A PROBABILISTIC MODEL FOR ESTIMATING DEMAND
FOR SELECTED EXISTING RURAL COMMUNITY HOSPITALS
THAT MAY BE FACING CLOSURE IN WEST VIRGINIA

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A wide range of people are interested in how local factors influence patient choice among hospitals. Administrators need to know why patients are admitted to their hospitals so they can develop more sophisticated marketing of their services in an increasingly competitive environment. Planners concerned with issues of patient accessibility need to know the geographic patterns of hospital use. To meet these needs, it becomes necessary to develop methods to estimate the probability that patients will be admitted to a particular hospital using models that incorporate location and size of competing hospitals.

In this paper, the focus of econometric investigation and prediction is the probability that a patient will select a particular hospital. Four different service areas were delineated and studied in West Virginia to test the Huff Consumer Spatial Behavior model for estimating demand at four hospitals that may be facing closure. It was found that through application of the Huff model that in a small system of hospitals and patients, each patient location (i.e., zip code) will send patients to nearly every hospital. The model
predicted sufficient demand for two of the four hospitals studied. Conventional methodologies were then compared to the Huff model. The model did not test for financial feasibility of any of the facilities nor did the model adequately address the issue of how patients select a particular facility.
DEDICATION

Why should we be in such desperate haste to succeed and in such desperate enterprises? If a man does not keep pace with his companions, perhaps it is because he hears a different drummer. Let him step to the music which he hears, however measured or far away. It is not important that he should mature as soon as an apple-tree or an oak. Shall he turn his spring into summer? If the condition of things which we were made for is not yet, what were any reality which we can substitute?

Henry David Thoreau

This work is dedicated to my wife. Although we sometimes heard different drummers and stepped to music that was often syncopated, I will always remember the assistance and support that I received from her.
ACKNOWLEDGEMENTS

As an internist of the West Virginia State Health Department, I wish to express my appreciation to the Office of Epidemiology and Health Promotion for the flexibility that enabled me to continue my education. I would like to express my appreciation to the members of my report committee, Dr. Redican, Dr. Baffi, and Dr. Bohland, for making valuable and meaningful contributions to my work. A special thanks goes out to who made special efforts above and beyond the call of duty in order to get this report typed. Finally, I would like to extend my gratitude to friends and family who endured the past three years and shared my frustrations as well as my accomplishments.

James R. Criniti

December 1989
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CHAPTER ONE
INSTRUCTION AND ORGANIZATION

INTRODUCTION

This study was initiated as a result of a growing awareness of the rapid changes occurring in the health care field. Both internal and external factors constrain health providers. The level of competition between providers has increased primarily due to national goals being carried out by federal agencies that mandate increased economic efficiency and decreased duplicity of services. The emergence of investor-owned hospitals and multi-hospital systems with aggressive management philosophies has made the health care delivery field more similar to non-regulated industries. In response to an increasing regulatory and competitive environment, hospitals have been forced to engage in planning. Strategic or market planning is becoming a vital activity for many hospitals in the public and private sector.

For generations, community hospitals, public schools, and churches have ranked among the leading human service institutions in rural America. Whether measured by numbers of employees, expenditures, board prominence, or social/political influence, the general hospital ranks very high in its community.

Until the beginning of the 1980's the patterns of medical practice, hospital utilization, and payment for health care remained fairly stable and predictable. The decade of the
80's has been turbulent, especially for rural communities. Major changes in the health care environment have increased the demand for modifications in the organization and delivery of rural health services. Reductions in inpatient utilization, inadequate supply of health care personnel, and radical changes in the payment for health care require that additional, immediate attention be given to duplication of services, horizontal and vertical integration of care, and the total restructuring of health service delivery. Further, rural communities exhibit special social problems, for example many communities have a proportionately higher percentage of elderly, a troubled rural economy, and stress related to the societal problems of divorce, alcoholism, suicide, and work accidents. Other problems are the burden of indigent care, especially in West Virginia and the lack of marketing of strengths.

When all these factors are taken into account, it is no wonder that a larger number of rural hospitals as compared to urban hospitals have closed or are facing closure. Closure of rural community hospitals is an important trend with serious implications for rural communities and the overall health care system. Almost half of all community hospitals are located in rural areas. Community hospitals as defined by the American Hospital Association (AHA) have a mean length of stay of 30 days or less, are not federally owned, and have facilities and services open to the public. They may be
privately-owned, for profit hospitals; privately-owned not-for-profit (voluntary) hospitals; or hospitals owned or managed by state or local government (Hospital Statistics AHA, 1989).

Rural community hospitals are community hospitals located outside a Metropolitan Statistical Area (MSA) as defined by the U.S. Census.\(^1\)

The current supply of hospitals in rural areas is to some extent the result of public policies adopted in the late 1940's and pursued effectively for twenty years. Federal grant monies were made available to assist states and communities in constructing hospitals starting in 1946, through the Hill-Burton Program. By June 30, 1971, 10,746 projects had received Hill-Burton funds. Approximately 43 percent of these projects were located in communities of less than 10,000 population, while 63 percent were in communities with fewer than 25,000 residents (Lave, 1974).

Nearly half of the community hospitals in the U.S. in 1986 were in rural areas (Figure 1). These rural hospitals continue to experience falling utilization; growing proportions of poor, elderly, and uninsured patients; lower federal payment rates than their urban counterparts; and increasing local and regional competition for both patients

\(^1\)An MSA is an area (usually a county) containing either: (1) a city of at least 50,000 population; or (2) an urbanized area of at least 50,000 with a total metropolitan population of at least 100,000 (Metropolitan Statistical Areas, Rand McNally, 1984).
**Number of Hospitals**

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<td>Total U.S. hospitals</td>
<td>5,678</td>
<td>5,759</td>
<td>-1.4%</td>
</tr>
<tr>
<td>Total rural hospitals</td>
<td>2,638</td>
<td>2,696</td>
<td>-2.2%</td>
</tr>
<tr>
<td>Total small urban hospitals</td>
<td>1,018</td>
<td>974</td>
<td>4.5%</td>
</tr>
<tr>
<td>Total urban hospitals</td>
<td>3,040</td>
<td>3,063</td>
<td>-0.8%</td>
</tr>
<tr>
<td>Total small or rural hospitals</td>
<td>3,656</td>
<td>3,670</td>
<td>-0.4%</td>
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Although the number of total U.S. community hospitals, rural hospitals, and urban hospitals decreased between 1984 and 1986, the number of small urban hospitals increased 4.5 percent—most likely a result of declining hospital admissions.

**Source:** American Hospital Association, Annual Survey of Hospitals, 1986

**Figure 1.** Percentage of Rural and Urban Registered Community Hospitals, 1986
and personnel. The growth of alternative forms of medical care delivery such as Health Maintenance Organizations (HMO's) and freestanding ambulatory care centers have sparked a lively and sometimes heated debate concerning the survival of rural hospitals (Profiles of Small or Rural Hospitals, 1980-1986, AHA, 1988).

In many rural areas, economic downturns have been reflected in hospital closures, as in the closure of 13 hospitals in rural Texas in 1986. West Virginia lost five hospitals, four rural, in 1987 alone (WVHA, 1989). Closures of rural hospitals in the United States have been rising: 21 in 1985, 37 in 1986, 40 in 1987 (See Figure 2).

As rural populations shrink, the residents who remain tend to be older and poorer than the national average. Economic troubles have caused many rural residents to move to urban areas in search of employment. As a consequence, rural incomes tend to be lower and the incidence of poverty higher. Both of these factors inhibit resident's ability to seek preventive or early health care, which can lead to more serious health problems and greater poverty.

For rural hospitals, troubled economics mean fewer paying patients, as more residents lack health care insurance and government is less willing to help hospitals pay for care of the poor and unemployed. According to the U.S. Bureau of Labor Statistics, West Virginia's unemployment rate was 13.8% in January 1988.
Figure 2 — Hospital Closures, 1980–87

As a result of fewer patients due to depressed economic conditions, utilization is falling and rural hospitals are finding that an increasing proportion of their patients are elderly (and sicker). In West Virginia in 1980 the elderly, those 65 and older, represented 12.2% of the population. In 1995, the elderly will represent almost 15% of the population (WVHA, 1989). Consequently, rural hospitals have become increasingly dependent on Medicare revenue. On the average, rural hospitals in the United States in 1986 relied on Medicare for nearly 42 percent of patient revenue (AHA, 1986). West Virginia hospitals relied on Medicare for 45% of their inpatient days and for 34% of their admissions in 1987 (See Figure 3).

Medicare payments discriminate against rural hospitals and Medicare recipients living in rural areas. Often rural hospitals are reimbursed as much as 35 percent less per DRG® than urban hospitals (AHA, 1989).

Uncompensated care is also rising, reflecting rural economics in which many workers are self-employed or work in small businesses that do not provide health insurance, or have been forced to drop insurance coverage because of economic downturns. Of the estimated 37 million Americans who lack

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\(^2\)Since 1983, Medicare has utilized Diagnostic Related Group (DRG) categories to calculate payment rates determined by the projected cost of patients' illness. For patients within these categories, the federally mandated Prospective Payment System (PPS) pays rural hospitals at a lower rate than their urban counterparts.
Source: West Virginia Hospital Association, 1989

Figure 3 - MEDICARE AND MEDICAID UTILIZATION WV HOSPITALS 1987
health insurance, 10.6 million live in rural areas (Strategic Planning, 1988).

The economy of rural America is heavily dependent on the agricultural, mining and oil, and energy industries. These industries experienced severe problems in the 1980's, largely because of increased competition from foreign producers. High domestic real interest rates and sharply falling farm asset values also contributed to problems in agriculture. Although the outlook for farmers has improved recently, the problems are by no means over. These economic changes, along with the lower taxable income of the elderly populations have eroded the tax base used to support community health care facilities, altered the case-mix\(^3\) which these facilities treat and increased the amount of uncompensated care provided by rural hospitals.

The real significance of the problem of rural hospital closures is that the rural hospital may be the sole health care provider in a community. Its closure would seriously affect access to health care by increasing the distance traveled and making the area less attractive to physicians.

\(^3\)Case-mix - Medical care is not a standardized product, but varies from patient to patient with more severely ill patients tending to be more costly to treat. If financially distressed hospitals serve a patient population that is sicker and costlier to treat, a major cause of financial distress becomes readily apparent. Hospitals serving more severely ill patients in a market where reimbursement is based on factors other than case mix (such as bed size and geographic location) are placed at a disadvantage. Hospital deficits may result because sicker patients require more care, more equipment, and generally more resources.
Between 1980 and 1985, 6 of the 85 rural counties that experienced closure of a community hospital had no hospitals after the closure.

The hospital is also one of the larger employers in rural areas, generating disposable income for other local business and suppliers, and providing amenities desired by local employees.

There was a sharp increase in hospital closures in 1987, with 40 rural hospital closings compared with 21 rural hospitals in 1985. Of the approximately 2,700 rural hospitals in the U.S., as many as 600 have been projected to close by 1990 (Robert Wood Johnson Foundation, 1987).

OBJECTIVES AND DEFINITION OF THE PROBLEM

Hospitals have traditionally been "product oriented," that is, more attuned to what is produced than to whom the product is intended. Thus there was little concern with the demands of the market. It was assumed that all people in a particular service area had the same health needs so therefore all purchase the same hospital products (hospital beds and services). With the advent of Federal laws and policies such as the National Health Planning and Resources Development Act of 1974 (P.L. 93-641) and its amendments (P.L. 96-79), and the growing consumer movement, hospitals are being forced to be more sensitive to the needs of the public. More and more,
hospitals today are becoming "consumer oriented." Evidence of this change can be seen in such services as outpatient surgery departments, community health education programs, alternative birthing options, ambulatory clinics, and other innovative programs that are aimed at giving the patient-consumer alternatives to typical in-hospital services.

The ultimate step in converting hospitals from "product orientation" to "consumer orientation" is to make hospitals as convenient as possible to the people that will be using them without causing an overbedding situation in the community.

PURPOSE

The purpose of this paper was to examine a probabilistic model for estimating demand for community hospitals which may be facing closure, based on location of the hospital in relation to population centers and other community hospitals.

The major purpose of this study was to test the Huff model of probabilistic consumer behavior for determining hospital bed demand on a local level. The Huff model is a marketing tool used to predict market share and expected sales for retail establishments. The model will be applied to a

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*The Huff model was introduced by Dr. David L. Huff in 1962 to represent a theoretical abstraction of consumer spatial behavior. The model is a variation of Reilly's model of retail gravitation.*
local situation to predict hospital utilization and then compared to results of recent bed need studies using conventional methodologies.

**SIGNIFICANCE**

As part of the process of becoming "consumer oriented" hospital planners have begun to adopt strategies practiced by planners in other fields. One such strategy involves market area analysis - the study of the spatial arrangement and distribution of consumers and producers - to determine the best location for new facilities or the viability of existing facilities. Historical methods for determining hospital need and location were based on "product oriented" assumptions, i.e. the location of the facility was not necessarily tied to expected population growth, nor was the need for a hospital necessarily tied to population hospitalization rates. The problems facing hospital planners today are, "How can the needs of the service area population best be met?" "What is the contribution of a rural hospital to the income of the community in which it is located?" "How does this contribution affect the overall health of the community?" "What would the impact be if the hospital closed?"

The hospital industry is one of the most regulated in the nation. Despite proposed cutbacks in federal health planning promised by the new administration, state regulatory
agencies will more than likely continue to administer Certificate of Need (CON) programs in some states. The CON programs will continue to impose restrictions and conditions requisite for hospital construction, expansion or closure. Any methodology used to support a need must address national guidelines as well as state guidelines pertaining to health care needs of the population and the effects of new construction as well as feasibility of closing existing facilities.

In summary this is the problem faced: to discover a methodology for determining the demand for hospital services, the location for such services in order to maximize utilization while minimizing adverse effects on existing hospital providers, and the best location for services in order to maximize accessibility to present and future populations.

CONVENTIONAL METHODS OF DETERMINING NEED

In the hospital industry, federal rules and guidelines are an everyday issue. However, the guidelines proposed under the National Health Planning and Resources Development Act (P.L. 93-641) generated controversy that is as heated now as it was when the guidelines were first proposed in 1975. Health providers led by the American Hospital Association,
resent the "top-down" planning forced upon them that they feel is unnecessarily rigid. Health planners and planning agencies on the other hand strive to emphasize cost containment and neglect situational differences that could affect the outcome of a CON application. The strict regulations mandate that predictive bed need studies be performed.

In a study conducted by Taggart and Mullner in which they interviewed 29 administrators of the 40 rural hospitals that closed in 1987, fewer admissions and insufficient utilization (which led to insufficient cash flow to meet current obligations), were leading indicators identified before closure (AHA, 1989).

In the following sections a review of the literature concerning rural hospital closures and a history of bed need methodologies is presented along with a discussion of current methodologies pointing to the need for improved techniques in the hospital planning field.

LITERATURE REVIEW - RURAL HOSPITAL CLOSURES

The closure of rural community hospitals, that is, community hospitals not in a Metropolitan Statistical Area (MSA) as defined by the U.S. Census, has come under increasing attention in the health services research literature. The presence of a hospital in a rural community is important for many reasons. In a recent study, for example, Doekson and
Loewen constructed a community simulation model to predict the economic impact of a rural hospital closure in a small Oklahoma community (population, 2,600). The model predicted that closure of a 45-bed hospital in 1988 would result in the immediate loss of 51 jobs, and that the community would have 78 fewer jobs in 1992 than would have been the case had the hospital remained open. The 1992 community population would decline by 154, and the total community income in 1992 would be $1,742,800 lower than the baseline prediction made on the assumption the hospital would not close (Doekson and Loewen, 1988).

One of the problems rural hospitals have faced, and one that many continue to face, is a shortage of physicians. Whether the difficulty in attracting physicians into rural communities is directly correlated with closure of rural hospitals is unknown. No empirical studies have found a shortage of physicians to be directly correlated with risk of closure for rural hospitals. Longo and Chase, using data from the American Hospital Association (AHA), found that among AHA-registered hospitals between 1976 and 1980, hospitals in counties with an increased physician-to-population ratio experienced a greater tendency for closure and financial failure than hospitals in counties with smaller physician-to-population ratios (Longo and Chase, 1984).

Although there is a wealth of literature on the general issue of hospital closure and many important studies have
examined variables correlated with risk of closure for urban hospitals, few studies have concentrated on rural hospitals. Mayer, Kohlenberg, Sieferman, Rosenblatt, (1987), found positive correlations were for profit ownership and competitive hospital beds per 1,000 residents within the county. Variables negatively correlated with closure were occupancy rate, number of facilities and services provided in the hospital, and change in county population during the preceding decade (Mayer, 1987).

In a recent study, Mullner, McNeil, (1986), used a matched epidemiologic case-control design to analyze variables correlated with rural hospital closure from 1980 to 1987. Four variables were identified as being associated with increased rural hospital closure: for-profit ownership, non-government not-for-profit ownership, presence of a skilled or other long-term care unit, and number of other hospitals located in the county. Three variables were identified as being negatively correlated with closure: accreditation by the Joint Commission on the Accreditation of Health-care Organizations, membership in a multi-hospital system (for not-for-profit hospitals), and number of facilities and services offered by a hospital. In contrast to the finding of Mayer et al, (1987) this study found no correlation between adjacency to an urban area and hospital closure (Mullner and Whities, 1988).
Rosenstein (1986) argues that membership in a multi-hospital system may provide hospitals with greater access to purchasing power and capital, improved management and information systems, improved financial experience and expertise, a wider geographic area in which to deliver medical services, and greater political power to access new service contracts.

Other authors have noted the presence of a nursing or other long-term care facility as correlated with closure. Spivak (1984) suggested that hospitals enter the long-term care market as a survival strategy of diversification, especially in rural areas with aging populations. Hospitals losing money in acute care may opt to close, discontinue their acute care services, and convert to a nursing or long-term care institution (Mullner and Whities, 1988).

Clearly, the issue of access to health care in rural communities needs further empirical investigation to determine the extent to which this problem is directly correlated with closure and whether it can be expected to increase if the number of rural closures continues to be high, as has been predicted (Robert Wood Johnson Foundation, 1987).

Although several important studies have identified variables correlated with risk of closure for rural hospitals, the implications of some of these findings need further investigation. The effects of adverse economic conditions in the hospital's community, though widely discussed in the
literature, have not been investigated empirically. In addition, the extent to which socioeconomic and demographic factors affect access and use of services, as well as the extent of coverage and comprehensiveness of health insurance in rural areas, needs to be better understood (NCHS, 1988).

HISTORY OF BED NEED METHODOLOGIES

Until 1920, there were no efforts to relate hospital construction or location to the needs of the community served (Hopkins, 1967). With the increasing use of hospitals between 1910 and 1930, the demand for hospital care increased, and as demand increased as a result of rising income levels, funds for hospital construction became available through philanthropic agencies and public taxing authorities. However, there was no systematic planning to adjust either the supply of beds available to a community or the needs or demands of the people served. In 1920 the first attempt to establish a bed-population ratio as a guideline for need was made by the New York Academy of Medicine. By studying 180 private and municipal hospitals in New York City it was found that there were approximately 5 beds available per 1,000 persons. The academy then estimated the incidence of morbidity and accidents and declared that the city's "needs" could be met if there were 32,000 hospital beds available, about 6 per 1,000 persons (Medical Records, 1921). No
recommendations were made about the location of the new beds. It was simply assumed that all currently unmet needs could be met from any location.

Through the 1920's there were several studies completed that attempted to relate hospital bed needs to population size. These included the ones by the American Hospital Association's Committee on County Hospitals and the Duke Endowment. One of the Duke studies made allowances for the differences between urban and rural influences on hospital use, and so was therefore the first to include a locational variable in the hospital siting problem (Rankin, 1928).

In 1935 the AMA's Committee on Hospital Planning and Equipment reported on the use of two formulas for estimating bed needs in urban communities. The formulas, one based on the prevalence of illness, the other on an arbitrary standard of 5 beds per 1,000 population, are important not for what they attempted to prove, but for indicating other factors that needed to be considered: (AHA, 37th Annual Convention, 37:751, 1935)

To intelligently determine how many beds a given community needs requires that many conditions be analyzed far in advance of the first architectural sketch. There are unvalued considerations of the size, racial groups and rate of growth of the population, its economic status and intelligence, the character of its housing and industries, its transient visitors and dependent districts, its present hospital facilities and to what extent they are used, its morbidity levels and the number and caliber of its medical profession.
The AHA study introduced the concepts of population growth, population centers, existing hospitals and their use and the size of the local medical community.

The concepts of "demand," "need," and "accessibility" were incorporated into the bed need analysis problem by T.R. Ponton in the mid 1940's. Demand according to Ponton was the actual use of a hospital while "need" was the ability of people needing hospital care to obtain it: "accessibility" was considered in terms of service areas and the ease with which patients received care (Ponton, 1943).

The preceding methods of determining "need" culminated in the ceiling set by the federal government of 4.5-5.5 general beds per 1,000 population. This ceiling was spelled out in the Hospital Survey and Construction Act of 1946 (The Hill-Burton Act); federal funds would not be approved for any construction that would raise the bed complement above the ceiling. The bed-population ratio has been used rather consistently since 1946 as a determinant of hospital need and location despite the fact that the ratio is a limited concept based on some biological relationship between the number of hospital beds and the incidence of disease in a community.

It was not until the mid-1960's that socio-demographic variables were investigated as reliable factors for determining demand need for hospital beds. Rosenthal in 1964 measured demand, or use, by patient days and admissions per 1,000 population and average length of stay. He found that
significant differences existed in the bed-population ratio's throughout the states due to differences in social and economic characteristics.

In a classic article published over 25 years ago, Feldstein and German compared two models that predicted future hospital use based on historical trends with one model that predicted future use from demand variables based on socio-economic characteristics of the population. Although the demand model was the least effective in predicting hospital use over a five year period, it was found to be theoretically superior in that it is capable of incorporating into the prediction, changes in the underlying factors that are believed to effect hospital use. These factors include age/sex distribution, income, and employment. Feldstein and German recommended improvements to the model but have not refined the model to date (Feldstein and German, 1965).

Lubin in 1965, observed that as a demand factor, travel time influenced not only the patient's use of a hospital but also the physician's. Travel time is now recognized as a valuable variable in assessing future hospital use and location, yet not all researchers attach the same importance to it nor favor it over travel distance which is more easily measured.

Kanaan concluded that more than just travel time and cost considerations should be included in hospital location methodologies; all transportation-related considerations such
as terminal needs (parking, etc.) and environmental problems should be included (Kanaan, 1973).

As the federal government became more involved in hospital and health issues in the late 1960's and early 1970's, there were many new methodologies proposed to determine hospital bed need. Brown (1975) analyzed the four major models used by planners in the industry. Of the four—regression methods, formula models, stochastic methods and simulation models—Brown concluded that none is completely reliable when predicated on historical performance and surrogate health indicators. It was pointed out however, that using hospital beds as a planning factor was adequate if there were considerations made for the type of bed needed; for example, surgical beds are not usually used by obstetric patients, pediatric beds are not used by adults, etc. MacStravic defended the four methodologies and proposed to improve the techniques instead of discarding them (MacStravic, 1984). Each methodology is appropriate for certain tasks, but none is applicable to all planning situations.

The more recent qualitative choice models are a class of methods used to study situations in which an individual makes a choice from among a set of alternatives. One method of estimating these models is the conditional logit method developed by McFadden (McFadden, 1974). The advantage of this model is that it explicitly considers the characteristics of the alternatives that were not chosen as well as the one that
was chosen in generating the parameter estimates. In a study done by Phibbs and Carson (1988), attractiveness of a hospital was measured as a linear function of the characteristics of the hospital including quality of care, ownership, and charges as well as distance from the zip code of residence to the hospital. They found that greater distance consistently deterred admissions for most medical diagnoses. The reverse was true for coronary artery bypass graft surgery where patients were willing to travel greater distances for such specialized procedures.

Other studies concerning hospital quality and the distance between the patient's residence showing choice of hospital will vary according to diagnosis were done by (Morrill, Earickson and Rica, 1970; Roghmann and Zastowney, 1979; Cohen and Lee, 1985; Phibbs and Carson, 1988). For example, considerations that are important in choosing a hospital for cardiac catheterization, which is often scheduled in advance, depends on referral from a cardiologist and might result in further treatment by open heart surgery, will generally differ from those involved in choosing a hospital for acute myocardial infarction, typically an emergency situation in which the closest hospital is selected (Garnick, Lichenberg, Phibbs, Luft, Peltzman and McPhee, 1989).

In summary, early bed need methodologies were crude in that they proposed an overall community bed need based on population without locational considerations. A locational
consideration would be one that took into account the spatial arrangement and distribution of hospitals and patients. The methodologies gradually became more technical and complex until they reached the present stage of development characterized by regression and simulation models. The following section reviews in more detail the major methodologies currently employed by hospital and health planners, followed by a discussion on the importance of a hospital's location to its service area.

CURRENT METHODOLOGIES

The major models used by hospital and health planners as alluded to earlier are discussed in the following section. This section concentrates on the general form of the regression model (which is by far the most prevalent) and the simulation model. Formula models such as Hill-Burton are being discarded by the experts in health planning because their relevance on historical hospitalization rates causes them to overestimate current needs (MacStravic, 1984). Stochastic methods are of questionable validity because they are based on random choice and assumptions that past utilization will continue to hold true in the future.

The regression model relies on fitting historical data on items that correlate well with patient days (e.g. population over 65 years old) to a trend line; projections
can be made for the number of patient days expected from a specific area for a given future date by projecting the items that correlate with patient days. The general form of the regression equation is:

\[ y = a + bx \]

where:
- \( y \) = number of patient days expected for a specific area
- \( x \) = the target year in question (usually coded)
- \( a \) and \( b \) reflect the base year patient days and rate of increase (or decrease) respectively.

The number of patient days expected for the target year is divided by 365 to yield an average daily census for the area which is then divided by an occupancy factor (normatively selected) to yield estimated bed needs. If the estimated bed needs exceeds current beds in service then there is a deficit. If estimated bed needs are less than current beds there is a surplus (See Exhibit 1).

The major fault with regression methods is that they are typically used in an aggregate manner; that is obstetric patient days are not separated from pediatric patient days, etc., with the result being a forecast of beds needed without knowledge of what type of bed is required. According to MacStravic, regression methods have the least applicability for total hospital operations but are appropriate to be applied to specific services within a hospital setting. Because the model is applied to area-wide planning the
EXHIBIT I

Example of regression equation.

Hospital Discharges - Montgomery General Hospital
1983 - 1992, Actual/Projected

Source: HCERA, West Virginia Hospital Discharges, 1983-1988
equation will be linear. A non-linear function would imply drastic changes in hospital utilization (MacStravic, 1984).

Simulation models attempt to analyze many factors operating in a community, rank them and organize them into a workable formula. These factors could include population characteristics, financial or economic characteristics, or even cultural characteristics that could affect hospital utilization. The formula is applied to historical data and refined, and is then applied to a future target area. Simulation models are primarily useful in the identification of variables that may deliberately be manipulated to alter institutional utilization rates, such as admission policies, financial policies and service mix; they are also useful in projecting potential hospital utilization because bed needs are often affected by numerous extraneous factors such as economic recessions and federal health policy which are beyond local control (Rode, 1978).

A model that is gaining popularity in the hospital planning industry is one that simply applies projected population figures to an estimated use rate to derive projected patient days (Vinson, 1980). The model is easy to apply and can be structured to show ranges of beds needed by assuming high and low use rates and/or high and low population estimates. An advantage of the model is that several factors can be included in the analyses, such as patient migration and population growth, to present the decision-makers a reasonable
range of expected outcomes. Disadvantages of the model are
that, 1) it groups all patient services into one lump sum, and
2) assumptions must be made about future hospital use rates
and population growth.

Of all the current methodologies (there are dozens of
the variations of the major types) none consider the variable
"location" in determining need. As Dever (1980) concluded
about current models, "None of the methods approaches the
problem of optimum utilization through optimum geographical
distribution of services." For this reason it is necessary
to test a model that does consider "location" as a variable
in a bed need assessment.

The location of a hospital facility carries certain
ramifications that are described in the following sections.

THE IMPORTANCE OF HOSPITAL LOCATION

Hospitals are the hub around which health care in this
nation rotates. They are the institutions where life begins
and often ends for the great majority of Americans. Despite
the ever-improving public health of this nation the chances
are very high that every person will at one time or another
be required to be admitted into a hospital. In fact, as the
population becomes older, more affluent, and as medical
technology increases, there is an accompanying rise in the
admission rates to general hospitals (Health U.S. 1988).
There are at least two factors that require discussion concerning the importance of hospital location: accessibility and service area delineation.

ACCESSIBILITY

Accessibility is "the state or quality of being easy to approach or enter." Hospital accessibility becomes an issue mainly when emergency services are considered. Hospitals are perceived as places of refuge in time of medical need, and therefore there is a community desire for accessible hospitals with emergency departments. There are existing standards that were approved by the former State Health Planning and Development Agency (SHPDA) [replaced by the Health Care Planning Council] pertaining to the accessibility of hospitals to population centers. For example, in West Virginia fifty-seven percent or 35 out of 61 hospitals are small and rural. Small being defined as less than 100 beds (WVHA, 1989). The 1982 West Virginia State Health Plan has established as a priority that the rural hospitals should be maintained to ensure access for the state's large rural population. The State Health Plan also adopted as a criterion for appropriateness review that "to ensure that this population has adequate access to care for acute illness or injury, where time is often paramount, 30 minutes travel time was chosen as a standard." The implications from these priorities is that
the location of hospitals is a component of need. The priorities and standards also point to the emotional importance attached to the issue of accessibility (West Virginia State Health Plan, 1982).

SERVICE AREA DELINEATION

The primary service area for a hospital is analogous to the primary service area of any business; generally defined as "the closest geographical area or areas from which 60% to 70% of a firm's customers originate" (Applebaum, 1966). For smaller hospitals in urban areas the primary service area is usually a collection of adjacent or adjoining zip code zones. Large urban hospitals often have primary service areas that include whole counties, while rural hospitals usually contain only the specific community within which they are located as their primary service area.

The importance of hospital location, especially new hospital location, on service area delineation concerns the impact of change caused by one facility on another facility's service area. Criteria established by P.L. 93-641 mandate that State Health Planning and Development Agencies consider "the relationship of services reviewed to the existing health care system of the area in which such services are provided" (P.L. 93-641) when acting on a CON application. In West Virginia the Orientation Manual for Certificate of Need
Project Review spells the mandate out more explicitly: "The proposed project should not adversely affect existing facilities, existing services...of the health care system in the medical service area (West Virginia Code 16-2D-6(a)(7) and (21)).

Therefore by careful market analysis an organization can locate and construct a facility that has no adverse impact on any other facility's service area: with "service area" defined as the closest area from which 70 percent of the hospital's patients originate. By locating a service or facility outside of another facility's primary service area, the argument can be made that there is no adverse impact on existing facilities.

ORGANIZATIONAL PLAN

Before a new model for predicting bed need in hospitals could be presented, the current literature was reviewed and conventional methods of determining need were examined. Chapter One presents the literature review and examination of current methods and then discusses the importance of hospital location as it relates to accessibility and service area delineations.

The theoretical background for location theory and the Huff model, and the model itself are presented in Chapter Two, followed by an application of the model to the Fayette,
Nicholas, and Summers County hospital areas in West Virginia. The results of the application of Huff's model is compared to conventional methods and national and state guidelines in Chapter Three.

Conclusions, policy implications and recommendations are presented in Chapter Four.

**SOURCES OF INFORMATION**

Because of the reliance of the Huff model on population projections it was necessary to obtain projections for the year 1995 by zip codes for Fayette, Nicholas and Summers Counties using 1980 census data as a base. An unpublished report "Acute Care Acceptable Bed Supply Analysis" which is computerized methodology from the State Health Plan furnished by Mary B. Antholz, contained population projections for the various study areas up to 1995.

Antholz's report along with West Virginia University School of Medicine, Office of Health Services Research reports provided valuable information on estimated utilization rates for community hospitals in West Virginia and Fayette, Nicholas, and Summers Counties in particular.
Variations of the Huff model have been applied to health planning with favorable results (most notably by Folland, 1980; Pearson, 1981), but no application of the model for hospital closures has been found. Because of the similarities of hospital trade areas and retail trade areas it is expected that the model will have applicability in defining a service area for a community hospital. However, because of the uniqueness of the consumer decision-making process in the hospital business as reported by Bailey and Feldstein, the model may fail to explain accurately how patients are placed in particular facilities (Bailey, 1977; Feldstein, 1973). The model does not account for the fact that physicians play a major role in determining hospital choice and hospital need.

EXPLANATION OF TERMS

Many early researchers who concentrated on hospital and health planning failed to distinguish between the terms "need" and "location". In justifying the chosen location for the establishment of a hospital, it was generally proven that the community had a need for one or, need was proven first and location taken for granted. Because of this apparent interchangeability of terms, the literature on the subject seems to confuse the issue until one realizes the almost
synonymity of the two words. Generally, the term "need" is most often seen in the literature. For the sake of clarity in this paper "location" will be used as a determinant of "need"; that is, "location" is a variable in the process of defining "need."(5)

"Need" is the "condition or situation in which something necessary or desirable is required or wanted." In this context "need" is the "condition or situation of a local area in which a hospital is required or wanted." The word "hospital" refers to general acute-care, short stay facilities only. In this context the term does not include mental hospitals, specialty hospitals, nor state or federal medical facilities.

Chapter One has set the background for the present study. It has been shown that there are several methodologies employed by planners to determine "need" for hospital beds; however, these methodologies are deficient in that they do not consider variables that could determine the location of potential or existing hospitals. The next step, therefore is to present a model, along with its theoretical foundation, that will enable planners to predict utilization of hospital

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(5) It is recognized that the terms "need" and "demand" are not synonymous in a marketing context. "Demand" is typically defined as "what is sought and bought in the market place". In this paper "need" is used broadly to include, more or less, the qualities of "demand"; it is not to be inferred that there are not distinctions between the two terms. There is a distaste for marketing concepts (i.e. "demand") in human service settings such as hospitals which is why the literature is replete with "need" studies and few "demand" studies.
facilities based upon such physical variables as size and location. Such is the objective of Chapter Two.
CHAPTER TWO

THE HUFF MODEL OF PROBABILITY CONSUMER SPATIAL BEHAVIOR

LOCATION THEORY AND PROBABILITY

The theoretical basis for the solution of location problems is found in classical central place theory as proposed by Christaller (1966) and Losch (1954). Both of these scholars concentrated on the behavior of retailers and consumers over time and in space. The difference or divergence of the Huff model to classical theory comes in the idea of probability. Whereas early theorists operated under the classical economic theory of utility, that is that consumers with perfect knowledge of the market make decisions that will always maximize utility, the Huff model operates under the assumption that consumers deal with uncertainty in making decisions pertaining to purchases. Therefore, they may or may not maximize utility. The Huff model considers the probability of a particular retail center being chosen among all possible choices and as a result, is a combination of classical location theory and probability.

THEORETICAL BACKGROUND

Location theory provides a framework for analyzing alternative locations for different kinds of industries. The
theory is not intended to describe the actual distribution of economic activities nor is it intended to predict location patterns (Huff, 1980). The purpose of location theory is to show spatial tendencies and interpret as much as possible the complexities of reality.

As the literature review points out there is a definite scarcity of location theory in recent hospital bed need analyses. In fact, there is a general lack of any substantial theory evident in recent empirical bed need studies.

Central place theory is a normative theory indicating the size, spacing and number of distribution centers required to provide goods and services to a dispersed population. The theory was first proposed by Walter Christaller, a German geographer, in 1933, and further developed by August Losch, a German economist, in 1940. The bases for both studies was a desire to gain an understanding of the spatial nature of cities (distribution centers) in a rural area (dispersed population). The theory has stimulated much investigation and interest in the fields of geography, planning and marketing.

The basic assumptions that underlie the theory are rooted in classical economics. Simply the assumptions are:

1. An unbounded plain.
2. An even distribution of population.
3. Homogeneous consumers.
4. Homogeneous product.
5. No restrictions to entry or exit.

7. Travel is equal in all directions.

The price that a consumer pays for a product includes not only the retail selling price but also a transportation cost. Therefore, if \( p \) is the retail selling price of the product, \( m \) the distance that the consumer travels to purchase the good and \( t \) the cost per unit of travel, then the total cost to the consumer is \( p + mt \). Theoretically there exists a point \( r \) that is the maximum distance a consumer will travel for a good from a particular distribution center. At the point \( r \), the cost for the good \( (p + rt) \) becomes prohibitive. Figures 4 and 5 demonstrate the relationship between price, quality and distance.

Because of the homogeneity assumption the individual demand curve is the same for all consumers. The equal travel and even population distribution assumptions makes possible the calculation of expected demand for the distribution center. Figure 6 demonstrates the expected market area of the distribution center based on the shaded region of figure 5, with the axes reversed. The market area for the distribution center for a particular good at price \( p \) will be a circle of radius \( r \). The volume of the cone represents expected demand.

Although classical central place theory follows through the chain of logic to predict the numbers and spatial arrangement of distribution centers, this brief summary provides a legitimate basis for a discussion of Huff's general
FIGURE 1

PRICE TO THE CONSUMER IS A FUNCTION OF DISTANCE

FIGURE 2

INDIVIDUAL CONSUMER
DEMAND CURVE

FIGURE 3

GEOGRAPHICAL DEMAND CONE

Source: Figures 1 through 3 are excerpted from David L. Huff, "Retail Location Theory"
model that incorporates the main concepts of central place theory but introduces probability in choice behavior.

**PROBABILISTIC ANALYSIS OF CONSUMER SPATIAL BEHAVIOR**

Huff's model of consumer spatial behavior was presented in 1962 in an effort to represent a theoretical abstraction of consumer behavior (Huff, 1962). The model depicts consumer choice behavior in terms of Luce's basic choice axiom:

\[ P_T(X) = \frac{V(X)}{\sum_{Y} V(Y)} \]

where \( P_T(X) \) is the probability of an individual choosing alternative \( X \) from a finite set of \( T \) alternatives; \( T \) is a subset of some universal set \( U \); \( V(X) \) is a positive real-valued function \( V \) on \( T \) (Luce, 1959).

The basic proposition of the Huff model is that consumer choice can best be described as a probabilistic phenomenon. Because it is probabilistic, the central place theory assumption pertaining to perfect knowledge is relaxed; instead it is assumed that consumers make decisions under conditions of uncertainty. The uncertainty stems from the fact that the products are not assumed to be perfectly homogeneous and consumers are not sure that a particular product will be found at a given location. When a consumer reaches a decision between alternatives \( a \) and \( b \), it is assumed that there is a probability \( P(a,b) \) that the choice will be \( a \) rather than \( b \) and this probability will generally be different from 0 and 1.
It is assumed that the consumer is able to evaluate the alternatives according to some comparative dimension and select the one that has the most appeal or "utility."

The real-valued function that is used in the model is:

\[ u(j) = S_j^a T_i^b \]

where \( u(j) \) = the perceived "utility" of facility \( j \) to a consumer at \( i \)

\( S_j \) = an attraction index of retail facility \( j \)

\( T_i \) = the accessibility of facility \( j \) to a consumer located at \( i \) and

\( \alpha, \beta = \) empirically determined parameters

The probability that a consumer located at \( i \) will choose to shop at facility \( j \) is:

\[ P_{ij} = \frac{S_j^a T_i^b}{\sum_j S_j^a T_i^b} \]

Square footage is typically used as a surrogate measure for attraction (\( S_j \)) while travel time or distance is used to represent accessibility (\( T_{ij} \)). By allowing for different values of accessibility (to account for actual conditions) another central place assumption is relaxed—equal travel in all directions. The number of consumers from an area \( i \) shopping at facility \( j \) can be estimated by multiplying the probability \( P_{ij} \) by the population of area \( i \), that is:

\[ E_j = P_{ij} C_i \]

where \( E_j = \) the expected number of consumers at \( i \) that are likely to travel to facility \( j \)

\( C_i = \) the number of consumers (population) at \( i \).

Other characteristics (total sales, sales from particular
areas, etc.) can be estimated also simply by applying appropriate location-specific factors to the model (Huff, 1964).

In many respects the above model resembles the original gravitation model proposed by Reilly, but there are important differences. First, the Huff model is not empirically contrived but is a theoretical abstraction of consumer behavior. It prescribes what should be, not necessarily what is. Second, the model estimates the likelihood of a single consumer or the number of consumers utilizing a particular shopping area by taking into account all potential shopping areas simultaneously. Third, the distance or travel parameter is not assumed to be the second power as in Reilly's model, but is assured to vary with different product classes. The smaller the distance parameter is, the farther consumers will travel for a product (Huff, 1980).

The probability values stemming from the model can be mapped as a continuous distribution. A probability surface analogous to the conical demand surface in central place theory can also be constructed. The continuous distribution would represent the market area of the firm while the surface would represent the expected demand.
APPLYING A MARKETING MODEL TO A HOSPITAL PLANNING SITUATION

The usefulness of Huff's model has been demonstrated in various retail location problems and studies; however, before the model can be applied to a hospital planning problem it needs to be demonstrated first that there are similarities between hospital services and goods and retail goods. If there are a great deal of similarities between the two subjects it can be assumed that the model may have legitimate applicability to hospital planning and service area delineation.

COMPARISONS BETWEEN HOSPITAL SERVICES AND RETAIL GOODS

The most obvious similarity between hospital services and retail goods is that the trade area for both is analogous; that is neither category recognizes political boundaries in real life situations. Although hospitals often report trade areas based on political boundaries, studies have shown that hospital patients tend to ignore county and state lines when seeking care (Folland, 1983).

Another important similarity can be observed in the facilities from which retail goods and hospital services emanate. In both facilities demand is often a function of size; that is smaller facilities tend to have less demand than larger ones. Also, data show that patients are more willing
to travel long distances to be hospitalized in large facilities than smaller ones, which is analogous to retail attraction (Health U.S., 1988).

There are generally three types of retail goods: convenience goods, consumer goods, and specialty goods (Stanton, 1987). Convenience goods are those things that 1) are purchased often, 2) have little unit value and, 3) are sold through numerous distribution centers. Consumer goods are purchased less often and have more unit value than convenience goods. Specialty goods are those goods with unique characteristics that have great unit value, are sold through few distribution centers, and for which consumers are willing to make an extra effort to find. Examples of specialty goods are photographic equipment, audio equipment, and fancy foods. Specialty goods have low substitutability; consumers are insistent upon buying a certain brand. Hospital services resemble specialty goods in that they are not purchased often, they have high unit value, they have low substitutability, and they are purchased through relatively few distribution centers.

A final similarity is the degree of "psychic income" derived from certain retail goods and hospital services. Some types of goods are not evaluated solely on their monetary value but by the amount of satisfaction or social significance attached to them. Because of their significance the consumer will give special attention to the selection process and will
demonstrate a willingness to travel further to get a broad selection from which to choose (Huff, 1962).

Of all the above mentioned similarities perhaps the strongest is the market or service area analogy. It is expected therefore that in the application of the model to the local hospital planning situation, that the greatest degree of success will be in estimating a service trade area.

THE HUFF MODEL APPLIED TO A LOCAL SITUATION

The dilemma for governmental non-profit hospitals, especially local government hospitals concerns how to survive and thrive in an environment controlled by regulatory agencies on one hand and aggressive profit-seeking corporations on the other. The solution could be marketing and market area analysis. Through market area analysis hospitals can predict where in the service area investor-owned chains are likely to locate, where satellite facilities should be located, how much market share will be lost by encroachment, and how well existing competitors will fare when new facilities are added or closed in the market.

The objective of this section is to test a model to determine whether, in a particular geographic setting, there exists a need for additional hospital beds or whether existing hospitals may be facing closure because of under in-patient utilization. Unlike conventional methodologies, the Huff model will not produce a number of beds needed; it will predict utilization of specific-sized hospitals in possible
locations or existing locations.

The geographic setting is the three county area of Fayette, Nicholas, and Summers Counties in West Virginia which experienced a decrease in population of 4.9 percent from 1980 to 1987 (WVU Office of Health Services Research 1989). Considering that the CON process includes criteria concerning utilization, community health needs, and effects on existing facilities, it is desirable to employ a model that considers those criteria and predicts market share concurrently.

The model employed was the Huff Consumer Spatial Behavior Model as modified by Folland (Folland, 1980). Four hospitals were selected, two in Fayette County and one each in Nicholas and Summers Counties. These hospitals are all in rural areas. (See Exhibit II, "Base Map for Huff Model Application") Montgomery General Hospital, 99 beds and Plateau Medical Center, 91 beds are in Fayette County while Summersville Memorial Hospital, 74 beds is in Nicholas County and Summers County Hospital, 95 beds is in Summers County. Since the objective of this report is to test a model for determining bed demand and not to determine bed need, it was concluded that model runs for approximately 90 bed facilities, would yield reasonable tests of the model. The four hospitals have a total of 359 beds for an average of 90 beds.

The West Virginia University Department of Community Medicine, Office of Health Services Research provided the 1987 population figures. The Regional Research Institute at West
Virginia University provided the population projections. In order to use the model it is assumed that the population within the Zip Codes is evenly distributed so that distance to the hospitals can be averaged at the tracts's centroid. Distance in this case was measured not by travel time but by State Highway Department mileage maps. Although travel time is the better measure, the difficulty involved in deriving accurate data outweighs the benefits received. According to Huff there is little validity lost by using travel distance in place of travel time.

The number of possible patient origins totaled 85--15 in the Summersville Memorial Hospital Service Area, 33 in the Montgomery General Hospital Service Area, 18 in the Plateau Medical Center Service Area, and 19 in the Summers County Hospital Service Area.

The probability function utilized by Folland and replicated in this study is:

\[ PR_{ij} = \frac{D_{ij}^{-1.63} \cdot S_i^{.92}}{\sum_{j=1}^{n} D_{ij}^{-1.63} \cdot S_j^{.92}} \]

where:

- \( PR_{ij} \) = the probability that a person in population center \( i \) will go to a hospital \( j \)
- \( D_{ij} \) = travel distance from population centroid \( i \) to facility \( j \)
- \( S_i \) = size of facility \( j \) measured by licensed beds
- \( n \) = number of facilities considered in model run (4 in this case)
The parameters were estimated from a study by Folland in South Dakota in which the extended version of the Huff model was employed with the following variables in addition to size and distance:

1) number of specialists in the area,
2) sales tax revenue from the city,
3) historical hospital admissions,
4) average inpatient revenues adjusted for patient mix. (Folland, 1980).

Folland found that size and distance were the best predictors of patient use ($R^2 = .657$, correlation coefficient = .99), and because of the small geographical area involved in this study, the variables and estimated parameters were deemed appropriate.

The results of the four model runs can be seen in Exhibit III. The number of people from each zip code that would be expected to choose each hospital is simply the population of the zip code ($C_i$) multiplied by the probability of one person choosing the facility ($P_{Rij}$) and is seen in the column headed "Projected Market Size" in Exhibit III. Total projected market size for each facility is:

$$\sum_{i=1}^{16} P_{Rij} C_i$$

The parameter 16 being number of possible destinations--four unique destinations in four separate model runs.
# EXHIBIT III

## RESULTS OF MODEL RUNS

### PROJECTED MARKET SIZE OF EXISTING HOSPITALS

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<th>SUMMERS COUNTY</th>
<th>SUMMERSVILLE MEMORIAL</th>
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54
In analyzing the data from the model runs it was decided that certain objectives had to be met in order to qualify a facility for further consideration; first the facility had to be located such that it would capture enough of the medical/surgical patient market that the facility would operate at 50 percent capacity. For example Summersville Memorial would need to experience at least 13,505 patient days or 74 beds times 365 days times 50 percent. Second, in order to satisfy CON criteria, it was preferable that there be a minimum amount of service area overlap with other facilities. The final objective was that, naturally, the number of patient days to be expected for a hospital should be maximized.

Exhibit IV demonstrates how the projected market size is translated into occupancy rates. The product of the projected market size and the average length of stay yields the gross number of expected patient days. Because one of the criteria stated that the operation should be at least 50 percent, Summers County and Summersville Memorial are potential facilities for closure if these projections are valid.

One further test of the Huff model was done. The 1988 population projections were used to calculate expected utilization of the four hospitals for the year 1988. The population estimates were provided by the State Health Department Office of Epidemiology and Health Promotion and the patient days were provided by the Health Care Cost Review Authority office. The same process was applied to arrive at
### Exhibit IV

**Expected Utilization**

**Four Existing Hospital Locations**

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*Average Length of Stay* from Department of Community Medicine, West Virginia University - Office of Health Services Research. *Geographic Area Profiles* (1989).

**Patient Days** = Projected Market Size X Average Length of Stay.

**Projected Occupancy Rate** = \( \frac{\text{Patient Days} \times 100}{\text{No. of Licensed Beds} \times 365} \)
the projected occupancy rates. In comparing the results of
the 1988 projected rates to the 1995 projected rates, it was
found that they were very similar. However, when both these
Huff model runs were compared to actual occupancy rates for
the four tested hospitals, the results were found to be very
different. Actual utilization figures for 1988 were provided
by Ms. Mary B. Antholz of the Health Care Cost Review
Authority office.

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**SUMMARY OF THE MODEL RUNS**

This section has demonstrated the use of a probability
model to estimate market share and predicted patient days for
existing hospital locations. A version of the model as used
by Folland was further modified to account for out-migration.
The final notation of the model is as follows:

\[
PD_j = K \sum \beta_i \, PR_{ij} \, C_i \, U_i
\]

where:

- \( PD_j \) = number of patient days predicted for
  facility \( j \)
- \( PR_{ij} \) = the probability that a person in zip
code \( i \) will go to hospital \( j \)
- \( C_i \) = population of zip code \( i \)
$U_i =$ use rate of the population in zip code $i$. This variable can be a constant if specific data are not available.

$K =$ any number of constants used to fine-tune the gross number of patient days.

From the model runs it can be concluded that there is a demand for only one hospital in Fayette County. The population cannot support both hospitals without impacting adversely the surrounding hospitals. The model does not compute an actual number of beds that the population "needs," nor does it select specific sites for the hospitals. What the model has done is this: given a hospital size and location, it estimates utilization, as measured in predicted patient days, and market service area. The estimated utilization is based on the probability of patients in a certain zip code choosing a specific hospital from among all other comparable hospitals in the area. The estimated service area is the closest group of zip codes that provide 70 percent of the estimated patient days.

Chapter Two presented the theoretical foundation and a model that predicts utilization of existing or potential hospital locations. The model was applied to a local setting to determine hospitals that were generating sufficient demand and to indicate which hospitals needed more marketing to remain viable. The next step (Chapter Three) is to compare the Huff model with conventional methodologies in order to see how they relate to specified guidelines and objectives.
CHAPTER THREE
COMPARISON OF THE HUFF MODEL AND
CONVENTIONAL METHODS

GUIDELINES FOR COMPARISON

One test for any new model or methodology must be how it compares to conventional methods. The basis for comparison should be national and statewide priorities or goals and institutional objectives. Typically, bed need studies performed by areawide planning agencies conform to national or state priorities and are carried out to fulfill legislative mandates (West Virginia State Health Plan, 1982). Bed need studies performed by provider institutions or consultants are typically conducted to justify additional beds; national health priorities or health systems plans are secondary concerns. The differences in the two perspectives result in bed need methodologies that often produce quite different results.

The following sections briefly discuss the major guidelines to which the Huff model and conventional methods of determining bed need will be applied. The result of the review will be a matrix comparison of the Huff model and conventional methods.
Under the National Health Planning and Resources Development Act (P.L. 93-641) medical facility planning was made an integral part of overall health planning. P.L. 93-641 set forth as priorities the following:

1. The achievement of equal access to quality care;
2. The control of increases in health care costs;
3. The provision of services for underserved populations.

Guidelines, for the development of medical facilities were developed from the priorities.

National Health Planning Guidelines, issued in 1978, consist of eleven total standards addressing the appropriate supply, distribution, and organization of health resources. Only the first two guidelines provide standards pertaining to bed supply and total hospital occupancy:

Standard #1
There should be less than four non-Federal, short-stay hospital beds for each 1,000 persons in a health service area except under extraordinary circumstances.

Standard #2
There should be an average annual occupancy rate for medically necessary hospital care of at least 80% for all non-Federal, short-stay hospital beds considered together in a health service area, except under extra-ordinary circumstances (National Guidelines for Health Planning, 1978).

Both standards define parameters for adjustment according to population age, seasonal population fluctuations and urban/rural milieu.

The National Guidelines do not address issues pertaining
to the service area of any particular institution. Impact issues are covered by State Certificate of Need criteria.

**STATE CERTIFICATE OF NEED CRITERIA**

The National Health Planning and Resources Development Act of 1974 provided for a State Health Planning and Development Agency (SHPDA) which was to perform a series of health planning and development functions in order to make health resources within the state eligible for certain federal funds (42 C.F.R. § 300(d)). Such functions include serving as the "designated planning agency" of the State for the purposes of administering a federal program under Section 1122 of the Social Security Act (42 U.S.C. § 1320 a-1) and administering a State certificate of need program (42 U.S.C. § 300m-2).

Section 1122 of the Social Security Act, as amended, provided that certain appropriated federal health care funds shall not be used to support unnecessary capital expenditures. Section 1122 provided for the making of an agreement between the Governor and the Secretary of Health and Human Services for a designated planning agency to review proposed capital expenditures of health care facilities. The Governor of West Virginia and the Secretary have entered into such an agreement, thereby implementing capital expenditure review as prescribed by Section 1122 and the regulations promulgated under it (42 C.F.R. Part 100). The designated planning agency
in West Virginia is the SHPDA and the effective date of the agreement was March 15, 1977.

The "certificate of need" law in West Virginia, West Virginia Code, 16-2D-1 et seq., provides that any proposed new institutional health service as defined therein, shall be subject to review by the SHPDA prior to the offering or development of the service. The law was effective July 8, 1977.

Health planning in West Virginia has undergone many changes over the past decade. From 1977 until September 30, 1986, West Virginia participated in the federally funded health planning program provided for by the National Health Planning Resources Development Act of 1974. After October 1, 1986, Congress ceased funding the various state agencies known as State Health Planning and Development Agencies (SHPDA) and in late 1986 repealed the former provisions of the original act. However, West Virginia has continued its state health planning and development functions although legislative changes have amended the scope of CON functions.

In June 1987, the Department of Health, in accordance with an Act passed by the 1987 legislature (Chapter 16, Article 21), Section 5) assumed responsibility from the Health Care Cost Review Authority (HCCRA) for coordinating and developing the health planning efforts of the state and for all amendments, revisions and updates of the state health plan. The state's certificate of need program continues to
be the responsibility of HCCRA.

The newly enacted legislation governing the state health plan includes specific language for the development of a fifteen member state Health Care Planning Council (appointed by the Governor) and eleven Regional Health Advisory Councils. The fifty-five county Commissions appoint three members from each county to the Regional Health Advisory Councils for each planning and development region of the state (Draft - West Virginia State Health Plan, 1988).

The State Health Planning and Development Agency, now replaced by the Health Care Planning Council has the final approval for new hospital facility construction or bed expansion or bed reduction in the state of West Virginia.

The following criteria apply to methodologies for bed need studies and service area delineations:

What is reviewable?

1. the construction, development or acquisition or other establishment of a new health care facility.

2. the partial or total closure of a health care facility with which a capital expenditure is associated.

3. a substantial change in bed capacity of a health care facility with which a capital expenditure is associated.

4. a substantial change in the bed capacity or health services offered by or on behalf of a health care facility whether or not the change is associated with a proposed capital expenditure, if associated with a CON issued within the previous two years.

NOTE: Health care facilities are subject to review regardless of private or public ownership, profit or non-profit status, or licensure requirements.
Certificate of Need law §16-2D-6 lists twenty-six review criteria. Among these are as follows:

Review Criteria

Community Health Care Requirements
The project must be necessary to meet the health care requirements of the community or population to be served. The applicant shall address at least the following:

1. the geographical areas and population groups that will be served by the project.
2. the barriers (i.e. cultural, physical, transportation, etc.) that could affect the project.
3. the inadequacies of existing health care delivery systems in the proposed medical service area as they relate to the proposed project.
4. the estimated numerical demand for the proposed project.

Service Area Population
The medical service area for the project must contain sufficient current and future population to require the additional facility or service or to protect the viability of existing facilities. The applicant shall address at least the following:

1. the population trends and vital rates for the county and the medical service area;
2. the accessibility of the proposed service or facility to patients in the established or proposed service area;

Relationship to Existing Services and Existing Facilities
The proposed or existing project should not adversely affect existing facilities, existing services or existing elements of the health care system in the medical service area. The project must not be or create an uneconomical or unnecessary duplication of services and facilities in the service area.

These review criteria establish the framework within which the CON staff must operate when formulating a draft for
consideration by the West Virginia Health Care Cost Review Authority (WV HCCRA) Board. An applicant meeting these criteria (as well as other criteria) will be issued a CON; therefore, it becomes imperative that institutions or providers wishing to obtain CON approval from HCCRA develop reliable, relatively straightforward bed need methodologies that conform to state criteria as well as federal criteria (Meadows, 1984).

INSTITUTIONAL OBJECTIVES

As was pointed out, there tends to be a divergence of opinion between areawide planning agencies and provider institutions concerning bed need methodologies. The differences are due to institutional objectives; whereas HCCRA strives to keep the supply of hospital beds at an optional number (that is minimize the addition of beds), most hospitals are oriented toward maximizing organizational objectives (that is maximizing market share through increased size or services). Another guideline for comparison for a new model therefore, is how the model conforms to organizational objectives. The major organizational objectives will include the reliability of the methodology as well as its ease of use.
Fayette, Nicholas and Summers Counties and the rest of the state of West Virginia have been experiencing a decrease in population over the last decade. Because health care facilities (and hospitals in particular) react to population changes there is a lag time following the commencement of population declines before health care facilities begin to react. As a result of the lag time between population declines and facility closure, there is now occurring activity to decrease bed capacity in West Virginia. Five West Virginia hospitals have closed their doors for acute hospital inpatient care since December 1987. Sixty-two acute care hospitals remain open, some of them potentially facing the same fate as the five that have already recently closed (WVHA, 1989). Concomitant with the intention to reduce bed capacity is the performance of bed studies by providers and state planning agencies. The following sections present the conventional methods and compare them to the Huff model.

RESULTS OF BED NEED STUDIES

Three separate bed need methodologies are presented to compare with the Huff model. After a review of the studies, the four methods are summarized in Exhibit V.
Bed Population Ratio

This ratio is the easiest methodology to employ. It is simply the number of licensed beds per 1,000 population. The West Virginia Department of Health, Office of Health Planning and Evaluation used this method to determine statewide and Fayette County Study area bed needs. Their results are:

<table>
<thead>
<tr>
<th></th>
<th>1987 Population</th>
<th>1987 Licensed Beds</th>
<th>Ratio</th>
<th>1987 Beds Needed to Achieve 4.0 Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Virginia</td>
<td>1,934,455</td>
<td>10,144</td>
<td>5.2</td>
<td>(-2,406)</td>
</tr>
<tr>
<td>Fayette Study Area</td>
<td>309,859</td>
<td>1,778</td>
<td>5.7</td>
<td>(-539)</td>
</tr>
</tbody>
</table>

Regression

In a report by Pearson in Texas the separate HSA's in conjunction with the Statewide Health Coordinating Council performed bed need studies as part of the Texas State Health Plan. The regression analysis computed the number of expected patient days for a target year, employing factors which tend to be predictive of patient days for each hospital service (in this case medical/surgical beds). The factors which were considered the best predictors of patient days in 1984 were:

- the population 65+ in 1984
- the population 45-64 in 1984
- the number of primary care physicians in 1984

After regression analysis yielded an expected number of

---

*The Study Area for Fayette included Fayette County, part of Clay, part of Kanawha, other West Virginia and out of state residents in the total population figures. The Study Area included two hospitals in Fayette County and six hospitals in Kanawha County.*
patient days a formula was utilized to compute bed needs for a service trade area (a service trade area is roughly analogous to a retail trade area). The formula was:

Service Bed Requirements \( i = \text{ADC} + Q \)

Where: \( i \) = a service trade area

\( \text{ADC} \) = Average Daily Census, projected to future target date, specific to a type of service

\( Q \) = a value reflecting an HSA determination of standards for availability, specific to a type of service

Where: \( Q = (p) \times (s) \)

Where: \( p \) = a specified number of standard deviations of daily census established by the HSA to set a level of probability where census could be expected to exceed bed supply

\( s \) = a standard deviation describing the actual distribution of daily census.

Average Daily Census (ADC) equals the total number of projected patient days in the target year divided by 365. This methodology is also recommended by Alan Dever and Robin MacStravic, health care experts in utilization projections.

The regression analysis and formula were applied by the HSA's to the several service trade areas in each region (Pearson, 1981). The results for the Central Texas Health Service Area and the service trade area that includes the Austin SMSA are listed below:
Regression can also be used in a more direct manner to project patient days by basing future projections on historical data. West Virginia uses a variation of models in calculating a range of acceptable bed supply for an area.\(^7\)

The West Virginia formula is as follows:

\[
\text{Bed limit in area for future years} = \frac{\text{Beds for residents of area who use area hospitals}}{\text{Beds for residents from outside the area}} + \frac{\text{Beds for current patient days Percent of patients residents from outside the area}}{\text{in area hospitals X outside the area acceptable occupancy rate for future year X 365}}
\]

\[
\text{Calculated Beds for future expected use} = \frac{\text{Future year Percent of residents of area rate for area in 1000's hospitals}}{\text{365 X acceptable occupancy rate for future year}}
\]

Where: Patient days = the sum of acute care patient days from each hospital in the study area.

Population = the population of the counties in the study area for the year that the patient days occurred.

Percentage of = the number of study area residents patients who admitted to area hospitals divided by the total number of admissions to area hospitals.

\(^7\) The range of acceptable bed supply is a proposal-specific figure since the limits of the range are, in part, a function of the bed changes proposed by the project under review. It is not to be considered a definitive indicator or the need for the acute care beds in a given area.
Percentage of = the number of study area residents residents who admitted to area hospitals divided by use area the total number of admissions of hospitals area residents to any hospital.

Sample calculation:


\[
\text{Bed limit} = \frac{1,331.2 \times 2,083.972 \times 0.932 + 2,619,590 \times (1 - 0.8985)}{365 \times 0.788}
\]

= 8,993 beds for WV residents + 925 beds for non-residents of state

= 9,918 beds for West Virginia

The above formula and calculations were taken from the West Virginia State Health Plan 1982, pages 287 and 288.

Use Rate Estimation

The use rate, or utilization rate, is simply the number of patient days experienced per 1,000 population. The use rate for the state of West Virginia is approximately 1295.8, that is patient days are experienced for every 1,000 residents. There are various methods of estimating use rates for local area. One method involves multiplying the number of admissions to local hospitals by the average length of stay while another one is based on adjustments to regional use rates. Calculation of use rates for West Virginia would be as follows:
Actual use rates for an area (West Virginia)

Use rate = patient days/1,000 population per year

\[
\text{patient days in area} \times \frac{\% \text{ of patients}}{\text{hospitals in year}} \times \frac{\% \text{ of residents}}{\text{population of area}} \times \frac{\% \text{ who use area hospitals}}{\text{for year}} \times \frac{1,000}{1,947,644}\]

Sample calculation

West Virginia = Use Rate

\[
\text{Use Rate} = \frac{2,619,590 \text{ patient days} \times 0.8985 \times 1,000}{1,947,644 \text{ population} \times 0.9326} = 1295.8 \text{ patient days/1,000 population per year}
\]

NOTE: 89.85 percent of admissions to West Virginia hospitals were residents of the State. 93.26 percent of the admissions of West Virginia residents were to hospitals in the State.

SUMMARY

These various studies demonstrate the variety of solutions possible for analyzing bed needs for local and regional areas. Although the end result of each study is a number of hospital beds that the community or region "needs", they each have unique perspectives of how the "need" is to be derived. In contrast, the Huff model does not produce a number of beds needed, but predicts the utilization (demand) of a specific-sized hospital. The methodologies are still comparable, however, because the underlying goal of each type of methodology is to describe the existing bed inventory in relation to a predicted hospital bed environment. In the
exhibit that follows the conventional methods and the Huff model are compared and contrasted in a matrix format to demonstrate the strengths and weaknesses of each.
## EXHIBIT V

### MATRIX COMPARISON OF SELECTED METHODOLOGIES

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Bed-to-Population Ratio</th>
<th>Regression</th>
<th>Use Rate Estimation</th>
<th>Huff Model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assumptions</strong></td>
<td>Assumes a relationship between Population and incidence of disease</td>
<td>Assumes historical trends will hold through some future target date</td>
<td>Assumes utilization will be constant over time</td>
<td><strong>Basically central place assumptions; also assumes analogy between hospital and specialty goods</strong></td>
</tr>
<tr>
<td><strong>Variables Used</strong></td>
<td>Population</td>
<td>A) age of population; number of physicians B) historical, patient days</td>
<td>Population; historical patient days; patient destination</td>
<td><strong>Size of facility; location extended versions include use rate</strong></td>
</tr>
<tr>
<td><strong>Ease of Use</strong></td>
<td>Extremely Easy</td>
<td>A) requires extensive data; reliance on computer B) relatively uncomplicated; both types require ability to perform correlations</td>
<td>Relatively easy; requires assumptions about patient migration</td>
<td><strong>Fairly difficult to use; requires extensive data and computing capability</strong></td>
</tr>
<tr>
<td><strong>Conformance to Guidelines</strong></td>
<td>A standard for National Guidelines; no relationship to State CON Guidelines</td>
<td>Conforms to National and State Guidelines type A) usually too cumbersome for provider institutions</td>
<td>Conforms to National and State Guidelines. Easily fits most organizational objectives</td>
<td><strong>Vague conformance to National Guidelines; very high conformance to State Guidelines and organizational objectives</strong></td>
</tr>
<tr>
<td><strong>Reliability</strong></td>
<td>Loss of reliability as size of area decreases</td>
<td>Reliability dependent upon correlation</td>
<td>Loss of reliability as size of area increases</td>
<td><strong>Untested; however results of this methodology similar to others</strong></td>
</tr>
<tr>
<td><strong>Locational Consideration</strong></td>
<td>None</td>
<td>None</td>
<td>Because its best use is for small areas, it is possible to say that this method does consider location</td>
<td><strong>Utilization based on proximity to population centers; therefore location is vital</strong></td>
</tr>
<tr>
<td><strong>Service Area Considered</strong></td>
<td>Can be used for very large areas or regions, not as useful for small areas such as counties</td>
<td>Can be used at all levels of geographic areas. Host applicability to medium-sized regions such as HSA's</td>
<td>Best when used for smaller areas such as counties</td>
<td><strong>Considers only the medical service area of the proposed or target facility</strong></td>
</tr>
</tbody>
</table>
CHAPTER FOUR

CONCLUSIONS AND RECOMMENDATIONS

FINDINGS AND CONCLUSIONS

This chapter summarizes the test of the Huff Model by pointing out findings, drawing conclusions and recommending future areas of concern and study.

FINDINGS

It was found in this report that there is a lack of current literature covering the issue of rural hospitals that may be facing closure from under utilization and predictions of bed demand based on probabilistic models that include size and location. The literature pertains mainly to bed "need" methodologies (which are usually demand-based) without including "location" as a determinant of need. In reviewing current methodologies it was found that regression analysis is the method most commonly employed by health and hospital planners; however other methods and variations are used quite regularly.

Hospital location was found to be important in terms of accessibility and service area delineations, two factors which are of concern to national and state health planners.
It was found that there are similarities between specialty retail goods and hospital services; the most important similarity pertains to the delineation of the market area, or medical service area, of the facility.

From the application of the Huff model to the local area it was found that there was not sufficient demand for both the hospitals in Fayette County that could be supported by the residents of their service areas. The model did not test for, and there is no implication of financial feasibility of any facility. The model delineated service areas from which the hospitals could expect to receive 70 percent of their patients.

The Huff model and several conventional methodologies were compared according to several indicators. (See Matrix, Exhibit V). It is reasonable to compare the various methodologies despite the fact that the Huff model does not compute a number of beds needed as do the others. The other methodologies are similar to each other in that they utilize demand variables to predict hospital bed needs, while the Huff model uses demand variables to predict estimated demand. All bed need methodologies, regardless of theoretical foundation, attempt to predict and describe the hospital bed inventory for a specific area for a specific future date.

The Huff model is based on a very rigorous, salient theory (central place), and although the conventional models are much less rigorous in their theoretical foundations, they
are nonetheless, based on universal theories. Summarizing, therefore, the matrix comparison is a logical comparison of similar techniques.

The Huff model was the only method that took into account physical variables such as "size of facility" and "distance" in addition to statistical variables; all methods employed the variable "population." The use rate estimation method and the Huff model consider "location" as a determinant, although the use rate estimations use of location is only peripheral.

Regression models were found to be the most difficult to use because of the need to collect extensive data and the reliance on computing and correlating ability. The Huff model is fairly difficult to utilize for the same reasons as regression. The bed to population ratio is the most simple methodology.

There is little difference between regression, use rate estimation, and the Huff model as far as conformance to National, State, and institutional objectives are concerned. The use rate estimation technique and Huff's model have the best applicability for use in small geographic areas. Bed to population ratios and regression techniques are more suited to regional, state or national areas.
CONCLUSIONS

Huff's model of probabilistic consumer spatial behavior, as a theoretical abstraction of spatial behavior, successfully estimated service areas for four hospitals in West Virginia. Organizational objectives, State and National guidelines were met satisfactorily.

There are, however, characteristics about health care and hospital care in particular that have some impact on the applicability of the Huff model to hospital planning. As was stated as an expected outcome there is a quality of uniqueness about the consumer decision-making process in the hospital choice situation. Generally, patients do not rationally choose a hospital, although they may rationally select a physician. The selection of which hospital to use is an act of negotiation between patient and doctor in which hospital location is one of several factors considered including admitting privileges, type of admission, insurance coverage, etc. Therefore, the model does not adequately nor appropriately address the issue of how patients are placed in particular facilities. However, none of the conventional methodologies address this basic issue.

There are significant differences between specialty retail goods and hospital services despite their similarities; one is that a large percentage of hospital services are paid by third-party payers, whereas retail goods are most often
purchased by the person that will eventually use them. This causes a lack of motivation to seek "cheaper" care by patients covered by insurance. Another vital difference is that specialty retail goods are tangible, that is "discernible by the touch or capable of being exactly understood" while "health" is intangible -- some patients undoubtedly have no idea when they leave the hospital what was purchased. A final important difference is in the pre-purchase planning. Specialty retail goods are purchased after considerable planning, and as a consequence, the "want" is satisfied after a relatively long time (in comparison to other retail goods) (Stanton, 1987). Hospital services in most cases are not purchased voluntarily, they are usually purchased under duress; therefore they are not planned. When hospital visits are made there is often little time to be spent for rational decision-making. The "want" quickly becomes a personal need that must be satisfied in a short time.

Because of the magnitude of the differences between retail goods and hospital services there may be a tendency not to use the model in a health-related situation. It does not destroy the validity of the model, however, if the model does not fit a situation perfectly. The model is not the real world, when it is found that there are data which conflict with the model, the model should be revised or modified, not rejected in toto.
RECOMMENDATIONS

One purpose of any professional study is to note the policy implications of any conclusions derived and to recommend future studies or actions. The final section of this report then fulfills that mandate by noting the author's perspective on implications and recommendations concerning the use of the Huff model in health planning.

POLICY IMPLICATIONS

If a researcher were to derive the perfect model for determining bed demand, location, and sizing for hospitals there would cease to be a need for most Certificates of Need legislation. Any organization desiring to construct a new facility or expand an existing one or close a facility would simply feed the model the required data and wait for the magic results. Public opinion and outcry would monitor sub-optimal actions and thousands of bureaucrats and public planners would be out of work. Such is the scenario of the perfect model.

Unfortunately the perfect model does not yet exist, and many planners and bureaucrats may be out of work anyway. Should the federal government contrive to deregulate the hospital industry the CON process will become more streamlined. As the industry is deregulated there should develop a trend for hospitals to become even more marketing
oriented than they are now. The increased marketing orientation will cause planning and research to become attuned to market area analysis and models such as Huff's will proliferate. Although this too is a futuristic scenario it is probably closer to what the future holds than the former scenario. Marketing models, especially those that have some success now will be used more often in the near future. Deregulation will increase competition and increased competition will spawn marketing-type analysis.

**RECOMMENDATIONS FOR FURTHER STUDY**

Further study concerning the Huff model and the health care delivery system will need to focus on two major areas: the parameters for Sj (size of facility j measured by licensed beds) and Dij (travel distance from population centroid i to facility j) and the problems of patient and physician input in the hospital use decision-making process. It is intuitively obvious that people are willing to travel greater distances for the more specialized hospital services; therefore the size and distance parameters should be improved to reflect the differences in friction for specialized services. Although small changes in the parameters would have little effect on the final answer, empirical data are not available to suggest the magnitude that such changes would take.
Another area requiring more empirical study is the question of how much input a patient has in the hospital choice decision-making process. Hospital planners and administration realize that as far as inpatient services go, it is the physician that must be seen as the customer; as long as the system is structured such that only physicians have the authority to fill and empty hospital beds, the hospital choice decision will be mainly the physicians.

Perhaps the Huff model may have more applicability to the location of physicians' offices. Physician offices are not regulated by CON legislation and so resemble specialty goods more than hospital services do. In addition the choice of physician (at least general practitioner) made by a patient can be argued to be more rational than the choice of hospital by a patient, because it is more or less by the patient alone. What is needed in order to apply the Huff model to the problem of predicting demand for physician offices are estimates for the attraction (Sij) and accessibility (Tij) parameters. As far as the author is aware no studies exist at this time that fulfill those requirements.

Rural hospitals are being affected by falling inpatient utilization; shortfalls in payment under the Medicare and Medicaid prospective pricing system, and a growing amount of indigent care and bad debt. Many rural hospitals with historically low occupancy have been struggling for years, and find themselves with few alternatives to increase
revenues. In these situations, it is necessary for management, board, and staff to realistically access future options. Difficult questions need to be asked concerning access to care, present and future availability of medical and professional staffs, number and quality of procedures performed, condition of equipment and physical plant, level of community support, and the possibility of subsidization. At some point, financial ramifications of closing the hospital or keeping it open in current or reconfigured form, with or without subsidization, should be considered.
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