probabilities in hospital market areas by adjusting bed size of the designated CAHs.

### 6.6.3. Linking Utilization and Outcomes Data to Hospital Choice

Aged rural Medicare beneficiaries bypassed their closest rural hospital for a surgical DRG, a psychiatric diagnosis, a cardiovascular procedure, a technical intensive condition, and a higher number of surgical procedures performed during the hospital stay. These aged rural Medicare beneficiaries should be better off by their bypassing their closest rural hospital because of their needs for complex treatments or procedures. However, whether bypassers really obtain appropriate care and services that achieve favorable outcomes are important for the welfare of these patients. Comparing utilization, outcomes, and future medical costs of bypassers and non-bypassers can identify the potential impacts of hospital bypassing on patient welfare. The results will be informative especially for policy makers.

6.6.4. Exploring Various Classifications of Rural Hospital Market Areas

As mentioned earlier in Chapter 3, one of the most important elements in studying hospital choice is to properly classify hospital market areas (Porell and Adams 1995). Either the exclusion of relevant alternatives or the inclusion of irrelevant alternatives for hospital market construction would bias the choice probabilities (Porell & Adams 1995).

Hospital market areas defined by patient-origin data are most prevalent in the current hospital choice literature. These hospital market areas are, in general, defined by grouping individual zip code information based on similar patterns of patient hospital choice. Researchers inevitably have to decide on cut-off points in creating such zip codes clusters as to where market starts or stops (Porell and Adams 1995).

Unlike earlier studies, the hospital choice admission patterns of all Medicare beneficiaries who resided in the same zip codes as beneficiaries in the study sample were used to derive hospital market areas for the sample population. Hospitals with a market share less than one percent in a rural aged Medicare beneficiary's zip code of residence were excluded from the set of feasible choice sets to exclude extraneous travel patterns. Although measures of market structure were found to be robust across alternative cut-off points chosen (Zwanziger et al. 1990), analyses involving various cutoff points for the hospital market area definition should be compared in the future to test the sensitivity of estimated coefficients in the multivariate hospital choice models.

## APPENDIX A

The below is the detailed summary of 17- item Dissatisfaction with Quality of Care Scale. They can be grouped into three categories.

**A. Overall quality of physician care (Item 1-6):**

Items 1-4 were coded as one for responses of very dissatisfied or dissatisfied to the four questions below. All other responses were coded as zero for these items.

1. The overall quality of medical care you have received in the last year?
2. The information given you about what was wrong with you?
3. The follow-up care received by you after an initial treatment or operation?
4. The concern of doctor for your overall health rather than just for an isolated symptom or disease?

Items 5-6 were coded one if at least one response to an open-ended question about reasons for dissatisfaction and about what needed improvement, respectively, were classified into one of eight categories related to quality. The two open-ended questions were:

What things about the medical care you receive are you dissatisfied with?
What things about the medical services you receive need to be improved?

The eight categories of responses related to quality were:
Time spent with doctor, Thoroughness of doctor, Unnecessary tests, Doctor's attitudes, Other medical providers' attitude, Doctor's competence, Other medical provider's competence, and No preventive care.

**B. Physician's technical competence (Items 7-11):**

Items 7-11 were coded one for responses of disagree or strongly disagree (on a Likert scale ranging from strongly agree to strongly disagree) with the following five statements about one's doctor. All other responses were coded as zero for these items.

1. Your doctor is very careful to check everything when examining you.
2. Your doctor is competent and well trained.
3. Your doctor has a good understanding of your medical history.
4. Your doctor has a complete understanding of the things that are wrong with you.
5. You have great confidence in your doctor.

**C. Physician practice style (Items 12-17):**

Items 12-15 were coded one for responses of agree or strongly agree (on a Likert scale ranging from strongly agree to strongly disagree) with the following four statements about one's doctor. All other responses were coded as zero for these items.

1. Your doctor often seems to be in a hurry.
2. Your doctor often does not explain medical problems to you.
3. You often have health problems that should be discussed are not.
4. Your doctor often acts as though he is doing you a favor by talking to you.

Items 16-17 were coded one for responses of disagree or strongly disagree (on a Likert scale ranging from strongly agree to strongly disagree) with the following statements about one's doctor. All other responses were coded as zero for these items.

1. Your doctor tells you all you want to know about your conditions and treatments.
2. Your doctor answers all your questions.

## APPENDIX B

Guttman scaling is also sometimes known as cumulative scaling. The purpose of Guttman scaling is to establish a one-dimensional continuum for a concept that is measured. In terms of the concept, a respondent who agrees with any specific question in the list will also agree with all previous questions. That is, we would like to be able to predict item responses perfectly knowing only the total score for the respondent. For example, image a ten-item cumulative scale. If a respondent scores a four, it means that he or she agreed with the first four statements. If another respondent scores an eight, he or she should agree with the first eight statements. The object is to find a set of items that perfectly matches this pattern. However, it will be very unlikely to find this perfect cumulative pattern in practice.

Regarding to hospital services offering, A Guttman scale is based on the premise that different services are more difficult to be provided than others. And all items form a statistically stable hierarchy. For example, some services, such as emergency services, may be offered by a large percentage of hospitals; other more specialized services, such as neonatal ICU, may occur much less frequently.

Calculation of a Guttman scale entails arranging variables or items in rank order of frequency and checking for consistency, so that every hospital that has the rarest service should also has all of the more common services. The score a hospital receives is the total number of hospital services that it reports to offer. The scale has a maximum value equal to the total number of services measured, and a minimum value of zero for hospitals offering none of the services measured.

Exhibit 1 illustrates the calculation of such a scale for five hospital services (A-E). To calculate a Guttman scale, the services are first ranked in ascending order so the service that is the least common (E) to the service that is the most common (A) can be identified. Then individual records are then arranged and displayed from the most common service (left) to the least common service (right). The occurrence of services is further checked for consistency. A "-" is an error of omission, and "_" is an error of commission. The degree to which data match the assumption of an underlying single dimension is measured by the coefficient of reproducibility, CR:

(CR= (1- (number of errors/total number responses))

Exhibit 1

| | A | B | C | D | E | Score |
|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 5 |
| 2 | 1 | 1 | 1 | 1 | | 4 |
| 3 | 1 | 1 | 1 | - | 1 | 4 |
| 4 | 1 | 1 | 1 | | | 3 |
| 5 | 1 | - | 1 | 1 | | 3 |
| 6 | 1 | 1 | | | | 2 |
| 7 | 1 | | | | | 1 |
| 8 | + | 1 | | | | 1 |
| 9 | - | | 1 | | | 1 |
| 10 | | | | | | 0 |

Number of errors: 7
Coefficient of reproducibility: 50-7/50=0.86

The next stage is to improve the scale by removing or rearranging the items included in the original scale development. The Guttman scale for the current study was developed iteratively by using a SAS program to include and exclude services with a goal of not only representing diversified frequency of occurrence but approaching as closely as possible to a perfect cumulative scaling. The services that were included for the final Guttman scale for the study were presented in the Exhibit 2.

Exhibit 2

Items Comprising Guttman Scale for Hospital Service Capacity
(From 1994 & 1995 AHA Annual Survey of Hospitals
In the Sample Persons' Feasible Alternatives)

| Service | Percent of Market Area Hospital Having Service | Percent of Observation In Error |
|---|---|---|
| 1. Burn Unit | 7.3% | 4.8% |
| 2. Pediatric Intensive Care | 15.2% | 8.5% |
| 3. Neonatal Intermediate Care | 19.3% | 14.3% |
| 4. Cardiac Intensive Care | 26.8% | 10.5% |
| 5. Open Heart Surgery | 34.2% | 6.8% |
| 6. Angioplasty | 36.6% | 6.5% |
| 7. Cardiac Catheterization Laboratory | 48.8% | 7.3% |
| 8. Oncology Services | 61.6% | 10.2% |
| 9. Diagnostic Radioisotope Facility | 61.9% | 10.3% |
| 10. Obstetrical Care | 66.7% | 12.8% |
| 11. Medical/Surgical Intensive Care | 71.5% | 5.5% |
| 12. CAT Scan | 75.0% | 4.6% |
| 13. Ambulatory Surgery | 79.9% | 1.2% |
| 14. Adult General Medical/Surgical Care | 80.8% | 0.8% |
| 15. Emergency Services | 79.5% | 3.6% |
| Coefficient of Reproducibility | | 0.928 |

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