A MULTI-HOSPITAL EXAMINATION OF THE

RELATIONSHIP BETWEEN HOSPITAL NURSING

RESOURCES AND HOSPITAL QUALITY OUTCOMES

by

CHERYL ANN PATTERSON

Submitted in partial fulfillment of the requirements

for the degree of Doctor of Philosophy

Frances Payne Bolton School of Nursing

CASE WESTERN RESERVE UNIVERSITY

January, 1998

CASE WESTERN RESERVE UNIVERSITY

SCHOOL OF GRADUATE STUDIES

We hereby approve the thesis/dissertation of

_____Cheryl Ann Patterson,_____

candidate for the _____Doctor of Philosophy_____ degree.*

(signed) ███████████████████████████████████

(chair of committee)

███████████████████████████████████

_____

_____

(date)   November 5, 1997
_____

*We also certify that written approval has been obtained for any proprietary material contained therein.

A MULTIHOSPITAL EXAMINATION OF THE RELATIONSHIP BETWEEN HOSPITAL NURSING RESOURCES AND HOSPITAL QUALITY OUTCOMES

Abstract

by

CHERYL ANN PATTERSON

This exploratory study examined the relationship between hospital nursing resources and quality outcomes of hospital care. A portion of Donabedian's model linking structure to outcome was used to frame the study. Structure variables consisted of hospital nursing resources. Outcomes were (1): patient satisfaction (with a: overall hospital stay, and with b: nursing care) and, (2): inpatient (risk-adjusted) mortality.

The purpose of this study was to explore at the institutional level these relationships; the hospital being the unit of analysis. Nursing resource data were collected by the investigator from hospitals belonging to the same health care market. Chief nursing officers (nursing directors) of 22 hospitals were interviewed for qualitative data; 17 supplied requested quantitative nursing resources data. Outcomes data were provided by a major cost-quality project (Cleveland Health Quality Choice Coalition) involving all hospitals in the metropolitan health care market. In addition, data pertaining to 15 selected hospital characteristics were obtained from a number of primary and secondary, published data sources.

Four research questions were addressed, beginning with an isolated exploration

of singular variables and progressing to relationships between the nursing resources and outcome variables, with the final addition of selected hospital characteristics. Data analysis included descriptive, exploratory data analysis (EDA), correlational, and multiple regression techniques. Statistical significance was generally lacking and the sample size was small, specific to one health care market. Nevertheless, several trends were identified relative to the four research questions.

The general patterns identified in this analysis are as follows. The two service volume measures (patient days and discharges) produced variable distributions whose characteristics differed in such a way that questions were raised regarding the potential impact on findings of studies using these variable measures. Licensed practical nurse variables behaved in distinctly and statistically significant different ways from registered nurse and nurse aide variables. A relationship between patient satisfaction with overall hospital stay, and amount and type of nursing resources appeared to emerge. A relationship between patient satisfaction with nursing care and nursing resources was less evident.

A number of study findings yielded suggestions for future studies related to: variable measurement; data collection methods; statistical analytic techniques; macrolevel data analysis at the institutional level; and research questions requiring exploration, testing, and further confirmatory analysis.

iii

DEDICATION

This endeavor is dedicated to those who have experienced it most

intimately right along with me:

my beautiful, joyful children-- Rachel, Adam, Elizabeth, & Matthew

and my devoted, loving husband-- Bob

iv

TABLE OF CONTENTS

v

vii

List of Tables

viii

List of Figures

CHAPTER I

Introduction and Background

This study explored the relationship between quality of hospital care and nursing resources. Hospitals invest in a number of different resource categories to produce patient care (Frank, 1988). Nursing personnel is one of these resource categories and is a primary component important to the production of hospital patient care. Curtain (1986) states that according to the American Hospital Association, 90% of patient care is delivered by nurses. Indeed, patient care is in fact often synonomous with nursing care. Others have asserted the centrality of nursing's role in patient care by naming it among the key components of patient care (Ashby & Altman, 1992; Caterinicchio, 1984; Cromwell & Puskin, 1989; Eastaugh, 1987; Levine, 1985; Nunamaker, 1983; Omachanu & Nanda, 1989; Sherman, 1990). Nursing clearly contributes a substantial proportion of hospital patient care, although this proportion has not, as yet, been conclusively quantified through empirical efforts.

Quality of care is considered a key hospital performance measure (Lohr, 1988). In discussions about the measurement of quality, quality indicators have been referred to as outcomes (Donabedian, 1966, 1976, 1980, 1992). Quality outcomes have received increasing attention in the empirical and non-empirical literature over the past decade. It follows logically that an organizational component as large as nursing and one that

1

clearly provides the bulk of what actually constitutes patient care, would contribute in some measure to the overall quality of hospital care. Providing high quality patient care is inextricably linked to the social mandate of nursing. If one considers the societal mission and moral obligation central to nursing, and to health care delivery in general, it can be argued that it is unconscionable to evaluate quantity or efficiency without concurrently examining the relative quality of health care. Donabedian (1966) also speaks about the social imperative of evaluating quality of care. It is this viewpoint which compels the proposed study.

Statement of Purpose

The purpose of this study was to explore at the institutional level the relationship between hospital nursing resources and quality of hospital care. Because systematic study of this relationship at this level of analysis is in its embryonic stages, a need exists for studies such as this. It is necessary to better understand one category of factors, nursing resources, and its relationship to quality of hospital care. Knowledge about the relationship between these two variables is relevant to managerial decision making regarding resource allocation. Another purpose of the proposed study was to examine nursing resources in relation to hospital characteristics. Previous studies have linked hospital characteristics to quality of hospital care and hospital efficiency. This study used descriptive methods and statistical techniques to examine the proposed relationship

between nursing resources and quality of hospital care.

Subsequent investigations to test hypotheses suggested by the study findings would be confirmatory in nature and analytic in technique. According to Kirk (1982) "every confirmatory data analysis should be preceded by an exploratory data analysis" to "eyeball the data and see what it seems to say", "uncover untenable assumptions and... unsuspected promising lines of investigation" (p.135-6). It was the purpose of this study to perform such an exploration.

Statement of the Problem

Greater understanding is needed within the nursing profession of macrolevel relationships between nursing and other organizational components within health care systems. On the surface, it appears that nursing administrative research is lacking both in substance and quantity. Upon further examination, this work is limited by the parochial approach typically taken. This parochial approach examines nursing issues and variables internal to nursing departments or specific to the nursing profession. While important, such an approach leaves unanswered questions about linkages between the nursing department and the organization as a whole.

Relatedly, an important perspective taken in this study is the hospital as the unit of analysis. This level of analysis is routine in empirical work dealing with hospital managerial issues such as productivity, efficiency, effectiveness, and other institutional

performance measures. However, multi-institutional empirical examinations of hospital level nursing resource utilization are scarce. Nurse leaders have observed the absence of research at this analytical level relative to various nursing administrative topics (Dimond & Slothower, 1978; Hinshaw, 1989; Meleis & Jennings, 1989; "National Conference", 1986).

Published systematic reports of nursing resources have focused more on individual nurse performance and related correlates (Given, Given, & Simoni, 1979; Schwirian, 1981; Stull, 1986), and on the nursing ward as the unit of analysis (Gallant & McLane, 1979; Hegedus, 1979; Overton, Schneck, & Hazlett, 1977). Empirical studies measuring the relationship between hospital nursing resources and hospital performance are nearly non-existent. A few examples of hospital-level nursing resource data do exist in relation to specific nursing managerial issues. However, published reports primarily involve one institution samples and the methods used often do not constitute research. Furthermore, nursing reports found in nursing and related journals are often atheoretical. An even smaller number of these reports attempt multiple hospital samples. An exception is a study by Thompson and Diers (1988), who compared nursing workload (nursing process data) using five different automated nursing information systems in nine separate hospitals. A macrolevel study will "benefit the larger community of health care providers -- research that can bring the greatest good to the greatest number" ("National Conference", 1986, p.iii). Findings from studies performed

at this level of analysis hold potential for far reaching conclusions and suggestions about health care system improvements. Those seeking significant health care reform are interested in institution or patient population specific investigations. Accordingly, nursing resources and quality of care were measured at the hospital level in this investigation, rather than the ward level or individual caregiving level to address this persistant research gap.

A full statement of the problem requires mention of three pragmatic points. These pragmatic points arise from current health care reform realities, which provide imperatives for related research. First, hospital financial and operational decisions affecting nursing resources, and the organization as a whole, are typically made at macrolevels. Decision-makers at higher levels use available relevant information to make resource allocation and budgetary decisions. Therefore, information about factors, including nursing resources, affecting quality of hospital care is important to health care managers.

Second, formation of multiple hospital networks and health care systems (an accelerating industry trend) will tend to elevate the analytical level of health care operations from the traditional subunit (ward) level to institutional and multi-institutional levels. Governing boards overseeing hospital networks or health care systems evaluate and compare the management and operation of individual hospitals comprising the system. Certainly there will be quality of care and outcome comparisons across patient

subpopulations at different hospitals, such as patients in specific diagnostic groups or undergoing certain surgical procedures. However, summary statements and comparisons about whole hospitals are already being made in the media and in the non-empirical health care literature. Newspaper articles have reported the decision by one large preferred provider organization (PPO) to switch patients to a different health care provider network for two reasons: 1) range of available outpatient services, and 2) hospital ratings in a community-wide health care quality program, the Cleveland Health Quality Choice Coalition (CHQCC). A recent corporate memo from a hospital system CEO to system affiliated physicians warned of a similar intent by a major insurance carrier to base provider selections and negotiations on results of the Cleveland Health Quality Choice Coalition (McCann, 1994).

Third, corporate buyers of employee health care benefits, one of the strongest forces influencing health care reform, are now seeking institutional level information upon which to base provider selections. Large corporations and pools of smaller enterprises are increasingly seeking hospital level data concerning cost and quality. These data are used in negotiations between purchasers and providers. This information also influences third party payors (insurers), affects hospital managers and professional providers, and concerns patients. Each of these constituencies has an interest in macrolevel information.

In summary, nursing research and theory development in the administrative area

remains scarce. A few existing models view nursing administration issues from an organizational perspective, but these models remain relatively untested. Most nursing models view nursing at the microlevel, the individual nurse-patient dyad. Some of these models have been applied to nursing administrative problems, often retaining the microlevel of analysis (Gueldner, 1989; Nunn & Marriner-Tomey, 1989). The current study supports the need to move the field of investigation regarding nursing resources away from the individual level to that of the organization, examining nursing's relationship to measures of overall hospital performance.

Significance to Nursing

This study has relevance to nursing science specific to nursing administration. Systematic investigation is necessary to expand and develop nursing science in general, and nursing science applicable to administrative issues in particular. Scalzi and Anderson (1989) present a series of models, a meta-theory, illustrating three different perspectives for nursing administrative research and theory development. These three levels show a hierarchy of nursing service levels progressing from the individual nurse-patient dyad to the context of the entire organization. Each level integrates nursing care more highly within the total health care system, and therefore changes the perspective and relevant variables. The current investigation is an example of a Stage Three: Systems View Model (Scalzi & Anderson, 1989). Advancement of nursing science for the

nursing management domain occurs through research efforts aimed at this level of analysis and viewed from this perspective.

Findings from this study contribute to theory development for nursing administration. Nursing administration theory describes the phenomena relevant to nurse managers' work. Nursing administrative research and theory development builds the knowledge base, organizes knowledge, and defines its boundaries, to assist nurse managers in the design, implementation, and evaluation of nursing service delivery. As previously noted, the body of research dealing with nursing administrative problems has lagged behind clinical nursing research, both in sheer volume and in theoretical development. This study represents one effort at systematic investigation of a nursing administrative issue.

Fawcett and Downs (1986) described a progression of theory development as more knowledge about a concept, or related concepts, is discovered. This study is related to their definition of explanatory theory development that focuses on how characteristics or "parts of a phenomonen are related to one another" (p.6). However, some descriptive work is additionally required in order to better understand the behavior of individual variables - in this case, nursing resources and quality of hospital care. Fawcett and Downs (1986) recognized that in some cases, examination of certain "elements of an established theory" is "combined with findings from empirical studies" (p.15). Consistent with Fawcett and Downs' statement, the current study examined certain

elements (structure and outcome) of an established theory, Donabedians' model, in combination with findings from related empirical work.

The primary significance of this study is its potential contributions to nursing knowledge about the relationship between nursing resources and institutional performance, the quality of care. These are two key variables in health care delivery. This information can lead to important nursing practice and professional improvements, as well as to further hypothesis testing studies. Ultimately, overall expansion and accrual of nursing administrative knowledge occurs incrementally from studies such as the one proposed here.

Data collection, data aggregation, data disaggregation, and data analysis at the institutional level represents some of the more difficult issues and challenges facing nursing administrators. Familiarity with these data related issues will be increasingly needed, especially as health care reform advances. Industry reform will involve analysis of institutional level data and inter-hospital comparison of nursing resources and performance concepts, such as quality of care and productivity. In short, the need clearly exists to examine the questions posed in the present study, and a conceptual model which has parity with the variables and relationships explored here was used to frame the study.

Conceptual Model

Why nursing resources should affect quality of hospital care is suggested by

Donabedian's model (1980). Donabedian, a physician, has written extensively about the issue of quality health care, in particular the quality of medical care. However, his model has also been used in nursing literature and investigations since his original writings (Donabedian, 1976; Given et al., 1979; Hegedus, 1979; Peters, 1989). Donabedian's earliest writings dealt more with the rationale and methodology of measuring quality, than with the explicit development of a model (1966). As a physician, Donabedian's perspective and illustrations focused on medical care. His discourse eventually led to a model linking the concepts of structure and process to the concept of quality outcomes which could be used irrespective of disciplinary perspective (1976). In addition, Donabedian presented a relatively generic cubic diagram with three axes illustrating: 1) dimensions of health, 2) levels of client aggregation, and 3) levels of provider aggregation (1976).

The model relates two major concepts, process and structure, to outcome. Donabedian theorized that process and structure affect quality of care. Process variables are those activities employed to bring about health care in response to identified health needs. These processes are sometimes called intermediate products of care, leading to more final or permanent outcomes. Outcomes are the end products of care (Berwick & Knapp, 1987). Structure variables are those resources organized and used to provide health care. Structure encompasses financial, physical, and human resources. Human resources is synonomous with nursing resources in the current investigation and was

examined in relation to quality of care outcomes. Donabedian states that the operationalization of structure in any given study is a function of the chosen structure variable's hypothesized influence on patient care (Donabedian, 1980). Moreover, Donabedian asserts the structure variable-patient care relationship is situation specific. Presently, the nature of nursing resources' influence on quality of hospital care has not been clearly demonstrated. The present study makes advancements in this regard.

According to Donabedian's definition of quality, outcomes measured at the individual patient level "represent the result of the efforts of all those who have been involved in the patient's care" (1976, p.9). This study isolated one health care provider group, nurses, to examine the relationship with quality outcomes. A portion of Donabedian's model (1980) relating structure and outcome was used here to link nursing resources, a measure of hospital structure, to outcomes indicative of quality hospital care. Numerous structure variables have been specifically measured in hospital efficiency and quality of hospital care investigations. Selection of variables in these efficiency and quality of care studies was based on the investigators' disciplinary perspective and research area of special interest, as well as the stated research questions. Donabedian (1988) acknowledges that the decision to measure structure, process, or outcome is determined by the research question, as well as by pragmatic constraints such as availability of information, accuracy of measurement, and cost. Accordingly, the present study: a) limited the scope of structure measurement to nursing resources and their

delivery methods, and b) limited hospital care quality outcome measures to patient

satisfaction and mortality. Published data on mortality and patient satisfaction outcomes

used in the study were measured at the individual patient level and aggregated to the

institutional level. The structure variable, nursing resources, was aggregated at the

institutional level as well. Because nurses are the primary caregivers in hospitals, the

relationship between these quality outcomes and nursing resources merits exploration.

The conceptual relationships identified in the study, based on Donabedian's work,

can be seen in the following figure:

STRUCTURE ——————————→ QUALITY OF CARE

NURSING
RESOURCES ——————————→ QUALITY
OUTCOMES
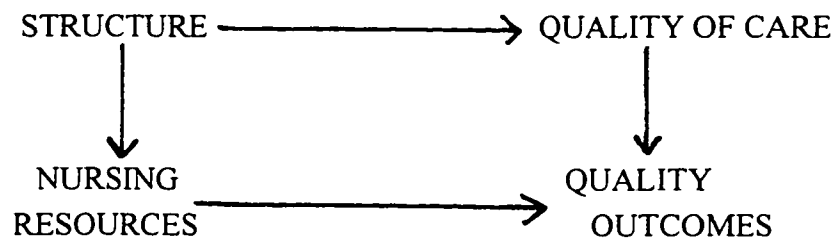
Figure 1.

This model was used to relate nursing resources, a measure of hospital structure,

to measures of quality (of hospital care). Other hospital resource categories were not

incorporated within the model here, because the focus of the investigation remained

solely on nursing resources. In Donabedian's terms, the model involves a measure of

structure, nursing resources, and its relationship to outcomes, clinical evidence of quality.

Measures of process were left for subsequent quality studies.

Nursing Concepts Linked to Donabedian's Model

Because of the generic nature of Donabedian's concepts, parallels can be found between them and numerous concepts discussed within the domain of nursing. These parallels render Donabedian's model relevant and useful for nursing research, clinical or administrative. Some of the nursing concepts which are analogous to Donabedian's concepts of structure and outcome will be briefly described here.

Donabedian's structure concept encompasses human resources, physical facilities, and financial resources. Nursing resources clearly parallel human resources. The nurse, as a therapeutic agent, singularly or collectively, is a key variable in clinical and administrative theory and research. Nurse theorists emphasize the impact and role of the nurse in the nursing care of patients. The nurse is variously viewed in relation to other persons or factors in the care environment by these nurse theorists.

Part of this interaction concept involves the concept of patient advocacy. It is within the nurse-patient, nurse-nurse, patient-environment, and nurse-environment interactions that patient advocacy is accomplished. Patient advocacy is recognized by nurses as a valued component of their role within the health care arena. It is where the nurse steps in, as Henderson clarified, to do for patients what they would otherwise do for themselves, if they had the necessary strength, will, or knowledge.

Related to patient advocacy is the concept of patient involvement, which interactionist nursing theory includes. One of the implicit assumptions in these theories

is that patients want to participate to some extent in their care and the decisions about their care. It is within the interactions between nurses and patients and all others in the patient environment that such patient involvement is enabled and encouraged. Interactional components are part of the environment, or structure.

A central component of the structure concept is the environment. Environment has been defined in numerous ways by nurse theorists. While recognized as a key variable in the patient's experience, it has been underinvestigated in all its myriad dimensions by nurse researchers (Chopoorian, 1986; Meleis, 1985). Investigators in other disciplines have been more inclined to measure and analyze specifics related to the environment, in particular the physical environment. Nurses know intuitively the physical care environment influences their work and the health of their patients, as Nightengale emphasized in her writings. Some nurse theorists have suggested that nurses themselves constitute the environment, or a significant portion of it (King, 1981; Rogers, 1980). Several features of nursing resources, such as number and type, may indeed affect the environment of patient care. More investigation of these relationships is needed.

Nurses have become increasingly interested in outcomes over the past two decades, lagging somewhat behind Donabedian's initial focus on outcomes with the introduction of his model in the 1960's. Nurses are recognizing that different care processes may result in different or similar outcomes for certain problems. Variation in care processes may be

desirable, even necessary, in different environments. However, care outcomes of interest to patients and caregivers are relatively universal. Many of the outcomes dealt with by Donabedian are the same as those discussed within the nursing discipline. Outcomes of primary interest include: optimal physical functioning of the patient in activities of daily living, patient/family satisfaction with the health care experience, optimum psychological, social, and biologic health, and minimization of adverse or untoward effects during the care experience.

Goal setting parallels Donabedian's concept of outcomes as well. Nurse theorists such as King (1981) have underscored the importance of goal setting in the context of nursing care. Goal setting makes explicit the desired outcomes and fosters a plan for achieving them. Focusing on the endproducts or endpoints of care requires linkages to the concepts of structure and process because these concepts contain the pertinent factors associated with desired outcomes or goals.

Study Concepts

Nursing Resources

Nursing care is provided by nursing resources; i.e., nursing personnel. Capital supplies and equipment, which constitute another major hospital resource category, do not represent a significant portion of resources necessary for provision of nursing care when compared to required human resources. Nursing resources consist of registered

nurses, licensed practical nurses, and nurse aides. Wage scales differ among these distinct nursing labor categories. Therefore, the particular nursing labor pool composition, in terms of absolute numbers, as well as skill mix, in any given hospital represents an investment decision by management.

A fundamental issue related to the current investigation involves the isolated examination of nursing relative to quality of hospital care, if nursing is only one component of total hospital activity. A specific research focus on nursing enables accumulation of nursing knowledge, which in turn advances the nursing discipline and nursing practice, as outlined by Donaldson and Crowley (1978). Academic nursing research, in fact, mandates such a focus. Growth and validation of knowledge about nursing in the context of the entire organization has been especially impeded due to a lack of systematic inquiry. Nursing's disciplinary advancement in isolation as well as in the global arena of health care delivery will require and stand on empirical efforts which analyze nursing in the context of complex health care organizations.

Isolated examination of nursing resources has pragmatic value as well. The size of nursing departments in terms of manpower and budget warrants this isolated nursing focus. The nursing department represents the single largest hospital labor group, and typically consumes 25% to 30% of the hospital budget (Bruttomesso, 1985; Cromwell & Puskin, 1989; Eastaugh, 1987; Flarey, 1990; Nunamaker, 1983; Omachanu & Nanda, 1989; Sherman, 1990; Staley & Luciano, 1984; Stanton, 1986; Walker, 1983; Wilson,

Prescott, & Aleksandrowicz, 1988). This study views hospital investment in nursing resources as one of numerous resource categories in which hospital management can choose to invest operating income. Because the budget for nursing can expand or contract relative to other departments, the contribution of nursing to the quality of hospital patient care becomes a relevant management issue.

Findings from research focused specifically on nursing would be of interest to health care policy and funding agencies. Information about nursing's contribution to quality outcomes will suggest nursing specific strategies for health care delivery improvements. This information becomes especially relevant, for example, when various responses to periodic nursing manpower shortages are contemplated by policy making and funding agencies and organizations. Related to this point is concern about cost of health care for collective groups, as well as for individuals, that has motivated national health care reform. Reorganization in many segments of health care is presently occurring in response to actual or anticipated health care reform. As reform continues, so will reorganization. Important to reform initiatives will be demonstrated evidence of nursing's economic value vis-a-vis other provider groups relative to desired quality outcomes (Patterson, 1992).

Link to Hospital Efficiency Research. Efficiency refers to how well a set of resources is used to produce a given product or service with the minimal degree of waste. At least a dozen multiple hospital empirical studies published within the past decade

deal with hospital efficiency. These studies identified various resource categories and hospital level products. Examples of resource categories measured for their relative contribution to identified hospital products have included: materials and supplies (non-payroll expenses); fulltime equivalent positions (FTEs); "ancillary charges"; property, plant, and equipment assets; and numerous other categories (Bowlin, Charnes, Cooper, & Sherman, 1985; Grosskopf & Valdmanis, 1987; Huang, 1990; Ozcan, Luke, & Haksever, 1992; Valdmanis, 1990). These studies disaggregate hospital operations into discrete components. Attempts were not made to ensure an exhaustive list of production resource categories, merely those which in the opinion of the investigators, were most relevant.

When hospital efficiency studies isolate production components, nursing generally tends to be imbedded in the selected components through aggregation with other measures comprising the production components. For example, some investigations incorporate nursing manpower expenses or positions into exceedingly broad categories such as "total [hospital] FTEs", "ancillary services", or "non-physician labor" (Grosskopf & Valdmanis, 1987; Ozcan, Luke, & Haksever, 1992). In rare cases, when nursing has been explicitly identified as one of several resource categories in published efficiency studies, the measures and associated analyses lacked detail meaningful to a nursing perspective. Description of nursing resources in these studies was meager, confined to a singular, numeric indicator such as RNs per bed, or RN/LPN

ratios (Banker, Conrad, & Strauss, 1986; Borden, 1988; Cromwell & Pope, 1989; Sexton, Leiken, Nolan, Liss, Hogan, & Silkman, 1989).

It is possible to isolate and dissagregate nursing data from total hospital manpower data. However, to do so would involve methods other than those used in hospital efficiency studies, which rely primarily on large publically available databases from health care organizations or government reporting sources. Moreover, more detailed nursing labor data would require primary data collection using interview and/or questionnaire methods, and has not been done in previous research.

Hospital efficiency studies have provided some meaningful groundwork for a study of hospital investment in nursing resources relative to hospital level outcomes. The current investigation is an extension of this work, in that the outcome was measured at the hospital level, as are many efficiency outcomes, sometimes called products. However, this study departs from hospital efficiency research by focusing on nursing resources as one important and substantial component of the total hospital production process, and was not concerned with hospital efficiency per se. In short, the focus here is on quality outcomes rather than cost analysis of various combinations of system inputs and outputs.

It is important to note that efficiency does not speak to the quality of work performed. By far, the greatest void in the body of hospital efficiency literature is in the area of quality. Investigators of hospital efficiency have not used quality as either a

dependent variable or an independent variable in their models. The concept of patient care quality has been uniformly left out of efficiency equations or definitions, except in nonempirical writings and study conclusions. In almost every study, the problem of unexplained variance in hospital efficiency is suggested by the investigators to be quality related. Recommendations then follow for subsequent studies involving clinical outcomes or quality measurement. These studies are discussed in Chapter II -- Review of Literature. In the present study, the opportunity was taken to use recent quality data rigorously collected from a sample of local hospitals in order to address this gap by relating nursing resources to hospital quality of care.

Quality of Care

Based on the nonempirical writings of nurse leaders, it is essential to view nursing productivity measures in relation to quality indicators, or that efficiency and effectiveness be combined (Curran & Smeltzer, 1991; Curtain & Zurlage, 1986; Edwardson, 1986, 1989; Erhat, 1987; Hegyvary, 1986; Hoffman, 1988; Levine, 1985; McHugh, 1991). Consonant with the philosophic views of these nurse leaders, this investigation examined nursing resources in relation to quality of care. Since an important element of nursing productivity measurement is nursing resources, the proposed study of nursing resources provides a preliminary link to nursing productivity work.

Quality of hospital patient care represents a key performance measure of overall

hospital production (Cleary & McNeil, 1988; Knaus, Draper, Wagner, & Zimmerman, 1986; Leavitt, 1994; Lohr, 1988; Shortell, 1985). Therefore, quality of care measures are of interest to those seeking global measures of hospital performance. Investigators have examined the relationship between quality and various structural or procedural elements of hospital patient care (Burstin, Lipsitz, Udvarhelyi, & Brennan, 1993; Kuhn, Hartz, Gottlieb, & Rimm, 1991; Leavitt, 1994; Knaus et al, 1986).

Studies of hospital quality as a dependent variable, like those of hospital efficiency, rarely isolate nursing resources to estimate the affect on hospital quality (Burstin et al, 1993). When hospital quality studies do include some measure of nursing resources, the data and subsequent analyses lack detail important to a nursing perspective, such as the amount and types of nursing personnel, and direct and indirect caregiver data (Kuhn et al, 1991).

Labor differences have been explored as a quality indicator in nonempirical writings (Campbell & Campbell, 1988; Fabricant, 1969). Nursing personnel differences in terms of experience, educational preparation, and clinical competence have been linked to differences in the quantity and quality of nursing care, but not to measures of hospital care quality (Donovan & Lewis, 1987; Halloran, 1983; Helt & Jelinek, 1988; Kramer, 1990; Kramer & Schmalenberg, 1988a, 1988b). At the unit analysis of the nurse, studies have demonstrated variables significantly related to higher performance by an individual nurse (Koerner, 1981; McCloskey, 1983; McCloskey & McCain, 1988;

Schwirian, 1981). However, as with nursing personnel viewed collectively at the hospital level, individual nurse performance has not been linked to quality of hospital care either. The interest and need for examination of nursing personnel differences at all measurement levels is apparent. Data at the macrolevel has been examined the least, and the greatest gaps involve the link between nursing resources and quality of overall hospital care.

As previously stated, hospital patient care is comprised primarily of nursing care provided by nursing labor resources. Patient care outcomes of many types must necessarily be related to nursing care to varying, if yet undetermined, degrees. If differences in nursing resources are known to relate to differences in nursing care quantity and nursing care quality, then differences in more global measures of hospital patient care should also be expected where differences in nursing resources are found. This connection has not been empirically demonstrated.

Potential Quality Mediators

A secondary purpose of this study was the examination of certain hospital characteristics in relation to nursing resources. These institutional characteristics may also present alternate explanations for quality differences and understanding of nursing resources. Hospital efficiency and hospital quality literature has addressed the question of how hospital characteristics relate to efficiency and quality outcomes. Some investigators have examined hospital ownership models (Grosskopf & Valdmanis, 1987; Morey, Fine & Loree, 1990;

Ozcan, Luke, & Haksever, 1992; Register & Bruning, 1987). Hospital case-mix index, clinical subpopulations of patients, hospital capacity utilization (occupancy rates), extent of hospital teaching mission, disproportionate charity care, percent Medicare, and hospital bed size, are characteristics that have been specifically examined (Banker, Conrad, & Strauss, 1986; Cromwell & Puskin, 1989; Grosskopf & Valdmanis, 1993; Nunamaker, 1983). Both bodies of literature, hospital efficiency and hospital quality, have attempted to link hospital characteristics to outcomes of efficiency and quality. However, neither area of hospital level research on efficiency nor quality of care has dealt with nursing resources in meaningful detail. This study departs from prior research by examining hospital characteristics previously linked to hospital efficiency and quality in relation nursing resources.

Study Variables

Figure 2 diagrams concepts studied and their operationalization (observables). Definitions are as follows:

Nursing Resources

This variable is conceptually defined as the combination of: 1) absolute amount of nursing resources, 2) skill mix of those same nursing resources, and 3) nursing care delivery methods.

Amount of nursing resources is operationally defined as the total number of hours worked by nursing personnel in all nursing job categories, and subsequently
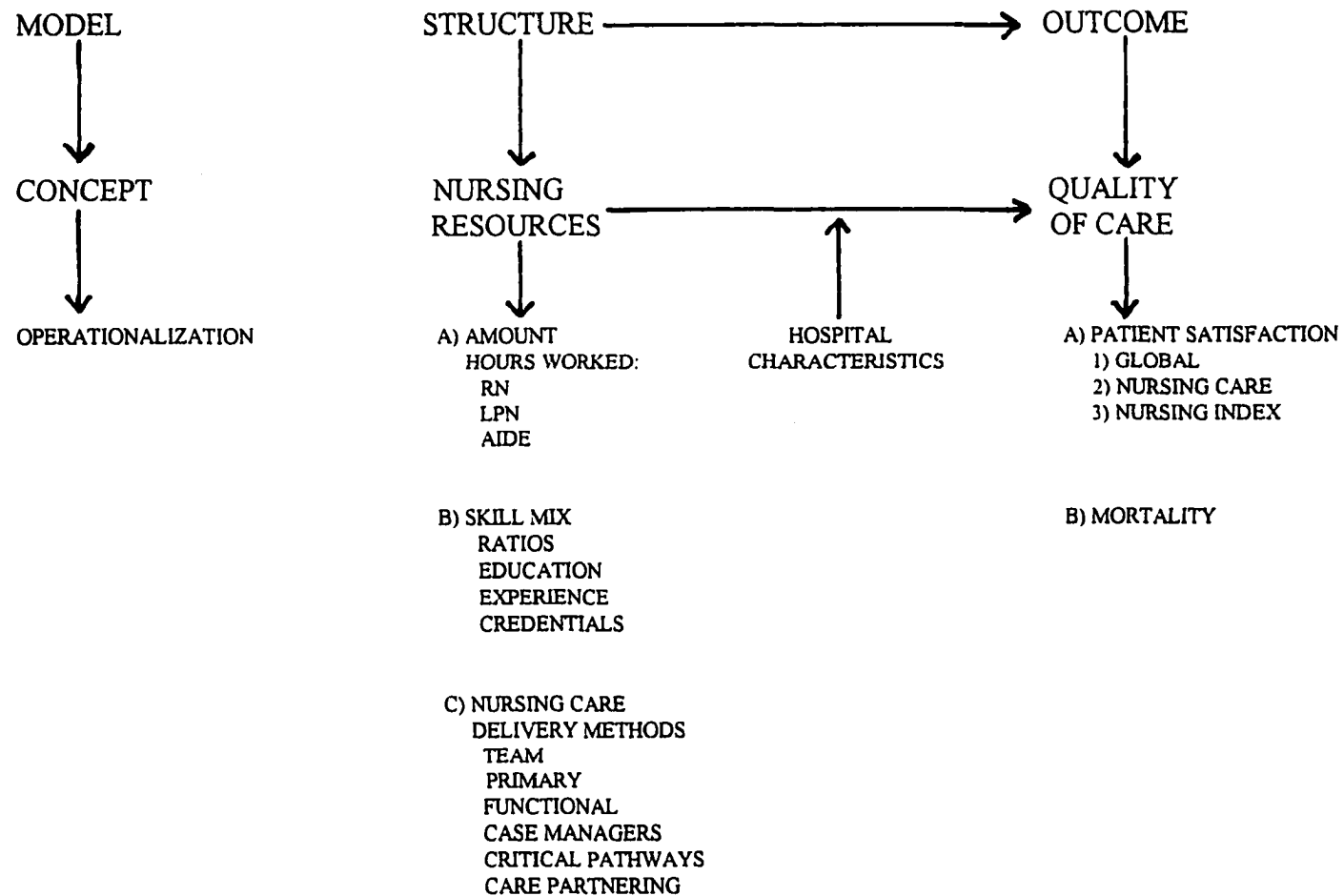
MODEL   STRUCTURE ⟶⟶⟶⟶⟶⟶⟶⟶⟶⟶⟶⟶ OUTCOME

⬇   ⬇   ⬇

CONCEPT   NURSING ⟶⟶⟶⟶⟶⟶⟶⟶⟶⟶ QUALITY
          RESOURCES   ⬆   OF CARE

⬇   ⬇   ⬇

OPERATIONALIZATION A) AMOUNT   HOSPITAL   A) PATIENT SATISFACTION
            HOURS WORKED: CHARACTERISTICS 1) GLOBAL
            RN   2) NURSING CARE
            LPN   3) NURSING INDEX
            AIDE

          B) SKILL MIX   B) MORTALITY
            RATIOS
            EDUCATION
            EXPERIENCE
            CREDENTIALS

          C) NURSING CARE
            DELIVERY METHODS
            TEAM
            PRIMARY
            FUNCTIONAL
            CASE MANAGERS
            CRITICAL PATHWAYS
            CARE PARTNERING

Figure 2. Diagram of investigation.

24

disaggregated into the indiviudal categories. These personnel provide nursing care to patients, directly or indirectly, at a given hospital. Included are nursing personnel in the categories of RN, LPN, nurse aide or other unskilled worker, administrative nursing staff, and other specialized clinical nursing staff.

Skill mix of nursing resources is operationally defined as the ratio of RNs to LPNs and aides, the educational preparation of the registered nursing staff, years of experience of the registered nursing staff, and the specialty nursing credentials earned by the registered nursing staff.

Nursing care delivery methods refers to the method of organizing nursing workload assignments and accountability for nursing care. Sometimes synonomous with the term nursing practice models, these methods define structures and protocols for managing the nursing care of patients and their families. Examples of these methods include: team nursing, primary nursing, case management, critical care paths, partners in care, among others.

The first two nursing resource variable categories, amount of nursing resources and skill mix of nursing resources, are labelled independent variables in this study. The third nursing resource variable category, nursing care delivery methods, is considered a dimension of nursing resources important to a full examination of hospital nursing resources.

Quality of Hospital Care

Quality is conceptually defined as the relative excellence of patient care delivered at a given hospital. In this study dimensions of quality care were operationalized by two types of patient satisfaction and by inpatient risk-adjusted mortality. Patient satisfaction with overall hospital stay and patient satisfaction with nursing care were measured using the Patient Judgements of Hospital Quality questionnaire (PJHQ). Inpatient mortality was risk-adjusted using the APACHE and Michael Pine patient classification systems. These three quality measures, 1) patient satisfaction with overall hospital stay, 2) patient satisfaction with nursing care, and 3) mortality, are the dependent variables in this study.

Hospital Characteristics

These are attributes of the hospital pertaining to and describing the nature of a hospital's operations and patient caseload. In this study fifteen hospital characteristics were grouped into four categories. These characteristics are considered mediating variables in this study.

Investigational Premises

The following premises underlie this investigation:

1) Nursing resources is one resource category employed in the delivery of total hospital patient care.

2) Nursing care is supplied primarily by nursing labor resources.

3) Nursing care, and therefore nursing resources, is a primary component of total patient care thereby influencing patient outcomes, and therefore global measures of care quality.

4) Measurement of nursing resources and its relationship to quality of hospital care at this unit of analysis is useful and needed, both academically and pragmatically.

5) Hospital nursing resources can be measured at the institutional level.

6) Proxy measures, such as patient satisfaction and mortality rates, reflect dimensions of hospital care quality.

7) The sub-category of nursing supplies, materials and equipment (non-personnel resources) have minimal material effect on the quantification of nursing resources. Therefore, measurement of this nursing resource sub-category has been omitted.

8) The extraorganizational environment, or the health care market as defined by Ozcan & Luke (1993), is considered a constant in this study, and thus accounts for a similar affect on all sample hospitals.

Research Questions

1. What is the hospital nursing resources distribution across the hospital sample?

2. Is there a relationship between hospital nursing resources and hospital quality of care outcomes?

3. To what extent does amount of hospital nursing resources and skill mix of hospital nursing resources explain variation in patient satisfaction and mortality outcomes?

4. Does the nursing resources-hospital quality of care relationship appear to vary with hospital characteristics and nursing care delivery methods?

CHAPTER II

Review of Literature

The aim of this study was to enhance understanding of variation in hospital nursing resources as relates to differences in quality of hospital care. Descriptive and exploratory methods were used. Additionally, this study explored differences in hospital characteristics relative to differences in nursing resources and hospital quality. A multiple hospital sample allowed the exploration of nursing resource differences, variation in the quality outcomes of patient satisfaction and mortality, and in hospital characteristics.

Structure and outcome are central elements of Donabedian's model dealing with quality of care. Most references to Donabedian's model in the literature occur in narrative writings rather than empirical works (Taylor, Hudson,& Keeling, 1991). When addressing research issues, Donabedian himself tends to focus on methods, designs and techniques without executing actual investigations to test the model (Rhee, Donebedian, & Burney, 1987). However, studies conducted over the past three decades using various models or theories containing structure related constructs, such as Donabedian's model, continue to lend overall support to a link between structure and outcomes. In this investigation, nursing resources were equated with structure, and quality outcomes are mortality rates and patient satisfaction scores. The review of literature important to this investigation focuses on studies involving these variables and their measurement. Numerous hospital structure variables have been examined

29

in previous studies, most often in relation to hospital efficiency as the dependent variable (or outcome, in Donabedian terms). Therefore, six studies from the hospital efficiency literature were selected for review according to five criteria. The criteria for selection of studies to review in this chapter are listed in that section. The next section in this chapter reviews four studies in the quality of hospital care literature, all of which included structure variables in the design. The two research areas of hospital efficiency and hospital quality are merged to illuminate the underinvestigation of nursing resources as a relevant structure variable. The following sections discuss empirical work on variables involved in this study: nursing resources as a structure variable; self-reported patient satisfaction as an outcome quality measure; mortality as an outcome quality measure; and, hospital characteristics as potential mediating variables.

Structure Variables and Hospital Efficiency as Outcome

The hospital efficiency literature offers a body of work relating the concepts of structure and outcome. These studies typically measure selected resource categories relative to one or more outcomes in the context of the entire organization. Nursing resources is absent from models used in a number of hospital efficiency studies (Grosskopf & Valdmanis, 1987, 1993; Huang, 1990; Morey et al, 1990; Ozcan, Luke, & Haksever, 1992; Valdmanis, 1990). These investigators focus on nonnursing structure variables, such as medical staff resources, plant assets, capital assets, bedsize, nondurable supplies and materials, and others. At best,

indirect interpretations regarding relationships between nursing resources and hospital efficiency can be made using data contained in these studies. The findings of these studies do not provide specifc, direct information about nursing resources as a structure variable. It is argued here these studies inadequately describe hospital efficiency since nursing, a large department and primary provider of patient care, is omitted.

Six hospital efficiency studies, however, were found that extracted and disaggregated an explicit nursing resources measure from other identified resource categories. Other reasons these studies were selected for review here are as follows: they are relatively recent, published since 1983; the unit of analysis is congruent with the current study, i.e.,hospital-level; multiple-hospital samples were used, consistent with the study reported here; other investigators have recognized these as important works through their citations (Banker, Conrad, & Strauss, 1986; Borden, 1988; Cromwell & Puskin, 1989; Eastaugh, 1990; Nunamaker, 1983; Sexton, Leiken, Nolan, Liss, Hogan, & Silkman, 1989). Other investigators (Ashby & Altman, 1992; Cromwell & Pope; 1989) only minimally mentioned nursing resources in their analyses, but did not include nursing resources as a model component. Reference to nursing resources in these studies simply illustrated the notion of labor skill-mix ratios. The gap in addressing nursing resources is most prominent in studies which involve no specific analysis of nursing resources as a model component; therefore, these studies are omitted from this discussion.

Banker, Conrad, and Strauss (1986) identify nursing services as one of four key

hospital resource categories in their comparison of two efficiency estimation methods computed for 114 North Carolina hospitals. The inclusion of nursing resources provided support of the philosophical argument made in this study that nursing is a hospital production process component of primary importance. The four key hospital resource categories in the Banker study are quantified using cost estimates. Banker, Conrad, and Strauss found a positive linear relationship between amount of utilized resources when all four resource categories were totalled, and three categories of increasing patient age; 1) <14 years, 2) 14 >65 years, and 3) >65 years old.

Direct inferences about nursing resources, as an isolated resource category, are not possible from Banker et al.'s analysis. The reason is that data are not disaggregated into the previously mentioned four resource categories, of which nursing services is one. The study's central purpose was the comparison of two efficiency estimation methods, not analysis of resource subcategories. Therefore, no detailed analysis of subcomponents comprising the efficiency measures was done.

Nursing resources were measured by Banker et al. as average cost per hour of nursing, including all fringe benefits. This computation assumably included all levels of nursing labor, although precise details outlining methods of data collection and computation are not provided. This study represents an example of nursing specific intrahospital data extraction in a multihospital sample. Findings regarding efficiency variations associated with patient age variation, particularly pediatrics and geriatrics, supports exploring differences in

nursing resources associated with differences in hospital patient population.

Congruent with Banker et al., Borden (1988) argued for the necessity of factoring out nursing labor resources from total hospital labor in order to provide an adequate analysis of hospital efficiency. Borden's central purpose, to assess hospital efficiency changes before and after implementation of DRG-based reimbursement, is not directly relevant to the purposes of this study. However, Borden's premise regarding nursing's importance to overall hospital operations supports the premises of this study. Moreover, support for this study was found in Borden's sources of data and methods of data collection, since he used annual American Hospital Association published data in conjunction with other state and local data sources.

In addition to total hospital labor resources and nursing labor resources, Borden included two additional resource measures in his model: number of beds and nonpayroll expenses, in a sample of 52 New Jersey hospitals. As dictated by Borden's central purpose, the analysis focused on efficiency changes relative to DRG implementation using three separate efficiency computational methods: data envelope analysis (DEA), ratio analysis, and regression analysis. The analysis did not evaluate quantified differences in the four identified resource categories related to hospital efficiency differences. Had this analysis been done, a direct link between structure and outcome could have been explored offering additional background work for this study.

Borden's definition of nursing labor resources was FTEs, although no further information was given regarding the specific sources of this data element. The method of

converting part-time positions to FTEs, or other details important to a full nursing resource analysis were not given. Of particular pertinence to the current study, Borden stressed the study's limitations by ignoring the "effectiveness issue, which in a hospital, corresponds to quality of care" (p.92). He acknowledged that efficiency may be confounded by effectiveness, and recognized that his analysis assumed that quality changes did not occur over the data collection period.

Nunamaker (1983) made an implicit argument for the importance of nursing resources in relation to hospital operations by selecting "nursing services" as his single summary statistic representing hospital efficiency. The purpose was to compare two different efficiency estimation methods in a small sample of 17 Wisconsin hospitals. The study's purpose was not directly relevant to this study; however, the study offers philosophical and methodological support of the present study.

Two limitations are noteworthy here. The first concerns the degree of nursing specificity inherent in Nunamaker's measure of "nursing services", Medicare reported daily service charges. These charges include items additional to nursing service costs, such as: dietary services, minor medical and surgical supplies, social services, and use of other equipment and facilities, as well as allocated overhead. While nursing costs remain a significant portion of the aggregated charge, the proportion attributable to nursing likely varies across hospitals. Therefore, this measure of nursing resources was rejected for use in this study. The second serious limitation in Nunamaker's study relative to this

investigation is the homogeneity of hospitals in the sample. Nunamaker chose seventeen hospitals most similar to each other on a number of criteria in order to satisfy constraints and assumptions of the two efficiency estimation methods used. The purposes of this study, on the other hand, required a purposive sample selected to insure hospital variation across the sample.

Cromwell and Puskin (1989) provided a descriptive report of hospital productivity trends in greater than 1,400 hospitals from 1980 to 1987. The investigators' purpose was to explore and discuss changes occuring across a time period during which prospective payment mechanisms (DRGs) were implemented by Medicare. Because Medicare's switch to this reimbursement mechanism was increasingly followed by similar changes in the private sector, findings from their study may have ramifications in the hospital industry beyond Medicare. Several aspects of the report are relevant to this study: a) philosophical congruence with this study relative to the isolation of nursing resource data; b) methodological congruence in the use of secondary data available from HCFA and AHA sources; c) congruence of purpose with a descriptive and exploratory study; and, d) examination of hospital characteristics such as bedsize and extent of teaching mission, relative to the dependent variable of hospital productivity.

Cromwell and Puskin's design was broad in scope, encompassing data from 30 different intrahospital departments, nine of which were nursing care unit types, such as adult medical-surgical, pediatric, and psychiatric. The data sources allowed nursing resources to be

quantified in terms of either nursing salary expenses or nursing hours paid (combines hours

worked plus hours not worked but paid, e.g, vacation, sick time, conference time, etc.).

The nine nursing care unit types used by Cromwell and Puskin provided some nursing

specific illumination for this study, such as observed variation in productivity trends by

patient subpopulation. For example, intensive care unit resource costs increased the most

over the study period by 138%. Psychiatric, pediatric, and subacute nursing divisions

followed with the three next largest cost increases, 109%, 103%, and 103%, respectively. This

finding implies differences in hospital nursing resources may be expected with variation in

hospital patient population. Differences in nursing hours per discharge among the nine

nursing divisions were also observed. Accordingly, this study excluded data from psychiatric,

pediatric, and subacute nursing divisions due to the wide variation seen in this and other

empirical studies.

It is difficult to explain observed changes in nursing resources over the study period

with the limitations of data contained in Cromwell and Puskin's report. Factors such as actual

wage scale changes over time, skill-mix changes, full-time/part-time ratio changes, and

others were not sufficiently addressed. How these factors may have confounded the analysis

also cannot be adequately answered on the basis of data presented.

Cromwell and Puskin (1989) make an incidental remark, obscured by an overriding main

point, concerning the "high fixed costs in nursing administration" (p.379) and the affect of

these costs on productivity. Certainly, any attempt at thorough, specific analysis of nursing

resources would include a quantified description of fixed as well as variable nursing resources, which Cromwell and Puskin did not report. This study included such nursing resources data and analysis thereof.

Sexton, Leiken, Nolan, Liss, Hogan, and Silkman (1989) evaluated hospital efficiency by using a model that explicitly identified nursing personnel as one of several resource categories. The model used by these investigators supports the position that nursing constitutes an important component of hospital patient care. Nonpersonnel hospital variables were included as well, such as university affiliation, age of facility, geographic location, and bedsize. Other personnel resource categories contained in the model included physicians, medical residents, nursing students, social workers, clerical workers, administrators, and allied health trainees.

The study's central purpose was the estimation and evaluation of relative efficiencies among 159 VA hospitals (Sexton et al., 1989). Data envelope analysis (DEA) was used to compute relative efficiencies among the sample hospitals. A secondary purpose dealt with identification of significant correlates of computed efficiency. Subsequent multivariate analyses were performed to investigate the relationship between site characteristics and DEA produced efficiency scores. In linear and probit models only two site characteristics appeared to be associated with efficiency: 1) university affiliated VA hospitals were associated with reduced efficiencies; and, 2) larger VA hospitals tended to be less efficient.

Separate detailed analyses of relationships between distinct resource categories and

variation in hospital efficiency were not reported by Sexton et al. (1989), because it was not

the purpose of the study to do so. However, for the reader who wishes to do so, the

investigators described a procedure for computing such detailed subanalyses for separate

resource categories in terms of the number of resource units, and the cost of resources, in

dollars. In fact, nursing data are used to illustrate both computational methods, in

reference to a given sample hospital. Nevertheless, no systematic reporting of information

derived through the previously described computational processes is displayed for any of the

resource categories. Data sources were not mentioned, but presumably data were obtained

through government mandated reporting mechanisms.

Eastaugh (1990) provided the most detailed investigation of efficiency involving

nursing data. He used a production function equation with five inputs to compute hospital

nursing efficiency in 29 hospitals using the Medicus System computerized nursing workload

systems. Production functions indicate how combinations of specified resources relate to a

particular quantity of output. Production functions also reveal how those resources can

complement or substitute for one another in the production process. The five production

process inputs included: a) nurse extenders; b) RNs; c) residents and interns; d) clerks,

LPNs, and nurse aides; and, e) capital assets. Eastaugh made a firm distinction between

professional nurses and nonprofessional nursing personnel by separating RNs from LPNs, aides

and clerks. This separation can be justified by cost and disciplinary reasons. However,

grouping clerks with LPNs and aides confounds the analysis because clerks do not provide

patient care, as do LPNs and aides.

Eastaugh selected a convenience sample to insure availability of Medicus derived automated data. Because the software system is proprietary and not adapted or modified in any way at individual sites, data is uniformly reported. In addition to assessing the production process in relation to the five inputs, a secondary objective was to target factors associated with variation in efficiency in the sample hospitals. Nursing input and output data were obtained through the Medicus System. Data concerning physician and clerk labor, and capital were captured from other hospital sources, although no specific mention of this procedural detail is given. Maximum likelihood methods of estimation were used in the analysis and partial elasticities of substitution were computed for all possible relationships among the production function variables.

Study findings must be interpreted with recognition that all sample hospitals were larger, more progressive hospitals, most of which were teaching institutions. Eastaugh concluded that primary nursing was generally associated with one of two extremes: either highly productive or inefficient, and that an all registered nurse staff had the lowest productivity. However, Eastaugh did not differentiate registered nurses' educational preparation. Additionally, Eastaugh found that community nurse shortages did not adversely affect productivity, and lastly, that use of nurse extenders decreased waste and increased nursing productivity. The two production function variables of physician labor and capital had the weakest association with, or effect on, nursing productivity. Eastaugh recommends

substituting nurse extenders for RNs to the point of diminishing returns. Of particular note is Eastaugh's concluding recommendation that patient care quality be analyzed in the context of nurse extender-RN substitution. This concluding remark leads to the central research question in the study reported here: is there a link between variation in hospital nursing resources and quality of hospital care?

In conclusion, nursing resources is one hospital resource category seldom analyzed for its specific influence on hospital efficiency. Accordingly, these studies as a body of work do not empirically address the question of how nursing resources specifically relate to hospital efficiency. No consistent, particular focus on nursing appears in findings, recommendations, or conclusions. However, those efficiency studies which do include a specific measure of nursing resources offered some background empirical work and support for measuring nursing resources in this study. Moreover, while numerous hospital outcomes are identified in this body of research, missing from these works is one important outcome -- quality of hospital care. This investigation narrowed the field of investigation and highlighted nursing resources in relation to that outcome.

Structure Variables and Quality of Hospital Care Outcomes

The following four studies comprise a group of recent investigations relating quality of hospital care to various resource categories (structure variables); progressing from a model containing no human resource categories (Leavitt, 1994), to two models with human

resource data (Burstin, Lipsitz, Udvarhelyi, & Brennan, 1993; Cleverley & Harvey, 1992), to one with an explicit measure of nursing resources (Kuhn, Hartz, Gottlieb, & Rimm, 1991). The four studies were selected for review here according to three criteria: (a) they parallel the proposed study's context, the hospital as unit of analysis; (b) structure variables are related to quality; and (c) all use secondary data as in the proposed plan.

Leavitt (1994) examines the relationship between quality of hospital care and hospital investment in the resource category of property, plant and equipment (PPE). PPE is a standard financial accounting line item receiving considerable and ongoing attention by business managers in all industries, including health care. Leavitt's approach is interesting and unconventional because it takes a resource category with limited and indirect connections to patient care outcomes and relates it to direct clinical measures of patient care quality, such as Medicare Generic Quality Screens (GQS).

Patient record abstracts (n=65,534) from 1984 to 1989 in 87 Massachusetts Hospitals were reviewed for GQS confirmed failure rates. Financial variables were derived from audited financial statements. Two regression models were used to test the extent to which PPE and other hospital characteristics explained variation in quality of hospital care. Examples of other hospital characteristics included: percentage of revenue from Medicare and Medicaid patients; hospital case-mix index; bedsize; occupancy rate; teaching status; and amount of market concentration.

Leavitt found that greater investment in PPE was significantly associated with higher

quality, measured in terms of lower GQS confirmed failure rates. He concluded that this particular resource category can predict certain dimensions of quality in hospital care.

In a study by Burstin et al. (1993) the effect of numerous hospital variables on quality of hospital care was examined. The theoretical model included three measures of hospital human resources, six hospital financial descriptors, and five other hospital characteristics. Patient records (n=30,195) of 1984 from 51 New York state hospitals were reviewed for evidence of medical injury and negligent adverse events resulting from substandard care. Trained medical record analysts and nurses initially screened patient charts to find evidence of adverse events. Charts identified to have positive evidence were secondarily screened by two physicians independently. Multiple regression, univariate and correlation analyses were performed to analyze relationships between the numerous variables and to deal with issues such as multicollinearity and statistical control. Data were derived from several secondary sources, and from retrospective records review.

The investigators found that patients in hospitals with the lowest inpatient operating costs per hospital discharge were at greater risk of negligent injury (Burstin et al., 1993). Labor resources in terms of staffing patterns did not explain a significant amount of variation in hospital negligence. Physician resources were split into two categories: percentage of foreign medical graduates; percentage of board certified physicians. However, human resource data was limited to a highly aggregated all inclusive nonphysician category: hospital personnel per bed. Such aggregation might explain the lack of significance found in

relation to quality of care. The broad category contains various labor groups that, if measured separately for affect on quality, might reveal significant findings. While this study introduces the element of human resources into a model and subsequent analysis, nursing resources were not specifically singled out for measurement, constituting an important missing element in the exploration and explanation of quality.

In a small sample of nine hospitals Cleverley and Harvey (1992) reported lower levels of quality in hospitals with exceedingly low profit levels. Poor quality hospitals were those identified by Medicare with higher than expected mortality rates for four consecutive years, 1986-1989. In addition to low profit levels, the authors also concluded that the nine poor quality hospitals were underinvested in capital assets and understaffed. Two measures of profitability were operating margin and return on assets. Standardized profitability scores were computed and description of data position and rank relative to each other and regional peers was provided.

The report by Cleverley and Harvey (1992) was not written for research publication, therefore little detail about methods and analysis is given. However, it does offer an example of better human resources data than the number of personnel per hospital bed used in Burstin et al.'s (1993) study. Cleverley and Harvey's ratio of manhours per adjusted discharge is a more relevant and appropriate measure in both the numerator and denominator. Manhours is a more precise indicator of labor resouce consumption than number of people or positions. Number of discharges is a truer indicator of service volume than number of hospital beds.

Number of hospitals beds says virtually nothing about the quantity of patients cared for in a given time period. Cleverley and Harvey linked the problem of lower median manhours per discharge, when compared to peer hospitals, to financial distress; for example, lower profitability and high debt. In spite of Cleverley and Harvey study's limitations, it does represent a step in the process of identifying measures increasingly relevant to this study.

A final example (Kuhn et al., 1991) of work relating nursing to quality of hospital care included an explicit measure of nursing resources. The measure was a ratio of RNs to total personnal in all nursing labor categories, including LPNs and aides. The investigators reviewed over 10,000 charts in 1,219 hospitals of six large states (CA, NY, PA, OH, IL, TX) to explore the relationship between hospital characteristics and quality of hospital care. Hospital variables were grouped into five categories: a) financial characteristics; b) ownership; c) training of the medical personnel; d) equipment; and, e) hospital bedsize.

Two data sources were used: 1) A.H.A. annual survey for hospital characteristics, and 2) Medicare Peer Review Organizations (PROs) for confirmed problem rates indicating quality. Confirmed problem rates were standardized for each hospital and represented the dependent variable in multiple regression techniques used for analysis. Univariate associations were also computed between hospital characteristics and confirmed problem rates, as were correlation coefficients between the hospital characteristics. The investigators recognized that the affect of each hospital characteristic on quality was highly confounded with that of the others. Nevertheless, seven characteristics were significantly associated with a lower

confirmed problem rate (p < .00001 for each): a higher occupancy rate; greater payroll

expenses per bed; a higher proportion of physicians who were board certified specialists;

greater technological sophistication; larger bedsize; teaching hospital status; and a higher

proportion of RNs.

The study by Kuhn et al, (1991) has direct relevance to this study. The stated ratios

of RNs to all nurses ranged from 52.2 to 67.3, although public hospitals in general were found

to have significantly lower ratios of RNs. The amount of variation explained by nursing was

reported not in isolation but in combination with four other variables such as occupancy rate,

teaching status, technology index, and bedsize. In spite of the limitations of nursing

specific data analysis, this study represents an important contribution to knowledge

regarding the link between nursing resources and quality of hospital care.

In conclusion, quality of hospital care research, like that of hospital efficiency,

contains many studies devoid of nursing specific data. The studies that do explicitly isolate

and measure nursing resources usually do so with a singular indicator and minimal analysis of

nursing. The studies that do include some measure of nursing resources lend support to

hypotheses linking nursing resources with quality of care. This investigation focused on

nursing resources with details important to knowledge building and the advancement of nursing

science, to nursing administrative practice and theory development, and to health care policy

making and management.

Nursing Resources as a Structure Variable

Researchers of nursing administrative topics have viewed nursing resources in a variety of contexts for numerous purposes. Nursing resources in this study means the collective body of individual nurses and their assistants who provide nursing care to a group of patients. This section will review articles which analyzed nursing resources specific to a particular issue or problem. The discussion will progress from microlevel to macrolevel. At the same time, it will be shown that while nursing resources have been examined in relation to various phenomena or issues, nursing resources have received minimal attention as a contributor to quality of hospital care.

Two studies reviewed here illustrate a focus on individual nurse performance. Quality in these studies refered to the effectiveness of nurse performance. Both studies sought to develop greater understanding of variables which explain differences in the effectiveness of nurse performance. The implicit assumption underlying both studies was that better performance by individual nurses has a desirable effect on patient experiences or outcomes.

Schwirian (1981) presented seven categories of variables, termed blocks, postulated in the literature to be nurse performance related. The seven blocks included: academic achievement; family of origin characteristics; demographic characteristics; personal characteristics; employment characteristics; nursing school characteristics; and, nurse career behavior. Schwirian reviewed the literature extensively and found the seven categories had received unequal attention. Some areas had received intense investigation, while other

areas had received scant attention.

Schwirian used a variable blocking technique to develop a causal model. A blocking technique enhances conceptual clarity and discrimination for inter- as well as intra-block variables. Research studies pertinent to each of the seven blocks were cited as the model was discussed. Schwirian developed the model further by suggesting three different multivariate analytic techniques to address hypotheses generated by the model. The remainder of the article discussed the three techniques of factor mapping, canonical correlation, and structural equation models.

Schwirian (1981) surveyed a decade of work by numerous investigators of nurse performance. The model developed by Schwirian organized and summarized prior work on the topic. The review of previous empirical work and the model developed by employing variable blocking technique constitute important work. Schwirian's additional discussion of suggested methodologies useful in examining complex performance data takes a useful step farther. The reader is thus assisted in understanding how the model can be used.

McCloskey and McCain (1988) used Schwirian's (1979) scale of nurse performance to identify determinants of nurse performance. The sample consisted of 320 nurses newly employed by a large midwestern teaching hospital. The sample represented nurses educated in associate degree programs, diploma programs, baccalaureate programs, and master's degree programs. In addition to Schwirian's scale, the hospital's staff nurse evaluation form was used to assess performance. Data were collected within the first month of employment, at six months,

and at one year of employment. Correlation and hierarchical regression analyses were performed involving subscales contained in the Schwirian performance scale and factors proposed to explain performance.

At the individual performance level, McCloskey and McCain (1988) found two factors most strongly related to job performance -- years of total education beyond high school (including nursing school) and amount of continuing education efforts. Interestingly, the investigators found a negative correlation between overall performance and pay scale. Other factors significantly related to job performance included job satisfaction, career commitment and feedback on performance. An underdeveloped aspect of the study concerned patient severity of illness measures. Individual job performance is likely to be affected by workload, which relates to patient acuity or illness. McCloskey and McCain gloss over this aspect with a superficial discussion. The investigators made an attempt to address this issue by asking head nurses to create an illness or acuity index for their respective units. However, this method of determining acuity for workload purposes has many weaknesses and caveats. Moreover, occupancy rate is related to workload as well, and McCloskey and McCain do not include this factor in the analysis.

In conclusion, the work by Schwirian (1981) and McCloskey and McCain (1988) illustrate two approaches taken to investigate the microlevel of nurse performance. Nurse effectiveness at the microlevel has implied importance to quality of care and quality related outcomes, but explicit linkages were not made. Nor are the investigations at the microlevel extrapolated

to the macrolevels of nursing care delivery and overall hospital care delivery. This investigation argued the need to move the field of investigation to the macrolevel of nursing resource variation and its role as a determinant of quality outcomes.

Halloran (1983) demonstrated a relationship between nursing labor resources and amount and type of care delivered. One nursing unit staffed with 72% registered nurses was compared in terms of cost and care delivery to another unit staffed with 40% registered nurses. The North American Nursing Diagnosis list consisted of 37 diagnoses at the time of data collection. Nurses were asked to denote all nursing diagnoses considered applicable to their assigned patients each day. In addition, a task checklist comprising the most frequently performed nursing tasks and accounting for over 85% of direct nursing care time (Dudek & Gailani, 1960, cited in Halloran) was completed each day for each patient. The diagnosis and checklist ratings were correlated with the Medicus classification system as a check for accuracy. The Medicus ratings yielded a time estimate of direct care delivered. Halloran found a .93 correlation between the checklist and Medicus time rating methods. A nursing diagnosis reliability check was performed for 8.2% (n=66) of the patient days of the study. Two nurses rated the same patient on the same shift and their ratings of selected and rejected diagnoses were compared. A reliability coefficient of 80.6% was computed.

Pearson product correlation coefficients were computed between nursing diagnoses and direct care time with patients. Findings revealed that the higher percentage RN staff spent more time than the other nursing staff on care related to psychosocial needs. Halloran used

Maslow's hierarchy of needs to classify diagnoses into levels of care. The higher percentage RN nursing staff attended more to patients' needs which Halloran classified according to Maslow as belonging needs, self esteem needs, and self actualization needs. Halloran thus concluded that registered nurses providing direct care to patients address a wider scope of needs with greater attention to the total patient. The findings must be considered in relation to the limitations of the study (Halloran, 1983). Data were collected for a short time period, only two weeks. Data were collected and compared on only two units. Therefore, conclusions were drawn from work done with a limited patient and nurse sample. The nurses had not used nursing diagnoses previously, and their orientation to this classification method was relatively brief. Nevertheless, this investigation introduced evidence that differences in nursing staff skill mix can affect amount and type of care delivered.

Donovan and Lewis (1987) conducted a study at Rush-Presbyterian St. Luke's Medical Center of changes in patient acuity and nurse staffing from 1969 to 1985. The study focused primarily on two issues, cost and productivity, from a defensive stance in response to the trend toward all registered nurse staffing. The Medicus Patient Classification System provided automated workload data for productivity measurement. Cost and nursing resource data were obtained from hospital information systems. Patient acuity and nursing dependency needs were shown to increase markedly over the study period. From 1972 to 1985 the hospital moved from a 36% RN staff to a 94% RN staff. At the same time, the nursing salary budget, as percentage of total hospital budget, decreased more than 3%. Donovan and Lewis' article was

not written for research publication, so extensive details about the study were not given. The article mainly summarized the findings and conclusions derived from the data. The foremost conclusion suggested by the data was that an all RN staff was highly productive and less costly than a nursing staff comprised of RNs, LPNs and aides.

The studies by Halloran (1983) and Donovan and Lewis (1987) showed that variation in nursing labor resources influence productivity and workload capability. That is, by changing the nursing staff mix it is possible to increase quantity of patient care delivered. Additionally, nurse staffing costs were found to decrease in spite of increasing the percentage of more highly trained nurses. The two studies have importance in moving the unit of analysis away from the individual caregiver toward the macrolevel of collective work groups. However, missing from these and other similar studies is the consideration and measurement of quality. The study reported here addressed this gap by evaluating the relationship between quality outcomes and nursing resources.

Helt and Jelinek (1988) provide one of few published multihospital studies. The study design exemplifies a macrolevel view of nursing resources in relation to quantity of work as well as quality of work. The authors examined productivity and quality trends from 1983 to 1985 at hospitals using the Medicus Patient Classification System (PCS). Data were compiled through four study phases. The sample size ranged during the study period from 46 hospitals in the first phase to 72 hospital in the last. Nursing resources were measured by actual nursing hours worked, consistent with the proposed plan. Workload was measured by the

automated Medicus PCS system. In this PCS, patients were grouped into one of four or five categories describing a general class of patients with their presumed attendant needs for nursing care. Actual patients were classified according to the category most closely describing the patient. Helt and Jelinek incorporated data from two distinctly different generations of the PCS; one using four categories, the second using five categories. Of concern is the authors' minimization of the impact the PCS change during data collection and the possible effect on findings.

In short, the data showed productivity enhancements occuring in these hospitals over the study period. Workload changes resulted from a trend of increased patient acuity and decreased nursing hours worked. According to the PCS, patients were generally sicker, especially in certain clinical subpopulations, such as oncology and surgery. These patients therefore had greater nursing care needs according to their classification. Numbers of nursing personnel in all categories, RN, LPN, and aides were reduced during the study period. RN reductions were the lowest, though. The combination of increased workload and decreased hours worked explained the measured productivity increases.

The Medicus System provided quality data through an assessment process performed by independent observers on six primary objectives and 32 subobjectives related to quality of nursing care. Every month on each nursing unit ten percent of the patient records were assessed. The authors reported only on broad percentage directional changes in quality, without giving more detailed information specific to each quality objective. Moreover, the

quality objectives (measures) were not listed but merely reported as "reliable and valid measures of quality" (p.38). Reliability and validity coefficients and related information were not given. Caveats associated with interpreting quality findings and conclusions must be formulated by the reader from the limited information provided.

Helt and Jelinek (1988) did not address the aspect of direct versus indirect, or fixed versus variable nursing hours in their productivity study. Data such as these would allow more detailed nursing resources analysis. Helt and Jelinek viewed nursing resources in relation to quality of nursing care. However, the present study moved beyond measuring quality in terms exclusive to nursing care. Nursing resources were viewed in relation to outcomes reflective of overall hospital care; outcomes of interest to a broad set of constitutencies in the health care arena.

The Magnet Hospitals study (McClure, Poulin, Sovie, & Wandelt, 1982) identified hospitals throughout the United States with reputations for having optimal work environments for nurses and for providing excellence in nursing care. Kramer (1988a; 1988b; 1990) analyzed the characteristics of 16 hospitals identified in the Magnet Hospitals study. Some of the studied characteristics involved nursing resources and therefore are relevant to the proposed study. Kramer's descriptive study was a macrolevel, multihospital look at similarities across the 16 nursing departments. Data were collected through personal interviews with nurse executives and nurse work groups, by hospital site visits, by chart and care plan reviews, by observation of various committee meetings, and by analysis of written nursing department

materials. Descriptive numeric data were presented in tables and much of the analysis consisted of narrative discussion.

When the 16 hospitals were revisited by Kramer (1990), hierarchical structures were found to be significantly flattened along with "enlargement and redefinition of the head nurse department head role" (p.38), and bureaucratization had been decreased throughout. The increased percentage of registered nurses within the nursing staff was the other remarkable change. Other observations included salaried status changes, nursing care delivery system changes, use of work force extenders, and central core values changes.

Examination of Magnet Hospitals was concerned with quality at the outset through the selection of particular hospitals reputed to have high quality labor pools delivering high quality nursing care. However, quality in this instance was assumed on the basis of reputation, not actually measured and examined for differences across similar or dissimilar hospitals. Nevertheless, some findings specific to the Magnet Hospitals were of interest to this study.

Hospital nursing resources have been linked to quality of the nursing care process; however, the nursing process is actually a means to an end, not an outcome in itself. Studies which explore relationships between nursing resources and excellence in nursing care process assume care delivered through processes judged to be of high quality will yield better patient outcomes. This assumption needs to be tested. Donabedian's model specifies that both process and structure influence outcome. However, it was not the purpose of this study to explore

differences in nursing care process relative to differences in quality outcomes of hospital care. Therefore, nursing process literature is not reviewed here.

In conclusion, nursing resources have a long history of examination at the microlevel of indiviudal nurse performance, and related issues such as turnover and job satisfaction. Systematic investigation of nursing resources at the macrolevel has more recently received increasing attention. At the macrolevel, hospital nursing resources have been studied more often in terms of amount of care and cost of care, than quality of care; and macrolevel nursing productivity literature consists mostly of nonempirical writings. In short, nursing resources may be indirectly linked through wide leaps to quality of hospital care via previous empirical work. However, a direct relationship has not yet been clearly demonstrated. This study makes an important step to address this relationship.

Patient Satisfaction: A Quality Outcome

Over the past decade patient satisfaction has become a quality indicator of increasing importance to hospital management, trustees, and employer purchasers of health care benefits. Patient perceptions of care are perhaps the most relevant judgements of certain aspects of care, especially to the extent that patients have sovereignty over provider choices. Even if purchaser choices are made by corporate health care managers, employers want employees who are satisfied with the health care providers chosen for them. Hospitals want to achieve high patient satisfaction levels in order to maintain or increase market share. Donabedian (1966)

has stated that "achieving and producing health and satisfaction... is the ultimate validator of the quality of care" (p.166).

Of the various quality indicators investigated, patient satisfaction data most often isolates a separate nursing component. That is, a subscale is incorporated which measures patient satisfaction with nursing care. Other subscales are included in some patient satisfaction questionnaires as well. While overall satisfaction with hospital care and satisfaction with medical care is typically high, satisfaction with nursing care is generally rated lower. This is important because nursing is consistently associated with overall satisfaction with the hospital stay (Abramowitz, Cote, & Berry, 1987; Doering, 1983; Fleming, 1981). Patients typically rate other components of hospital care such as housekeeping, billing, dietetics, and others even lower. However, these components are not usually associated with overall patient satisfaction. Because of this relationship between patient satisfaction with nursing care and overall satisfaction with a hospital stay, it is important to measure both aspects of patient satisfaction.

Like mortality, patient satisfaction research has gone through a period of focused attention on instrument development. Even so, most patient satisfaction surveys are simple in design and have never been psychometrically evaluated (Carey & Seibert, 1993). Reliability and validity are particularly important as these data are used for quality evaluation and are made public. A valid instrument should distinguish between hospitals; that is, quality at different hospitals is expected to vary.

Abramowitz, Cote, and Berry (1987) conducted an instrument development study. These investigators developed a 35 item patient satisfaction questionnaire and then identified determinants of patient satisfaction. The sample consisted of 841 patients discharged from a large teaching hospital in New York City, 91.3% of whom responded to a telephone survey. After several drafts reviewed by hospital administrators, a questionnaire was developed which identified ten areas of hospital services. The questionnaire was then field tested by a private market research firm. A five point Likert scale was used for each of the ten areas. Interitem relationships were evaluated using correlation analysis to determine reliability of scales. Factor analysis further confirmed the independence of measured dimensions of hospitalization. After isolating independent factors describing different aspects of hospital care, path analysis was performed to determine strength of causal links and amount of explained variance.

Consistent with previously reported patient satisfaction studies, Abramowitz et al. (1987) found that satisfaction with nursing care was the major determinant of overall satisfaction with hospital stay. In addition, these investigators found that satisfaction with nursing care was in large part affected by satisfaction with two distinct sets of variables: nurse's aides, and the environment (in particular, noise levels and cleanliness). Patients clearly held nursing personnel responsible for these factors. A second, more minor influence than nursing care on satisfaction, was patient expectation of the hospital experience. Given the weight of nursing's influence on patient satisfaction, more attention

is warranted on nursing care. Abramowitz et al. (1987) conclude that "nursing staff, therefore, is key to patient satisfaction...the hospital's goodwill ambassadors and frontline representatives" (p.128). They recommend improved recognition of nurses who are attentive to patients' needs and acknowledgement of nurses who contribute to patients' positive perceptions about their care and hospital stay.

Doering's (1983) study of factors influencing inpatient satisfaction with care is another example of a single institution sample, utilizing a new questionnaire developed by a committee of hospital managers from that institution. Questionnaires were mailed to 1,080 patients discharged from a large teaching hospital. Response rate was 58%. Consistent with findings of other studies, satisfaction was lowest with amenities and "hotel" services of the hospital stay. Factors examined by Doering in relation to patient satisfaction were primarily patient descriptors such as age, race, gender, socioeconomic status, and others. These patient specific factors are incorporated into computations to risk-adjust satisfaction and mortality data in the CHQCC; however, these patient descriptors did not receive separate analysis in this study.

The questionnaire used in Doering's study was exceedingly brief and simplistic. Some questions clearly pertained to specific aspects of care or hospital departments. Other questions were more global. However, the questionnaire contained no subscales or isolated factors describing aspects of care. As noted by Carey and Siebert (1993), the instrument was not psychometrically tested. Nevertheless, associations were examined between satisfaction

with selected components of care and overall satisfaction. Doering (1983) found, as did Abramowitz et al. (1987), that satisfaction with nursing care was more strongly related to overall satisfaction than any other aspect of the hospital stay. Doering's study conclusions and recommendations addressed the need to focus on nursing care and other interpersonal aspects of care to improve patient satisfaction. While findings and conclusions were limited due to the constraints of the questionnaire, the findings supported the importance of satisfaction with nursing care to the overall satisfaction with and impressions of the hospital stay.

In conclusion, psychometric studies of patient satisfaction have mainly involved single sites (Rubin, 1990). Moreover, Cleary and McNeil (1988) note that while "several investigators have developed detailed, multidimensional scales, surprisingly few investigators have used scales developed by other researchers...that have been validated and reported in the literature [and that would] facilitate comparisons among studies in different settings" (p.32). Cleary and McNeil further observe that "the amount of satisfaction research conducted among hospitalized patients is nowhere near the amount among outpatients" (p.32). These authors note the irony of such emphasis on outpatients in light of the conflicting emphasis in the industry on monitoring and improving quality of inpatient services. This study contributes to patient satisfaction research by using data from an existing instrument for which reliability and validity information has been reported, by employing a multi-hospital sample, and by exploring differences in hospital inpatient satisfaction relative to differences in hospital nursing resources.

Finally, research has demonstrated the influence of nursing care patient satisfaction on overall patient satisfaction with hospital stay. However, studies have lacked an important aspect for managerial decision making and policy development. Missing from this research is a detailed investigation of differences in nursing resources relative to patient satisfaction with nursing care and overall satisfaction with hospital stay. This study provides a detailed exploration of those relationships.

Mortality: A Quality Outcome

Mortality has been used as a key indicator of quality. Unexpected or preventable death is an obvious undesirable outcome and may be related to quality of care problems. In 1986, the Health Care Financing Administration (HCFA) began the annual release of hospital mortality statistics. These statistics have been widely criticized for their computational method and implications (Blumberg, 1987; DesHarnais, Chesney, Wroblewski, 1988; Green, Wintfeld, Sharkey, & Passman, 1990; Hannan, Bernard, & O'Donnell, 1989). In addition, various state level agencies, health care coalitions and third party payors are publishing data on mortality. The purpose of such data is to assist patients, employers, insurers, unions, and governmental programs, in making provider selections. Whenever these data are released for public scrutiny, questions regarding data collection and computational methods are raised.

Proponents of inpatient mortality as a quality indicator argue that post discharge mortality is significantly influenced by factors beyond the control of professional

observation and supervision. Therefore, it is suggested that hospital quality ratings should not be based on risk-adjusted post discharge outcomes. To the extent that hospital nursing resources influence inpatient mortality rates and not post discharge events, this argument is relevant to this study. Hospital nursing resources should not be held responsible for post discharge preventable or unexpected deaths. Mortality rates reported in this study are inpatient measures.

A study by DesHarnais, McMahon, Wroblewski, and Hogan (1990) is a continuation of a 1988 study, performed to develop a measure of risk-adjusted mortality. The 1990 study adds a measure of risk-adjusted readmission, and risk-adjusted complication rates to the 1988 mortality measure. These investigators construct an index for each of the three quality indicators, explaining that "measures of adverse outcomes are used as proxies for positive measures of outcomes" (p.1128). Throughout the quality literature, measures of "disquality" are used routinely to indicate quality, under the assumption that hospitals with lower rates of adverse events are producing higher quality care.

DesHarnais et al. (1990) aggregated DRGs into DRG clusters and computed death, readmission, and complication rates associated with each DRG cluster. Two models were used to analyze risk of mortality: a contingency table model for DRG clusters with death rates less than 5%, and a logistic model for DRG clusters with death rates greater than 5%. These investigators were interested in using preexisting data sources to constuct the measures, allowing convenience and cost advantages to anyone interested in computing the measures. Data

were obtained from the Commission on Professional and Hospital Activities (CPHA) and HCFA databases. Some data for this study were also obtained from preexisting data sources for convenience and cost advantages as well.

According to their discussion, DesHarnais et al. (1990) accomplished their study objectives. The risk adjustments made to the three measures of mortality, readmission, and complications appeared to have face validity and appeared to account for much of the variation in rates across hospitals. The three indexes were stable over time and did not appear to be biased by three hospital characteristics of bedsize, ownership type, or teaching status. Further testing revealed that the three indexes had construct validity also.

DesHarnais et al. (1990) were primarily concerned with developing measures and methods to compute quality. The subsequent quality computations could then be used in hypothesis testing quality studies. Much of the mortality research during the 1980s focused on the issue of computing quality. In fact, numerous issues related to quality measurement have been debated and studied. One important issue frequently raised was the need to adjust for case-mix index (CMI) and severity of illness (SOI). DesHarnais et al. (1990) discussed the importance of CMI and SOI, especially as measured upon admission. Since admission data was desirable but not available from the data sources used by DesHarnais, et al, a complex series of data extractions and manipulations were used to estimate comorbidities and complications at admission. APACHE was specifically mentioned as a system capable of generating desirable admission data, though unavailable for their study. APACHE is the severity of illness system

being used by the Cleveland Health Quality Choice Coalition to compute risk adjustments of mortality rates and was a part of the study reported here.

Fleming, McMahon, DesHarnais, Chesney & Wroblewski (1991) used methods developed in the previously described study to explore the issue of incorporating post discharge deaths with inpatient deaths for certain conditions. Expanding the measurement window for mortality data collection beyond the hospital discharge date is argued necessary by some (Lubitz, Riley, & Newton, 1985). Length of stay variations across hospitals for various clinical conditions or surgical procedures is felt to confound the analysis. The same DRG clustering method used in the DesHarnais et al. (1990) study was used along with the contingency tables and logistic regression models developed in the DesHarnais et al. study. Fleming et al. (1991) also separated out the medical and surgical patients, as did DesHarnais et al. (1990).

Five DRG-specific time window measures, all varying in temporal dimension, were the central focus of the Fleming et al. (1991) study. The method attributes responsibility to the hospital for mortality within a time window specifically assigned to each DRG cluster. Thus, length of stay differences across hospitals were controlled. Validity was assessed by comparing the methods across different types of hospitals. However, the findings of the study did not support any of the five measures as being the more valid. Because the issue of expanding time windows for incorporating post discharge deaths into mortality rates remains unsettled, using inpatient deaths is adequately justified.

One limitation of the study by Fleming et al. (1991) is the use of data obtained from

HCFA and AHA databases. These data sources are based on discharge abstract information, not admission information. If health status deteriorates during hospitalization as a result of poor care, leading to additional diagnoses or problems appearing on the discharge abstract, the calculated risk of death would be higher. For this reason, admission information about severity of illness is better, and was used for this investigation.

Bradbury, Stearns, and Steen (1991) acknowledged the importance of admissions data for risk-adjustment in measuring mortality. The investigators used the MedisGroups system to categorize patients into one of five severity of illness ratings. MedisGroups data is collected upon admission from laboratory, pathology, radiology, and documented physical findings. MedisGroups is a proprietary software system developed by MediQual Systems, Inc. in place at more than 450 hospitals at the time of the study. Upon testing, Thomas and Ashcraft (1989, cited in Bradbury et al., 1991) found an interrater reliability coefficient of 0.84 for the MedisGroups system.

A stratified random sample of 10 hospitals was selected from MedisGroups user hospitals. Data for the study were from the 1989 MedisGroups database. The 10 most frequently occurring DRGs for the adult medical service were chosen to examine interhospital variations in hospital mortality and morbidity. Mortality rates were standardized and calculated for each DRG. In-hospital standardized rates for mortality and morbidity were reported for the 10 selected DRGs. Considerable variation among the 10 hospitals was observed and test results demonstrated statistical significance of mortality and morbidity rate differences among the

sample hospitals.

Bradbury et al. (1991) noted the potential for hospital bias resulting from the self selection process of choosing to purchase a particular software system from among the many available products. Therefore, this sample is not likely to be representative of the hospital population. Indeed, this sample was skewed in terms of larger bed size. As recognized by other investigators, hospital length of stay differences not measured in this study could potentially influence inpatient mortality rates, as well. Patient variables not included in the MedisGroups system may also account for interhospital variation. Nonetheless, the study by Bradbury et al. (1991) is consonent with this study by: a) arguing for severity of illness rating to adjust outcomes risk; b) using admissions data to obtain such severity ratings; c) using inpatient mortality rates as a proxy measure of quality; and, d) acknowledging the need to do interhospital comparison. These four aspects were incorporated into this study.

During the course of CHQCC data collection for this investigation, Aiken, Smith, and Lake (1994) published their study of Medicare mortality in a matched sample of hospitals, Magnet versus non-Magnet (control) hospitals. The published works of Kramer defining and describing Magnet hospitals were the basis for the hospital sampling by Aiken, Smith, and Lake's study. Magnet hospitals are reputed among nurses to be particularly desirable places in which to practice nursing, and which are known for providing good nursing care. Their study found a 4.6% lower mortality rate in Magnet hospitals among Medicare patients, after adjusting for predicted mortality. As these researchers noted,"Research to date on

determinants of hospital mortality has not focused on the organization of nursing" (p.771). Therefore, their study makes an important contribution to this persistant gap. Likewise, the present investigation sought to provide additional information in this area. One aspect of particular note in the study by Aiken et al. (1994) is their attention to risk-adjustment by using computed predicted mortality rates in a ratio of observed over expected mortality. In studies using multiple hospital samples, mortality variation across hospitals reflects patient population differences in terms of patient demographics, as well as comorbidities/ case mix. It is important to adjust for such differences. The mortality rates used in the present study included similar risk adjustment with observed over expected incidences.

Aiken et al. (1994) used the 1988 HCFA Medicare morality file to investigate whether mortality rates differed between two groups of hospitals (Magnet versus control). These two groups which were matched to insure similarity in relation to numerous non-nursing organizational characteristics, differed primarily with respect to nursing organizational characteristics. The two groups differed significantly in relation to nursing skill mix and nurse to patient ratios. However, these particular nursing resource differences did not in large part explain lower mortality. The investigators believed this finding supported the idea that lower mortality rates were linked more to "the greater status, autonomy, and control afforded nurses in the magnet hospitals, and their resulting impact on nurses' behaviors on behalf of patients -- i.e., this is not simply an issue of the number of nurses, or their mix of credentials." (p.783). They also concluded that: "hospital-level differences in the

organization of nursing care" hold the potential for "understanding why some hospitals achieve better patient outcomes than others" (p.784); and that these nursing departmental attributes are capable of being replicated in other institutions "across a range of organizational types" (p.783).

In conclusion, mortality has become an accepted measure of quality and has been selected as one proxy measure of quality for the present study. A number of issues related to mortality as a quality indicator have been debated and investigated in the literature. In addition, numerous stucture and process variables have been studied in relation to mortality. However, one structure variable in need of more attention in the mortality literature is hospital nursing resources and its relationship to inpatient mortality. This study is an important contribution to the examination of this relationship.

Mediation: Hospital Characteristics

Hospital characteristics are financial, facility, patient population, and other hospital descriptors identified in this study as possible mediators of the nursing resources-hospital quality relationship. Exploration of selected hospital characteristics enhance understanding of their relationship to nursing resources and hospital quality data, and offer alternate explanations for observations regarding the hospital quality-hospital nursing resources relationship.

Fleming's study (1981) of patient satisfaction began with a conceptual model that

incorporated four variable categories (structure, process, environment, and outcome) based on work by Neuhauser and Anderson (cited in Fleming, 1981). Use of a conceptual foundation represented a departure from other satisfaction studies. As outlined by Fleming (1981), Neuhauser and Anderson's concepts of structure, process, and outcome differ in defintion and scope from Donabedian's, although similarities exist. Fleming's study of hospital structure and satisfaction shares a focus similar to this study. Fleming's use of the term, hospital structure variables, parallels the term, hospital characteristics, in this study.

Three structure variables were measured: ownership type, teaching status, and bed size. These variables are called hospital characteristics in this study and are offered as mediating variables. Hospitals were classified into two types of ownership: government operated and private nonproft. For profit hospitals were eliminated from the sample without a theoretical or empirical reason given. Teaching status was divided into hospitals with no medical teaching programs, and those with approved medical teaching programs. Bed size was split between hospitals with greater than 300 beds and those less than 300 beds. One weakness of Fleming's study was the small number of structure variables studied, as well as the small number of categories within each structure variable. Data were obtained from A.H.A. annual reports for the hospital structure variables. The major limitation of Fleming's (1981) study relates to its relevance, due to the age of the data. Data from 1976 annual reports were used. Considerable changes have occurred in health care delivery since that time. Another consideration important to interpretation of findings is the circumstances of data

collection. Subjects were interviewed for a study primarily focused on access to medical care. A subsample of 589 people from the 7,787 persons in the original total survey qualified for inclusion in the study. Eighty-three percent (490) of the 589 were interviewed for the study. A portion of the interview dealt with recall about hospitalizations experienced within the past calendar year. Cleary and McNeil (1988) have discussed the affect of temporal distance from hospital discharge on patient satisfaction response. Memory over time may change recollections and impressions of the hospital experience.

The structure variables examined in Fleming's study were explored in this study as mediating variables. Fleming computed Pearson correlation coefficients for the three structure variables and the patient satisfaction scale. The patient satisfaction scale consisted of five levels. Teaching status and bed size showed significant relationships to patient satisfaction; those treated in teaching hospitals and larger hospitals were the most dissatisfied. Just short of statistical significance at the 0.05 level was satisfaction with ownership type. Those treated at government hospitals were less satisfied than those treated at private, nonprofit hospitals. A regression analysis was performed to determine whether the effects of teaching status and bed size on patient satisfaction would offset each other. Bed size was subsequently dropped from later regressions because of its correlation with teaching status. Fleming (1981) concluded that ownership and teaching status affect patient satisfaction, although ownership had a weaker effect than teaching status.

Fleming's study represents an early analysis of patient satisfaction, and the major

limitation is related to this historical time period. Nevertheless, this study documents an important early step linking patient satisfaction with hospital characteristics. Hospital characteristics were viewed in the current investigation as mediating variables in the nursing resources-hospital quality relationship. Since Fleming's study, other investigators have looked at numerous additional structure and process variables in relation to patient satisfaction.

Brennan, Hebert, Laird, Lawthers, Thorpe, Leape, Localio, Lipstiz, Newhouse, Weiler, & Hiatt (1991) examined hospital characteristics associated with adverse events and substandard care. Brennan et al. (1991) reported on the same dataset used by Burstin et al. (1993). However, Burstin et al. included more variables in the 1993 analysis than were incorporated in the 1991 analysis by Brennan et al. In particular, Burstin et al. (1993) included labor resources, relating the study to this investigation of nursing resources, as previously discussed.

The database used by Brennan et al. (1991) involved a representative sample of 31,429 patient records, excluding psychiatric patients. Patients were discharged from 51 randomly chosen, nonfederal, acute care New York hospitals during 1984. Data were obtained from chart review and reports published by the New York Department of Health and the A.H.A. Charts were first screened by nurses and medical record analysts for evidence of adverse events (AE). AE is defined as injuries caused by medical intervention as distinct from the disease process. A subset of AE was specified as those events resulting from negligence. Charts selected in

the first screening were then reviewed separately by at least two independent board certified physicians for verification of AEs. Hospital characteristics included ownership model, location, patient volume in number of discharges, proportion of black and Hispanic patients, and teaching status.

Findings suggested that patients in some hospitals may be at greater risk for achieving poorer outcomes. Univariate analyses demonstrated significantly higher rates of AEs in major teaching hospitals and significantly lower AE rates in rural hospitals. However, the subset of AEs due to medical negligence was found to be lower in primary teaching hospitals. Thus alternative reasons for the adverse events in primary teaching hospitals need further investigation. The subset of AEs due to medical negligence was found to be associated with only one distinguishing characteristic. The finding was that hospitals with predominantly minority patients had significantly higher rates of negligent AEs. Statistical control of individual risk factors of patient age and severity of illness was performed. Quality outcomes should be risk-adjusted to account for confounding patient related differences.

Brennan et al. (1991) demonstrated that significant variation in adverse events and negligence occured among sampled hospitals, and that the incidence of AEs and negligent AEs were not correlated. The study showed that substandard care did not occur randomly and pointed to specific hospital characteristics related to substandard care. This investigation also looked at a number of hospital characteristics representing mediating variables in the

hospital nursing resources--quality of hospital care relationship.

Summary

This review of literature covered the major topics contained within the study reported here. Concepts and variables pertinent to this investigation were discussed. The overriding deficiency in all areas of research is the systematic study of macrolevel nursing resources, especially as it relates to quality outcomes. This study looked beyond measures of nursing care quality to those of overall hospital quality of care. Findings will be of interest to decision makers involved in theory development, hospital operations, and policy making.

CHAPTER III

Methods

Design

This exploratory study examined the relationship between hospital nursing resources and quality of hospital care. Data analysis included detailed description of hospital nursing resource variables and selected hospital characteristics in a local hospital sample as related to four research questions. The major emphasis in this study was the examination of the nursing resource-quality of hospital care relationship at a macrolevel, the hospital being the unit of analysis in this multihospital sample.

Sample

Setting and Sample Size

This convenience sample consisted of 22 hospitals located within the health care market of a moderately large Midwestern metropolitan area. All hospitals in this market participating in the Cleveland Health Quality Choice Coalition (CHQCC) at the time of their outcome data collection (Spring through Fall, 1994) were requested to participate in this investigation. Initial requests were made in writing to the Chief Nursing Officer (CNO) at each hospital involved in the CHQCC. Follow-up telephone contact was made by the investigator and appointments were scheduled for face-to-face interviews with the CNOs.

The CHQCC is an ongoing program aimed at measuring differences in cost and risk-adjusted quality of care delivered at Cleveland area hospitals (Allen, 1993; Bergman, 1993;

73

Brandt, 1993; "CHQCC Releases", 1994; Green, 1994; Jopek, 1992; Phipps, 1993; Rice, 1993). A consortium of three health care stakeholder groups: 1) local large businesses (buyers of employee health care benefits), 2) hospitals, and 3) physicians, has worked on this initiative since November, 1989. The project has generated a large database of cost and risk-adjusted quality measures collected from 29-31 Cleveland area hospitals since 1991. (Some hospital consolidation within the Cleveland market has occurred during this time.) The program seeks to address a number of issues important to institutional performance measurement, with possible implications for public policy development, but lacks an important focus. It fails to include a specific evaluation of nursing resources.

Ozcan and Luke (1993) asserted that hospitals located within the same local health care market are peers for comparative purposes due to "similar area characteristics" (p.722). These investigators grouped sample hospitals by geographic area to control for "local environmental variations" (p.722). All hospitals are therefore assumed to be exposed to effects of competitive market elements having the same order of magnitude, such as local business health care bidding influences, munificence, supply of health care labor categories (M.D.s, R.N.s, therapists, etc.), and other local economic and political conditions (Ozcan & Luke, 1993). For the purposes of this study, the reasoning asserted by Ozcan and Luke was used to assume that nursing resource variance would not be significantly confounded by market related variables. The sampled hospitals did, however, provide diversity with respect to the various institutional characteristics of interest to this investigation. Moreover, this

sample offered the advantage of hospital-specific quality data organized and uniformly collected through a rigorous process established by the CHQCC committees. Data were collected about inpatient adult medical-surgical units and intensive care units only. Excluded were data specific to pediatric units, obstetrical units and nurseries, psychiatric units, emergency rooms, and outpatient clinics. Research findings from published studies suggest the nursing workload variation in these areas might confound the findings of this study (Banker, Conrad, & Strauss, 1986; Cromwell & Puskin, 1989).

Variables and Their Measurement

Independent Variables: Nursing Resources

Nursing resource variables were divided into three groups: 1) absolute amount of nursing resources, 2) relative amount, or skill mix, of nursing resources, and 3) nursing care delivery methods. Absolute amount and nursing skill mix were measured by number of nursing hours actually worked. Nursing care delivery methods data were categorical and qualitative, and were derived from extended face-to-face interviews.

Nursing Categories. Table 1 contains explanations of the variables quantifying amount and skill mix of nursing resources provided. To maintain the macrolevel (hospital unit) focus emphasized in this investigation, total number of nursing hours actually worked was summed for all intensive care and adult medical-surgical units. The two most broadly defined variables, TNH/DC and TNH/PD, included direct bedside nursing hours, as well as fixed

Table 1
Nursing Resource Variables

Variable Label	Definition

Absolute amount of nursing resources:

TNH/DC   Total (fixed + direct) nursing hours per discharge

TNH/PD   Total (fixed + direct) nursing hours per patient day

VNH/DC   Direct bedside (variable) nursing hours per discharge

          (RN + LPN + Nurse Aide hours summed)

VNH/PD   Direct bedside (variable) nursing hours per patient day

          (RN + LPN + Nurse Aide hours summed)

RNH/DC   Registered Nurse hours per discharge

RNH/PD   Registered Nurse hours per patient day

LPNH/DC   Licensed Practical Nurse hours per discharge

LPNH/PD   Licensed Practical Nurse hours per patient day

NAH/DC   Nurse Aide hours per discharge

NAH/PD   Nurse Aide hours per patient day

FNH/DC   Fixed administrative hours per discharge

FNH/PD   Fixed administrative hours per patient day

FNH/VNH   Fixed administative hours per variable nursing hour

Skill mix:

%RNH   RN hours/Total direct bedside nursing hours

          (RN, LPN, & NA)

%RNH+LPNH   RN hours + LPN hours/Total direct bedside nursing hours

administrative and clinical staff hours. More narrowly defined are two variables recorded without the fixed hours, VNH/DC and VNH/PD, which reflect actual amount of direct bedside nursing care given. Data were further disaggregated into three labor categories: 1) RN; 2) LPN; and 3) Nurse Aide, all of which fluctuated according to patient demand for nursing services. Fixed nursing hours, which included fixed supervisory/administrative and fixed clinical (nonadministrative) hours, labelled FNH/DC and FNH/PD, were isolated as well. (Fixed clinical hours includes staff development nurses, clinical nurse specialists, intravenous nurses, and other nurses whose roles involve patient-related responsibilities, but who are not specifically patient-assigned.) These fixed administrative and clinical hours are regularly scheduled, remain constant, and do not vary with patient volume. In addition, data concerning hours worked by temporary agency nurses were obtained and added to variable nursing hours data.

Service Volume. Measurement of nursing resources in this study requires concomitant measurement of service volume to provide a standardization of the absolute nursing hours across the hospital sample. Nursing hours were therefore divided by two measures of service volume: 1) number of inpatient days (PD), and 2) number of patient discharges (DC). These are the most frequently used units of service volume measurement in efficiency and productivity literature. Consistent with the macrolevel focus, both volume measures in this sample combined adult medical-surgical and ICU volume. All nursing hours data were divided by both service volume measures to derive the nursing resource variables listed in Table 1.

Subsequent data analysis and discussion involved comparison of the results obtained by these two different volume measures.

Nursing hours versus FTEs. Nursing hours were selected to measure nursing resources, rather than fulltime equivalent positions (FTEs), the more frequently used measure in efficiency studies which included nursing resources as a hospital structure variable. Nursing hours data contain greater precision, specificity, and information than FTEs, but involve more time and effort to obtain. Until recent years, these data were not generally automated through hospital information systems or easily retrievable, rendering them impractical for multi-hospital samples. While FTEs data are easier to obtain, especially from published data sources, they require assumptions regarding unworked hours attached to each full-time equivalent position, which may result in broad overmeasurement or understatements. In addition, precise numbers of occupied budgeted FTE positions is difficult to compute for any given time period, given the continual turnover of nursing personnel across time. For this reason, nursing hours data is recognized to be the preferred measure in cost and productivity literature (Cromwell & Puskin, 1989; Erhat, 1987; Helt & Jelinek, 1988; Hoffman, 1988; Kirk, 1990; Spitzer, 1986; Strasen, 1987).

Nursing care delivery methods. The third group of nursing resource variables examined in this study, nursing care delivery methods, was qualitative data obtained through extended interviews with CNOs. To quantify and calculate macrolevel institutional measurement of these variables would extend beyond the scope of this investigation. The

interviews with CNOs included open-ended questions concerning these various nursing care delivery methods to obtain descriptive, narrative data. Appendix A contains the interview questions.

Reliability of nursing resource measures. Efforts to verify accuracy of nursing hours data occurred both before and after data collection. The data collection form was discussed with the CNOs during the interviews and questions were answered. Follow-up phone calls to verify understanding were made to persons working with the CNOs to report data and complete the forms. Clarification of what to include or exclude was repeated. After data were received by the sample hospitals, a written form was mailed to each institution. This form was a checklist which rephrased questions that would insure data accuracy and completeness. Responses on these forms indicated understanding and compliance with the data requests. Tracking nursing hours data is an important part of internal hospital reporting processes related to fiscal, budgetary, and productivity activities. Payroll functions and management decisions involve the use of such information. Complete, accurate, and reliable discharge and patient days data are a required, routine part of external reporting mechanisms for regulatory purposes, independent audits, and third party payor reimbursement operations. Because the nursing resource measures used in this study were derived from the databases supporting these internal and external reporting activities, the data were judged to be adequately reliable.

Dependent Variables: Quality of Hospital Care

Because quality is a complex, multidimensional concept, it is difficult to operationalize. Various proxy measures of good care and poor care have been tested in published studies as indicators of quality. This study employed two proxy measures used in an existing program to evaluate hospital care quality: 1) patient satisfaction and, 2) mortality. These two indicators have received more attention in the literature than any other quality indicators and are of interest to various health care providers and recipients. Data measuring patient satisfaction and mortality were obtained from the CHQCC.

Patient Satisfaction with Overall Hospital Stay. Patient satisfaction with hospital care is probably one of the most frequently measured patient attitudes and is becoming a focal point for quality measurement in health systems (Carey & Seibert, 1993; Cleary & McNeil, 1988; Hays, Larson, Nelson, & Batalden, 1991; Lohr, 1988; Meterko & Rubin, 1990; Rubin, 1990). The Patient Judgment of Hospital Quality (PJHQ) questionnaire is being used by the CHQCC to measure patient satisfaction. The instrument contains 41 items relating to eleven distinct subscales of hospital care: 1) admissions, 2) daily care, 3) information, 4) nursing care, 5) doctor care, 6) auxiliary staff, 7) living arrangements, 8) discharge, 9) billing, 10) total process, and 11) allegiance (Nelson, Hays, Larson, & Batalden, 1989). The 41 individual items are rated along a five category Likert scale: excellent, very good, good, fair, or poor. Eight additional items measure patients' overall satisfaction. Seven items report health status, pain, and dietary restrictions during hospitalization. Three open-

ended items solicit suggestions for improvement. Fourteen questionnaire items are used to adjust each individual patient's satisfaction score for patient sociodemographics shown to influence self-reported patient satisfaction. Appendix B contains the PJHQ questionnaire.

Data for this study were obtained from the CHQCC after proceeding through the protocol required for outside investigators who wish to use their data. The CHQCC patient satisfaction survey data given to this investigator were collected from patients discharged during a finite six month period (4/1/94–9/30/94). Excluded from the CHQCC survey are patients less than 18 years old, patients admitted to physical rehabilitation units, patients with psychiatric and/or substance abuse principal diagnoses, patients discharged to long term care facilities, and patients discharged against medical advice. Computer generated lists of eligible patients are submitted to an independent survey research firm which randomly selects 600 patients per hospital per survey period. A sample size of 600, with an assumed response rate of greater than 40%, was determined adequate to minimize potential variation of hospital outcomes between reporting intervals, and to ensure requisite sensitivity in examining hospital performance.

Questionnaires are mailed with cover letters explaining the survey. Post card reminders are sent one week later. Follow up reminders and questionnaires are mailed to all nonrespondents four weeks after the initial mailing. At eight weeks the response field is closed. Response rates have averaged 56%, although response rates have varied among hospitals. Through August of 1993, CHQCC had collected and analyzed satisfaction data from greater than 40,000 patients.

The reliability and validity of the PJHQ is documented (Hays, Nelson, Rubin, Ware, & Meterko, 1990; Rubin, Ware, & Hays, 1990). Reliability estimates for the subscales were good or excellent with Cronbach's alphas ranging from 0.87 to 0.95. In addition to internal consistency reliability, homogeneity (the average interitem correlation within each scale) was examined. Homogeneity estimates were all within the acceptable range, indicating sufficient internal consistency and reliability in the instrument. Test-retest reliability was not assessed in the study by Meterko et al. (1990).

Hospital scores are reported to the public by the CHQCC categorized into three groups: higher-than-expected satisfaction, within-expected range of satisfaction, and below-expected satisfaction. Raw scores of patient satisfaction provided to this investigator by the CHQCC were used in this study. The study variables were computed for this investigation using a ratio of each hospital's actual score over that hospital's predicted score. Aiken, Smith, & Lake (1994) used this ratio method to measure and evaluate Medicare mortality rates as relates to nursing care in Magnet versus non-Magnet hospitals.

Patient Satisfaction with Nursing Care. The PJHQ questionnaire contains a nursing subscale comprised of five questions specific to nursing care and four other questions regarding daily care primarily provided by nurses and their assistants. This nine question subscale is reported to have high internal consistency reliability through psychometric evaluation, as well as high discriminant and construct validity (Hays, Nelson, Rubin, Ware, & Meterko, 1990; Rubin, Ware, & Hays, 1990). Psychometric testing strongly suggested that

patients rate separately the six subscales reflecting the different dimensions of patient care addressed in the questionnaire. Furthermore, these dimensions varied independently of each other, even within the same hospital, and with relatively short subscales (ranging from four to 13 items) (Ware & Berwick, 1990). Hays et al. (1990) found that patients discriminate between different aspects of hospital care, and specifically between nursing care and physician care. However, initial content review from patient focus groups and other methods did not suggest patients distinguish between professional and nonprofessional nursing staff (Rubin, 1990).

Two subscale scores were used in this study to explore patient satisfaction with nursing care. One was the nursing subscale by itself, as contained in the questionnaire. The other was a composite score, termed "Nursing Index" here, which was computed by combining three subscales from the PJHQ questionnaire. The three subscales were: 1) Daily Care, 2) Information, and 3) Nursing Care. The Daily Care and Information subscales are highly correlated with nursing care, probably because nurses are the providers principally involved in the delivery of daily care and information given to patients. Table 2 displays the results of three correlation tests on the sample hospitals' subscale scores which comprise this composite Nursing Index variable. This variable was constructed to provide an additional measure of patient satisfaction with nursing care, and thereby allow a fuller examination of the relationship between patient satisfaction with nursing care relative to variation in hospital nursing resources.

Table 2

<u>Correlation Coefficients between Nursing Care(NC) Subscale Scores and Two Other</u>
<u>Subscale Scores: Daily Care(DC) and Information(I)</u>

Subscale	Correlation Coefficients		
Relationships	Pearson	Spearman	Kendall
NC-DC	.9248	.9321	.8459
Significance	.000	.000	.000
NC-I	.8784	.9013	.7920
Significance	.000	.000	.000

Inpatient Mortality. In general, the necessity of adjusting outcome scores based

on factors shown to influence the probability of achieving those outcomes has been addressed

in the literature (Brewster, Karlin, Hyde, Jacobs, Bradbury, & Chae, 1985; DesHarnais,

McMahon, & Wroblewski, 1991; Grosskopf & Valdmanis, 1993; Horn, 1983; Iezzoni, Restuccia,

Shwartz, Schaumburg, Coffman, Kreger, Butterly, & Selker, 1992; Lubitz, Riley, & Newton, 1985;

Wagner, Draper, & Knaus, 1989). Hospital inpatient mortality, perhaps one of most commonly

measured quality outcome indicators, in particular requires risk-adjusted rate reporting

(Bradbury, Stearns, & Steen, 1991; DesHarnais, McMahon, Wroblewski & Hogan, 1990; Fleming,

McMahon, DesHarnais, Chesney & Wroblewski, 1991; Green, Wintfeld, Sharkey, & Passman, 1990;

Park, Brook, Kosecoff et al.,1990).

Risk adjustment is a mathematical modification of data to control for factors which

confound dependent variable measurement. The influence of numerous factors on patient

outcomes is well recognized by experts in a number of fields. Some factors influencing patient

outcomes are hypothesized to reside in the skills, practices, and care of the physicians,

nurses, and other clinical providers. Other factors are hypothesized to be related to patient

demographics, morbidity and comorbidities, and other patient specific variables. Because

quality improvements in health care are generally sought through manipulation of the former

group of provider related variables, efforts are made to control for the latter group of

patient related variables in quality measurement. This is done with the CHQCC project.

The CHQCC contains two mortality ratings: one for medical-surgical patients with

specific diagnoses, and one for intensive care unit patients. The hospitals' scores are then

categorized and publicly reported in three groups: 1) hospitals with fewer-than-expected

death rates. 2) those with similar-to-expected death rates, and 3) hospitals with greater-

than-expected death rates. Raw scores of actual and predicted frequencies, rather than

publicly reported group classifications, were used in this study to compute actual-to-

predicted ratios, as described for patient satisfaction data. Hospital mortality scores for

this study are the ICU and medical-surgical actual frequencies summed, divided by the ICU and

medical-surgical predicted frequencies.

Mortality rates in the CHQCC are adjusted for patient related risk with the use of one

instrument for intensive care (ICU) patients and another instrument for non-ICU patients.

Upon admission to the ICU, patients are scored with the APACHE III (The Acute Physiology And

Chronic Health Evaluation) severity of illness instrument. APACHE III data are acquired from individual patient medical review and extraction of information from patients' medical records. APACHE data include various laboratory, radiologic, and physical findings, as well as patient clinical history. This instrument is widely used throughout the United States to describe ICU patient severity of illness (Knaus, Draper, & Wagner, 1989; Knaus, LaRosa, Marks, & Bisbee, 1994). Validity and reliability of the APACHE system have been well established in studies over the past fifteen years.

Non-ICU patients are rated with a proprietary severity of illness instrument developed by a private health care consulting firm based in Chicago, Illinois, in cooperation with CHQCC personnel and Cleveland area physicians serving on CHQCC committees. The instrument is used to construct risk-adjustment models for data comparison among hospitals. The independent consultant has developed outcome prediction models using multivariate statistical techniques, logistic and linear regression. The models are ongoingly refined and validated with sequential data sets from separate, subsequent data collection periods. Part of the ongoing iterative revision process also includes periodic physician feedback about specific variables, which are then empirically tested relative to the predictive models. The development of these risk adjustment models is one of the key features and unique research contributions of the CHQCC. Satisfactory to good predictive validity continues to be demonstrated with these models (Rosenthal & Harper, 1994).

Data collection using both patient rating instruments is performed by ICU and/or

quality assurance nurses at each hospital. Data are entered into a computerized database and then sent in electronic format for analysis to an independent vendor and the consultant. Preliminary analyses of 1991-92 CHQCC data have demonstrated satisfactory predictive validity of the risk-adjustment methods (Rosenthal & Harper, 1994).

Various measures have been employed by the CHQCC to assure data quality. First, a period of preliminary testing and data reporting only to individual hospitals, not to the general public, was provided. This process allowed hospitals the opportunity to examine quality of data and to institute necessary changes in medical records documentation and abstraction, or training of personnel. Second, content and criterion validity were evaluated. Panels comprised of people with expertise in related areas were involved in content validation. Criterion, or predictive, validity was enhanced through the iterative process mentioned earlier. Values generated by these risk adjustment models were also evaluated by comparing them to other severity of illness and case-mix adjustment methods reported in the literature and for which peer-reviewed data existed. Goodness of fit techniques were also used to further minimize the possibility that risk predictions were biased at high or low levels of patient severity (Rosenthal & Harper, 1994).

A third measure to ensure data quality was establishment of minimum sample size thresholds. These thresholds would decrease potential variation in hospital outcomes due to

differences between reporting periods. These sample size minimums were set to enable model

development that would assure robust and stable parameters for subsequent data collection

periods.

As a final measure to ensure validity of the program's risk adjusted outcome

measurement, an external review was sought to provide an objective assessment. Independent

evaluations from nationally recognized experts in severity of illness and case-mix adjustment

were obtained for this external review. These experts looked at program methods related to

data collection, statistical analysis, validity, reliability, and reporting of hospital

comparisons.

Efforts were also instituted to monitor and maximize data reliability. First,

consultants and CHQCC staff provide training and educational programs several times per year

for hospital personnel who abstract the data. A written educational newsletter is published

regularly and distributed to abstracters, supervisors and project contact persons at each

hospital. This publication contains updates, modifications, advice for increasing

abstraction efficiency, and answers to frequently asked questions. Second, data is reviewed

by software vendors for outlier and missing values for all abstracted variables. Follow up

is provided by and between registered nurse personnel at the hospitals, and RNs employed by

the vendors. Third, periodic internal audits are performed which reabstract a 10% random

sample of patient charts by a second hospital abstracter. Necessary feedback and follow up is done in response to these internal audits. Fourth, regularly scheduled external audits are performed by CHQCC records reviewers. Results are shared with individual hospitals and problems are addressed as necessary. If indicated, follow up external audits are conducted and outcomes are recalculated prior to including data in CHQCC reports. Separate external audits have also been done to detect evidence of systematic bias that would result from diagnostic upcoding. Comparison of original data and reabstracted data has demonstrated high levels of reliability and a lack of upward bias in severity ratings of patients.

Mediating Variables: Hospital Characteristics. To enhance description and exploration of how nursing resources relate to quality of hospital care, fifteen hospital characteristics were included in the analysis. Selection of these descriptors is derived from previous empirical work done on hospital outcomes of efficiency and hospital care quality, as discussed in Chapters I and II. Table 3 lists these characteristics and the data sources.

Table 3

<u>Selected Hospital Characteristics</u>

Characteristic	Data Source
General Descriptors:	
Teaching Mission	CNO/HM; GCHA
Ownership/Affiliation	CNO/HM; GCHA
Case Mix Index	HCFA
Support Personnel:	
Ward Secretaries	CNO; HIS
Dietary Tray Passers	CNO; HIS
Patient Transporters	CNO; HIS
Unit Assistants/House-	CHO; HIS
keeping Workers, ward level	
Capacity/Utilization:	
Registered Beds	GCHA;AHA
Beds in Use	CNO; HIS; GCHA
ICU/MS Beds	CNO; HIS
Occupancy Rate	HIS
Financials:	
Operating Margin	HIS
Return on Assets Ratio	HIS
Hospital Fund Balances	HIS
Nursing Payroll Expenses/Discharge	HIS

Note: CNO=Chief Nursing Officer; HIS=Hospital Information Systems; HM=Hospital Management; GCHA=Greater Cleveland Hospital Association; AHA=American Hospital Association; HCFA=Health Care Financing Administration

Procedures

Data were obtained from six sources: 1) hospital chief nursing officers(CNOs) via face-to-face interviews, 2) automated hospital information systems, occasionally supplemented by hospital managers, 3) the Cleveland Health Quality Choice Coalition (CHQCC) 1994 database, 4) 1994 American Hospital Association (AHA) annual report, 5) 1994 Health Care Financing Administration (HCFA) reports, and 6) the Greater Cleveland Hospital Association.

Data collected by face-to-face interview method from May through July, 1995 provided more detailed nursing resources data relative to nursing care delivery methods. During the face-to-face interviews, the requested quantitative nursing resources data collection was reviewed to clarify the request and address any questions or concerns. All interviews were tape recorded with the permission of the nurse executives to facilitate analysis of verbal responses at a later time.

Following the interviews, CNOs worked with various personnel within the nursing departments, financial offices, and/or information systems departments of their respective hospitals to obtain the requested data. During the seven months following the first CNO interview, 17 hospitals had mailed the completed data collection forms to the investigator.

Data cleaning procedures primarily involved visual inspection of the individual data values. This was possible because of the small sample size. Where data values seemed particularly large or small relative to the overall sample, individuals at the involved hospitals were contacted to verify correct understanding of requested data. Instances of checking such data values are discussed in detail as findings are presented in Chapter IV. Data reported as disaggregated nursing resource categories on the data collection forms

allowed the investigator to check addition and reported totals. In several instances it was unclear whether temporary nursing personnel hours were included in totals, or itemized separately. Telephone contact clarified the reported data in such cases. Inspecting the data revealed two hospitals with identical numbers of discharges for the data collection period, raising suspicion. Retracing the data collection steps proved this was in fact an unexpected coincidence. The data set was searched for other data values outside the coding scheme; deviant or erroneous values were investigated and correct values entered. Examples primarily involved two typographical errors in entering missing-data code numbers.

Manipulation of data was limited to: 1) dividing nursing hours by the two volume measures (discharges and patient days); 2) dividing support personnel FTEs by nursing hours; 3) adding three patient satisfaction questionnaire subscale scores to create the "Patient Satisfaction--Nursing Index" scores; and, 4) dividing actual patient satisfaction scores and mortality rates by predicted scores/rates. This is discussed more in Chapter IV -- Results.

Data Analysis

Data analysis followed in large part the exploratory techniques explicated by Hartwig and Dearing (1979) and Tukey (1977). Exploratory data analysis (EDA) begins with the critical initial step of understanding each variable as a separate entity (Hartwig & Dearing, 1979). Nursing resources data are presented numerically and visually using EDA methods to learn about the variables' distributions. Univariate techniques provided answers to research question #1: "What is the hospital nursing resources distribution across the hospital sample?"; as well as the requisite preliminary steps of analysis prior to engaging the techniques indicated for

research questions #2 and #3, respectively: "Is there a relationship between hospital nursing resources and hospital quality of care outcomes?" and "To what extent does amount of hospital nursing resources and skill mix of hospital nursing resources explain variation on patient satisfaction and mortality outcomes?" Three graphical methods were used to display each variable's distribution shape: 1) stem-and-leaf, 2) box-and-whisker, and 3) histogram. Emphasis was placed on two numeric summary statistics: 1) the median, and 2) the midspread, or interquartile range. These two distribution characteristics are influenced less by extreme, outlier values than the more typically examined measures of mean and standard deviation. Four additional and important distribution characteristics are discussed in relation to specific variables: 1) distribution skewness, 2) outliers/extreme values, 3) gaps, and 4) multiple peaks in the distribution.

Research questions #2 ("Is there a relationship between hospital nursing resources and hospital quality of care outcomes?") and #3 ("To what extent does amount of hospital nursing resources and skill mix of hospital nursing resources explain variation on patient satisfaction and mortality outcomes?") were addressed by subsequent correlational and multivariate analyses which demonstrated shape, strength, and directionality of relationships between variables. Scatterplots were generated for each of the nursing resource variables against each of the quality of hospital care variables. In order to discern patterns existing within the scatterplots, linear regression (least squares) and Lowess lines were fitted to the data points.

Multiple regression equations involving the nursing resource variables were generated for each outcome: 1) Global Patient Satisfaction (i.e.,with overall hospital stay -- "PS-G"); 2) Patient Satisfaction with Nursing Care ("PS-NC"); 3) Patient Satisfaction with composite index of nursing care-related aspects of hospital care ("PS-IX"); and 4) Mortality.

Findings from this exploration generated suggestions for subsequent studies regarding measurement of variables, research designs, analytic methods, and possible variable relationships requiring further investigation and validation through confirmatory techniques.

Human Subjects

Informed consent from human subjects to acquire patient satisfaction and mortality data for the purposes of the CHQCC was obtained by those associated with the CHQCC. Patients included in that data collection were informed the data would be reported only in the aggregate in reference to the institution providing their care, and not by individual patient at any time.

Approval to collect and use nursing resources and hospital characteristics data was obtained by the Chief Nursing Officer at each institution. Written assurances were given that the names of individual institutions would not be used at any time when reporting the data and that the individual hospitals would be referred to by code numbers only, if individual labeling was deemed necessary (Appendix C).

All data, whether on computer disc, audio cassette, or hard copy, were secured in the investigator's home in a locked filebox. Quantitative data were kept primarily on floppy disc

and were used on the investigator's home computer. Interview materials were maintained

primarily in written format and on audio cassette, secured in the investigator's home. Notes

and tapes were destroyed after the completion and successful defense of this dissertation.

All data were kept in strict confidentiality and CNOs were given written and verbal assurances

of this.

CHAPTER IV

Results

The purpose of this study was to explore the relationship between hospital nursing resources and quality of hospital care at a macrolevel (hospital) unit of analysis. Prior to exploring this relationship, the individual hospital nursing resource (independent) variables were examined in isolation using Exploratory Data Analysis (EDA) techniques to address Research Question 1. A basic objective of EDA is to become familiar with data at an intuitive level, by emphasizing univariate analysis and by using resistant yet robust statistics which have desirable properties across different distributions for a variable (Iglewicz, 1983). This initial exploratory process is indicated when little prior knowledge about a variable has been established through confirmatory research methods, as is the case with macrolevel nursing resources. The individual hospital outcome (dependent) variables were examined as well by these techniques in order to address subsequent research questions dealing with the nursing resource-hospital outcome relationship.

Following this univariate exploratory phase, attention was turned to three subsequent research questions dealing with the nursing resources-hospital quality relationship. The results of the data collection process and data analysis are arranged in this chapter according to the four research questions. Under each research question, the discussion is organized by the method or technique used to explore and analyze the data relative to that particular question. Prior to the presentation and discussion of data, the hospital sample is described.

96

Sample Hospitals

All 29 hospitals included in the CHQCC 1994 database were requested to participate in this study. Senior level nursing executive refusal or inability to provide necessary nursing resources data resulted in the initial sample size of 22 hospitals. Six of the seven hospitals which declined participation did so because data were not automated or were insufficiently automated to allow easy, quick retrieval. In each of these cases, interest and willingness to participate was expressed; however, due to time and personnel constraints, data could not be gathered. In three of these hospitals the situation was further complicated by recent merger, acquisition, or major reorganization events which resulted in the unavailability of 1994 data.

Face-to-face interviews with chief nursing officers (CNOs) were conducted for each of the 22 sample hospitals. These interviews provided descriptive data about the systems of nursing care delivery at the sample hospitals. All CNOs allowed the interviews to be audiotaped for repeated review by the investigator. During these interviews the process and content of the quantitative data collection was reviewed and questions were addressed. All CNOs expressed willingness to provide the quantitative nursing resources data. In a seven month period following the interviews, 17 hospitals had supplied the quantitative data. After repeated contacts with the remaining five hospitals, it was evident quantitative data would not be forthcoming. Interestingly, at four of the 17 final sample hospitals, nursing resources data were not completely available in automated format, requiring manual data collection methods in part, and the necessary personnel were made available to do so, indicating their desire and willingness to be included in this study. One hospital could not provide nursing hours data

disaggregated for all personnel (RN, LPN, and Nurse Aide); records were not available at all in manual or automated format for separate nursing labor categories. Therefore, for the variables of Total Nursing Hours per Discharge, Total Nursing Hours per Patient Day, Variable Nursing Hours per Discharge, Variable Nursing Hours per Patient Day, Fixed Nursing Hours per Variable Nursing Hours, Fixed Administrative Hours per Discharge, Fixed Administrative Hours per Patient Day, the sample size is 17 hospitals. For the disaggregated RN, LPN, and Nurse Aide variables the sample size drops to 16 hospitals. For those hospitals which lacked sufficient data automation and personnel to allow easy retrieval, discussions revealed this situation was due to change in the near term for most of these hospitals. Nurse managers verbalized the importance of these capabilities for optimal management of patients and nursing resources, and they anticipated acquiring such capabilities soon. Accordingly, one of this study's determinations is the feasibility of using nursing hours data, based on accessibility and availability, rather than FTE data with its inherent inaccuracies and relative imprecision. This finding has relevance to studies using multiple institution samples. Consistently recorded nursing hours data would enhance cross institution comparison.

Prior to data collection, a presentation was given by this investigator to a standing committee of chief nurse executives representing the local hospital association membership. At the conclusion of this presentation, several nurse executives expressed enthusiasm and interest in providing necessary data and participating in this investigation, but whose hospitals could not be included in the sample because they were not involved in the CHQCC. In only one of the 29 hospitals was CNO refusal seemingly related to concerns about: 1) data

security, 2) potential negative consequences from loss of anonymity (assuming hospital identity could be discerned from scatterplots and charts), and 3) derived benefits to the hospital for the time and effort required to provide data. The nurse executive requested additional written explanation from the investigator which would address these three issues. A supplementary six page document was submitted whereupon a final decision was made by the nurse executive to not participate.

Data collection specific to Research Question 4 provided the demographics of the final sample of 17 hospitals. Tables 4, 5, 6, and 7 display four categories of hospital characteristics which describe this sample. The first category (see Table 4) consisted of three general characteristics: 1) teaching mission (major, minor, non-); 2) ownership/affiliation: 3) Case Mix Index, as reported by the Health Care Financing Administration for the 1994 year.

The second category (see Table 5) included four types of support personnel whose roles impact relatively directly the work of nurses. These personnel were: 1) ward secretaries (WS); 2) dietary workers (DW), if they actually passed trays and assisted patients with opening containers; 3) patient transporters (PT); 4) ward-based housekeeping/unit assistant workers (WBHW). These support personnel were measured in fulltime equivalent positions (FTEs).

The third category (see Table 6) dealt with hospital capacity and its utilization. Four characteristics in this category included: 1) registered bed size, as listed for regulatory purposes; 2) actual beds in use during data collection period (thus eliminating wards closed through downsizing efforts); 3) unit bed size (number of adult medical-surgical and intensive

Table 4

Hospital Characteristics -- Category I (n = 17)

Characteristic	Sample Values
Teaching Mission:	
Major	2
Minor	7
Non	8
Ownership/Affiliation:	
Tax-Exempt (Not for Profit)	17
For Profit	0
County-, State-, Government-Owned	0
Stand-Alone Facility, without formal merger of assets or affiliation membership with a health system network (for entire period of data collection)	1
Case Mix Index:	
Range	0.882
Minimum Value	1.21
Maximum Value	2.09
Mean	1.45
Median	1.33
Standard Deviation	.27
IQR	.21
Skewness	1.83

Table 5

Hospital Characteristics-- Category II: Support Personnel[+]

Descriptive Statistics	WS	DW	PT	WBHW
Number of Cases	17	5*	9**	11***
Minimum Value	.057	.035	.039	.028
Maximum Value	.217	.309	.309	.309
Range	.160	.273	.270	.280
Median	.140	.046	.075	.063
Mean	.138	.097	.105	.089
Standard Deviation	.048	.118	.085	.080
IQR	.070	.146	.089	.038
Skewness	-.226	2.208	2.006	2.458

WS= Ward Secretary
DW= Dietary Workers, with tray passing and patient assistant responsibilities
PT= Patient Transporters
WBHW= Ward-Based Unit Assistants/Housekeeping Workers

Notes:
[+] values computed as FTEs/Total Direct Nursing Hours x 10^3

* Only 5 of the 17 hospitals reported DW roles as defined
         for study purposes.
** Only 9 of the 17 hospitals reported PT FTEs > 0.00.
         (3 hospitals could not provide PT data.)
*** Only 11 of the 17 hospitals reported using this worker category
         in at least one unit/ward.

Table 6

Hospital Characteristics-- Category III: Capacity/Utilization (n = 17)

Descriptive Statistics	Registered Beds	Beds in Actual Use	ICU/MS Beds	Occupancy Rate
Minimum	122	117	72	.408
Maximum	1192	1066	935	.826
Range	1070	949	863	.418
Median	336	240	171	.613
Mean	404.00	337.588	217.412	.624
Standard Deviation	276.29	242.767	197.383	.131
IQR	264.00	194.50	69.50	.169
Skewness	1.959	2.051	3.344	-.087

Table 7

Hospital Characteristics -- Category IV: Financial Descriptors

Descriptive Statistics	OM	ROA	HFB	NPEPD
Number of Cases	12	12	12	9
Minimum	-3.2	.076	13.08	845.13
Maximum	19.68	5.0	555.38	2090.23
Range	22.88	4.924	542.30	1245.10
Median	1.40	2.32	47.79	1475.00
Mean	3.629	2.239	108.77	1513.82
Standard Deviation	6.81	1.61	164.09	419.89
IQR	4.673	2.600	80.998	713.575
Skewness	1.693	.374	2.319	-.261

OM= Operating Margin
ROA= Return on Assets Ratio
HFB= Hospital Fund Balances, in millions
NPEPD= Nursing Payroll Expenses Per Discharge, in dollars

care unit beds to coincide with nursing resources data); 4) occupancy rate of unit bed size.

The fourth category (see Table 7) consisted of financial characteristics, namely: 1) hospital operating margin (OPM); 2) return on assets ratio (ROA); 3) hospital fund balance (HFB); 4) nursing payroll expenses per discharge (NPEPD).

Research Question 1: What is the Hospital Nursing Resources Distribution across the Hospital Sample?

Descriptive Statistics—Nursing Resource Variables

Descriptive statistics are presented in Appendix D and includes the following: Table D1, Nursing Resource Variables Central Tendency Measures; Table D2, Nursing Resource Variables Dispersion Measures; Table D3, Hospital Outcome Central Tendency Measures; Table D4, Hospital Outcome Dispersion Measures. These tables contain numerical measures selected to portray the distribution of the data set: i.e., location on the measurement axis, density patterns, spread, and symmetry. Consistent with Exploratory Data Analysis (EDA) techniques, emphasis was given to measures more resistant to outliers or extreme values, and more reflective of the majority of the data values. (Chambers et al., 1983; Harris, 1985; Hartwig & Dearing, 1979; Tukey, 1977). In addition to the arithmetic mean, the 5% trimmed mean and Tukey's mean were viewed in relation to variable median value, along with the computed skewness value, to assess distribution symmetry. Descriptive statistics used to assess variable distribution spread, the interquartile range (IQR), Tukey's Hinges, and the midspread (distance between Tukey's hinges) augmented the more frequently referenced measure of standard deviation.

Location, or central tendency, was initially assessed with descriptive statistics by rank ordering the variable median value and the three progressively restrictive means contained in Table D1. From Table D1 the following nursing resource variables were observed to display approximate symmetry: Variable Nursing Hours per Discharge, LPN Hours per Patient Day, Nurse Aide Hours per Patient Day, Fixed Nursing Hours per Discharge, Fixed Nursing Hours per Patient Day, and the Second Skill Mix (%RN+LPN Hours). However, the skewness values for these variables varied widely, indicating the need to use several measures in the assessment of centrality (Weisberg, 1992). Subsequent graphical methods provided additional information regarding variable distribution symmetry and skewness. Therefore, as a singular descriptor of a variable's distribution, means and medians alone provide limited information, representing only a middle anchor point on a variable's measurement axis.

Table D2 displays measures of spread in the nursing resource variables. Standard deviation, range, minimum, and maximum values can be misleading as singular measures of dispersion because they are influenced by individual extreme data points (Weisberg, 1992). For that reason, EDA techniques emphasize order-based measures of dispersion. (Because Tukey's hinges are a mathematical variant of the 25th and 75th percentile values used to compute the interquartile range (IQR), the midspread (distance between Tukey's hinges) is slightly different and smaller than the IQR.) The various spreads and hinges referred to in EDA are based on *quantiles*, or fractions, of the data set, rather than percentiles of the data set used for conventional descriptive statistics (Chambers et al., 1983). Table D2 shows that, for this sample, the range of nursing hours per volume measure (discharges or patient days) can be quite

wide, however the bulk of hospitals fall within a much less dispersed range.

Table D2 also shows the difference between using an order-based statistic to describe variable dispersion and a deviation-based measure of dispersion. In the four most highly aggregated variables (Total Nursing Hours per Discharge, Total Nursing Hours per Patient Day, Variable Nursing Hours per Discharge, Variable Nursing Hours per Patient Day) the standard deviation approximates or is larger than the midspread and IQR. These four variables show a distribution pattern of values through their range such that the squared deviations from the mean communicate more variability than those measures (midspread and IQR) which are computed using location of data points relative to the range midpoint. This relationship occurs because the few farther points in the range increase the standard deviation, and do so at an increasing rate due to the squaring. The disaggregated and two skill mix variables all display the opposite relationship: the standard deviation is smaller than the IQR and midspread. It can be seen by this finding that the impact on the standard deviation of the squared mean deviations in these variables is smaller than the rank ordering effect is on the order-based measures of spread. Weisberg (1992) notes that while order-based dispersion statistics do not generalize well beyond the single variable, they effectively reflect amount of spread for certain data types or when nonresistant statistics (standard deviation, variance) are not appropriate or helpful in understanding the dispersion.

Descriptive Statistics--Hospital Outcome Variables

Relationships between medians and means in Table D3 indicate only slight skewing in the

variables of Nursing Care Satisfaction (PS-NC), Nursing Index Satisfaction (PS-IX), and

Mortality, and the skewness values for Nursing Index Satisfaction and Mortality are small as

well. However, Global Patient Satisfaction shows a median which lies within the range of the

three mean values, but has a skewness value greater than 1. Graphical methods contribute

important clarifying information in such cases where numerical information is inconclusive.

Visual shape is not easily discerned from relationships between numerical measures. However,

it is of note that PS-Global has a smaller midspread than standard deviation, while all other

variables display the opposite relationship between these measures, especially Mortality.

The influence of individual PS-Global data points upon this observed relationship is made

evident when visual summary techniques are reviewed. PS-Global had a wider range but a smaller

midspread than PS-NC and PS-IX, indicating that the middle half of PS-Global data values were

packed into a tighter interval, but that there was also a greater spread of PS-Global values

overall. Mortality had the largest range and midspread, as well as the largest disparity

between the midspread and standard deviation, demonstrating the effect of more extreme data

points on standard deviation values.

Stem-and-Leaf Diagrams

Appendix E presents the variables' observed values in the form of stem-and-leaf (S&L)

diagrams. This technique shows actual data values, rank ordered and arranged in a way that

distribution shape begins to emerge for the observer. Chambers et al. (1983) calls the S&L "a

hybrid between a table and a graph, since it shows numerical values as numerals but its profile

is very much like a histogram" (p.26). As seen in Appendix E, if a S&L diagram had data gaps in the integer(s) forming the stem, the stem integers were left out on the diagrams to highlight their absence. In this way distribution gaps can be readily identified without confusion.

Stem-and-leaf diagrams allow more detailed examination of data than the histogram because histogram bars can obscure distances between points within them. The numeric values retained in the S&L diagrams create a picture of variable distribution which bring out areas of data density and gaps not perceptible through numeric descriptive statistics. Degree of distribution skewness is also more readily appreciated through these diagrams than with numeric statistics. Appendix E shows several variables which appear to be fairly uniformly and symmetrically distributed, with neither remarkable gaps nor densely concentrated data point areas. These distribution characteristics are key considerations in the use of less restrictive (nonparametric) statistical procedures (Gibbons, 1993). Variables displaying such distributions are as follows: Total Nursing Hours per Discharge, Variable Nursing Hours per Discharge, RN Hours per Patient Day (with the exception of 1 case), Fixed Nursing Hours per Total Nursing Hours, Fixed Nursing Hours per Discharge (although symmetry presents as bimodality, and one case departs markedly from other cases), the Second Skill Mix (%RN+LPN Hours), Global Patient Satisfaction, and Nursing Index Satisfaction (bimodal).

Conversely, some variables showed evidence of skewed distributions due to identifiable areas of data density. Of note, they are: Total Nursing Hours per Patient Day and Variable Nursing Hours per Patient Day (slight skewing to the right), RN Hours per Discharge (to the right), LPN Hours per Patient Day (to the right), and Nurse Aide Hours per Patient Day (to the

right). The two variables of LPN Hours per Discharge and Nurse Aide Hours per Discharge showed the widest and most erratic distributions. The observation that these nursing variables present quite differently depending on whether the volume measure is discharges or patient days should be considered when choosing measures for subsequent investigations.

Table 8 lists the variables which appeared to be symmetrical by three techniques used and discussed previously. This table illustrates the point that each technique views the data somewhat differently, and that using multiple techniques to fully examine variable distribution is advisable.

Table 8

Variables Appearing Symmetrical by Technique Used

Descriptive Stats (median/means)	SPSS Generated Skewness Value	S&L Diagram
VNH/DC	TNH/DC	TNH/DC
LPNH/PD	VNH/DC	VNH/DC
NAH/PD	FNH/TNH	RNH/PD
FNH/DC	FNH/PD	FNH/TNH
FNH/PD	PS-IX	FNH/DC
%RNH+LPNH		%RNH+LPNH
		PS-Global
		PS-IX

Contemplation of information conveyed by S&L diagrams requires consideration of factors influencing the technique. Construction of the diagram depends on the variable's measurement unit. In some cases it is necessary to either truncate the data values or expand

the data by using a multiplication factor. SPSS contains default settings which generated S&L

diagrams that were not always optimal data arrangements. Therefore, the S&L diagrams in

Appendix E were constructed by hand to derive meaningful arrays, the ease of construction being

one of this technique's appeals. For some variables the data values were truncated for the

stem, in others the leaf rows were split in half (0-4, 5-9) or in thirds (0 or 1-3, 4-6, 7-9),

depending on the range of data values. Nevertheless, the number of rows produced by

contracting or expanding the stem will influence somewhat the picture created by the diagram,

thereby obscuring deviations, irregularities, or unsystematic variation or conversely,

obscuring the systematic variation or regular patterns. Finally, the S&L diagram is a visual

technique of portraying variable distribution through data simplification, as is the

histogram, but by retaining the actual numeric values, the potential for oversimplification

is decreased.

Histograms

Of all the exploratory techniques used to discover distribution characteristics of a

variable, the histogram is the least emphasized by those who discuss such techniques in detail

(Chambers et al., 1983; Mosteller & Tukey, 1977; Tukey, 1977; Weisberg, 1992). Chambers et al.

(1983) observe that histograms are a "widely used", "convenient" communication device for

"general audiences", easily understood by "nontechnical people"(p. 24). Nevertheless, the

histogram has a long tradition in the methods of scientific inquiry to organize data sets in a

graphical format. The inherent weakness, however, is the relatively "arbitrary" decision

regarding interval width. Figure 3 illustrates the differing presentations for the variable, Total Nursing Hours per Discharge, produced by altering the data interval width. Changing the bar width will alternately generate more smoothness or more detail in the histogram profile. This aspect of histograms must be considered when examining them. Notwithstanding, Appendix F contains a histogram for each variable using SPSS default settings. While the search for symmetry is emphasized more than the search for normality in EDA (the normal curve being inherently symmetrical), the SPSS generated normal curve was superimposed on each diagram for illustrative purposes.

Reviewing the histograms added a different perspective on the variables. This sequential act of summarizing the data begins to collapse the S&L diagrams. Several variables displayed more noteworthy patterns, and a general overall effect was to make more evident the appearance of modes. A number of variables appeared to be unimodal, although the distinctness of the mode within the diagram varied. Several variables showed data clustered more around two or three areas in the range, and other variables demonstrated a particularly flat distribution across most of the range.

The Variable Nursing Hours and RN Hours variables (both per Discharge, and per Patient Day) looked similar in shape, and this is not surprising since the majority of Variable Nursing Hours are comprised of RN Hours (as demonstrated by the First Skill Mix variable, %RNH). Nurse Aide Hours variables are not too dissimilar in shape from RNH variables as well. It is the LPN Hours variables which seem to stand out with a distinctly different histogram shape. It would appear that perhaps the use of nurse aide resources is linked more systematically than
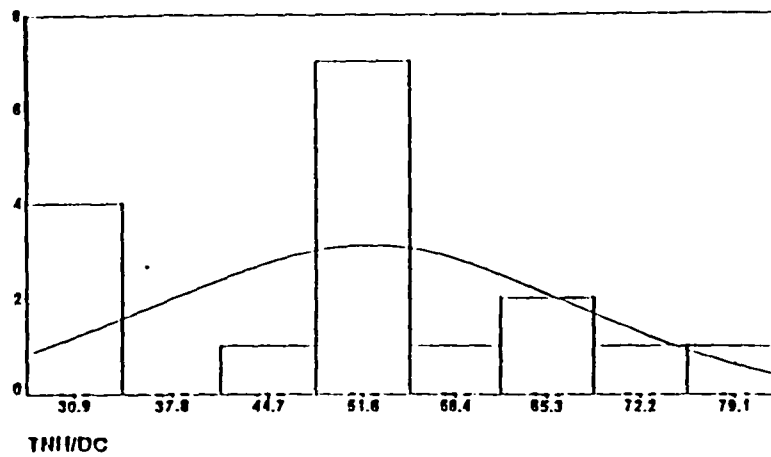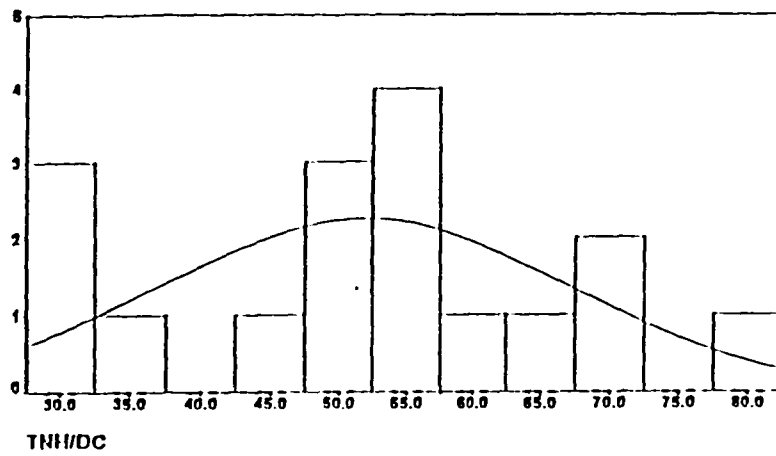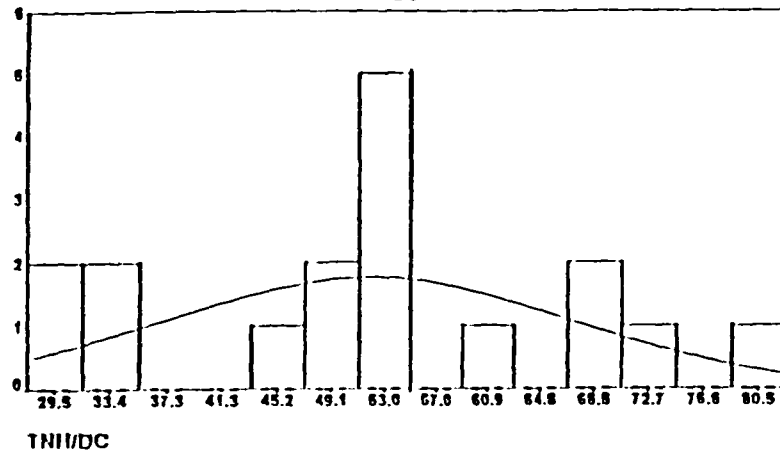
Figure 3. Affect on appearance of histogram by varying data intervals

practical nurse resources, to registered nurse utilization patterns. This may in fact be a reflection of the growing application of care partnering models (RN--Nurse Aide teams). Hospitals may differ more significantly from one another in the extent to which LPNs are utilized, and in the model of nursing care delivery. For example, one hospital in the sample employs no practical nurses in patient care positions; all patient care is delivered by registered nurses working with nurse aides as their assistants.

In taking the data set through the beginning stages of summarization, the histograms are a logical step to survey the variables. Concentration of data points in certain areas became more evident. Symmetry and normality could be assessed with caution.

Box-and-Whisker Plots

Another visual analytic technique, the box-and-whisker (B&W) plot, advances the progression of data summary specific to each variable by highlighting key distribution characteristics on one diagram. The B&W plot offers a compact picture of the bulk of a variable's data points, while also providing enhanced detail regarding the areas emphasized in the EDA perspective; namely, the tails of the distribution, where exceptions, outliers, and extreme points reside.

Appendix G presents a B&W plot for each variable. Several figures place side by side the plots for the nursing hours categories (Total Nursing Hours, Variable Nursing Hours, RN Hours, LPN Hours, Nurse Aide Hours) as measured against the two volume measures (Discharge and Patient Day). The Fixed Nursing Hours variables are also shown together in the same figure.

Skill Mix variables and outcome variables are grouped within single figures as well.

In a B&W plot, the box itself is bounded by Tukey's hinges and illustrates the central half of the data. The horizontal line within the box is the median. The endpoints of the whiskers show the highest and lowest values of the data set that do not qualify as outliers. With this information, the symmetry of the distribution can be assessed to some extent. While location of the median line within the box, and the length of each whisker will make readily apparent any remarkable inequality of the two distribution halves, detail regarding spread of actual values within these areas is lost. Nevertheless, the B&W plot gives a quick, general impression of distribution symmetry and a better picture of the tails than the S&L diagram. Together the S&L and B&W diagrams offer a clear portrayal of distribution symmetry, since shape is best perceived visually through these graphic methods.

The most readily apparent observation regarding dispersion in the nursing resource variables was the difference between using discharges or using patient days as the volume measure. Discharge volume resulted in variables with larger distribution spreads in every nursing resource category. Because these two volume measures produced variables with different locations on the nursing hours measurement axis, z-scores were generated for each of the nursing resource variables. These standardized scores gave a truer picture of dispersion differences between nursing hours measured against discharges versus patient days. Examination of z-score boxplots revealed that discharge volume continued to produce variables with wider dispersion; however, the magnitude of the differences were far less dramatic. In addition, it was noted that z-score boxplots of LPN Hours variables departed from the other

nursing resource variables in one respect. The midspread, illustrated by the box, was slightly wider for LPN Hours per Patient Day than for LPN Hours per Discharge. This finding is further illustrated in the scatterplots discussed in relation to Research Question 2, where the spread of LPN Hours per Discharge data points was seen to be less than the data point spread of LPN Hours per Patient Day, contrary to what was observed for of all other nursing resource variables. The particular contribution unique to B&W plots was the identification of cases which depart markedly from the overall distribution. The examination of such outlier cases is emphasized in the EDA approach, to discover previously unrecognized latent variables, uncover situations where theoretical relationships do not hold, detect data measurement or collection problems, or other matters pertaining to the specific investigation undertaken. SPSS defines outlier points as those falling more than 1.5 box-lengths from the upper or lower Tukey's hinge (boundaries of the box), denoted by a small circle. Extreme points are those which fall more than 3 box-lengths from the hinges, and are denoted by an asterisk. These criteria are Tukey's recommendation (Tukey, 1977), although other intervals may be used as criteria for defining outliers (Hartwig & Dearing, 1979; McNeil, 1977).

Several outlier and extreme points emerge from the B&W plots in Appendix G. Because the distributions for nursing hours per patient day variables are much tighter than for their counterpart 'per discharge' variables, the outlying and extreme values are most often seen in the 'patient day' variables. For example, the most highly aggregated category, Total Nursing Hours, presents the first outlier in Total Nursing Hours per Patient Day, but not in Total Nursing Hours per Discharge (which has a much wider distribution pattern). Variable Nursing

Hours per Discharge has a narrower spread than Total Nursing Hours per Discharge, which

explains the Total Nursing Hours per Patient Day outlier (case number 14) also appearing as an

outlier in the Variable Nursing Hours per Discharge boxplot. More illustrative of this point,

the Variable Nursing Hours per Patient Day boxplot contains four isolated cases: three are

outliers, one is an extreme point; two are high points, two are low points. (The two low points

are superimposed on each other due to the constraints of the program and diagram. They are case

numbers 7 and 16.) RN Hours per Patient Day and Nurse Aide Hours per Patient Day also exhibit

one outlier, the same case seen in the other boxplots (number 14). The Fixed Nursing Hours

variables showed the greatest dispersion of all the nursing resource variables, and among them,

Fixed Nursing Hours per Variable Nursing Hours displayed the widest variance.

The only outcome variable to exhibit any outliers was Global Patient Satisfaction. As

noted previously, the narrower midspread of the Global Patient Satisfaction distribution

pushed several data points into positions of relative marked distance from the bulk of the data

points, rendering them outliers in three cases and an extreme point in one case. Nursing Care

Satisfaction and Nursing Index Satisfaction had wider midspreads, but smaller ranges than

Global Patient Satisfaction, hence no outlying points appeared.

Implausibility is one question regarding outlying or extreme points which must be

considered in such cases (Chambers et al., 1983). Data collection or recording errors are

possible explanations. Attempts to verify accuracy and completeness of nursing hours data were

made both before and after data collection. Communication before and during the data

collection phase with those providing the data occurred primarily through verbal means, in

person or over the telephone. This was done in follow-up to the written materials given to the CNO during the interviews. In most cases, the CNO obtained data from nursing personnel in their departments who handle such information. In many instances, this investigator was given direct access to these persons which made personal communication possible. Clarification of needed data, what to include and what to exclude, was done verbally after the CNO interviews. Periodic reminder telephone contact was done as well, to prompt return of the data as well as to restate the requested data.

After the data were submitted by the sample hospitals, a written form was mailed to each institution. This was a checklist which rephrased questions that would insure data accuracy and completeness. Responses from these forms indicated understanding and compliance with the data requests. In the cases with the most extreme high and low nursing hours data, telephone contact was made again directly with the personnel who provided the data for assurance that data included what was requested. This was done before any data analysis was begun since it appeared some values were quite high or low. Interestingly, one hospital system had two member hospitals which showed up as outliers, one a low point and one a high point. The computerized nursing information systems for the two hospitals were merged and managed by the same person who supplied data for both hospitals. His reports were among the most comprehensive and well organized. In addition, this person's interest and initiative were evidenced by two telephone calls to this investigator; 1) offering more discrete data than was requested, prior to collecting the data, and 2) verifying that submitted data satisfied the request and was clearly understandable. For these reasons, the data from these two hospitals displaying outlier points

was judged to be accurate and plausible.

The other hospital which appeared as a high outlier in several variable distributions was evaluated for accuracy and plausibility as well. This hospital did not have a comprehensive computerized nursing information system. However, the hospital was small and processes were informal. Nursing management was anxious and enthusiastic about being in the study. The hospital had recently been purchased by a large health care system, and it was generally regarded as a positive move. The arrival of a new CNO liberated the time needed by the interim acting CNO, who had since moved into a special projects type position, to manually collate the data. Communication was facilitated by both these persons and response time was short. Follow-up discussions led to the conclusion that these data were accurate and plausible. Prior to the purchase of this hospital, patient volume was decreasing, but management philosophy involved reluctance to lay off personnel. Therefore, the high nursing hours per volume measure seemed to be explained. The other hospital (case number 7) presenting as a low outlier point was examined as well. A computerized nursing information system was in place which allowed all data to be provided quickly. The nursing hours data were downloaded onto floppy discs in Lotus format and given to this investigator. Knowing the management style of this hospital CEO to focus on efficiency of operation, the numbers seemed plausible.

Only two variables appeared to be symmetrical as portrayed in B&W plots, using median lines and whisker lengths as key indicators: Total Nursing Hours per Discharge and Global Patient Satisfaction. Several others were very close to achieving symmetry: Total Nursing Hours per Patient Day, LPN Hours per Patient Day, Fixed Nursing Hours per Discharge, Fixed

Nursing Hours per Patient Day. Some of these can be found in Table 4, identified as symmetrical through other techniques. Aside from distribution symmetry, the B&W plot presents a clearer image of the distribution tails relative to the distribution as a whole. The whiskers and outlying points of the diagram gives a recognizable scale to the tails, more than can be discerned from the S&L or histogram, and certainly more appreciable than numeric measures.

Normality Q-Q Plots

EDA makes extensive use of various point plotting techniques (Chambers et al., 1983; Hartwig & Dearing, 1979; Tukey, 1977). The symmetry plots of EDA are designed specifically for the purpose of assessing distributional symmetry. These plots use order-based measures and computations to locate data points graphically. Normality Q-Q plots are a type of symmetry plot since, by definition, normal curves are symmetrical. Normality is, however, a more restrictive condition than symmetry. Appendix H displays the SPSS generated Normality Q-Q plot for each variable.

In general, the Q-Q plots exhibited some scatter of the data points about the line in each variable, indicating departure from normality. Some variables showed slightly less linearity in the pattern than most (Nurse Aide Hours per Patient Day, Mortality). Several variables exhibited a more linear scatter pattern, closer to a normal distribution, namely: Total Nursing Hours per Patient Day, Variable Nursing Hours per Discharge, LPN Hours per Patient Day, Global Patient Satisfaction, Nursing Care Satisfaction and Nursing Index Satisfaction. With the exception of Nursing Care Satisfaction, these same variables also

displayed histograms with shapes most closely approximating a normal curve. Two variables, Nurse Aide Hours per Discharge and Nurse Aide Hours per Patient Day, had histograms with shapes very closely resembling normal curves, but were skewed to the right. Together, the normal curve overlaying the data and the Q-Q plot, contribute to the assessment of normality. Both techniques consist of an eyeballing process and judgement regarding normality, a hallmark of the exploratory method when early efforts are undertaken for discovery purposes.

Summary

These descriptive and exploratory data analysis techniques provided an answer to the question of what the nursing resources distribution looked like across the sample. First, while a few deviant cases were found in this small local hospital sample, examination of variable distributions indicated there is a generally accepted and typical quantity of nursing resources provided to patients. Second, in general variable distributions portrayed sufficient symmetry to warrant nonparametric tests, as are introduced in relation to Research Question 2. In addition, these data can be analyzed using statistical tests which are somewhat robust to violations of normality assumptions, such as multiple regression.

Thirdly, another finding in this exploration was the difference seen between the nursing resources per patient day and nursing resources per discharge. The effect of these two service volume measures on the distributions of nursing resource variables was seen to vary in magnitude across the sample and across the nursing resource variables explored in this investigation. This aspect of variable measurement should be considered in the planning of

investigations using such variables.

Finally, the LPN variables exhibited variable distributions which looked distinctively different from the other nursing resource variables across the sample. The visual pictures displayed by graphical methods illustrated this point particularly. As data analysis proceeded through subsequent stages in response to Research Questions 2 and 3, this LPN related distinction was found again.

Research Question 2: Is there a Relationship between Hospital Nursing Resources and Hospital Quality of Care Outcomes?

Correlation Coefficients

Bivariate relationships are described by three fundamental characteristics: strength, direction, and shape. Correlation coefficients provide numerical information regarding the first two characteristics. Scatterplots allow a visual picture of shape. With the exception of Fixed Nursing Hours variables, correlation coefficients were computed for each of the nursing resource variables and each of the outcome variables. Three different correlation coefficients were generated for each of these bivariate relationships: the Pearson product-moment correlation coefficient, Spearman's rho, and Kendall's tau. Tables 9, 10, and 11 display these three coefficients for each of the relationships, respectively. Besides exploring the nature of these relationships, this correlation procedure is a preliminary step to regression analysis, which was performed in answer to Research Question 3.

Each of the three correlation coefficients contributes somewhat different information

Table 9

Pearson Correlation Coefficients between Nursing Resource Variables and Hospital
Outcome Variables

	PS-Global	PS-NC	PS-IX	Mortality
TNH/DC	.1349	-.0321	.0399	-.1044
p value	.690	.903	.879	.690
TNH/PD	.1606	.1297	.1821	-.2593
p value	.538	.620	.484	.315
VNH/DC	.1350	.0093	.0904	-.1058
p value	.605	.972	.730	.686
VNH/PD	.1592	.1716	.2331	-.2583
p value	.542	.510	.368	.317
RNH/DC	.4684	.0911	.1938	-.2477
p value	.067	.737	.472	.355
RNH/PD	.4319	.2189	.3024	-.3873
p value	.095	.415	.255	.138
LPNH/DC	-.6291	-.2863	-.3008	.2193
p value	.009	.282	.258	.414
LPNH/PD	-.6133	-.2389	-.2693	.1756
p value	.012	.373	.313	.515
NAH/DC	.3985	.2635	.3126	-.1944
p value	.126	.324	.239	.471
NAH/PD	.3421	.3032	.3440	-.2192
p value	.195	.254	.192	.415
%RNH	.4785	.1566	.1982	-.1522
p value	.061	.563	.462	.574
%RNH+LPNH	-.4279	-.2244	-.2467	.0933
p value	.098	.403	.357	.731

Note: n = 17 for TNH/DC, TNH/PD, VNH/DC, VNH/PD
       n = 16 for all other nursing resource variables

Table 10

Spearman's Rho Correlation Coefficients between Nursing Resource Variables and Hospital Outcome Variables

	PS-Global	PS-NC	PS-IX	Mortality
TNH/DC	.1665	.0297	-.0099	.0700
_p_ value	.523	.910	.970	.790
TNH/PD	.2162	.1546	.0764	-.1301
_p_ value	.405	.554	.771	.619
VNH/DC	.1416	.0903	.0702	.0921
_p_ value	.588	.730	.789	.725
VNH/PD	.2505	.1343	.0536	-.0743
_p_ value	.332	.607	.838	.777
RNH/DC	.4605	.1383	.1317	-.0088
_p_ value	.073	.610	.627	.974
RNH/PD	.5576	.1993	.1376	-.1960
_p_ value	.025	.459	.611	.467
LPNH/DC	-.5173	-.1680	-.2293	.2845
_p_ value	.040	.534	.393	.286
LPNH/PD	-.5083	-.1606	-.2101	.2594
_p_ value	.044	.552	.435	.332
NAH/DC	.4545	.1205	.1213	-.0236
_p_ value	.077	.657	.655	.931
NAH/PD	.3708	.1264	.1302	-.0133
_p_ value	.157	.641	.631	.961
%RNH	.3289	.1889	.2101	-.2506
_p_ value	.214	.484	.435	.349
%RNH+LPNH	-.3842	-.1859	-.1982	.0368
_p_ value	.142	.491	.462	.892

Note: n=17 for TNH/DC, TNH/PD, VNH/DC, VNH/PD
    n=16 for all other nursing resource variables

Table 11

Kendall's Tau_b Correlation Coefficients between Nursing Resource Variables and Hospital Outcome Variables

	PS-Global	PS-NC	PS-IX	Mortality
TNH/DC	.1242	.0153	.0075	.0967
p value	.503	.934	.967	.591
TNH/PD	.1553	.1222	.0679	-.0967
p value	.402	.505	.709	.591
VNH/DC	.1087	.0764	.0830	.1264
p value	.558	.677	.648	.483
VNH/PD	.1948	.1150	.0606	-.0299
p value	.295	.532	.740	.869
RNH/DC	.3369	.1219	.1116	.0084
p value	.081	.523	.555	.964
RNH/PD	.4256	.1741	.1116	-.1266
p value	.027	.361	.555	.498
LPNH/DC	-.4079	-.1219	-.1632	.2110
p value	.035	.523	.389	.259
LPNH/PD	-.3901	-.1044	-.1460	.1941
p value	.043	.584	.440	.229
NAH/DC	.3192	.0522	.0773	.0422
p value	.098	.784	.683	.821
NAH/PD	.2660	.0696	.0945	.0422
p va;ue	.168	.715	.618	.821
%RNH	.2660	.1567	.1632	-.2110
p value	.168	.411	.389	.259
%RNH+LPNH	-.2305	-.1567	-.1975	.0253
p value	.232	.411	.297	.892

Note: n=17 for TNH/DC, TNH/PD, VNH/DC, VNH/PD
n=16 for all other nursing resource variables

about the relationships and has a different interpretation. The Pearson coefficient is based on two assumptions: interval-level measurement and bivariate normal distribution (Gibbons, 1993). The Pearson coefficient itself implies a linear relationship between two variables, the value of which is a ratio whose denominator is computed using the variables' standard deviations, a nonresistant measure. Therefore, for nonlinear monotonic relationships, this coefficient would not adequately or accurately describe the strength of the relationship.

Spearman's rho and Kendall's tau, two nonparametric measures of bivariate association, were generated for these variables because they are less restrictive in their assumptions and more resistant to the effect of outlier values. As such, these measures are appropriate for this exploratory analysis. Spearman's rho is based on rankings, Kendall's tau is based on paired comparisons. Both measures assume a random sample, ordinal level data measurement, and a continuous bivariate distribution.

Rho and tau are interpreted similarly in terms of what their magnitudes indicate. However, linearity cannot be inferred and the shape or curve of the relationship cannot be discerned from the values. Pearson's coefficient provides an intuitively understood interpretation of relationship strength and direction, and relates to linearity. Kendall's tau has a particular and explicit interpretation. Spearman's rho, however, allows no similarly direct, immediate, or intuitive interpretation. Gibbons (1993) notes that values of rho and tau cannot be compared against one another in terms of the relative strength of association implied by each; that "Only the P-values are indicative of the strength of the relationship between variables" (p.17).

Because rho and tau measure association differently, the computed correlations were expectedly different. Values of rho are typically larger than those of tau, and this can be seen in Tables 10 and 11. The rho coefficients are larger than the tau coefficients in all but six of the 48 bivariate relationships. Statisticians tend to prefer Kendall's tau to Spearman's rho for two reasons (Gibbons, 1993). The first reason relates to the more direct interpretation of tau, mentioned previously. The second reason is because the sampling distribution of Kendall's tau reaches a normal distribution relative to sample size more quickly than does Spearman's rho. Gibbons (1993) states in conclusion, "If Spearman's rho, Kendall's tau, and Pearson's r are each equal to .5, the value .5 needs to be interpreted in three different ways" (p. 20).

Because of the introductory exploratory nature of this study, all three correlational statistics were computed to observe for patterns and additional insights contributed by each. The correlation coefficients contained in Tables 9, 10, 11 were reviewed for overall patterns. Table 12 identifies trends of directionality across the three techniques while recognizing the limits of statistical nonsignificance.

Summary. In relation to all three correlation coefficients, only one outcome, Global Patient Satisfaction, achieved or approached statistical significance (indicated in boldface type). In general, very few of the p-values showed significance levels of around .05 or less. For this reason, specific conclusions cannot be drawn, and any observed relationships could have occurred as much by chance as by any real association. The coefficients that did have significance levels under .10 were those of relationships between certain disaggregated

Table 12

Bivariate Relationships with Consistency of Positive or Negative Signs in all Three
Correlation Coefficients

Positive Coefficients	Negative Coefficients
TNH/DC and PS-Global	TNH/PD and Mortality
TNH/PD and PS-Global	VNH/PD and Mortality
TNH/PD and PS-NC	RNH/PD and Mortality
TNH/PD and PS-IX	LPNH/DC and PS-Global
VNH/DC and PS-Global	LPNH/DC and PS-NC
VNH/DC and PS-NC	LPNH/DC and PS-IX
VNH/DC and PS-IX	LPNH/PD and PS-Global
VNH/PD and PS-Global	LPNH/PD and PS-NC
VNH/PD and PS-NC	LPNH/PD and PS-IX
VNH/PD and PS-IX	%RNH and Mortality
RNH/DC and PS-Global	%RNH+LPNH and PS-Global
RNH/DC and PS-NC	%RNH+LPNH and PS-NC
RNH/DC and PS-IX	%RNH+LPNH and PS-IX
RNH/PD and PS-Global	
RNH/PD and PS-NC	
RNH/PD and PS-IX	
LPNH/DC and Mortality	
LPNH/PD and Mortality	
NAH/DC and PS-Global	
NAH/DC and PS-NC	
NAH/DC and PS-IX	
NAH/PD and PS-Global	
NAH/PD and PS-NC	
NAH/PD and PS-IX	
%RNH and PS-Global	
%RNH and PS-NC	
%RNH and PS-IX	
%RNH+LPNH and Mortality	

Note: Patterns were found across Pearson's r, Spearman's rho, and Kendall's tau, but
statistical significance was generally absent.

nursing resource variables and Global Patient Satisfaction. Among these coefficients, a consistent pattern emerged. For all three types of coefficients, a positive association existed between RN Hours variables and Global Patient Satisfaction, and an inverse relationship was observed between LPN Hours variables (including the Second Skill Mix variable, containing LPN Hours) and Global Patient Satisfaction. Because p-values were generally not significant throughout, all that can be derived from these data are suggestions for further exploratory investigations to seek stronger evidence of possible relationships. Coefficients in Tables 9, 10, and 11 were searched for consistency of sign (- or +). This directional consistency, absent statistical significance, is considered substantively significant enough to provide a basis for suggesting areas for subsequent investigations.

Scatterplots

Scatterplots furnish information related to all three characteristics of relationships: strength, direction , and shape. However, this technique is particularly valuable in depicting shape. Like the S&L diagram, the scatterplot displays actual data values of selected variables. Consistent with EDA methods, analysis of these diagrams commenced with a visual inspection to survey the overall scatter of points in each diagram. This eyeballing process, while not systematic, confirmed the results of the correlation coefficient tests. The scatter of points was generally so diffuse in each diagram that if any relationships exist, they are clearly weak and probably not linear.

Two kinds of lines were fitted to the bivariate relationships previously examined by

correlation coefficients: a) least squares regression, and b) Lowess. Least squares linear regression lines tend to track points which lie furthest from the bulk of data points as a result of minimizing squared residual variance. This was noted in the scatterplots which contained extreme or outlier points identified by B&W plots. Lowess lines are a variant of Tukey lines. Tukey lines are more resistant to the influences of more distant or outlier points because they are based on medians (McNeil, 1977; Tukey, 1977). Like Tukey lines, Lowess lines are utilized in the exploratory approach because they are not unduly distorted by a small number of more extreme points (Chambers et al., 1983). SPSS is capable of generating Lowess lines, and therefore this was the type of exploratory line used to compare with least squares lines. SPSS-generated Lowess lines were modified several times during the data analysis by changing the specified region used to localize the line. The SPSS default value of .5 was ultimately accepted for the diagrams analyzed in this investigation. Appendix I exhibits two scatterplots for each bivariate relationship, one with an overlying least squares line and one with an overlying Lowess line.

In general the disaggregated nursing resource variables displayed lines with greater slopes than the aggregated variables. In addition, the nursing resource variables measured against patient days had lines with greater slopes than those measured against discharges. Interestingly, three variables containing LPN Hours consistently exhibited lines which sloped in the opposite direction from all other nursing resource variables, and this observation held for all four hospital outcomes. These observations were consistent with the numeric values contained in Tables 9, 10, 11 which displayed negative correlation coefficients.

Lowess lines revealed the possibility of nonlinear monotonic relationships between certain nursing resource and hospital outcome variables. Examples of this nonlinear monotonic relationship were found in the scatterplots of LPN Hours per Discharge & Global Patient Satisfaction, LPN Hours per Patient Day & Global Patient Satisfaction, and First Skill Mix (%RNH) & Global Patient Satisfaction. Nonmonotonic relationships display lines which change direction within the scatterplot and are therefore by definition nonlinear. Examples of this type of relationship were found in the scatterplots of the Second Skill Mix variable and all four outcomes. However, for mortality, the curve moves in a direction opposite to what is seen for the three patient satisfaction outcomes. In each case, the direction of the line takes a turn when the skill mix reaches a value of approximately 95%.

The scatterplots of Global Patient Satisfaction showed the clearest relationships in relation to three variables (LPN Hours per Discharge, LPN Hours per Patient Day, and the First Skill Mix). RN Hours per Discharge and RN Hours per Patient Day demonstrated slight trends, but less than those just listed. In general, the scatterplots of Nursing Care Satisfaction showed less distinctive relationships than Global Patient Satisfaction. In fact, the scatterplots of Nursing Care Satisfaction & Total Nursing Hours per Discharge, Total Nursing Hours per Patient Day, Variable Nursing Hours per Discharge and Variable Nursing Hours per Patient Day variables had erratic lines communicating very little relationship. LPN Hours per Discharge and LPN Hours per Patient Day and First Skill Mix variables showed more evident nonlinear curves in Nursing Care Satisfaction scatterplots, suggesting some degree of relationship. Nevertheless, the point clouds in these scatterplots showed considerable spread and

inconsistency throughout the diagram. For example, four hospitals with the lowest nursing care hours had among the highest Nursing Care Satisfaction values. Therefore, based on these diagrams, it appears that Skill Mix relates more to patient satisfaction with nursing care, than absolute number of nursing care hours provided.

The outcome measure of Nursing Index Satisfaction, created for this investigation by combining the scores of three PJHQ subscales (Nursing Care, Daily Care and Information received) yielded results which looked very similar to those of Nursing Care Satisfaction alone. This can be explained in part because Nursing Care Satisfaction scores are contained within the Nursing Index Satisfaction scores, and because the correlation coefficients between the three subscales were high (Table 2, Chapter III). This can be understood intuitively because nurses are involved to a great extent in many aspects of patients' overall daily care and information exchanges. Even so, there were some differences in how these outcomes presented. For instance, Pearson coefficients (Table 5) were higher for Nursing Index Satisfaction than for Nursing Care Satisfaction with every nursing resource variable. However, having seen in the scatterplots a stronger tendency toward nonlinear monotonic and nonmonotonic relationships, the linearity implied by the Pearson coefficient diminishes the appropriateness of this measure.

The patterns identified by Spearman's rho and Kendall's tau were manifested in the scatterplots and the Lowess lines as well. For example, with the exception of one bivariate relationship (Variable Nursing Hours per Discharge & Nursing Index Satisfaction), rho and tau coefficients were higher for Nursing Care Satisfaction than for Nursing Index Satisfaction in

relation to the variable categories of Total Nursing Hours, Variable Nursing Hours, and RN

Hours. Conversely, rho and tau coefficients were lower for Nursing Care Satisfaction than for

Nursing Index Satisfaction and the categories of LPN Hours, Nurse Aide Hours, and Skill Mix.

In many instances the differences were slight, and in general the values for these two outcomes

tracked each other closely. The Nursing Care Satisfaction and Nursing Index Satisfaction lines

curved similarly for most of the nursing resource variables.

Mortality scatterplots exhibited findings similar to the patient satisfaction plots.

One hospital (case number 14), with the lowest actual-to-predicted mortality score and the

highest Total Nursing Hours, Variable Nursing Hours, RN Hours, and Nurse Aide Hours variable

values, pulled the end of each Lowess line in a downward direction. Without this point, those

lines would not have had such a distinctive upward or downward curve. The LPN Hours variables

had lines with more decisive upward trends, in spite of some downward dips. In addition, the

Skill Mix variables showed: a) an overall downward slope for the First Skill Mix (%RN Hours),

and b) an inverted u-shaped (nonmonotonic) curve for the Second Skill Mix (%RN Hours+LPN

Hours).

Summary

At this point in the investigation there appears to be a relationship between some

measures of nursing resources and the hospital outcomes. Evidence brought out by correlation

tests and scatterplot diagrams is limited but sufficient to suggest the presence of some

relationships requiring further investigation. Because of the introductory exploratory nature

of this study, three correlational statistics were computed to observe for patterns and additional insights contributed by each. In relation to all three correlation coefficients only one outcome, Global Patient Satisfaction, displayed or approached statistical significance as indicated by bold type face in Tables 9, 10, and 11. It is problematic to draw any definitive conclusions from these correlation coefficients in the absence of significant p-values. Table 12 identifies trends of directionality across the three correlation techniques, while recognizing the limits of non-significant statistical levels.

Nevertheless, a number of patterns emerged: a) some relationships appeared to be nonlinear (for example, the relationship between Mortality and the disaggregated nursing resources, especially Skill Mix); b) the relationships appeared quite similar for the outcomes of Nursing Care Satisfaction and Nursing Index Satisfaction and the various nursing resources; c) consistent and observable dissimilarities were seen in the fitted lines of hospital outcome--nursing resource relationships when comparing the two different volume measures (discharges versus patient days); d) LPN hours appeared to have a negative relationship with hospital quality outcomes and RN Hours appeared to have a positive relationship with the outcomes; e) the relationship was stronger between nursing resources and Global Patient Satisfaction than with either Nursing Care Satisfaction or Nursing Index Satisfaction.

Research Question 3: To what extent does Amount of Hospital Nursing Resources and Skill Mix of Hospital Nursing Resources Explain Variation in Patient Satisfaction and Mortality Outcomes?

Beyond asking whether or not hospital nursing resources are related to hospital outcomes (Research Question 2), the question was posed regarding the extent to which variation in the measured outcomes was explained by differences in hospital nursing resources. This question was addressed using multiple regression procedures, which are based on the general linear model. Therefore, use of this technique applies a specific form and set of assumptions to the data, not demanded by correlational questions and tests. More specifically, regression assumes the dependent variable is a function (to some extent) of the independent variables in the equation. Other assumptions related to regression analysis and the linear model are discussed after the results of the statistical procedures are reported. Multiple regression was done using the outcome (dependent) variables of: Global Patient Satisfaction, Nursing Care Satisfaction, Nursing Index Satisfaction, and Mortality. Disaggregated nursing hours and skill mix variables were the independent variables.

Relationships Among Independent Variables

Prior to performing the multiple regression analyses, a correlation matrix was generated for the independent variables to identify intercorrelations among these variables. A better test to assess multicollinearity among independent variables is to regress each independent variable on all other independent variables and examine the R^2s for those regressions (Berry & Feldman, 1985). Table 13 displays the correlation matrix. Table 14 displays the R^2s for each of the independent variables regressed on the other independent variables in each equation. Additional multicollinearity diagnostics were done on the three

Global Patient Satisfaction regression equations, because the models for this outcome exhibited statistical significance.

Tables 13 and 14 suggested several points regarding interrelationships between nursing resource variables. First, there was high correlation between RN Hours per Discharge & RN Hours per Patient Day, LPN Hours per Discharge & LPN Hours per Patient Day, and Nurse Aide Hours per Discharge & Nurse Aide Hours per Patient Day, the latter two having slightly higher and statistically significant coefficients. This suggests that, in general, statistical results in studies using one or the other of these volume measures might be similar. Decisions regarding volume measure selection to quantify nursing workload or resources provided to patients could rely more on the nature of the research questions, or knowledge about individual variable behavior/characteristics, or other issues. Preliminary univariate data analysis of selected nursing resource variables from a specific sample in a given study would lend support to such decisions.

Table 13

Correlation Matrix of Independent Variables

	RNH/DC	RNH/PD	LPNH/DC	LPNH/PD	NAH/DC	NAH/PD	%RNH	%RNH+LPNH
RNH/DC	1.000							
RNH/PD	.9442	1.000						
LPNH/DC	-.0354	-.0563	1.000					
LPNH/PD	-.0595	-.0403	.9893**	1.000				
NAH/DC	.6656	.7213**	-.0777	-.0635	1.000			
NAH/PD	.6366**	.7275**	-.0665	-.0402	.9920**	1.000		
%RNH	.0663	.0445	-.8577**	-.8648**	-.2606	-.2693	1.000	
%RN+LPNH	-.4194	-.4444	.2280	.2196	-.9189**	-.8976**	.2107	1.000

**$p < .01$

Table 14

R² Values when Regressing Each Independent Variable on the Other Independent
Variables contained in the 3 Regression Equations

Variable	R^2
Equation 1	
RNH/DC	.358
LPNH/DC	-.146
NAH/DC	.361
Equation 2	
RNH/PD	.457
LPNH/PD	-.152
NAH/PD	.457
Equation 3	
%RNH	-.024
%RNH+LPNH	-.024

* $p < .05$

Another consistent pattern was the correlation between RN Hours per Discharge &
Nurse Aide Hours per Discharge, and RN Hours per Patient Day & Nurse Aide Hours
per Patient Day (although, Patient Day coefficients were greater than Discharge
coefficients). Moreover, this pattern of correlation still held even when the two nursing
categories (RN and Nurse Aide) of opposite volume measures were examined (i.e., RN
Hours per Discharge & Nurse Aide Hours per Patient Day, and RN Hours per Patient
Day & Nurse Aide Hours per Discharge). Within the two regression equations using the
different volume measures (Table 14), R²s showed the collinearity between RN Hours
and Nurse Aide Hours to be higher again for Patient Days than for Discharges.
This collinearity between RN and Nurse Aide resources seems to suggest a

complementary relationship in the utilization and scheduling of these two nursing resource categories. This is consistent with the increasing literature and practices endorsing variants of "care partnering" models, which link skilled and unskilled nursing personnel, as well as the move to primary nursing models and all-RN staffing in the 1980s. Conversely, LPN Hours variables appear not to be correlated to RN Hours or Nurse Aide Hours variables. There appears to be a possible substitution effect involved with these nursing resource categories.

The two Skill Mix variables (%RNH, and %RNH+LPNH), departed from the patterns previously noted. Correlation coefficients between %RNH and the other two RN Hours variables (RN Hours per Discharge and RN Hours per Patient Day) were quite low. Therefore, a difference clearly emerges when measuring a nursing resource category as a percentage of total resources, versus measuring a resource in relation to service volume. Furthermore, while percentage of RN Hours is subsumed within the Second Skill Mix variable (%RNH+LPNH), correlation between these variables is not high, nor is the R2 value. Because of the possible substitution effect, or other explanatory factors related to the utilization patterns of these two different but licensed nursing resource categories, measurement of both Skill Mix variables, in studies where skill mix is of interest, is likely to contribute additional and worthwhile information. While not all values contained in Tables 13 and 14 were statistically significant, the substantive significance of the patterns warrant further investigation as relates to subsequent studies involving such variables.

The optimal technique for dealing with multicollinearity is to gather more information by increasing the sample size (Berry & Feldman, 1985). This solution was not feasible in this

study. Because prior knowledge about these particular relationships is lacking in the research literature, this source of additional information was unavailable also. Combining or deleting these independent variables was not felt to be an appropriate response to the multicollinearity. Therefore, the multicollinearity was handled by acknowledging its presence and suggesting interpretations (Berry & Feldman, 1985). The consequences of accepting this collinearity are probably less severe here since this is not a hypothesis-testing investigation, and because no policy-making decisions or actions in the practice setting are being made in connection with study findings.

Multiple Regression

Three regression equations were run for each outcome (dependent) variable. The first equation used RN Hours per Discharge, LPN Hours per Discharge, and Nurse Aide Hours per Discharge as the independent variables. The second equation used RN Hours per Patient Day, LPN Hours per Patient Day, and Nurse Aide Hours per Patient Day for the independent variables. The third regression was done with the two Skill Mix variables; %RN Hours, and %RN Hours +LPN Hours. Tables 15, 16, 17, and 18 present the multiple regression results for the four outcome variables, respectively. Global Patient Satisfaction, Nursing Care Satisfaction, Nursing Index Satisfaction and Mortality.

Only Global Patient Satisfaction (Table 15) showed evidence that the linear model might describe the relationship between amount and type of nursing resources and this outcome. Regressions of the other three hospital outcome variables (Tables 16, 17, 18) displayed a lack

Table 15

Multiple Regression of Patient Satisfaction--Global

Variable	B	SE B	Beta	t	p
Equation 1					
RNH/DC	.00118	7.5463E-04	.38264	1.564	.144
LPNH/DC	-.00348	.00105	-.60802	-3.320	.006
NAH/DC	6.94649E-04	.00177	.09649	.393	.701
Model: Adjusted R^2 =.5002, df =3,12; F =6.003, p =.0097					
Equation 2					
RNH/PD	.00706	.005354	.37489	1.318	.212
LPNH/PD	-.02089	.006842	-.59635	-3.053	.010
NAH/PD	.00182	.011407	.04534	.159	.876
Model: Adjusted R^2 =.4289, df =3,12; F =4.755, p =.0208					
Equation 3					
%RNH	.00203	6.6940E-04	.59514	3.033	.010
%RNH+LPNH	-.00283	.001004	-.55332	-2.820	.015
Model: Adjusted R^2 =.448, df =2,13; F =7.086, p =.008					

Table 16

Multiple Regression of Patient Satisfaction--Nursing Care

Variable	B	SE B	Beta	t	p
Equation 1					
RNH/DC	-4.67196E-04	.00116	-.14362	-.403	.694
LPNH/DC	-.00160	.00161	-.26508	-.994	.340
NAH/DC	.00257	.00271	.33853	.948	.362
Model: Adjusted R² =-.060, df =3,12; F =.717, p =.561					
Equation 2					
RNH/PD	-1.76324E-04	.00773	-.00888	-.023	.982
LPNH/PD	-.00839	.00988	-.22715	-.849	.412
NAH/PD	.01271	.01647	.30050	.772	.455
Model: Adjusted R²= -.071, df =3, 12; F =.670, p =.587					
Equation 3					
%RNH	7.67485E-04	9.7163E-04	.21334	.790	.444
%RNH+LPNH	-.00145	.00146	-.26934	-.997	.337
Model: Adjusted R² =-.0456, df =2,13; F =.673, p =.527					

Table 17

Regression of Patient Satisfaction--Nursing Index

Variable	B	SE B	Beta	t	p
Equation 1					
RNH/DC	-5.17663E-05	.00104	-.01748	-.050	.961
LPNH/DC	-.00153	.00144	-.27791	-1.056	.312
NAH/DC	.00209	.00244	.30261	.859	.407

Model: Adjusted R^2 =-.031, df =3,12; F =.847, p =.494

Variable	B	SE B	Beta	t	p
Equation 2					
RNH/PD	.00189	.00685	.10482	.277	.787
LPNH/PD	-.00857	.00876	-.25474	-.979	.347
NAH/PD	.00992	.01460	.25746	.679	.510

Model: Adjusted R^2 =-.014, df =3,12; F =.931, p =.456

Variable	B	SE B	Beta	t	p
Equation 3					
%RNH	8.57913E-04	8.6879E-04	.26187	.987	.341
%RNH+LPNH	-.001484	.001304	-.30189	-1.138	.276

Model: Adjusted R^2 =-.008, df =2,13; F =.940, p =.416

Table 18

Multiple Regression of Mortality

Variable	B	SE B	Beta	t	p
Equation 1					
RNH/DC	-.00134	.00223	-.21861	-.598	.561
LPNH/DC	.00237	.00310	.20907	.764	.460
NAH/DC	-4.64539E-04	.00523	-.03259	-.089	.931
Model: Adjusted R^2 =-.117, df =3, 12; F =.476, p =.705					
Equation 2					
RNH/PD	-.01790	.01417	-.48031	-1.264	.230
LPNH/PD	.01122	.01810	.16173	.620	.547
NAH/PD	.01086	.03018	.13677	.360	.725
Model: Adjusted R^2 =-.019, df =3,12; F =.905, p =.468					
Equation 3					
%RNH	-.00122	.00188	-.17985	-.647	.529
%RNH+LPNH	.00133	.00282	.13125	.472	.645
Model: Adjusted R^2 =-.108, df =2,13; F =.268, p =.769					

of statistical significance in regression coefficients, as well as in the overall regression models (R^2s). This finding does not necessarily suggest that no relationships exist between amount, type, or mix of nursing resources and these outcomes; simply that the relationships are not linear, if they do exist (Achen, 1982). These regressions support previous suggestions stated earlier that nonlinear monotonic, and nonmonotonic relationships might exist.

Each regression model for Global Patient Satisfaction displayed a statistically significant F value, summarizing the amount of total variation explained by the independent variables taken together. However, in the first two equations, only the regression coefficients for LPN Hours per Discharge and LPN Hours per Patient Day (respectively) showed statistical significance; the other coefficients did not. The third equation had significant t-values and F values, both. In addition, the magnitudes of the standardized regression coefficients is very close in the third equation, but one is a positive relationship (%RN Hours), while the other (%RN Hours + LPN Hours) is negative. In spite of the absence of coefficient statistical significance as noted, collinearity diagnostics were done on the variables in the interest of completeness. Tolerance is a numerical measure of the multiple correlation of an independent variable predicted from the other independent variables. The variance inflation factor (VIF), the reciprocal of the tolerance value, increases with variance in the regression coefficient. Together the tolerance and VIF are indicators of collinearity. Examination of these values indicated some consistency with other measures, which indicated the presence of collinearity between RN Hours and Nurse Aide Hours variables (Table 19). The VIF values are not as high, and the tolerance values are not as low, as would

be expected with strong collinearity; however, the parallel between RN Hours and Nurse Aide Hourse variables is apparent.

Table 19

Collinearity Measures of Independent Variables

Variable	Tolerance	VIF
Equation 1		
RNH/DC	.557	1.80
LPNH/DC	.993	1.01
NAH/DC	.554	1.81
Equation 2		
RNH/PD	.471	2.13
LPN/PD	.998	1.01
NAH/PD	.471	2.13

The tables containing variance proportions of regression coefficients and their relationships to eigenvalues were not analyzed for these equations. Detailed and definitive diagnostic procedures such as these are more appropriately applied to larger data sets which give stronger indications of fitting a linear model, and for which other types of analysis are desired (e.g., principal components analysis, or discriminant analysis) (Pedhazur, 1982).

Assumptions

Residual analysis enables evaluation of the extent to which certain regression assumptions have been met. Because the Global Patient Satisfaction outcome exhibited the only

statistically significant findings, residual analysis was limited to the three regression

models involving this outcome. The first model (Equation 1) regressed Global Patient

Satisfaction on RN, LPN, and Nurse Aide hours per Discharge. The second model (Equation 2)

regressed this outcome on RN, LPN, and Nurse Aide hours per Patient Days. The third model

(Equation 3) regressed the same outcome on the two nursing Skill Mix variables. Appendix J

contains scatterplots pertaining to residual analysis used to check assumptions. The

following are assumptions of multiple regression: the mean value of the residual (error term)

is zero; the variance of the residual is constant; each independent variable is uncorrelated

with the residuals; residuals are normally distributed; there is no autocorrelation

(residuals are uncorrelated); no perfect collinearity between independent variables is found

(Berry & Feldman, 1985; Schroeder et al., 1986).

Residual statistics generated for the models showed the residual mean was 0 in each

equation, indicating the first assumption was met. The second assumption, constant residual

variance, was evaluated with plots of standardized residuals against predicted dependent

(outcome) variable values (Ott, 1984). While some amount of generalized scatter was seen,

there were areas of point concentration in each plot. Based on the visual inspection of these

plots, violation of this assumption cannot be ruled out.

The third assumption regarding absence of correlation between residuals and

independent variables was tested with the use of plots displaying residuals against the

independent variables of each equation. Equation 1 involved the disaggregated nursing

resource variables (RN, LPN, Nurse Aide hours) measured per Patient Day. The second equation

involved the same disaggregated nursing variables measured per Discharge. The third equation regressed the outcome on the two skill mix ratios. These plots suggested possible violation of this assumption. The residual plots for Equations 1 and 2 looked distinctly different from those of Equation 3. Once again as noted previously, the Skill Mix variables, their individual behavior and their behavior in bivariate relationships, differed noticeably from the nursing resource variables of absolute amount of nursing hours delivered to patients.

The fourth assumption, that residuals are normally distributed, was addressed by examining P-P plots and histograms. Some departure from normality was evident in these graphs. A larger sample is likely to move closer to normality. Nevertheless, regression has been shown to be fairly robust to violations of this assumption (Achen, 1982; Berry & Feldman, 1985; Pedhazur, 1982).

The fifth assumption dealing with autocorrelation is most commonly a problem in time series designs. Because there were no repeated measures in this study, a major cause of violation of this assumption was not present. However, this assumption was tested by examining the plots of standardized residuals and independent variables. As previously noted in relation to the third assumption, inspection of these plots indicated a violation of this assumption to some extent. However, another explanation beside serial correlation would account for violation of this assumption.

The sixth assumption listed above, collinearity, was discussed first in this section as a prelude to approaching multiple regression, and a second time when reviewing the results of the regression equations and tests. As noted previously, there does appear to be some degree

of collinearity between RN and Nurse Aide variables. The presence of multicollinearity can affect the results of regression, depending on the extent of the collinearity. Multicollinearity is recognized as probably always present to some degree, although there is no one statistical test to definitively measure the amount of collinearity or the magnitude of the problems it presents. Nor is there a uniquely preferable method for solving problems related to collinearity (Schroeder et al., 1986). The primary consequence of collinearity, by its tendency to increase standard errors which then decreases the t-ratios, is to decrease the chances of finding statistical significance. The question seems not to be so much about whether or not collinearity exists, but rather to what degree, and then how important a problem it poses in a particular study (Berry & Feldman, 1985).

Summary

Regression analysis results were a consistent continuation of findings found in previous stages of data exploration. Specifically, in every equation the LPN variable exhibited an inverse relationship; RN and Nurse Aide variables showed positive relationships with outcomes. In addition, Skill Mix showed the possibility of a stronger relationship to outcomes than absolute amount of nursing resource hours delivered to patients.

Multicollinearity was found among the independent (nursing resource) variables, but it was not deemed appropriate for the purposes of this study to drop any variables from the regression equations. Because no other methods of dealing with the collinearity were advisable, available, or possible, this condition was accepted and recognized in data

interpretations.

Finally, the only outcome that was found to show statistical significance was Global Patient Satisfaction (satisfaction with the overall hospital stay). Together the disaggregated nursing resource variables in Equation 1 (nursing resources per discharge) explained half the variation in Global Patient Satisfaction. The model expressed by Equation 2 (nursing resources per patient day) explained 43% of the variation in Global Patient Satisfaction. However, only the LPN variables in these equations exhibited statistically significant regression coefficients. Equation 3, involving the two Skill Mix variables, explained 45% of the variation, and both skill mix variables had significant regression coefficients.

Research Question 4: Does the Nursing Resources-Hospital Quality of Care Relationship appear to vary with Hospital Characteristics and Nursing Care Delivery Methods?

This investigation focused on one major hospital structure variable (nursing resources) and its relationship to quality outcomes. Previous empirical work in the area of quality outcomes usually focused on other hospital structure variables (Burstin et al., 1993; Cleverley & Harvey, 1992; Leavitt, 1994). These variables were institutional characteristics related to human resources, operating capacity, financial performance, capital equipment, among others. Data about selected hospital characteristics were collected for this investigation that would link this study to previous work, as well as suggest research questions for subsequent studies. In addition, face-to-face interviews with Chief Nursing

Officers (CNOs) incorporated discussion about nursing care delivery methods in use at the time of nursing resources data collection. These delivery methods represent another dimension of structure related to nursing care delivery, as depicted in Figure 2, Chapter I.

Hospital Characteristics

Hospital characteristics were grouped into four categories. The first category consisted of three general characteristics: 1) teaching mission (major, minor, non-); 2) ownership/affiliation; 3) Case Mix Index, as reported by the Health Care Financing Administration for the 1994 year. Table 4 summarizes the sample in relation to these characteristics.

The second category included four types of support personnel whose roles impact relatively directly the work of nurses. These personnel were: 1) ward secretaries (WS); 2) dietary workers (DW), if they actually passed trays and assisted patients with opening containers; 3) patient transporters (PT); 4) ward-based housekeeping/unit assistant workers (WBHW). These support personnel were measured in fulltime equivalent positions (FTEs). To enable comparisons across the sample, a ratio was computed for each variable, as follows: the reported number of FTEs was divided by the absolute number of total direct nursing care hours. Table 5 presents summary measures of these variables in this sample.

The third category dealt with hospital capacity and its utilization. Four characteristics in this category included: 1) registered bed size, as listed for regulatory purposes; 2) actual beds in use during data collection period (thus eliminating wards closed through downsizing efforts); 3) unit bed size (number of adult medical-surgical and intensive

care unit beds to coincide with nursing resources data); 4) occupancy rate of unit bed size. Table 6 describes the sample in terms of these characteristics.

The fourth category consisted of financial characteristics: 1) hospital operating margin (OPM); 2) return on assets ratio (ROA); 3) hospital fund balance (HFB); 4) nursing payroll expenses per discharge (NPEPD). Table 7 presents a summary of these data for this sample.

Hospital characteristics data were considerably more difficult to obtain than the nursing resources data. For example, while the four types of hospital support personnel are fairly standard, universally understood roles, hospitals varied widely in how support personnel data are organized into departments and recorded/reported. Very little data were actually missing from the support personnel category; however, other difficulties were found. Ward secretary FTEs were computed routinely and carefully at each hospital for budgetary purposes. Dietary workers seemed to be clearly identified as having tray passing and patient assistance responsibilities, or not. Only 5 of the seventeen hospitals reported dietary workers with such responsibilities. Patient transporter (PT) data were provided by sample hospitals, but deemed not reliable due to inconsistencies in recording/reporting methods and sources of data across the sample. PT positions (and therefore, PT FTE data) often resided in various and multiple departments, such as the operating room, radiology, physical therapy, nursing, and other departments. Various PT scheduling and staffing routines existed across the entire sample and even within the same hospital. The ward-based housekeeping/unit assistant role was defined during the CNO interviews. As defined, this role was either present

and specifically designated within the hospital organizational structure, or it was not. However, even where such a ward-based role existed, wide variation in expected nursing support duties was found. In some instances, this personnel type was found in the ICUs, but not on the general medical-surgical units of the same hospital. Eleven of the seventeen hospitals reported the presence of such personnel in at least one unit.

The third category, operating capacity and utilization data, were readily available and considered satisfactorily accurate due to their necessity for a number of official reporting purposes. They are widely used for regulatory, fiscal/budgetary, and productivity measurement activities. These data were felt to be reliable, accurate, and complete enough for systematic analysis (Table 20).

The fourth category of characteristics, financial variables, contains the highest number of missing data fields. Hospital executives were generally hesitant to provide these data. However, several executives quickly and readily released financial data directly from their financial reports. One hospital sent a complete copy of their 1994 audited annual financial statements prepared by the independent accounting firm hired by that hospital. Twelve of the 17 hospitals sent operating margin, return on assets, and hospital fund balances data. Nine of the 17 hospitals sent nursing payroll expenses per discharge (NPEPD) data. The reason three hospitals did not send NPEPD data along with the other financial data is not clear. It would have been among the easiest numbers to compute. Because it was uncertain whether the computational methods used for the prior three financial characteristics were precisely the same for each hospital, these data were not felt to be reliable enough for systematic analysis.

Therefore, these data could only be viewed as general indicators of overall financial position among those hospitals which sent data.

Data insufficiency in a number of areas prevented findings that would assist in answering Research Question 4. However, nonparametric correlation coefficients were computed for the hospital characteristics variables which were felt to be measured with sufficient reliability and accuracy to justify such analyses. Table 20 lists the variables and contains the coefficients. This table reveals that no statistical significance was found for any of the bivariate relationships. Two rather low p-values for the Occupancy Rate/PS-G relationship appear to be anomalous and therefore probably spurious. Aside from the pure numerics of coefficient values and significance levels, directionality of relationships is of interest. For example, two relationships (Case Mix Index/Mortality and Occupancy Rate/Mortality) display identical coefficients and p-values, but one is positive, the other is negative. A larger sample is needed for subsequent investigations to test these relationships.

Hospital level analysis versus unit level analysis. While a primary feature of this investigation pertained to the hospital level of analysis perspective, findings raised interest in exploration at the unit level. In particular, questions concerning the impact of differences between intensive care unit volume versus medical-surgical unit volume were prompted. It is commonly known that ICUs are staffed with decidedly different amounts and kinds of nursing resources than routine medical-surgical units. Imbedded in the performed statistical analyses are the effects of differences among the sample hospitals in these two unit types (ICU vs. medical-surgical), as related to their respective differences in nursing

Table 20

Spearman's Rank and Kendall's Tau$_b$ Correlation Coefficients for Outcomes and Selected Hospital Characteristics (n= 17)

Hospital Characteristics	Spearman's Rank Coefficients			
	PS-G	PS-NC	PS-IX	Mortality
Case Mix Index	.005	-.059	.031	.297
p value	.985	.821	.907	.247
Registered Bedsize	.297	.071	.165	.081
p value	.247	.788	.527	.757
Beds In Use	.329	-.049	.019	.065
p value	.197	.850	.944	.804
Unit Bedsize	.374	.181	.200	.091
p value	.140	.488	.442	.729
Occupancy Rate	.448	.001	.094	-.282
p value	.071	.996	.721	.272

Hospital Characteristics	Kendall's Tau$_b$ Coefficients			
	PS-G	PS-NC	PS-IX	Mortality
Case Mix Index	-.015	-.046	.023	.216
p value	.933	.803	.901	.231
Registered Bedsize	.186	.031	.128	.097
p value	.315	.868	.481	.591
Beds In Use	.248	-.061	.007	.037
p value	.180	.739	.967	.836
Unit Bedsize	.288	.146	.182	.030
p value	.121	.428	.319	.869
Occupancy Rate	.342	.000	.038	-.216
p value	.065	1.00	.836	.231

resources associated with the two unit types. Table 21 lists the individual sample hospitals with their number of ICU days and number of medical-surgical days, along with the descriptive statistics for these two measures. The percentage of the ICU days varied widely across the sample from 6.7% to 28.3% of the combined patient day totals. If proportion differences in patient day type produces a measurable impact on the studied relationships between nursing resources and certain outcomes, then analyzing the data at this unit level could likely bring out additional insights and suggestions for further study.

If it were posited that these proportional differences in ICU/medical-surgical patient volume (and therefore the respective nursing resources variation associated with these differences) influence the quality outcomes, then they should be factored into the analyses. This could be accomplished by using of some sort of weighing schemata involving ICU/medical-surgical volume measures before going to the hospital level. Weighing the data could be done in a number of different ways. For example, an overall ICU/medical-surgical proportion for the whole hospital sample could be computed first to generate weights such as to standardize to the same proportion (i.e., if a 25% ICU/75% medical-surgical split exists overall, then weight the actual hospital numbers to these proportions: e.g., Hospital 1 = .25(Hospital 1 ICU ratio) + .75(Hospital 1 medical-surgical ratio) = Total Hospital 1 weighted ratio).

Or another technique might consist of computing individual within-hospital weights by using the number of patient care units or number of patient days (ICU versus medical-surgical) at each sample hospital, (that is, if Hospital 2 has 3 ICUs/7 medical-surgical units, or 30% ICU patient days/70% medical surgical patient days, then use the .3 and .7 as respective patient

Table 21

ICU and Medical-Surgical Unit Patient Days of Sample Hospitals
(% of total in parentheses)

Case #	ICU days	Med-Surg Days
1	901 (8%)	9794 (92%)
2	1401(10%)	12494 (90%)
3	1579 (11%)	12503 (89%)
4	3052 (11%)	23901 (89%)
5	2682 (12%)	20374 (88%)
6	6218 (12%)	44310 (88%)
7	1789 (9%)	19031 (91%)
8	1240 (13%)	8446 (87%)
9	2778 (15%)	16010(85%)
10	1691 (7%)	23412(93%)
11	2313 (12%)	16962(88%)
12	4886 (23%)	16620(77%)
13	15764(13%)	106414(87%)
14	554 (8%)	6448 (92%)
15	2887 (28%)	6584 (72%)
16	4865 (15%)	26528(85%)
17	1472 (12%)	10460(88%)

Raw number of Days -- Descriptive Statistics

	ICU Days	Med-Surg Days
Mean	3298.35	22370.06
S.E. Mean	863.93	5712.1
Std. Dev.	3562.06	23551.61
Min/Max	554/15764	6448/106414
Range	15210	99966

Percent of Days -- Descriptive Statistics

	ICU Days	Med-Surg Days
Mean	.129	.871
S.E. Mean	.013	.013
Std. Dev.	.054	.054
Min/Max	.067/.283	.717/.933
Median	.120	.880
Range	.216	.226

volume weights at Hospital 2. Follow in the same manner with all other individual hospitals in the sample, and then proceed with statistical analyses).

The purpose of weighing the sample hospitals on the basis of ICU/medical surgical volume differences is related to the potential for finding different results from the analyses after such data manipulation. Consequently, other inferences may be discerned from analyses along with additional implications and conclusions. Continued study of relationships such as those explored in this investigation at both the hospital and the unit level (either concurrently in the same study, or individually and sequentially in separate studies) is warranted. Such analyses will inform both areas of nursing administrative science, as well as nursing administrative practice; science and practice being two important components of the nursing discipline (Donaldson & Crowley, 1978).

Nursing Care Delivery Methods

The conceptual model presented in Chapter I grouped Nursing Structure variables into three broad categories: 1) Amount, 2) Expertise, and 3) Nursing Care Delivery Methods. Nursing care delivery is a complex topic in itself. Detailed information and systematic analysis regarding these methods would require time and resources beyond the scope of this investigation. Ideally, a questionnaire developed specifically to address nursing care delivery methods would be used to measure these variables. However, none was available for this investigation. Nevertheless, a few questions related to nursing care delivery methods were posed during the interviews with the CNOs to see if any additional insights might emerge. Twenty-two CNOs were interviewed and consented to be audiotaped for this investigation.

Seventeen of these twenty-two CNOs submitted the requested nursing resources data as well.

CNOs were asked open-ended questions about the following areas related to nursing care delivery

methods (see Appendix A):

* Describe the various nursing care delivery systems in place at the time. Describe

these systems as implemented at your hospital and where they were used. (e.g., team,

functional, primary, modified primary, care partnering)

* Were case managers being used in conjunction with unit nurses to meet patient/family

needs? With which patient types/groups? Briefly describe the procedure of patient selection

for case management, the role function, accountability.

* Were any critical pathways or care maps in place and being used? For which patient

groups, diagnoses, or surgical procedures?

* Were any nursing conceptual models or theories being used by the hospital nursing

department or by individual units to guide nursing care delivery? Which one?

It was clear from the interviews that wide variation existed in the kinds of nursing

care delivery methods used. All the traditional nomenclature was used to identify and describe

methods. In addition, some less common terminology, such as "district nursing", was used. Even

within the more familiar classification, such as team and primary nursing, individual

modifications and unique applications were found. A few hospitals appeared to be relatively

uniform in the type of nursing delivery method implemented across the entire institution. But

the majority of hospitals were characterized by two or three delivery types across the various

nursing units. Hospitals also varied across the sample in the degree of decision making

decentralization regarding the selection of which nursing delivery method to use within the hospital. Only one hospital reported that it was beginning to pilot a clearly structured care partnering delivery method in 1994. Several others had begun to consider a trial of care partnering during 1994. This RN-NA team structure links one professional nurse with one unskilled nursing worker to provide care to a specific group of inpatients. The NA is assigned to the RN rather than directly to the patients, which differs from traditional assignment approaches philosophically, conceptually, and operationally. By 1995, during the CNO interviews, several hospitals were actually implementing some form of care partnering on some units. These CNO interview responses highlighted the need to employ a detailed, structured data collection instrument to obtain discrete, discriminatory categorical data if systematic analysis is intended.

Less than half the sample hospitals employed nursing case managers during 1994 to specifically follow a select patient population from admission to discharge for purposes of monitoring/assessing care plans, coordinating resources, providing ongoing interdisciplinary and family communication, planning for discharge needs, and other activities intended to optimize desired outcomes and minimize avoidable problems. Several hospitals had professional roles with some components of the case manager role; for example, a post-acute care discharge planner position. In hospitals where the full case manager role was utilized, a limited number of patient groups or units were covered by such services.

Critical paths, fully developed and in actual use during the 1994 data collection period existed in 5-6 hospitals. (One CNO was uncertain about the precise period when the first

critical path was implemented at her institution.) The most frequent diagnoses/clinical problems for which pathways had been developed were: pneumonia, chronic obstructive pulmonary disease, acute myocardial infarction, and total joint replacement procedures. Approximately 10 hospitals were in some stage of conceptualizing, organizing formal committees, or drafting early versions of critical pathways. Others had only talked about the need to initiate the procedures.

Summary

Relative lack of data precision, reliability, and validity, as well as missing values concerning hospital characteristics prevent posing an answer to Question 4. Even with a number of qualifying statements, it would be difficult to suggest an affirmative or negative response to the question of whether the nursing resources-hospital quality relationship varies in relation to a) hospital characteristics, and/or b) nursing care delivery methods, in this sample.

Related to the concept of nursing care delivery methods, given the nature of the data collection and the received responses, it was concluded that a case study, qualitative analytic approach would best fit these data if further investigation of the research question were desired. This could be pursued on an adhoc basis at a future time. For a systematic and quantitative analysis of an entire sample (this or another one), a different approach to data collection would be required.

CHAPTER V

Discussion, Conclusions, and Recommendations

The purpose of this study was to examine key variables constituting a major structure component in hospital care, nursing resources, and their relationship to quality outcomes. This was done at the hospital unit of analysis, a macrolevel unit rarely found in the nursing research literature (Dimond & Slothower, 1978; Hinshaw, 1989; Meleis & Jennings, 1989; "National Conference", 1986). A convenience sample of hospitals located in one Midwest healthcare market was used. Twenty-two hospital Chief Nurse Officers contributed descriptive narrative data pertaining to nursing care delivery methods at their respective institutions. Seventeen of the 22 hospitals also provided quantitative data about their hospital nursing resources. Two kinds of risk-adjusted quality outcomes, patient satisfaction and mortality, were examined in relation to the measured hospital nursing resources. The hospital-specific outcome data were derived from a local market driven initiative which seeks to generate hospital level cost and quality data to inform purchasers of health care services.

The analysis began with description and exploration of individual nursing resource variables (Research Question 1). In subsequent stages of analysis (Research Questions 2 and 3) the nursing resource (independent) variables were examined in relation to the outcome (dependent) variables. A final research question gave consideration to selected hospital characteristics and nursing care delivery methods as relates to the structure-outcome relationship. This chapter presents an overview and discussion of the findings organized

161

according to the four research questions, followed by implications for theory and practice, limitations of the study, and suggestions for further research.

Overview of Study Findings

Research Question 1: What is the hospital nursing resources distribution across the hospital sample?

The findings related to this question serve two purposes. The first purpose addresses the need to understand the individual variables and their distributions prior to examining relationships between the variables in subsequent research questions. This purpose satisfies requirements internal to this investigation, linked to additional phases of data analysis (Ott, 1984). The second purpose relates to the lack of published empirical work dealing with hospital nursing resources at the macrolevel. General descriptions of data, suggested interpretations, and implications for further study generated by this study contribute to nursing administration literature, specifically nursing resources.

The first purpose was accomplished through Exploratory Data Analysis (EDA) techniques used to examine the independent and dependent variables. These techniques provided easily generated and readily understandable displays of the data set. They support the intuitive nature of the EDA approach and enabled the familiarity with variable distribution characteristics recognized by research literature to be a desirable precursor to confirmatory analyses (Chambers et al., 1983; Hartwig & Dearing, 1979; Tukey, 1977). For example, the decision regarding which singular statistic better describes a variable's dispersion can be

facilitated by the use of certain EDA techniques which portray the data graphically. Variables with several significant outliers may be best described by an order-based statistic, the median. This analysis confirmed a basic tenet of EDA; that is, the superiority of visual representations over purely numeric representations for purposes of understanding and distinguishing the characteristics of a variable's distribution shape (Hartwig & Dearing, 1979).

A number of highly sample-specific observations were noted in Chapter IV which answered the question of what the hospital nursing resources looked like in this sample. Overall, three general patterns were found: 1) differences between using patient days versus using discharges as the service volume measure; 2) while normality was often not absolutely apparent, symmetry was generally observed throughout most variables' distributions; and, 3) LPN variables had distinctly different distribution shapes from the other nursing resource variables.

Addressing the first observed overall pattern, researchers generally select either patient days or discharges to measure service volume. This investigation found differences between nursing resource variable distributions using these two different volume measures. This raises additional questions. For example, would the findings of other studies have differed if other volume measures had been used? Cromwell & Puskin's (1989) observed productivity differences between nursing units using nursing hours per discharge may have yielded different results if nursing hours per patient day were used instead. Burstin et al. (1993) doubly complicated the question of quality outcomes as related to numerous hospital structure variables by using two volume measures within one of their structure variables

(inpatient operating costs per discharge computed by, among other items, hospital personnel per hospital bed). Their findings which failed to explain variation in incidence of negligence as a function of labor resources may have been different if another volume measure used. Observed differences in distributional characteristics between nursing hours per discharge versus per patient day may influence decisions concerning data measurement and/or collection in specific studies, and could be applicable to operations research and efficiency functions.

The second observed pattern (distribution symmetry) combined with the small sample size was the indication for including nonparametric techniques to fully explore Research Question 2. The relative robustness of multiple regression to violations of normality allowed the use of this technique in answering Research Question 3. A number of studies investigating hospital structure--quality linkages have used multiple regression (Brennan, Hebert, Laird, Lawthers, Thorpe, Leape, Localio, Lipsitz, Newhouse, Weiler, & Hiatt, 1991; Burstin et al., 1993; Fleming, 1981; Harkey & Vraciu, 1992; Kuhn et al., 19091; Levitt, 1994).

The third observed pattern involving the distinctly different distribution shape of LPN variables in this sample has implications for Research Question 3, as well as for subsequent studies. In light of this finding, it is advisable to disaggregate nursing resources and to enter the different nursing personnel categories into regression equations. Eastaugh (1990) separated professional nurses from LPNs, aides, and clerks in his use of production functions to examine various hospital inputs relative to nursing efficiency. The highly nursing focused outcome variable of nursing efficiency in Eastaugh's study explains his greater attention to hospital nursing resource detail, but such nursing resource detail is rarely found in the

empirical literature (Banker et al., 1986; Borden, 1988; Cromwell & Puskin, 1989; Nunamaker, 1983; Sexton et al., 1989).

The second purpose was accomplished by this study; i.e., adding to the nursing research literature a description and exploration of nursing resources in a multihospital sample. Nursing administrative literature calls for such nursing resource descriptions in various settings, geographical regions, and segments of health care (Curtain & Zurlage, 1986; Edwardson, 1989; Hinshaw, 1989; Jennings, 1991; "National Conference", 1986). It will be through cumulative efforts at measuring and describing nursing resources in actual practice settings that knowledge and understanding about nursing practice will be increased. Observations regarding these variables has relevance to different phases of the research process. For example, differences in the distribution patterns among nursing labor categories may suggest specific relational statements among concepts contained in various theories used to study nursing administrative issues (Walker & Avant, 1983).

Nursing hours data are widely automated and relatively easy to retrieve from hospital information systems, but does require the individual contact and soliciting of data from selected hospitals. As such, the data are not readily available to outside investigators. Obtaining these data would not be as easy as accessing the large publicly available databases. The advantage to the researcher, though, is more refined data with respect to types of personnel, types of units, time periods and other parameters. This investigation showed that nurse executives are generally agreeable and willing to provide these data. The data elements found to be rarely available in automated format at the institutional level were RN educational

preparation, specialty credentials, and years of experience in nursing. Obtaining these data would require considerably more data collection manpower and time. The necessary data collection resources for larger sample sizes would be possible with sources of funding.

Research Question 2: Is there a relationship between hospital nursing resources and hospital quality of care outcomes?

Overall, statistical significance was not generally found in the three types of correlation coefficients used to test the bivariate nursing resource--hospital outcome relationships. However, in light of this singular data collection, involving a small sample, the observed patterns in coefficient values, directional sign, and in scatterplot diagrams was sufficient evidence to suggest possible nonlinear relationships between hospital nursing resources and hospital outcomes. In particular, a relationship between Global Patient Satisfaction and nursing resources appeared to emerge from the analysis, as well as a possible relationship between Mortality and nursing resources. A relationship between Nursing Care Satisfaction and nursing resources was less evident. Scatterplots of disaggregated nursing resource variables provided interesting patterns: a) increasing LPN hours appeared to adversely affect Global Patient Satisfaction and Mortality; b) increasing RN and Nurse Aide hours seemed to relate positively to these outcomes.

These preliminary findings are consistent with other studies which found a link between nursing and overall satisfaction with the hospital stay (Abramowitz et al., 1987; Doering, 1983; Fleming, 1981), and mortality (Aiken et al., 1994). However, these studies

lacked detailed measurement of disaggregated nursing resources personnel. The findings in this study regarding LPN variables and RN variables suggests the need for further study specifically focused on various nursing resource categories.

Outliers. Hospitals which appeared as either high or low outliers specifically, as well as those occupying otherwise highest or lowest positions in the bi-variate relationships could be further examined using: a) case study analytic methods, and b) contingency table analysis, with groupings into high, middle, and low positions.

Switching of relative positions was seen with certain cases between the various measures (for example, Hospital 1). Hospital 13, a high outlier for Global Patient Satisfaction, switched to a low position in scatterplots for Nursing Care Satisfaction. However, Hospital 6 was a consistent high outlier for both Global Patient Satisfaction and Nursing Care Satisfaction. Both these hospitals (13 and 6) enjoy a reputation in the lay and professional community for superior patient care, including specifically nursing care, and for having among the richest nursing resources mix. In addition, both Hospitals 6 and 13 show nursing resource amounts and skill mix ratios that are fairly similar. Therefore, differences in other nursing related structure and/or process variables must be sought out through selected methods to explain these differing outlier positions.

Hospital 15, a low outlier for Global Patient Satisfaction, and Nursing Care Satisfaction, dropped out of bivariate analyses involving disaggregated nursing resources because these data were not included in this hospital's record keeping systems. Based on information collected from the Nursing Director interview, this hospital appeared to be the

least sophisticated and most backward in areas related to nursing management. If the low Global Patient Satisfaction and Nursing Care Satisfaction scores are indeed related to this impression given by the content and process of the interview, then it would be a logical and credible connection.

Hospital 8 (the other low outlier for Global Patient Satisfaction and Nursing Care Satisfaction) was similar to Hospital 15 in its seeming lesser level of professional leadership and lack of current state-of-the-art organization of the Nursing Department, as compared to other sample hospitals. These impressions were communicated through responses given by the Nursing Director to interview questions. Of note, was the apparent absence of clinical role discrimination between the categories of nursing personnel, especially RN and LPN. Both Hospitals 8 and 15 were small community hospitals, among the smallest in the sample. Both were stand alone hospitals, suffering financial difficulties until they were purchased, each by a different and larger health care system, close to the period of data collection.

The importance and potential value of concentrating on outliers depends on their relationship to the rest of the data and the use for which the data is intended. Instead of setting aside outliers for the usual purpose of focusing on the bulk of the data, an isolated and specific analysis of the outliers themselves may yield more valuable findings in a particular study. Outliers are cases that reflect something different about the posited relationships characterized by the other cases in the sample, and as such may merit closer examination. Outlier analysis can potentially uncover additional important characteristics of the relationships being studied, thereby improving the analysis and understanding both of

the outliers and of the remaining cases, as well as to suggest other factors for inclusion in subsequent studies. For example, the outliers noted here point to a need for continued and heavier emphasis on selected nursing department descriptors (such as leadership features), and on certain hospital characteristics (such as size).

Research Question 3: To what extent does amount of hospital nursing resources and skill mix of hospital nursing resources explain variation in patient satisfaction and mortality outcomes?

More is implied by identifying and supporting relationships through regression techniques than by correlation tests. Regression analysis moves beyond simply discovering whether or not two variables consistently display a systematic relationship to each other (when in fact there may be third variable explaining the observed correlation). Multiple regression implies and assumes the dependent variable is a function of the independent variables (and some unnamed, unmeasured factor(s) reflected by the error term), and that the relationships are linear and additive. In this study evidence that Nursing Care Satisfaction and Mortality outcomes are a function, to some measurable extent, of the nursing resource variables is weak. Evidence for a nursing resources--Global Patient Satisfaction relationship is stronger. Findings of these analyses are considered preliminary and indicative of the need for further testing with modifications in a number of areas. Nevertheless, regression analysis results were a consistent continuation of findings found in previous stages of the data exploration. Any nonlinear relationships, if they exist, would not be appreciated through these techniques.

As posited under Research Question 2, bivariate relationships between nursing resources and Nursing Care Satisfaction and Mortality may be curvilinear. Findings of multiple regression tests did not support a linear relationship between hospital nursing resources and the outcomes of Nursing Care Satisfaction or Mortality. However, statistically significant findings of multiple regression supported a relationship between hospital nursing resources and Global Patient Satisfaction.

Assumptions of regression analysis were not met, compromising the generalizability of results. If generalizability of findings was the objective, even these violations would not necessarily discount completely the value of observations made here. Regression is recognized for its robustness and resilience to violation of assumptions (Achen, 1982; Berry & Feldman, 1985; Pedhazur, 1982; Schroeder et al., 1986). However, statements about an entire population resulting from hypothesis-testing procedures performed on samples, were not the aim of this investigation. Rather, the intent was to do an initial exploration and examination of nursing resource variables and their relationships to outcome measures in a way that has received little prior systematic analysis, especially at macro-analytic levels.

The absence of significance seen here between Nursing Care Satisfaction and hospital nursing resources conflicts with the findings of others (Abramowitz et al., 1987; Carey & Siebert, 1993) where greater satisfaction with nursing care was linked to greater satisfaction with overall (global) patient satisfaction. One explanation for this lack of significance may be the need for further instrument development. While the developers of the PJHQ Questionnaire report the psychometric testing of this instrument, it was a relatively new instrument with

fairly short subscales (5-9 questions) at the time of data collection (Rubin et al., 1990). Further testing and development with instrument modifications may result in greater validity and precision of nursing care satisfaction measurement.

The three regression equations for Global Patient Satisfaction exhibited statistical significance for the overall model. However, in the first two equations, two of the independent variables in the model did not display statistical significance. There are several probable reasons for the observed lack of statistical significance in the t-values. One reason is the multicollinearity and its effect on the standard errors of the coefficients and t-ratios as previously discussed in relation to assumptions in Chapter IV. Coefficient estimates with large standard errors also occur due to small sample size and/or variables with small variances in the sample, both of which were found in this study (Achen, 1982; Schroeder et al., 1986). Therefore, the SE B is likely to be higher in this sample than in a larger sample, or in a sample from another health care market, or in a more representative/random sample. This yields a concomitant decrease in the chances of finding statistical significance here.

More important than the statistical significance of regression coefficients, is the consistency of regression coefficients, which is critical to validation of regression conclusions (Achen, 1982). This requires repeated measurement, samples, and testing in a variety of contexts to detect consistency, further emphasizing the need for additional investigations. Achen (1982) stresses that "...[statistical] significance tests are essentially illustrative rather than definitive in character. The assumptions on which they are based are simply implausible for realistic data (p.39)". Yet interpretations and

conclusions sanctioned by statistically significant, albeit "illustrative" findings, serve to strengthen the related body of empirical knowledge, the desired character of which is definitive. Nevertheless, disciplined data exploration such as this can provide illustrative knowledge, even while acknowledging absence of statistical significance and limits imposed by practical constraints. As observed in the first two regression equations, the LPN variable exhibited an inverse relationship; the RNH and NAH variables showed positive relationships. The third regression equation for Global Patient Satisfaction involving the nursing skill mix variables, showed a stronger relationship to this outcome than the first two equations which contained the disaggregated nursing resources per service volume (Discharges and Patient Day). These areas warrant further exploration and empirical study of how certain outcomes are related to individual categories of nursing personnel, as well as to their proportions in the workgroup.

Exploration of these data also suggested the possibility of nonlinear relationships. A larger number of data points would allow patterns to become more prominent. The Gauss-Markov theorem proves that when all assumptions are met, the least squares estimators are best, unbiased and efficient. However, if the true relationship between the independent variable and the dependent variable is not linear, then some other model will always give better estimates, and in these situations biased estimators may have a smaller variance than the least squares estimate (Berry & Feldman, 1985). Follow-up studies could involve various methods to confirm and deal with nonlinearity.

Research Question 4: Does the nursing resources--hospital quality of care relationship appear to vary with hospital characteristics and nursing care delivery methods?

In addition to using hospital level outcome data, this question further moved the vantage point from the parochial nursing department level to the broader organizational context of the entire institution by examining selected hospital characteristics in relation to the findings of questions 1, 2, and 3. However, problems related to data collection, such as missing data values and concerns about data unreliability, severely compromised the ability to generate findings that would suggest answers to this question. Only hospital capacity and utilization data were deemed sufficiently reliable to examine relative to this question, but results of correlation tests were inconclusive. Other investigators have used publically available data about hospital characteristics to explain factors associated with quality of care (Al-Haider & Wan, 1991; Fleming, 1991; Harkey & Vraciu, 1992; Hartz et al., 1989; Keller et al., 1992). In most of those studies, hospital characteristics are viewed as having a more direct relationship to outcomes. In this investigation, hospital characteristics are conceptualized as moderating or mediating variables (see Figure 2, Chapter 1). In order to discern whether or not this conceptualization can be supported, additional data collection efforts would be required. Success of primary data collection in this area could be enhanced with careful instrument development and with adequate support for the study. Prior to additional study it would be necessary to address the issues of access to data and barriers to obtaining desired data, especially financial data.

In addition to these recommendations related to continued study at the hospital level

of analysis, findings related to Research Question 4 (and Research Question 3 as well) support

the recommendation that future study be conducted at the unit level in conjunction with the

hospital level either concomitantly, or separately and sequentially. Because nursing resource

differences exist among various clinical unit types (e.g., ICUs, medical-surgical units,

emergency rooms, obstetrical units, etc.), research questions involving nursing resources may

provide valuable added information if these differences are accounted for. Chapter IV

introduced specific weighting methods to adjust for ICU/medical-surgical volume variation.

Any follow-up analyses of this dataset, or of subsequent data collection efforts would include

both the hospital level and the unit level of analysis.

Narrative data obtained through C.N.O. interviews may well illustrate patterns and

highlight distinctions among hospital nursing departments. The interviews contained a

substantial amount of hospital-specific description. However, another method of analysis

would allow a fuller exploration of the meaning and findings imbedded within the interview

discussions. A subsequent analysis of the same data using qualitative methods could be

informative for suggesting and planning further studies that build on this investigation

(Parse, 1989; Smith, 1989). Hinshaw (1989) recommends that "quantitative designs ... be

coupled with ... ethnographic approaches to provide the rich data base needed for valid

interpretations... and understanding less well defined phenomena in nursing administration

research" (p.263).

These interviews contained dialogue suggestive of some factors related to such nursing

administrative phenomena. Investigations dealing with nursing resources in the aggregate are

needed in order to identify, define, clarify, and validate pertinent constructs. In this study

each of interviews addressed the topic of professional nursing practice models. As certain responses were followed by additional explication, two related concepts emerged: a) clinical and administrative decision-making, and b) control of practice/work environment. Hospital nursing departments seemed to vary along these lines, possibly to a substantial degree.

Other impressions of potentially significant factors were derived from the interviews. They all relate more or less in a general way to variation in the overall level of nursing practice professionalism. For example, differences in compensation and evaluation reflective of education and professional experiences, as well as recognition of specialty credentials, seemed to exist. Differences in this area might relate to other hospital nursing resource descriptors such as job satisfaction and turnover, and the consequential effect on certain outcomes of interest. Also related to this area were possible differences in opportunities made available for continuing professional development, such as nursing grand rounds and other internal activities, as well as support for events external to the hospital.

Interviews also left impressions of possible differences in emphasis placed on the importance of continuity of care, and management of the patient through the entire episode of care— even beyond the hospital stay. Examples of indicators related to this impression were roles such as case manager and discharge planning nurse, and care planning/evaluation tools such as critical pathways and care maps.

Tangential remarks during the interviews hinted at another potentially significant factor in analyzing nursing resources at the hospital level. This factor could be termed collaborative practice, defined as two or more disciplines working together to devise and implement the patient's care plan. Examination of this area would place the study perspective

176

at the macro systems level, as the nursing department relates to other hospital system components outside the nursing department.

Each of these factors or areas: professional nursing practice models; decision-making/control of practice; compensation/evaluation/recognition of nursing education, credentials, acquired experience; continuing professional development; continuity of care and management of the care continuum; and, collaborative practice) all warrant further investigation with multi-hospital samples in different health care markets. This introductory examination begins to suggest areas for exploration in subsequent studies dealing with hospital nursing resources, viewed either in isolation, or as relates to selected dependent variables of interest.

Implications for Theory Building

This investigation used Donabedian's framework which specifies two major concepts under which variables having hypothesized relationships with quality outcomes are organized: 1) structure, and 2) process. The model is simplistic yet comprehensive, the economy of the model being part of its attractiveness. Later work describes the model as applicable at various levels of analysis, a feature also relevant to this study (Donabedian, 1976, 1980, 1988, 1992). It is posited that without appropriate structure, processes are impeded and outcomes are adversely affected (Brett, 1989; Donabedian, 1966). Other theoretical frameworks are based on similar propositions which link structure and outcomes (Drazin &Van de Ven, 1985; vonBertalanffy, 1968). However, most explicit references to Donabedian's framework in the nursing literature are found in narrative discourses about quality rather than empirical works

(Bloch, 1975; Bond & Thomas, 1991; Hegedus, 1979; Peters, 1989). Moreover, while Donabedian recommends that studies testing his model include measures of all three concepts, reported investigations have typically included two of the three, in some combination, such as those cited which link hospital characteristics and outcomes . Likewise, this investigation focused on outcome and structure only, and narrowed the field of inquiry further by quantifying one group of structure variables (hospital nursing resources). Process variables were left to subsequent investigations.

Structure variables are probably easier to operationally define and quantitatively measure than process variables. In addition, data used to measure structure variables are more likely to be available in an automated format obtained through computerized information systems. This feature has advantages for multihospital studies such as this. The more difficult challenge for nurse researchers may be to define and measure process variables in a way that allows macrolevel multihospital investigations. Knowledge gained in this area will inform nurse administrators about practice and policymaking issues.

Specification error, related to theoretical and conceptual underpinnings, is an important consideration in explaining the inability of these models to achieve statistical significance. The omission of one or more important variables can result in an ill-fitting model. Specification error involving exclusion of relevant variables generally adversely affects the significance of the regression model more than the individual regression coefficients. In fact, the standard errors of the coefficients may decrease in such situations, depending on the amount of correlation between the excluded and included variables (Berry & Feldman, 1985). Published discussions of specification error and decisions regarding

retaining or dropping variables in a model, routinely emphasize the importance of using reasons other than purely empirical findings and statistical significance to make such decisions. This is a matter driven by theory development and testing, embellished by the investigator's experiential and intuitive knowledge about the field. Even if statistical significance is lacking in a given study there may be theoretical reasons to retain and continue investigating posited relationships.

Support for Donabedian's full conceptual framework rests on the findings of this study, which suggest that process variables not included in this investigation may represent key explanatory variables in modeling these relationships. While findings of this study showed evidence of a relationship between nursing resources and patient satisfaction with the overall hospital stay, similar evidence was not found for the nursing resources--satisfaction with nursing care relationship. The ways in which nurses collectively work and interact with each other in the care of patients are likely to affect outcomes as much or more than the precise numbers and types of nursing personnel. This idea was the central conclusion from a study of outcomes in ICUs in major medical centers, where physician/nurse workgroup interaction and coordination significantly influenced effectiveness (Knaus et al., 1986). The analysis of these data support this intuitively reasonable and conceptually appealing model formalized by Donabedian which emphasizes the fundamental importance of both structure and process.

In conclusion, Donabedian's model offers a parsimonious framework by which to organize the myriad variables related to outcome measurement, explanation, and prediction. Given the vast number and complexity of factors postulated to influence quality outcomes throughout the literature in this broad field of inquiry (theoretically, clinically, intuitively, and

empirically), the philosophical doctrine of Ockham's Razor seems indicated. That is, simpler is better, ceteris paribus. More streamlined theory aides in the search for explanations containing the fewest but optimal number of variables. Clearly, the conclusion drawn from this investigation was that the variables of absolute nursing hours and nursing skill mix were too parsimonious. The key factors related to patient satisfaction with nursing care and to mortality did not appear in this study.

Implications for Practice

Nurse administrators are in a position to influence factors affecting nursing practice settings (Meleis & Jenning, 1989). Organizational structure is an aspect of the practice setting noted to affect patient outcomes (Moritz, 1991). Structure is identified as an important aspect of nursing care delivery, the manipulation of which in the aggregate is theorized to optimize patient care outcomes (Henry & Arndt, 1989; Meleis & Jennings, 1989). As a major component of hospital structure, nursing resources warrants more emphasis in nursing administrative research. Knowledge about the relationship between nursing resources and quality of care, or other outcomes of interest, will assist nurse administrators with decision making about nursing resource factors under their control.

The influence of nursing resources on nursing care processes has been posited and investigated (Erhat, 1987; Given et al., 1979; Halloran, 1983; Hinshaw, Chance, & Atwood, 1981; Helt & Jelinek, 1988). For a considerable period of time, research on health care quality focused more on processes considered to be effective, desirable, and beneficial, than on

outcomes indicative of quality care (Bloch, 1975; Brett, 1989; Donabedian, 1966; Taylor, Hudson, & Keeling, 1991). Such processes, if actively used, were presumed to produce higher quality and better outcomes. Ideally, studies seeking to identify effective antecedents to quality outcomes will incorporate both structure as well as process variables in relation to measured outcomes. Such studies would be the most informative to nurse administrators and policymakers. With the growing number of academic and industry-wide programs dealing with clinical outcome measurement, and as automated databases are increasingly sophisticated and accessible in health care facilities, analyses encompassing structure, process, and outcome will likely multiply. Implications for management of nursing resources and nursing processes will follow such analyses.

This investigation represents a beginning look at nursing resources in the context of the entire organization. The volume of nursing empirical work conducted from this organizational perspective is minimal (Hinshaw, 1989). However, as the scope of the investigational context is widened, the number of possible influencing variables increases, adding to the study complexity. While this study limited measurement of structure to hospital nursing resources, the findings do suggest a relationship to the outcome of overall patient satisfaction with hospital stay and possibly, in a nonlinear fashion, to mortality. The findings here tend to support the notion that differing proportions of nursing personnel categories may alter the degree of their influence in these relationships. In particular, this study may be viewed as endorsing an investment in a higher ratio of professional nurses (registered nurses) to achieve higher quality of care. This supports the work of others who

have described positive effects of higher RN ratios (Halloran, 1982; Hinshaw, Chance, & Atwood, 1981). If further investigation lends additional support, the implications for practice involve setting goals to achieve an optimal supply and skill mix of nursing personnel. An optimal supply and skill mix of nursing personnel balances the cost of providing care against the benefits of better outcomes.

This process of optimizing nursing resource inputs to achieve the best attainable outcomes with the least cost is the notion of efficiency. Health care delivery efficiency studies often deal explicitly with the issue of cost, but rarely include explicit consideration of quality (Banker et al., 1986; Borden, 1988; Cromwell & Puskin, 1989; Eastaugh, 1990; Nunamaker, 1983; Sexton et al., 1989). Moreover, the inputs in efficiency studies seldom include measures of nursing resource input in terms meaningful to nurse administrators (Kuhn et al., 1991). Nurse administrators are charged with controlling cost in their facilities, but have a professional and moral obligation to assure quality care as well. Information provided by studies which explore and clarify relationships between nursing inputs and patient outcomes can guide nurse administrators in their efforts to develop practice settings which, in the aggregate, would contribute to successful achievement of desired outcomes.

Further analyses of nursing resources is needed in the pursuit of knowledge about these variables, both as independent variables and dependent variables. It will be through the converging evidence of numerous studies using different methods, designs, and analyses on different samples that knowledge will be built and conclusions warranted. Advancement of nursing administrative science will depend on cumulative empirical efforts dealing with all

aspects of the work nurses perform. In this way, nurse researchers can contribute significantly not only to the nursing discipline itself, but to a larger health care recipient, provider, and public policy audience.

Limitations

A number of limitations are associated with this study, most of them related to cost, time, and human resource constraints. No specific measure of nursing care process was incorporated into this study. Therefore, the extent to which variation in these process variables influenced quality of hospital care could not be evaluated. Data regarding specific nursing care processes at each hospital would have required extensive data collection beyond what was possible for this study.

Except for the PJHQ Questionnaire's nursing subscale of patient satisfaction, quality measures here are not specific to, nor are isolated measures of, nursing care quality. Quality of nursing care and its contributions to overall quality of hospital care require inference from these data. Nevertheless, patient satisfaction and mortality are two common quality indicators found throughout the empirical literature, and used in the health care industry and in public policymaking bodies to evaluate health care delivery. These two quality measures are used in federal and state government mandated programs, local community health care market projects, third party payor investigations, and academic studies. Because so many diverse groups are using these indicators, and because nursing resources are a major component of health care delivery, it is important to examine how variation in nursing resources relates to

these quality measures.

Nonetheless, patient satisfaction and mortality rates provide a limited measure of quality, the construct validity of which may be questioned (Dubois, Rogers, Moxley, Draper, & Brook, 1987; Vuori, 1987). Quality of care, which is multidimensional and complex, and poses numerous measurement challenges is probably best addressed by the use of an index composed of various quality indicators (Donabedian, 1976; 1980; 1988; Iezzoni, 1993). Therefore, the use of satisfaction scores and mortality rates alone represents another limitation with which investigators using these measures must contend. Incorporation of other valid indicators of hospital care quality are advisable for subsequent studies. Discriminant and convergent validity of quality measurement require such expanded exploration.

Questions could be raised about the reliability and clerical precision of the nursing resources and CHQCC data, impacting degree of measurement error (Jacob, 1984). Because CHQCC data have been publicly released, and because businesses and third party payers are already acting on the reported results (Mazzolini, 1994), numerous efforts to ensure reliability have been implemented. To address this issue relative to nursing resources data, future studies could involve a prospective data collection method rather than retrospective data collection.

Singular data collection, reflective of only one period in time, limits the strength of conclusions. Capturing a snapshot in time, may be affected by factors unaccounted for in the analysis. Moreover, serial time periods of data collection might yield divergent conclusions. The design aspect of a singular data collection point represents a threat to internal validity, more than external validity (Cook & Campbell, 1979; Kirk, 1982). Likelihood of false positive

or false negative conclusions about the nature of the relationship between nursing resources and hospital quality would be reduced with repeated measures across time.

Limitations in sample size and geographic representation is acknowledged with interpretation of findings, stated conclusions, and study recommendations. While this sample provided some heterogeneity among hospitals with respect to hospital characteristics of interest to this investigation, it occurred within the constraints of one market. Cook and Campbell (1979) discuss the strategy and procedure of "deliberate sampling for heterogeneity" (p.75) to increase external validity, though maximizing external validity requires a representative and random sample of the hospital population. Externally valid findings were not the objective of this beginning exploration. However, Cook and Campbell emphasize that external validity is probably "enhanced more by many heterogeneous small experiments [or studies, such as this one] than by one or two large experiments" (p.80). This initial effort sought to describe and explore one sample, small and convenient, thus qualifying any conclusions, yet potentially contributing knowledge relevant to research in this area.

Suggestions for Further Research

Based on the overall findings, indications exist to warrant further investigation in several specific areas. First, the influence of nursing resources on global patient satisfaction (satisfaction with overall hospital stay) compared with the influence on satisfaction with nursing care is of particular interest. The findings of the current study supporting a relationship between global patient satisfaction and nursing resources is not

surprising, as others have noted this finding (Abramowitz et al., 1987; Doering, 1983). However, the lack of evidence in the current study supporting a relationship between satisfaction with nursing care and nursing resources was unanticipated. Use of the conceptual model and intuition would predict otherwise. Two areas for further investigation arise from this finding. The satisfaction instrument itself, the PJHQ Questionnaire, should receive additional testing, in particular the subscales relating to the work of nurses. Nunnally (1978) describes the distinction between the sampling and analyzing of people, versus the sampling and analyzing of "content (test items)" (p.11). Both are recommended here for additional study. Also of interest would be an investigation of patient satisfaction with nursing care using two different instruments for the same sample. With even stronger emphasis, it is recommended that subsequent studies include operationalization and measurement of Donabedian's concept of process, as relates to nursing care delivery and outcomes of interest. Examples of such processes would include decision making, communication patterns among nurses, and coordination of patient care between nursing and other disciplines

A second area for subsequent study is the apparent parallel between registered nurses and nurse aides within hospitals and how it relates to outcomes. Following the trend toward all-RN staffing and primary nursing in the 1980s, a shift occurred in the 1990s to develop care teams employing unlicensed (nurse aide) types of personnel (Brooten & Naylor, 1995; Lengacher, Kent, Mabe, Heinemann, VanCott, & Bowling, 1994). Beyond describing absolute amounts and proportions of registered nurse and nurse aide resources, examination of relevant process variables as well as their relationships to outcomes could inform nurse administrators of

strategies that would enhance achievement of desired outcomes. A related recommendation is the investigation of the relationship between variation in nurse expertise/academic preparation of RN resources and selected outcomes. This would require a prospective data collection method, because it was apparent from the current investigation that these data are not systematically collected or available through hospital information systems.

Thirdly, the nature of the differences seen in licensed practical nurse resources (distinct from RN and NA resources) and their seeming negative impact on hospital outcomes, and explanations for the differences warrants further investigation. Here again, it would be advisable to analyze this area in a study designed to include the full Donabedian model; i.e., structure, process and outcome measurement.

Continued and enhanced prospective investigations of the magnitude, direction, and consistency of influence by nursing resource skill mix differences on outcomes of interest is needed. These questions could be more rigorously pursued with larger samples, randomly selected samples, and additional measures of outcomes of interest. Additionally, a times series design and analysis beginning with this same sample, having repeated measurement of nursing resources and hospital outcomes would indicate changes over time and would contribute substantially to the findings of this particular study. In general, there is a need for more data points in order to allow for true patterns to emerge.

Finally, subsequent studies are needed that examine outcomes more related than mortality to the work of nurses. Patient and family satisfaction will always remain an important quality outcome, deserving continued evaluation of the many health care workers and

components of the health care delivery experience aside from the nursing care component. It would be difficult to identify any patient care outcomes that are not related to the work of at least several different categories of health care workers. In addition, factors related to the patient which influence outcomes (for example, physiologic, cognitive. social/family, environmental, and others) should be considered as well. This involves risk-adjustment procedures in the measurement of variables. Nevertheless, discussion of outcome research in the nursing literature repeatedly calls for nurse researchers to focus more on health care outcomes, the achievement of which are theorized to be highly nursing care related (Brett, 1989; Brooten & Naylor, 1995; Jennings, 1991). Because these outcomes tend to be more difficult to operationalize (e.g. caring), are often highly complex (e.g., quality of life), and often involve a multidisciplinary approach making partitioning of nursing care effects difficult (e.g.. functional status), these outcomes have received less attention. As such, advancement of empirical work and knowledge development in this area is slow. but should continue to be given a high priority on the nursing research agenda.

REFERENCES

Abramowitz, S., Cote, A.A., Berry, E. (1987). Analyzing patient satisfaction: a multianalytic approach. Quality Review Bulletin, 13, 122-130.

Achen, C.H. (1982). Interpreting and using regression. Newbury Park: Sage Publications.

Aiken, L.H., Smith, H.L., & Lake, E.T. (1994). Lower Medicare mortality among a set of hospitals known for good nursing care. Medical Care, 32, 771-787.

Al-Haider, A.S. & Wan, T.T.H. (1991). Modeling organizational determinants of hospital mortality. Health Services Research, 26, 303-323.

Allen, G.H. (1993, June). Committing to quality: Cleveland business must honor CHQC. Healthcare News, p.13-14.

Ashby, J.L. & Altman, S.H. (1992). The trend in hospital output and labor productivity, 1980-1989. Inquiry, 29, 80-91.

Banker, R.D., Conrad, R.F., & Strauss, R.P. (1986). A comparative application of data envelopment analysis and translog methods: An illustrative study of hospital production. Management Science, 32, 30-44.

Bergman, R. (1993, December 5). The measuring stick. Hospitals & Health Networks, 67, 36-42.

Berry, W.D. & Feldman, S. (1985). Multiple regression in practice. Newbury Park: Sage Publications.

Berwick, D.M. & Knapp, M.G. (1987). Theory and practice for measuring health care quality. Health Care Financing Review, 9 (Suppl), 49-55.

Blumberg, M.S. (1987). Comments on HCFA hospital death rate statistical outliers. Health Services Research, 21, 715-718.

Borden, J.P. (1988). An assessment of the impact of diagnosis-related group (DRG)-based reimbursement on the technical efficiency of New Jersey hospitals using data envelopment analysis. Journal of Accounting and Public Policy, 7, 77-96.

188

Bradbury, R.C., Stearns, F.E., Steen, P.M. (1991). Interhospital variations in admission severity-adjusted hospital mortality and morbidity. Health Services Research, 26, 407-424.

Brandt, J. R. (1993, July). A local start on the road to health-care reform. Corporate Cleveland, pp.68-71.

Brennan, T.A., Hebert, L.E., Laird, N.M., Lawthers, A., Thorpe, K.E., Leape, L.L., Localio, A.R., Lipsitz, S.R., Newhouse, J.P., Weiler, P.C., & Hiatt, H.H. (1991). Hospital characteristics associated with adverse events and substandard care. Journal of the American Medical Association, 265, 3265-3269.

Brett, J.L. (1989). Outcome indicators of quality care. In B. Henry, C. Arndt, M. DiVincenti, & A. Marriner-Tomey (Eds.), Dimensions of nursing administration: Theory, research, education, practice (pp. 353-369). Boston: Blackwell Scientific.

Brewster, A.C., Karlin, B.G., Hyde, L.A., Jacobs, C.M., Bradbury, R.C., Chae, Y.M. (1985). MEDISGRPS*: a clinically based approach to classifying hospital patients at admission. Inquiry, 22, 377-387.

Brooten, D. & Naylor, M.D. (1995). Nurses' effect on changing patient outcomes. Image: Journal of Nursing Scholarship, 27, 95-99.

Bruttomesso, K.A. (1985). Variable hospital accounting practices: Are they fair for the nursing department? Journal of Nursing Administration, 15, 8-12.

Burstin, H.R., Lipsitz, S.R., Udvarhelyi, I.S. & Brennan, T.A. (1993). The effect of hospital financial characteristics on quality of care. Journal of the American Medical Association, 270, 845-849.

Campbell, J.P. Campbell, R.J., & Associates. (1988). Productivity in organizations. San Francisco: Josey-Bass.

Carey, R.G. & Seibert, J.H. (1993). A patient survey system to measure quality improvement: questionnaire reliability and validity. Medical Care, 31, 834-845.

Caterinicchio, R.P. (1984). Relative intensity measures: Pricing of inpatient nursing services under diagnosis related group prospective hospital payment. Health Care Financing Review, 6, 61-70.

Chambers, J. M., Cleveland, W. S., Kleiner, B., & Tukey, P. A. (1983). Graphical methods for data analysis. Boston: Duxbury Press.

Chopoorian, T.J. (1986). Reconceptualizing the environment. In P. Moccia (Ed.), New approaches to theory development (pp.39-54). New York: National League for Nursing.

CHQC releases second quality report at The Health Museum. (1994, January). Healthcare News, p.19.

Cleary, P.D. & McNeil, B.J. (1988). Patient satisfaction as an indicator of quality care. Inquiry, 25, 25-36.

Cleverley, W.O. & Harvey, R.K. (1992, September). Is there a link between hospital profit and quality? Healthcare Financial Management, 46, 40-45.

Cook, T.D. & Campbell, D.T. (1979). Quasi-Experimentation: Design & analysis issues for field settings. Boston: Houghton Mifflin Company.

Cromwell, J. & Pope, G. (1989). Trends in hospital labor and total factor productivity, 1981-86. Health Care Financing Review, 10, 39-50.

Cromwell, J. & Puskin, D. (1989). Hospital productivity and intensity trends: 1980-87. Inquiry, 26, 366-380.

Curran, C. & Smeltzer, C.H. (1991). Operation improvement: Efficiencies and quality. Journal of Quality Assurance, 5, 1-6.

Curtain, L. (1986). Who says "lean" must be "mean"? Nursing Management, 17, 7-8.

Curtain, L. & Zurlage, C. (1986). Nursing productivity: From data to definition. Nursing Management, 17, 32-41.

Dayhoff, D.A. & Cromwell, J. (1993). Measuring differences and similarities in hospital caseloads: A conceptual and empirical analysis. Health Services Research, 28, 293-312.

DesHarnais, S.I., Chesney, J.D., Wroblewski, R.T. (1988). The risk-adjusted mortality index: A new measure of hospital performance. Medical Care, 26, 1129-1142.

DesHarnais, S.I., McMahon, L.F., Wroblewski, R.T., Hogan, A.J. (1990). Measuring hospital performance: The development and validation of risk-adjusted indexes of mortality, readmissions, and complications. Medical Care, 28, 1127-1141.

Dimond, M. & Slothower, L. (1978). Research in nursing administration: A neglected issue. Nursing Administration Quarterly, 2, 1-8.

Doering, E.R. (1982). Factors influencing inpatient satisfaction with care. Quality Review Bulletin, 9, 291-299.

Donabedian, A. (1966). Evaluating the quality of medical care. Milbank Memorial Fund Quarterly, 44(Suppl), 166-206.

Donabedian, A. (1976). Some basic issues in evaluating the quality of health care. In A.N.A. (Ed.), Issues in evaluation research: An invitational conference (pp.3-28). St. Louis: American Nurses Association.

Donabedian, A. (1978). The quality of medical care. Science, 200, 856-64.

Donabedian, A. (1980). Explorations in quality assessment and monitoring. Ann Arbor, MI: Health Administration Press.

Donabedian, A. (1988). Quality assessment and assurance: Unity of purpose, diversity of means. Inquiry, 25, 173-192.

Donabedian, A. (1992). The role of outcomes in quality assessment and assurance. Quality Review Bulletin, 18, 356-360.

Donaldson, S.K. & Crowley, D.M. (1978). The discipline of nursing. Nursing Outlook, 26, 113-120.

Donovan, M.I. & Lewis, G. (1987). Increasing productivity and decreasing costs: The value of RNs. Journal of Nursing Administration, 17, 16-18.

Dubois, R.W., Rogers, W.H., Moxley, J.H., Draper, D., Brook, R.H. (1987). Hospital inpatient mortality: Is it a predictor of quality? New England Journal of Medicine, 317, 1674-1680.

Eastaugh, S.R. (1987). Hospital productivity: Managing cost reductions without harm to quality or access. In S.R. Eastaugh (Ed.), Financing health care: Economic efficiency and equity, (pp.257-276). Dover, MA: Auburn House Publishing Co.

Eastaugh. S.R. (1990). Hospital nursing technical efficiency: Nurse extenders and enhanced productivity. Hospital & Health Services Administration, 35: 561-573.

Edwardson, S.R. (1986). The cost-quality tradeoff in productivity management. In F. Shaffer (Ed.), Patients and Purse Strings, (pp.259-271). New York, NY: National League for Nursing.

Edwardson, S.R. (1989). Productivity measurement. In B. Henry, C. Arndt, M. diVincenti, & A. Marriner-Tomey (Eds.), Dimensions of nursing administration: Theory, research, education, practice, (pp.371-385). Boston: Blackwell Scientific Publications.

Erhat, K.S. (1987). The cost-quality balance: An analysis of quality, effectiveness, efficiency, and cost. Journal of Nursing Administration, 17, 6-12.

Fabricant, S. (1969). A primer on productivity. New York: Random House.

Fawcett, J. & Downs, F.S. (1986). The relationship of theory and research. Norwalk, CN: Appleton-Century-Crofts.

Flarey, D.L. (1990). A methodology for costing nursing service. Nursing Administrative Quarterly, 14, 41-51.

Fleming, G.V. (1981). Hospital structure and consumer satisfaction. Health Services Research, 16, 43-63.

Fleming, S.T., McMahon, L.F., DesHarnais, S.I., Chesney, J.D., Wroblewski, R.T. (1991). The measurement of mortality: A risk-adjusted variable time window approach. Medical Care, 29, 815-825.

Frank, R.G. (1988). On making the illustration illustrative: A comment on Banker, Conrad, and Strauss. Management Science, 34, 1026-1029.

Gallant, B.W. & McLane, A.M. (1979). Outcome criteria: A process for validation at the unit level. Journal of Nursing Administration, 9, 14-21.

Gibbons, J.D. (1993). Nonparametric measures of association. Newbury Park: Sage Publications.

Given, B., Given, C.W., & Simoni, L.E. (1979). Relationships of processes of care to patient outcomes. Nursing Research, 28, 85-93.

Green, J. (1994, March 7). Measuring quality: A formidable task. AHA News, p. 7.

Green, J., Wintfeld, N., Sharkey, P. & Passman, L.J. (1990). The importance of severity of illness in assessing hospital mortality. Journal of the American Medical Association, 263, 241-246.

Grosskopf, S. & Valdmanis, V. (1987). Measuring hospital performance: A nonparametric approach. Journal of Health Economics, 6, 89-107.

Grosskopf, S. & Valdmanis, V. (1993). Evaluating hospital performance with casemix-adjusted outputs. Medical Care, 31, 525-532.

Gueldner, S.H. (1989). Applying Roger's model to nursing administration: Emphasis on client and nursing. In B. Henry, C. Arndt, M. DiVincenti, & A. Marriner-Tomey (Eds.), Dimensions of nursing administration: Theory, research, education, practice. Boston: Blackwell Scientific Publications.

Halloran, E.J. (1983). RN staffing: more care -- less cost. Nursing Management, 14, 18-20.

Hannan, E.L., Bernard, H.R., O'Donnell, J.F. (1989). A methodology for targeting hospital cases for quality of medical record reviews. American Journal of Public Health, 79, 430-441.

Harkey, J. & Vraciu, R. (1992). Quality of health care and financial performance: Is there a link? Health Care Management Review, 17, 55-63.

Harris, R.J. (1985). A primer of multivariate statistics (2nd Ed.). Orlando: Academic Press, Inc.

Hartwig, F. & Dearing, B.E. (1979). Exploratory data analysis. Newbury Park: Sage Publications.

Hartz, A.J., Krakauer, H., Kuhn, E.M., Young, M., Jacobsen, S.J., Gay, G., Muenz, L., Katzoff, M., Bailey, R.C., & Rimm, A.A. (1989). Hospital characteristics and mortality rates. The New England Journal of Medicine, 321, 1720-1725

Hays, R.D., Larson, C., Nelson, E.C., Batalden, P.B. (1991). A short-form patient-based measure. Medical Care, 29, 661-668.

Hays, R.D., Nelson, E.C., Rubin, H.R., Ware, J.E., Meterko, M. (1990). Further evaluations of the PJHQ scales. Medical Care, 28 (September Supplement), S29-39.

Hegedus, K.S. (1979). A patient outcome criterion measure. Supervisor Nurse, 10, 40-45.

Hegyvary, S.T. (1986). Perspectives on nursing productivity. In The National Invitational Conference on Nursing Productivity: Report of the Conference, (p. 81-96). Grant #HS-05480, National Center for Health Services Research and Health Care Technology Assessment (NCHSR) and the Division of Nursing, Bureau of Health Professions, U.S. Department of Health and Human Services, Washington, D.C.: U.S. Printing Office.

Helt, E.H. & Jelinek, R.C. (1988). In the wake of cost cutting, nursing productivity and quality improve. Nursing Mangement, 19, 36-48.

Henry, B. & Arndt, C. (1989). Introduction: Nursing theory for nursing administration. In B. Henry, C. Arndt, M. Divincenti, & A. Marriner-Tomey (Eds.), Dimensions of nursing administration: Theory, research, education, practice (pp.1-6). Boston: Blackwell-Scientific.

Hinshaw, A. (1989). Programs of nursing research for nursing administration. In B. Henry, C. Arndt, M. DiVincenti, & A. Marriner-Tomey (Eds.), Dimensions of nursing administration: Theory, research, education, practice, (pp.251-266). Boston: Blackwell Scientific Publications.

Hinshaw, A.S. & Atwood, J.R. (1982). A patient satisfaction instrument: Precision by replication. Nursing Research, 31, 170-175.

Hoffman, F. (1988). Nursing productivity assessment and costing out nursing services. Philadelphia: J.B. Lippincott Co.

Horn, S.D. (1983). Measuring severity of illness: Comparisons across institutions. Journal of Public Health, 73, 25-31.

Hornbrook, M.C. (1982). Hospital case mix: Its definition, measurement and use: Part I. The conceptual framework. Medical Care Review, 39, 1-43.

Huang, Y-G. L. (1990). An application of data envelopment analysis: Measuring the relative performance of the health care industry. Journal of Medical Systems, 14, 191-196.

Iezzoni, L.I., Restuccia, J.D., Shwartz, M., Schaumberg, D., Coffman, J.R., Kreger, B.E., Butterly, J.R., Selker, H.P. (1992). The utility of severity of illness information in assessing the quality of hospital care. Medical Care, 30, 428-444.

Iglewicz, B. (1983). Robust scale estimators and confidence intervals for location, in D. Hoglin, F. Mosteller, & J.W. Tukey (Eds.), Understanding robust and exploratory data analysis. New York: John Wiley.

Jacob, H. (1984). Using published data: Errors and remedies. Newbury Park: Sage Publications.

Jennings, B. M. (1991). Patient outcomes research: Seizing the opportunity. Advances in Nursing Science, 14, 59-72.

Jennings, B.M. & Meleis, A.I. (1988). Nursing theory and administrative practice: Agenda for the 1990's. Advances in Nursing Science, 10, 56-69.

Jopek, M.K. (1992, October). The Cleveland Health Quality Choice Program addresses issues of cost and quality. Medical Digest, p. 3.

Keeler, E.B., Rubenstein, L.V., Kahn, K.L., Draper, D., Harrison, E.R., McGinty, M.J., Rogers, W.H., & Brook, R.H. (1992). Hospital characteristics and quality of care. Journal of the American Medical Association, 268, 1709-1714.

King, I.M. (1981). A theory for nursing: Systems, concepts, process. New York: John Wiley & Sons.

Kirk, R. (1982). Experimental design. Monterey, CA: Brooks/Cole Publishing Co.

Knaus, W.A., Draper, E.A., Wagner, D.P. & Zimmerman, J.E. (1986). An evaluation of outcome from intensive care in major medical centers. Annals of Internal Medicine, 104, 410-418.

Knaus, W.A., LaRoas, J.C., Marks, R.D., & Bisbee, G.E. Jr. (1994) The value of commercial funding in health services research: The case of the APACHE III methodology. Health Services Research, 28: 673-8.

Koerner, B. L. (1981). Selected correlates of job performance of community health nurses. Nursing Research, 30, 43-48.

Kramer, M. (1990). The magnet hospitals: Excellence revisited. Journal of Nursing Administration, 20, 35-44.

Kramer, M. & Schmalenberg, C. (1988, January). Magnet hospitals: Part I, Institutions of excellence. Journal of Nursing Administration, 18, 13-24.

Kramer, M. & Schmalenberg, C. (1988, February). Magnet hospitals: Part II, Institutions of excellence. Journal of Nursing Administration, 18, 11-19.

Kuhn, E.M., Hartz, A.J., Gottlieb, M.S. & Rimm, A.A. (1991). The relationship of hospital characteristics and the results of peer review in six large states. Medical Care, 29, 1029-1038.

Leatt. P. & Schneck, R. (1982). Technology, size, environment, and structure in nursing subunits. Organization Studies, 3: 221-242.

Leavitt, S.W. (1994). Quality of care and investment in property, plant, and equipment in hospitals. Health Services Research, 28, 713-727.

Lengacher, C.A., Kent, K., Mabe, P.R., Heinemann, D., VanCott, M.L., Bowling, C.D. (1994). Effects of the partners in care practice model on nursing outcomes. Nursing Economics, 12, 300-308.

Levine, E. (1985). Some issues in nursing productivity. In F.A.Shaffer (Ed.), Costing out nursing: Pricing our product, pp.237-253. New York: National League for Nursing Publications.

Lohr, K. (1988). Outcome measurement: Concepts and questions. Inquiry, 25, 37-50.

Lubitz, J., Riley, G., & Newton, M. (1985). Outcomes of surgery in the medicare aged population: Mortality after surgery. Health Care Financing Review, 6, 103-112.

Mark, B. (1985). Task and structural correlates of organizational effectiveness in private psychiatric hospitals. Health Services Research, 20, 199-224.

Mazzolini, J.M. (1994, June 2). Hospitals get a new checkup: Business group plans to reward quality care. The Cleveland Plain Dealer, pp. 1, 12.

McCann, R.J. (1994, July 8). Unpublished memo. Mayfield Village, OH: Meridia Health System.

McClosky, J.C. (1983). Nursing education and job effectiveness. Nursing Research, 32, 53-58.

McClosky, J.C. & McCain, B. (1988). Variables related to nurse performance. Image, 20, 203-208.

McClure, M., Poulin, M., Sovie, M., & Wandelt, M. (1982). Magnet hospitals: Attraction and retention of professional nurses. Kansas City: American Nurses Association.

McHugh, M.L. (1989). Productivity measurement in nursing. Applied Nursing Research, 2, 99-102.

McNeil, D.R. (1977). Interactive data analysis: A practical primer. New York: John Wiley.

Meleis, A.I. (1985). Theoretical nursing: Development & progress. Philadelphia: J.B. Lippincott Co.

Meleis, A. I. & Jennings, B. M. (1989). Theoretical nursing administration: Today's challenges, tomorrow's bridges. In B. Henry, C. Arndt, M. Di Vincenti, & A. Marriner-Tomey, (Eds.), Dimensions of nursing administration: Theory, research, education, practice, (pp.7-18). Boston: Blackwell Scientific Publications.

Meterko, M. & Rubin, H.R. (1990). Patient judgments of hospital quality: A taxonomy. Medical Care, 28 (September Supplement),S-10-S15.

Morey, R.C., Fine, D.J. & Loree, S.W. (1990). Comparing the allocative efficiencies of hospitals. Omega, 18, 71-83.

Moritz, P. (1991). Innovative nursing practice models and patient outcomes. Nursing Outlook, 39, 111-114.

Mosteller, F. & Tukey, J.W. (1977). Data analysis and regression. Reading, MA: Addison-Wesley.

Mozes, B., Easterling, M.J., Sheiner, L.B., Melmon, K.L., Kline, R., Goldman, E.S. & Brown, A.N. (1994). Case-mix adjustment using objective measures of severity: The case for laboratory data. Health Services Research, 28, 689-712.

National Invitational Conference on Nursing Productivity: Report of the Conference. (1986). Grant #HS-05480 National Center for Health Services Research and Health Care Technology Assessment and the Division of Nursing, Bureau of Health Professions, U.S. Department of Health and Human Services. Washington D.C.: U.S. Government Printing Office.

Nelson, E.C., Hays, R.D., Larson, C., & Batalden, P.B. (1989). The patient judgment system: Reliability and validity. Quality Review Bulletin, 15, 185-191.

Nunamaker, T. (1983). Measuring routine nursing service efficiency: A comparison of cost per patient day and data envelopment analysis models. Health Services Research, 18, 183-205.

Nunn, D. & Marriner-Tomey, A. (1989). Applying Orem's model in nursing administration. In B. Henry, C. Arndt, M. DiVincenti, & A. Marriner-Tomey (Eds.), Dimensions of nursing administration: Theory, research, education, practice. Boston: Blackwell Scientific Publications.

Nunnally, J.C. (1978). Psychometric theory (2nd edition). New York: McGraw-Hill.

Omachanu, V.K. & Nanda, R. (1989). A conceptual framework for hospital nursing unit productivity measurement. Industrial Engineering, 20, 56-67.

Ott, L. (1984). An introduction to statistical methods and data analysis, (2nd edition). Boston: Duxbury Press.

Overton, P., Schneck, R., & Hazlett, C.B. (1977). An empirical study of the technology of nursing subunits. Administrative Science Quarterly, 22, 203-219.

Ozcan, Y.A. & Luke, R.D. (1993). A national study of the efficiency of hospitals in urban markets. Health Services Research, 27, 721-739.

Ozcan, Y.A., Luke, R.D., & Haksever, C. (1992). Ownership and organizational performance. Medical Care, 30, 781-794.

Park, R.E., Brook, R.H., Kosecoff, J. (1990). Explaining variations in hospital death rates: Randomness, severity of illness, and quality of care. Journal of the American Medical Association, 264, 484-490.

Parse, R.R. (1989). The phenomenological research method: its value for management science. In B. Henry, C. Arndt, M. DiVencenti, & A. Marriner-Tomey, (Eds.), Dimensions of nursing administration: Theory, research, education, practice, (pp.291-296). Boston: Blackwell Scientific Publications.

Patterson, C. (1992). The economic value of nursing. Nursing Economics, 10, 193-204.

Pedhazur, E.J. (1982). Multiple regression in behavioral research. Fort Worth: Holt, Rinehart, and Winston.

Peters, D.A. (1989). An overview of current research relating to long-term outcomes. Nursing & HealthCare, 10, 133-136.

Phipps, P. (1993, March 14). If Hillary wants to reform health care, she should look at Cleveland. The Providence Sunday Journal, p.F1-F2.

Register, C.A. & Bruning, E.R. (1987). Profit incentives and technical efficiency in the production of hospital care. Southern Economic Journal, 53, 899-914.

Renn, S.C., Schramm, C.J., Watt, J.M., & Derzon, R.A. (1985). The effects of ownership and system affiliation on the economic performance of hospitals. Inquiry, 22, 219-236.

Rhee, K.J., Donabedian, A., Burner, R.E. (1987). Assessing the quality of care in a hospital emergency unit: A framework and its application. Quality Review Bulletin, 13, 4-16.

Rice, C.W. (1993, January). Cleveland Health Quality Choice is a collaborative effort. Healthcare News, p.2, 29.

Rogers, M. (1980). Nursing: A science of unitary man. In J.P. Riehl and C. Roy (Eds.), Conceptual models for nursing practice, (2nd edition). New York: Appleton-Century Crofts.

Rosenthal, G.E. & Harper, D.L. (1994) Cleveland Health Quality Choice: a model for collaborative community-based outcomes assesssment. Joint Commission Journal of Quality Improvement, 20: 425-42.

Rubin, H.R. (1990). Patient evaluations of hospital care: A review of the literature. Medical Care, 28 (September Supplement), S3-S10.

Rubin, H.R., Ware, J.E., & Hays, R.D. (1990). The PJHQ Questionnaire: Exploratory factor analysis and empirical scale construction. Medical Care, 28 (September Supplement), S22-S29.

Scalzi, C.C. & Anderson, R.A. (1989). Conceptual model for theory development in nursing administration. In B. Henry, C. Arndt, M. DiVincenti, & A. Marriner-Tomey, (Eds.), Dimensions of nursing administration: Theory, research, education, practice, (pp. 137-141). Boston: Blackwell Scientific Publications.

Schroeder, L.D., Sjoquist, D.L., & Stephan, P.E. (1986). Understanding regression analysis. Newbury Park: Sage Publications.

Schwirian, P.M. (1981). Toward an explanatory model of nursing performance. Nursing Research, 30, 247-253.

Sexton, T.R., Leiken, A.M., Nolan, A.M., Liss, S., Hogan, A., & Silkman, R.H. (1989). Evaluating managerial efficiency of Veterans Administration medical centers using data envelopment analysis. Medical Care, 27, 1175-88.

Sherman, J.J. (1990). Costing nursing care: A review. Nursing Administration Quarterly, 14, 11-17.

Shortell, S. M. (1985). High-performing healthcare organizations: Guidelines for the pursuit of excellence. Hospital & Health Services Administration, 30, 7-35.

Shortell, S.M., Zimmerman J.E., Gillies, R.R., Duffy, J., Devers, K.J., Rousseau D.M., & Knaus, W.A. (1992). Continuously improving patient care: Practical lessons and an assessment tool from the national ICU study. Quality Review Bulletin,18, 150-155.

Smyth, K. (1989). Case study methodology. In B. Henry, C. Arndt, M. DiVincenti, & A. Marriner-Tomey (Eds.), Dimensions of nursing administration: Theory, research, education, practice, pp. 307-321. Boston: Blackwell Scientific Publications.

Spitzer, R. (1986). Defining and measuring productivity. In R. Spitzer (Ed.), Nursing productivity: The hospital's key to survival and profit (pp. 7-11). Chicago: S-N Publications.

Staley, M. & Luciano, K. (1984). Eight steps to costing nursing services. Nursing Management, 15, 35-38

Stanton, L. (1986). Nursing care and nursing products: Revenue or expenses? Journal of Nursing Administration, 16, 29-32.

Strasen, L. (1987). Standard costing/productivity model for nursing. Nursing Economics, 5, 158-161, 198.

Strong, V.L. (1986). Nursing products: Primary components of health care. Nursing Economics, 3, 60-66.

Stull, M.K. (1986). Staff nurse performance: Effects of goal-setting and performance feedback. Journal of Nursing Administration, 16, 26-30.

Taylor, A.G., Hudson, K., & Keeling, A. (1991). Quality nursing care: The consumers' perspective revisited. Journal of Nursing Quality Assurance, 5, 23-31.

Thompson, J.D. & Diers, D. (1988). Management of nursing intensity. Nursing Clinics of North America, 23, 473-49.

Tukey, J.W. (1977). Exploratory Data Analysis. Reading, MA: Addison-Wesley.

Valdmanis, V.G. (1990). Ownership and technical efficiency of hospitals. Medical Care, 28, 552-60.

vonBertalanffy, L. (1968). General system theory: Foundations, development, applications. New York: Braziller.

Vuori, H. (1987). Patient satisfaction--an attribute or indicator of the quality of care? Quality Review Bulletin, 13, 106-108.

Wagner, D., Draper, E., Knaus, W. (1989). Chapter 7. Analysis: Quality of care. Critical Care Medicine, 17, S210-S212.

Walker, D.D. (1983). The cost of nursing care in hospitals. Journal of Nursing Administration, 13, 13-18.

Walker, L.O., and Avant, K.C. (1983). Strategies for theory construction in nursing. Norwalk, CT: Appleton-Century-Crofts.

Ware, J.E. & Berwick, D.M. (1990). Conclusions and recommendations. Medical Care, 28, (September Supplement), S39-S44.

Weisberg, H.F. (1992). Central tendency and variability. Newbury Park: Sage Publications.

Wilson, L., Prescott, P. A., & Aleksandrowicz, L. (1988). Nursing: A major hospital cost component. Health Services Research, 22, 773-796.

Appendix A

<u>Chief Nursing Officer Interview Questions</u>

During the time period, 4/1/94-9/30/94:

1. Was there a flexible staffing system in place whereby nurses could be called in or sent home on a shift-by-shift basis, depending on projected patient care needs? How did it work? Was it unit-specific or whole hospital? Was there cross coverage floating among units?

2. Does the hospital use temporary nurses employed by agencies? Is there a record of hours worked by these temporary nurses? What rules or policies govern where and how these nurses function?

3. Is data available about registered nurse personnel regarding: educational preparation? additional credentials awarded to individual nurses by specialty nursing organizations? years of experience in nursing profession? years of experience at this hospital?

4. How many intensive care and medical-surgical units? How many head nurses?

5. How many administrative nursing personnel levels above the head nurse level? (including off-shift and weekend supervisors). Briefly describe their functions.

6. What kinds of specialty nurses does the hospital employ in staff (vs. line) positions? (examples: staff development educators, clinical nurse specialists, psychiatric nurse clinicians)

203

7. Are there any other nurses employed within or outside the nursing department in positions accounted for on the nursing payroll? (example: "research nurse") How would their role be described?

8. Are staff nurses paid hourly wage or salary? Which units? Are administrative nurses paid salary? Which levels?

9. Describe the various nursing care delivery methods in place at the time. (Define this term for managers for clarification.) Describe these methods as implemented at your hospital and where they were used. (examples: team, functional. primary, modified primary, care partnering)

10. Were case managers being used in conjunction with unit nurses to meet patient/family needs? With which patient types/groups? Briefly describe the procedure of patient selection for case management, the role function, accountability.

11. Were any critical pathways or care maps in place and being used? For which patient groups, diagnoses, or interventional procedures?

12. Were any nursing conceptual models or theories being used by the hospital nursing department or by individual units to guide nursing care delivery? Which one?

Patient Judgements
of
Hospital Quality

1. *Our records indicate that you were recently hospitalized. This questionnaire will ask about your opinions of your recent stay. If you have not been recently hospitalized, please return the material in the postage paid envelope.*

2. *Please answer all of the questions that follow. If you wish to comment on any questions or qualify your answers, please feel free to use the spaces in the margins. Your comments will be read and appreciated!*

THANK YOU FOR YOUR HELP!

Judy Williams
MedFacts, Inc.

P S. *Should you have any questions about this survey, please call me directly (Toll Free) at* ███████████ *, between 9:00 a.m. - 5.00 p.m., Central Standard time, Monday thru Friday.*

3. First of all, about how long ago were you discharged from the hospital?

_____Number of Days

(or)

_____Number of Weeks

4. Prior to this hospitalization, about how many times have you been admitted to a hospital and stayed one or more nights?

_____Never, this was first time ever

_____One other time

_____Two other times

_____Three or more other times

5. Have you previously been treated at this hospital as an out-patient or an emergency room patient?

_____Yes

_____No

6. Thinking about your recent hospitalization; who chose the hospital? Was it your doctor, or was it you or another family member, or was it someone else? (Check all they apply)

_____Doctor chose

_____Patient chose

_____Family member chose

_____Someone else chose

_____No decision/Not applicable (i.e. ambulance)

If you made part or all of the decision on what hospital to choose —
Please answer question #7. Otherwise skip to question #8.

---

7. In your choice of hospital, how important was:

	Very Important	Somewhat Important	Not Very Important	Not At All Important
a. The hospital's location	☐	☐	☐	☐
b. Your previous experience at that hospital	☐	☐	☐	☐
c. The reputation of the hospital for providing quality care	☐	☐	☐	☐
d. The out-of-pocket cost to you of using this hospital	☐	☐	☐	☐

8. Which type of unit were you on for most of your stay?

_____Medical Unit

_____Surgical Unit

_____Combined Medical/Surgical Unit

_____Coronary Care Unit

_____Intensive Care Unit

_____Maternity Unit

_____Pediatric/Children's Unit

_____Other (Specify) _____

9. What was the main reason or type of problem that led to this hospitalization? (One answer please)

_____Heart problem

_____Lung problem (such as asthma, emphysema, pneumonia)

_____Cancer or cancer-related problem

_____Intestinal, stomach or digestive problem

_____Diabetes

_____Childbirth

_____Broken bone, fracture or accidental injury

_____Other: Please describe: _____

10. Were you admitted to the hospital . . . .

_____Through the Emergency Room

_____By scheduling in advance

_____Other (Specify) _____

> If admitted through the Emergency Room, please
> answer question #11. Otherwise skip to question #12.

11. How did you choose this emergency room? Was the decision based on . . . (check all that apply)

_____Your doctors' recommendation

_____A family member or friends' recommendation

_____Your own prior experience with the hospital

_____It being close by when you needed help

_____Other (Specify) _____

12. Did you have surgery during this hospitalization?

_____Yes

_____No

13. Were you in an Intensive Care or Coronary Care Unit at all during your stay?

_____Yes

_____No

14. For the majority of your stay, were you in a private room or in a room with other patients?

_____private room

_____room with other patients

15. How serious was your condition when you were first admitted to the hospital?

_____Minor

_____Moderate

_____Serious

_____Critical or emergency

16. Which of the following best describes your health condition when you were admitted to the hospital?

_____Excellent

_____Very good

_____Good

_____Fair

_____Poor

17. During your hospital stay, how much assistance did you need from the hospital staff with your everyday activities (eating, bathing, dressing, using the bathroom, getting out of bed)? Did you need . . . .

_____a lot of help
_____quite a bit of help
_____some help
_____a little help
_____no help at all

18. During your hospital stay, did you experience . . .

_____a lot of pain
_____quite a bit of pain
_____some pain
_____a little pain
_____no pain at all

19. How many nights were you in the hospital?
_____ Number of nights

20. Do you think that the time spent in the hospital was about right, or do you think it was too short a time, or too long a time?

_____About right
_____Too short
_____Too long
_____Not sure

Now we would like you to rate some things about your hospital stay in terms of whether they were **Excellent, Very Good, Good, Fair or Poor**. Please check only one rating for each statement.

ADMISSION: ENTERING THE HOSPITAL

		Excellent	Very Good	Good	Fair	Poor	Don't Know
21.	PREPARATION FOR ADMISSION: How clear and complete the information was about how to prepare for your stay in the hospital and what to expect once you got there	☐	☐	☐	☐	☐	☐
22.	EFFICIENCY OF THE ADMITTING PROCEDURE: Ease of getting admitted, including the amount of time it took	☐	☐	☐	☐	☐	☐
23.	HELPFULNESS AND CONCERN OF ADMITTING STAFF: Their courtesy and concern for your comfort and feelings	☐	☐	☐	☐	☐	☐
24.	ATTENTION OF ADMITTING STAFF TO YOUR INDIVIDUAL NEEDS: Their flexibility in handling your personal needs and wants	☐	☐	☐	☐	☐	☐

	Excellent	Very Good	Good	Fair	Poor	Don t Know
YOUR CARE IN THE HOSPITAL						
25. MEDICAL FACILITIES: How complete and up-to-date the medical equipment was	☐	☐	☐	☐	☐	☐
26. OVERALL EFFICIENCY OF HOSPITAL: How smoothly things ran	☐	☐	☐	☐	☐	☐
27. RECOGNITION OF YOUR OPINIONS: Asking you what you think is important and giving you choices	☐	☐	☐	☐	☐	☐
28. CONSIDERATION OF YOUR NEEDS: Willingness to be flexible in meeting your needs	☐	☐	☐	☐	☐	☐
29. INFORMATION YOU WERE GIVEN: How clear and complete were the explanations about tests, treatments, and what to expect	☐	☐	☐	☐	☐	☐
30. INSTRUCTIONS: How well doctors, nurses and other staff explained how to prepare for tests and operations	☐	☐	☐	☐	☐	☐
31. COORDINATION OF CARE: The teamwork of all the hospital staff who took care of you	☐	☐	☐	☐	☐	☐
32. THE DAILY ROUTINE OF THE DOCTORS, NURSES AND HOSPITAL STAFF: How well they adjusted their schedules to your needs	☐	☐	☐	☐	☐	☐
33. INFORMING FAMILY OR FRIENDS: How well they were kept informed about your condition and needs	☐	☐	☐	☐	☐	☐
34. INVOLVING FAMILY OR FRIENDS IN YOUR CARE: How much they were allowed to help in your care	☐	☐	☐	☐	☐	☐
35. EASE OF GETTING INFORMATION: Willingness of hospital staff to answer your questions	☐	☐	☐	☐	☐	☐
36. SPECIALISTS AND SPECIAL THERAPY: Availability of getting the specialized tests, medicines, or treatments you needed	☐	☐	☐	☐	☐	☐
37. HELPFULNESS: Ability of hospital staff to make you comfortable and reassure you	☐	☐	☐	☐	☐	☐
38. SAFETY AND SECURITY: The provisions for your safety and the security of your belongings	☐	☐	☐	☐	☐	☐

		Very				Don't
	Excellent	**Good**	**Good**	**Fair**	**Poor**	**Know**

YOUR NURSES

39. SKILL AND COMPETENCE OF NURSES: How well things were done, like giving medicine and handling IVs
   ☐   ☐   ☐   ☐   ☐   ☐

40. ATTENTION OF NURSES TO YOUR CONDITION: How often nurses checked on you and how well they kept track of how you were doing
   ☐   ☐   ☐   ☐   ☐   ☐

41. NURSING STAFF RESPONSE TO YOUR CALLS: How quick they were to help
   ☐   ☐   ☐   ☐   ☐   ☐

42. CONCERN AND CARING BY NURSES: Courtesy and respect your were given; friendliness and kindness
   ☐   ☐   ☐   ☐   ☐   ☐

43. INFORMATION GIVEN BY NURSES: How well nurses communicated with patients, families, and doctors
   ☐   ☐   ☐   ☐   ☐   ☐

YOUR DOCTOR

44. ATTENTION OF DOCTOR TO YOUR CONDITION: How often doctors checked on you and how well they kept track of how you were doing
   ☐   ☐   ☐   ☐   ☐   ☐

45. AVAILABILITY OF DOCTOR: How easy it was to get your doctor when needed
   ☐   ☐   ☐   ☐   ☐   ☐

46. CONCERN AND CARING BY DOCTOR: Courtesy and respect you were given; friendliness and kindness
   ☐   ☐   ☐   ☐   ☐   ☐

47. SKILL OF DOCTOR: Ability to diagnose problems, thoroughness of examinations, skill in treating your condition, and scientific knowledge
   ☐   ☐   ☐   ☐   ☐   ☐

48. RESPECT FOR YOU: How well the doctor listened to what you had to say, how well the doctor understood what you thought was important
   ☐   ☐   ☐   ☐   ☐   ☐

OTHER HOSPITAL STAFF

49. HOUSEKEEPING STAFF: How well they did their job and how well they acted towards you
   ☐   ☐   ☐   ☐   ☐   ☐

50. LABORATORY WORKERS: How well they did their jobs and how they acted towards you
   ☐   ☐   ☐   ☐   ☐   ☐

51. X-RAY STAFF: How well they did their jobs and how they acted towards you
   ☐   ☐   ☐   ☐   ☐   ☐

LIVING ARRANGEMENTS

		Excellent	Very Good	Good	Fair	Poor	Don't Know
52.	CONDITION OF YOUR ROOM: Cleanliness, comfort, lighting, and temperature	❑	❑	❑	❑	❑	❑
53.	SUPPLIES AND FURNISHINGS: Completeness of supplies, condition of the furniture and how well things worked	❑	❑	❑	❑	❑	❑
54.	RESTFUL ATMOSPHERE: Amout of peace and quiet	❑	❑	❑	❑	❑	❑
55.	PRIVACY: Provisions for your privacy	❑	❑	❑	❑	❑	❑
56.	QUALITY OF FOOD: Overall, how well it tasted, serving temperature, and variety available	❑	❑	❑	❑	❑	❑
57.	HOSPITAL ENVIRONMENT: Other than your room, how comfortable, quiet, and pleasant it was	❑	❑	❑	❑	❑	❑
58.	SIGNS AND DIRECTIONS: Ease of finding your way around the hospital	❑	❑	❑	❑	❑	❑
59.	HOSPITAL BUILDING: How you would rate the hospital building overall	❑	❑	❑	❑	❑	❑
60.	PARKING: Number of spaces available, convenience of location, and cost	❑	❑	❑	❑	❑	❑
61.	PROVISIONS FOR FAMILY AND FRIENDS: Adequacy of visting hours and facilities for them; visitors treated like welcome guests	❑	❑	❑	❑	❑	❑

DISCHARGE: LEAVING THE HOSPITAL

		Excellent	Very Good	Good	Fair	Poor	Don't Know
62.	DISCHARGE PROCEDURES: Time it took to be discharged from the hospital and how efficiently it was handled	❑	❑	❑	❑	❑	❑
63.	DISCHARGE INSTRUCTIONS: How clearly and completely you were told what to do and what to expect when you left the hospital	❑	❑	❑	❑	❑	❑
64.	COORDINATION OF CARE AFTER DISCHARGE: Hospital staff's efforts to provide for your needs after you left the hospital	❑	❑	❑	❑	❑	❑

BILLING BY HOSPITAL

		Excellent	Very Good	Good	Fair	Poor	Don't Know
65.	EXPLANATIONS ABOUT COSTS AND HOW TO HANDLE YOUR HOSPITAL BILLS: The completeness and accuracy of information and the willingness of hospital staff to answer your questions about finances	☐	☐	☐	☐	☐	☐
66.	EFFICIENCY OF BILLING: How fast you got your bill, how accurate and understandable it was	☐	☐	☐	☐	☐	☐

LOOKING BACK ON YOUR CARE

67.	Overall quality of care and services you received	☐	☐	☐	☐	☐	☐
68.	How good a job the hospital did in meeting your expectations for your stay	☐	☐	☐	☐	☐	☐
69.	Amount of information you were given about your illness and treatment	☐	☐	☐	☐	☐	☐
70.	Teamwork among doctors who cared for you	☐	☐	☐	☐	☐	☐
71.	Competence and skill of the nurses	☐	☐	☐	☐	☐	☐
72.	Courtesy and friendliness of the nurses	☐	☐	☐	☐	☐	☐
73.	The outcome of your hospital stay: How much you were helped by the hospitalization	☐	☐	☐	☐	☐	☐

> Obstetrical Patients (delivering a baby) Please skip questions 74, 75, 76 and 77.
> All other patients please continue

74. Think back to the time just before you entered the hospital. Did you think your health or condition would be helped or improved by your stay in the hospital . . .

_____a great deal

_____quite a bit

_____somewhat

_____a little

_____not at all

_____not sure/does not apply

75. Now that you have been out of the hospital for a while, how much do you think you were actually helped by your stay in the hospital? Do you think you were helped . . .

_____a great deal
_____quite a bit
_____somewhat
_____a little
_____not at all
_____not sure/does not apply

76. If your condition improved due to your hospital stay, who or what in particular helped you to improve?

_____
_____
_____
_____
_____
_____
_____
_____

77. If your condition did not improve due to your hospital stay, who or what in particular kept you from improving?

_____
_____
_____
_____
_____
_____
_____
_____

OVERALL SATISFACTION WITH HOSPITAL

Here are some things that people sometimes say about their hospital stay. Please tell me whether you **strongly agree, somewhat agree, somewhat disagree or strongly disagree** with each statement.

	Strongly Agree	Somewhat Agree	Somewhat Disagree	Strongly Disagree
78. There were some things about my hospital stay that could have been better.	☐	☐	☐	☐
79. The care I received at the hospital was so good that I have bragged about it to family and friends.	☐	☐	☐	☐

	Very Satisfied	Somewhat Satisfied	Somewhat Dissatisfied	Very Dissatisfied
80. How satisfied were you with:				
a. The quality of care provided by your doctors?	☐	☐ ·	☐	☐
b. The quality of nursing?	☐	☐	☐	☐
c. The rooms and facilities?	☐	☐	☐	☐
d. The food and meals?	☐	☐	☐	☐
e. Your insurance coverage for the hospital bill?	☐	☐	☐	☐
f. The out-of-pocket cost to you: that is, what was not paid for by insurance?	☐	☐	☐	☐

81. *Were you Completely Satisfied, Somewhat Satisfied or Not At All Satisfied with the hospital stay overall?*

_____Completely satisfied
_____Somewhat satisfied
_____Not at all satisfied

INTENTIONS TO RETURN TO SAME HOSPITAL

82. *How likely would you be to return to the same hospital if you ever need to be hospitalized again?*

_____Definitely would
_____Probably would
_____Probably would not
_____Definitely would not

83. *Would you recommend the hospital to your family or friends if they needed hospital care?*

_____Definitely would
_____Probably would
_____Probably would not
_____Definitely would not

YOUR COMMENTS: OPEN ENDED REMARKS

84. *Did we forget to ask you about something that you feel is important regarding your stay in the hospital? If so, what is it we forgot to ask about? Please rate.*

	Excellent	Very Good	Good	Fair	Poor
_____	☐	☐	☐	☐	☐
_____	☐	☐	☐	☐	☐
_____	☐	☐	☐	☐	☐
_____	☐	☐	☐	☐	☐

85. *Did any particular thing happen during your stay in the hospital, good or bad, that surprised you? If so, what was it that surprised you. (List all things that surprised you).*

_____
_____
_____
_____
_____

FACTS ABOUT YOU

These next few questions are for statistical purposes. These answers will be kept strictly confidential

86. *In what year were you born?* _____

87. *What was the last grade or level of school you have had an opportunity to complete?*

_____Eighth grade or less   _____Some college
_____Some high school   _____Two-year college graduate
_____High school graduate   _____Four-year college graduate
_____Technical/Trade/Vocational school   _____Postgraduate
         (after high school)

88. Your occupation:_____
    (Please provide exact title of position)

89. Your sex?
    _____Male   _____Female

90. Which of the following income categories best describes your total 1986 household income?
    _____$ 7,500 or less
    _____$ 7,501 to $25,000
    _____$25,001 to $50,000
    _____$50,001 or more

91. How many people, including yourself, depend on this income?
    _____ people

92. In order to represent all groups properly, may we ask if you are . . .
    _____White
    _____Black
    _____Hispanic
    _____Oriental
    _____Other

93. Was part or all of your hospital bill paid for by some type of health insurance?
    _____Yes   _____No

94. If yes, which type of health coverage did you use to pay for your hospital costs?

    ☐ AARP
    ☐ AETNA
    ☐ ALLSTATE
    ☐ BANKERS LIFE & CASULATY
    ☐ BLUE CROSS/BLUE SHIELD
    ☐ CNA
    ☐ CONNECTICUT GENERAL
    ☐ EQUITABLE/BELL HELICOPTER
    ☐ FIDELITY
    ☐ GENERAL AMERICAN/McDONALD DOUGLAS
    ☐ GOVERNMENT EMPLOYEES HOSPITAL ASSOC.
    ☐ GROUP INSURANCE
    ☐ HCA
    ☐ HARTFORD
    ☐ HEALTH AND WELFARE
    ☐ JOHN HANCOCK

    ☐ LINCOLN NATIONAL
    ☐ MAXICARE
    ☐ MEDICAID
    ☐ MEDICARE
    ☐ METROPOLITAN
    ☐ MUTUAL OF OMAHA
    ☐ NATIONAL LIFE
    ☐ NEW YORK LIFE
    ☐ PASB
    ☐ PILOT LIFE
    ☐ PROVIDENT
    ☐ PRUCARE
    ☐ PRUDENTIAL
    ☐ SANUS HMO
    ☐ STATE FARM
    ☐ TRANSPORT LIFE
    ☐ TRAVELER'S
    ☐ WORKMAN'S COMPENSATION
    ☐ Other (Specify) _____

95. Would you classify your current health insurance as an HMO, PPO or a regular insurance program?

    _____ HMO (Health Maintenance Organization)
    _____ PPO (Preferred Provider Organization)
    _____Regular Insurance
    _____Don't Know

    .

96. Do you have to file an insurance claim form when you see a doctor?

_____Yes
_____No

97. When you have a physical check-up, do you have to pay for it yourself or is it covered by insurance?

_____Pay for it yourself
_____Covered by insurance

98. Can you go to any doctor you wish or does your insurance require you to see only certain doctors?

_____Any doctor
_____Certain doctors

99. Can you go to any hospital you wish or does your insurance require you to use a specific hospital or hospitals?

_____Any hospital
_____Specific hospitals

100. Do you have to pay some amount of a deductible, such as the first $300 or $400 of your medical bills, before your insurance begins to help pay for your expenses?

_____Yes
_____No

If any additional comments use space below:

Thank you for completing this questionnaire. Please double check that you have answered all questions and then place the questionnaire in the postage paid envelope provided. Thank you again for your help!

Appendix C

Assurance of Confidentiality

The investigator of this study, Cheryl Patterson, RN, is a doctoral candidate in the Frances Payne Bolton School of Nursing, Case Western Reserve University. This will be an independently conducted investigation by this candidate in partial fulfillment of the degree of Ph.D., Nursing.

The hospital sample for this investigation includes all institutions involved in the Cleveland Health Quality Choice Coalition. All hospitals will be invited to participate in the investigation. Participation is voluntary.

This investigator is not employed by, and has no formal relationship with, the Cleveland Health Quality Choice Coalition (CHQCC), its purposes or operations. The protocol for outside investigators has been followed by the candidate, allowing the confidential use of certain data elements contained in the CHQCC database.

All hospital specific data collection will be mediated through the chief nursing officer (CNO) at each institution. Initial interviews with the hospital CNOs will require approximately 60 minutes in length. Subsequent communications, if required, can occur by telephone. Any procedures or protocols required for authorization of data collection will be followed as prescribed by the hospital CNO. Refusal to participate or withdrawal from the study can be done at any time without penalty whatsoever.

Individual hospital identity will be concealed at all times and known only to

217

the researcher. Code letters or numbers will be used to refer to individual hospitals in any presentations or publications. All data will be transcribed, entered, and analyzed by the investigator; no third parties will be involved.

At the conclusion of the investigation, an abstract summarizing the findings and recommendations for further study will be given to each participating hospital. In addition, each hospital will be given the individual code name for their own hospital only. In this way their own position can be located within the accompanying scatterplots, charts and graphs relative to the hospital sample as a whole.

Some benefit may be derived by the participating hospitals through this process, in gaining some additional insights and understandings of their own hospital relative to the community as a whole. The risks of disclosure and any material negative consequences from such disclosure are minimal.

Any questions or concerns may be directed to the investigator personally (home telephone --█████████

Appendix D

Descriptive Statistics of Individual Study Variables

Research Question 1 deals with the individual nursing resource variables of

interest to this study. In addition, to address Research Questions 2, 3, and 4 an

examination of the outcome variables is indicated as well. Numeric data describing the

individual nursing resource and outcome variables are contained in Tables D1 through D4.

These data are discussed in Chapters IV and V.

219

Table D1

Nursing Resource Variables Central Tendency Measures

Nursing Variable	Median	Arithmetic Mean	5% Trimmed Mean	Tukey's Mean	Skewness
TNH/DC	53.70	51.97	51.77	52.98	-.0478
TNH/PD	8.70	8.68	8.57	8.34	.6117
VNH/DC	46.97	47.51	47.08	46.63	.2439
VNH/PD	7.66	7.94	7.80	7.64	1.0074
RNH/DC	30.29	32.85	32.30	30.41	.9118
RNH/PD	5.10	5.53	5.39	5.02	1.3162
LPNH/DC	8.10	8.05	7.80	7.59	.5634
LPNH/PD	1.28	1.36	1.33	1.30	.4326
NAH/DC	4.68	5.77	5.40	4.75	1.1994
NAH/PD	.848	.975	.898	.778	1.5384
FNH/VNH	.080	.095	.094	.094	.0690
FNH/DC	4.57	4.58	4.48	4.42	.3918
FNH/PD	.751	.753	.741	.741	.2551
%RNH	73.69	71.65	71.97	72.92	-.6274
%RNH+LPNH	88.89	88.70	88.84	88.82	-.1645

220

Table D2

Nursing Resource Variables Dispersion Measures

Nursing Variable	Min	Max	Range	IQR	Tukey's Hinges	Midspread	Std Dev
TNH/DC	28.30	79.27	50.97	24.70	46.54;61.62	15.08	15.03
TNH/PD	4.70	14.57	9.87	2.92	7.30; 9.51	2.21	2.50
VNH/DC	26.00	76.66	50.66	18.38	42.24;54.56	12.32	14.05
VNH/PD	4.27	14.09	9.82	1.86	7.03; 8.42	1.39	2.39
RNH/DC	20.73	54.97	34.24	14.54	25.23;38.75	13.52	10.52
RNH/PD	3.44	10.10	6.66	2.14	4.58; 6.44	1.86	1.72
LPNH/DC	0.0	20.71	20.71	8.63	2.90;11.37	8.47	5.68
LPNH/PD	0.0	3.20	3.20	1.52	0.51; 2.00	1.49	0.93
NAH/DC	0.79	17.28	16.49	7.00	1.95; 8.81	6.86	4.51
NAH/PD	0.17	3.18	3.01	1.07	0.34; 1.40	1.05	0.81
FNH/VNH	0.02	0.18	0.17	0.09	0.05; 0.14	0.09	0.05
FNH/DC	0.52	10.41	9.89	4.26	2.41; 6.49	4.08	2.64
FNH/PD	0.10	1.61	1.51	0.76	0.38; 1.11	0.73	0.42
%RNH	53.95	83.63	29.68	14.08	65.29;79.16	13.87	9.50
%RNH+LPNH	77.46	97.40	19.94	12.62	82.72;94.71	11.99	6.34

Note: Midspread is the distance between Tukey's hinges.

221

Table D3

Outcome Variables Central Tendency Measures

Outcome Variable	Median	Arithmetic Mean	%5Trimmed Mean	Tukey's Mean	Skewness
PS-Global	1.0000	1.0006	0.9990	0.9959	1.0029
PS-NC	1.0200	1.0071	1.0078	1.0182	-0.4956
PS-IX	1.0000	1.0047	1.0052	1.0046	-0.1008
Mortality	0.9500	0.9332	0.9330	0.9432	-0.1546

Table D4

Outcome Variables Dispersion Measures

Outcome Variable	Min	Max	Range	IQR	Tukey's Hinges	Midspread	Std Dev
PS-Global	.9300	1.1000	.1700	.0300	.9900;1.0100	0.02	.0363
PS-NC	.9400	1.0600	.1200	.0700	.9800;1.0400	0.06	.0374
PS-IX	.9400	1.0600	.1200	.0550	.9800;1.0300	0.05	.0345
Mortality	.8150	1.0550	.2400	.1175	.8650;.9800	0.115	.0661

Note: Midspread is the distance between Tukey's Hinges.

223

Appendix E

Stem-and-Leaf Diagrams

Stem-and-leaf diagrams offer one method of visualizing a variable's distribution shape, while displaying the actual raw data values. A stem-and-leaf diagram for each nursing resource and quality outcome variable is presented in this Appendix. Spaces were left in the vertical scale (stem) to show any missing integer values in the variables' data sets.

TNH/DC (x 10)

```
2.  89
3.  13
4.  68
5.  013344
6.  178
7.  19
```

TNH/PD

```
 4.  79

 6.  38
 7.  3
 8.  011779
 9.  25
10.  47

12.  5

14.  6
```

VNH/DC (x 10)

```
2.  66
3.  02
4.  24467
5.  11478
6.  46
7.  6
```

VNH/PD

```
 4.  34

 6.  25
 7.  0266777
 8.  048
 9.  9

11.  8

14.  0
```

224

RNH/DC(x 10)

2. 0114
2. 6899
3. 113
3. 8
4. 0
4. 5
5. 2
5. 5

RNH/PD

3. 45
4. 05778
5. 0128
6. 09
7. 07

10. 1

LPNH/DC(x 10)

0. 0

2. 357
3. 0
4. 47

6. 0

10. 22
11. 025

13. 5
14. 7

LPNH/PD

0. 044
0. 558
1. 01
1. 5579
2. 13
2. 7
3. 2

20. 7

NAH/DC

```
 0. 8
 1. 578
 2. 19
 3. 8
 4. 59
 5. 6
 6. 6

 8. 79
 9. 4

11. 9




17. 3
```

NAH/PD

```
0. 22334
0. 56899
1. 044
1. 5
2. 2

3. 2
```

FNH/VNH

```
.0 234
.0 555
.0 688
.1 2344
.1 555
.1 8
```

FNH/DC

```
0. 5
1. 47
2. 1678
3. 8
4. 0
5. 19
6. 0468
7. 0


10. 4
```

FNH/PD

```
0. 133
0. 44456
0. 789
1. 0122
1. 1
1. 6
```

%RNH (% in whole numbers)

5 4
5 69

6 568
7 22
7 57899
8 224

%RNH+LPNH (% in whole numbers)

7 7
8 2224
8 669
9 034
9 5677

PS-Global

.9 3
.9 6
.9 889999
1.0 0000
1.0 122
1.0 5
1.1 0

PS-NC

.9 4566
.9 89
1.0 0
1.0 22223
1.0 44456

PS-IX

.9 46
.9 77899
1.0 00
1.0 12333
1.0 556

Mortality

.8 2
.8 566
.8 7
.9 0
.9 555566
.9 889

1.0 2
1.0 5

Appendix F

Histograms

Histograms of all nursing resource variables and hospital outcome variables are presented in this Appendix. SPSS default settings were used to determine the data intervals for this data set. Normal curves based on the variables' distributions were superimposed on the diagrams.

228

TNH/DC
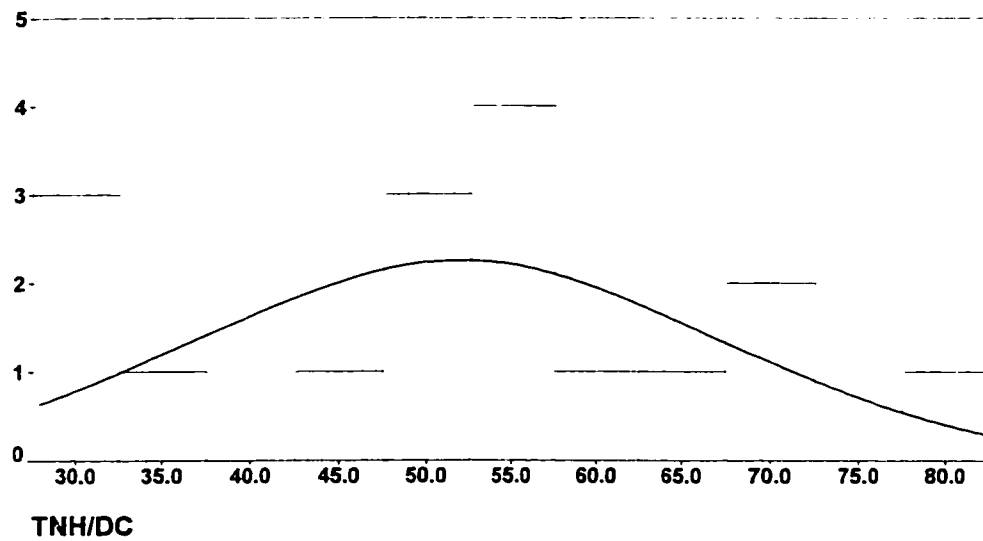
Figure F-1. Total Nursing Hours per Discharge (x axis).

TNH/PD
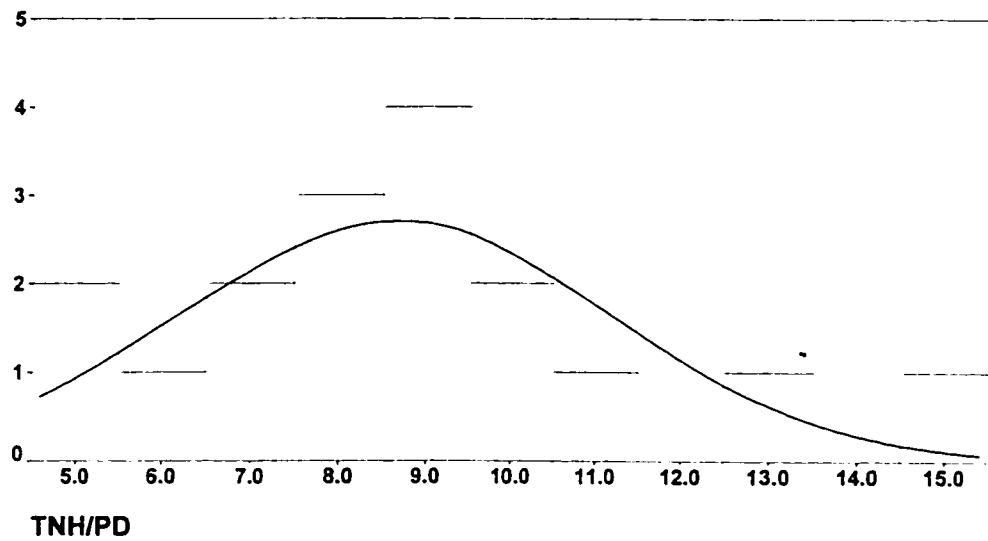
Figure F-2. Total Nursing Hours per Patient Day (x axis).

VNH/DC
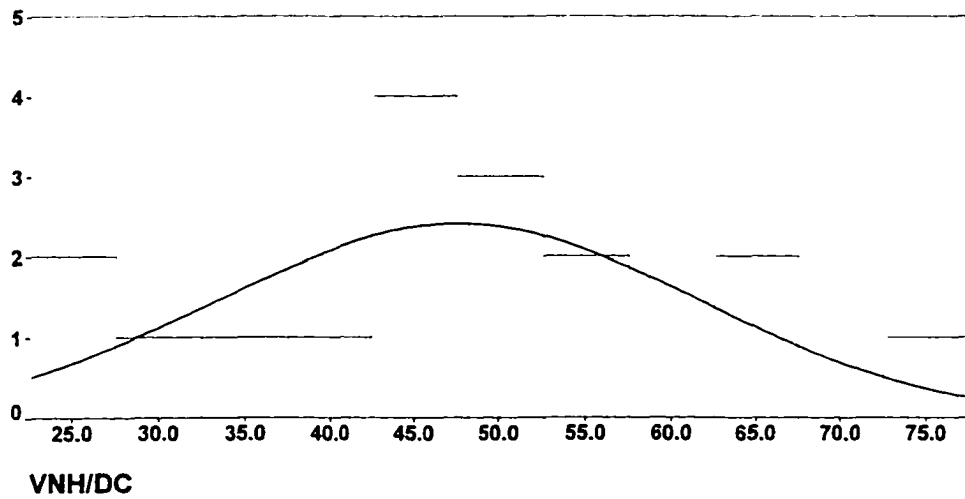
Figure F-3. Variable (direct bedside) Nursing Hours per Discharge
(x axis).

VNH/PD
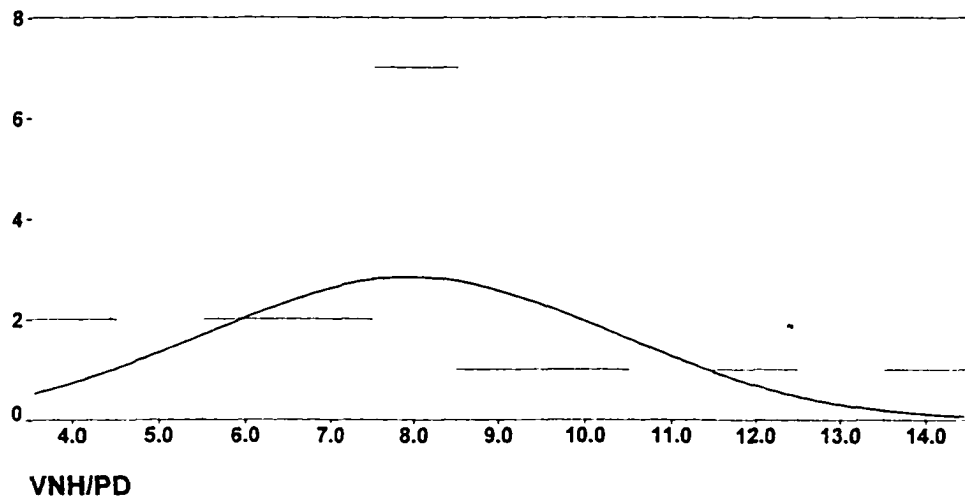
Figure F-4. Variable (direct bedside) Nursing Hours per Patient Day
(x axis).

RNH/DC
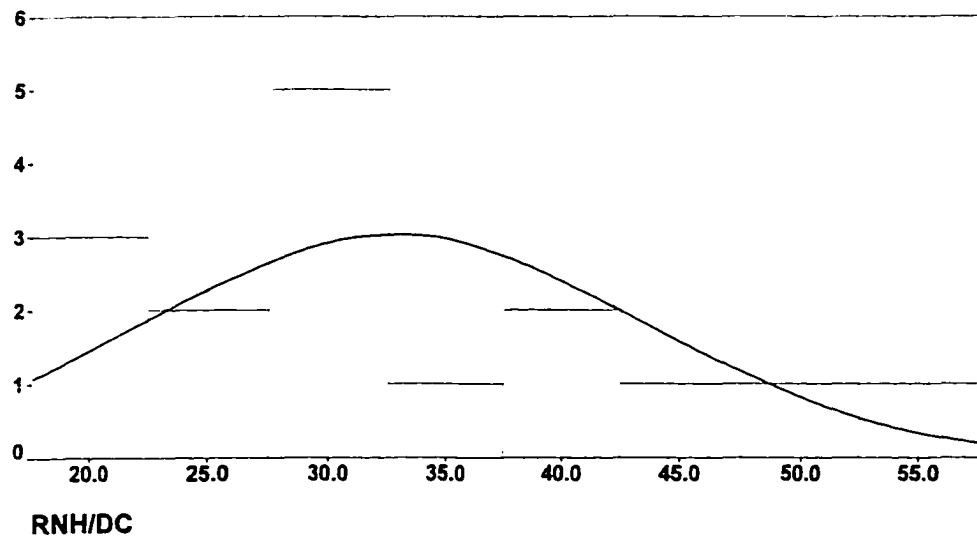
Figure F-5. Registered Nurse Hours per Discharge.

RNH/PD
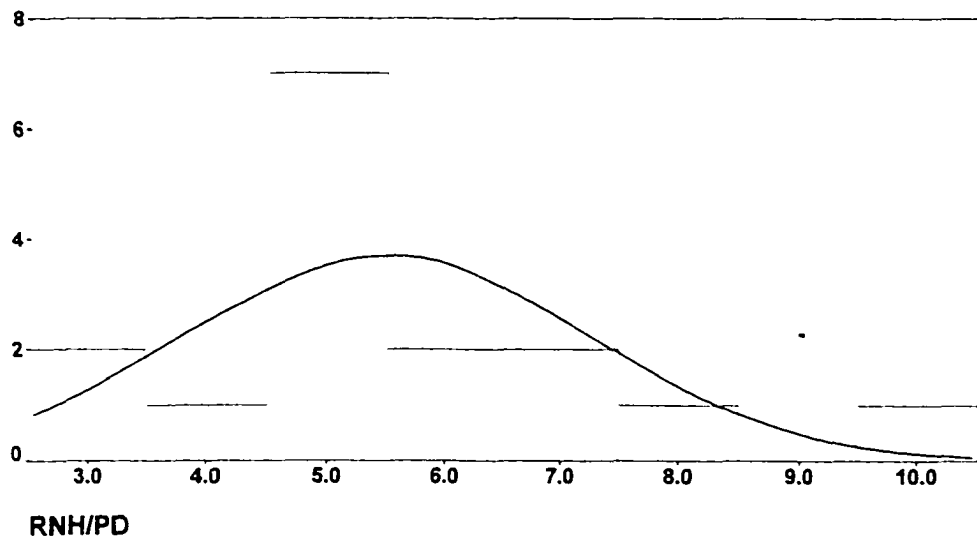
Figure F-6. Registered Nurse Hours per Patient Day (x axis).
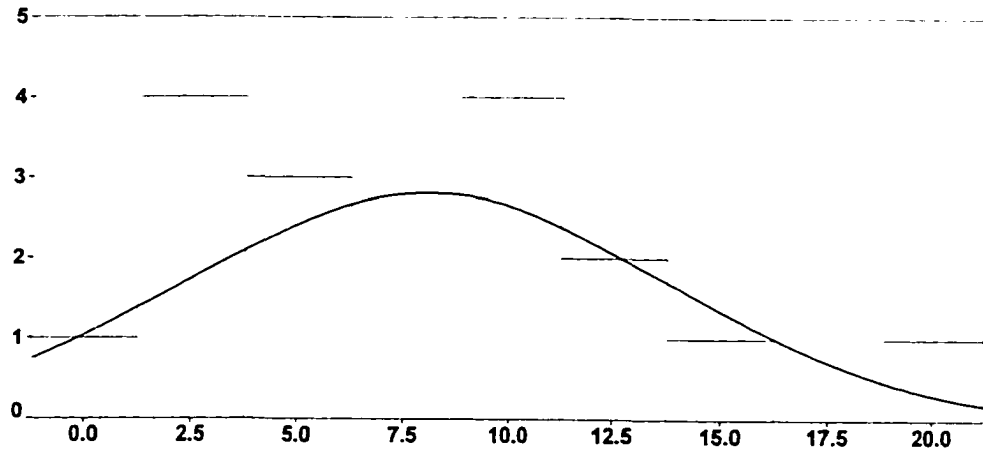
LPNH/DC

Figure F-7. Licensed Practical Nurse Hours per Discharge
(x axis).
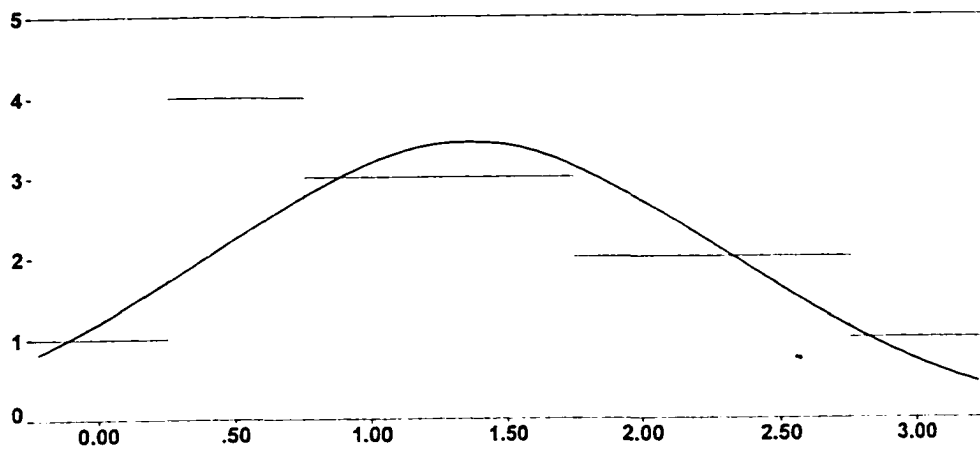
LPN/PD

Figure F-8. Licensed Practical Nurse Hours per Patient Day
(x axis).

NAH/DC
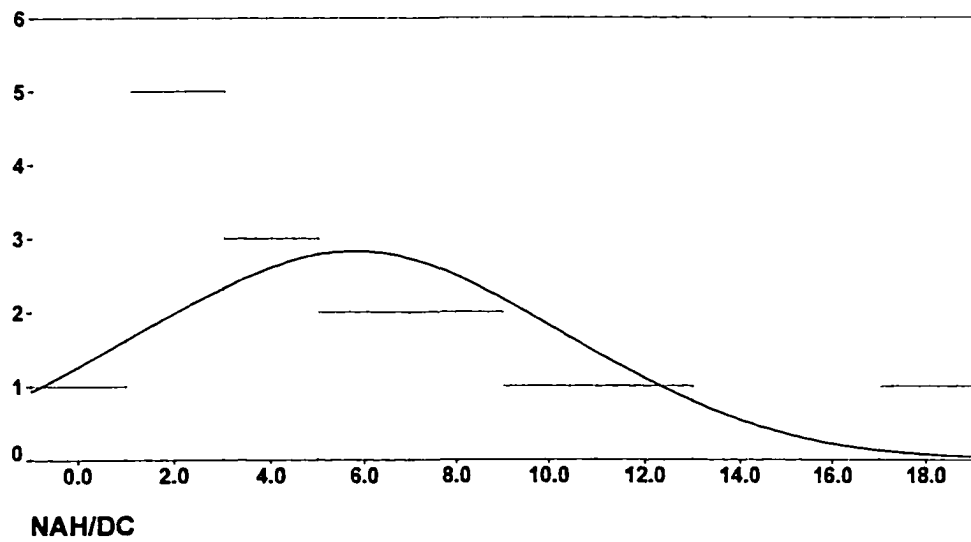
Figure F-9. Nurse Aide Hours per Discharge (x axis).

NAH/PD
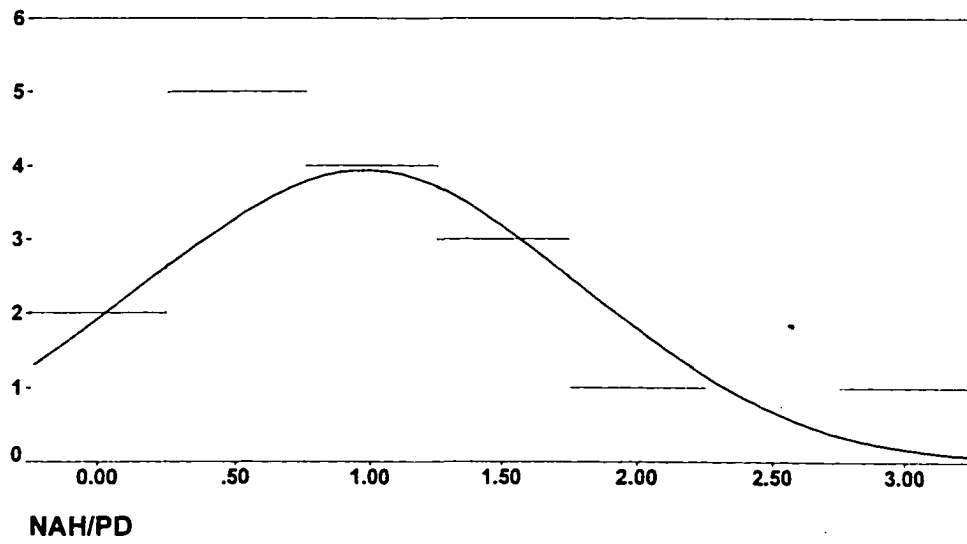
Figure F-10. Nurse Aide Hours per Patient Day (x axis).

FNH/VNH
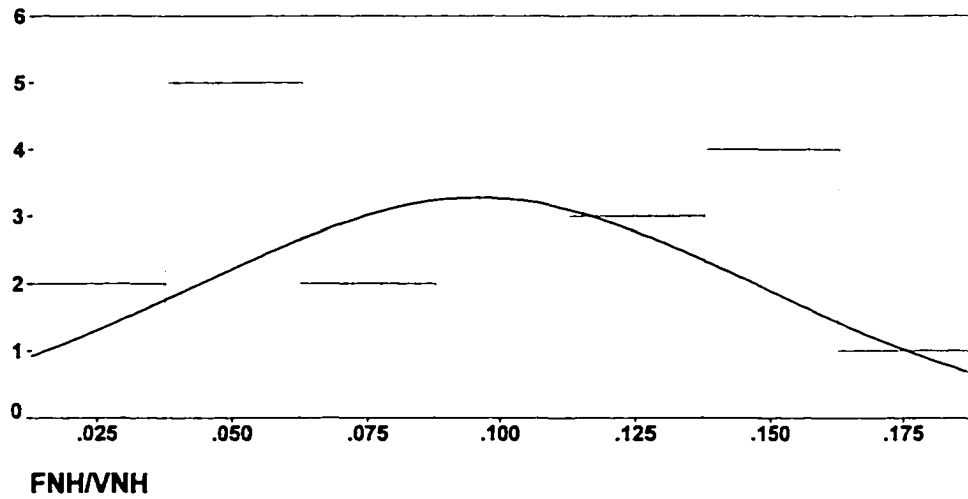
Figure F-11. Fixed Nursing Hours per Variable (direct bedside) Nursing Hours (x axis).

FNH/DC
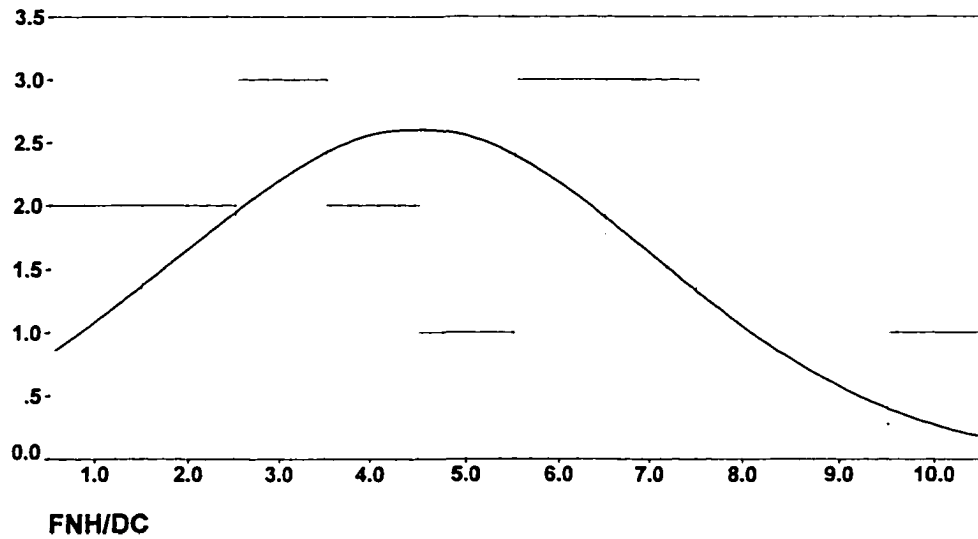
Figure F-12. Fixed Nursing Hours per Discharge (x axis).

FNH/PD
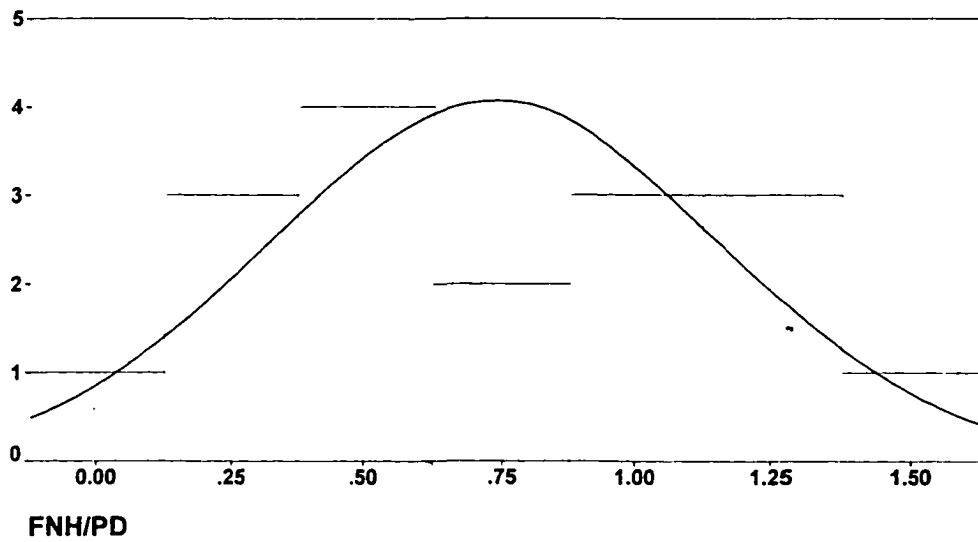
Figure F-13. Fixed Nursing Hours per Patient Day (x axis).

%RNH
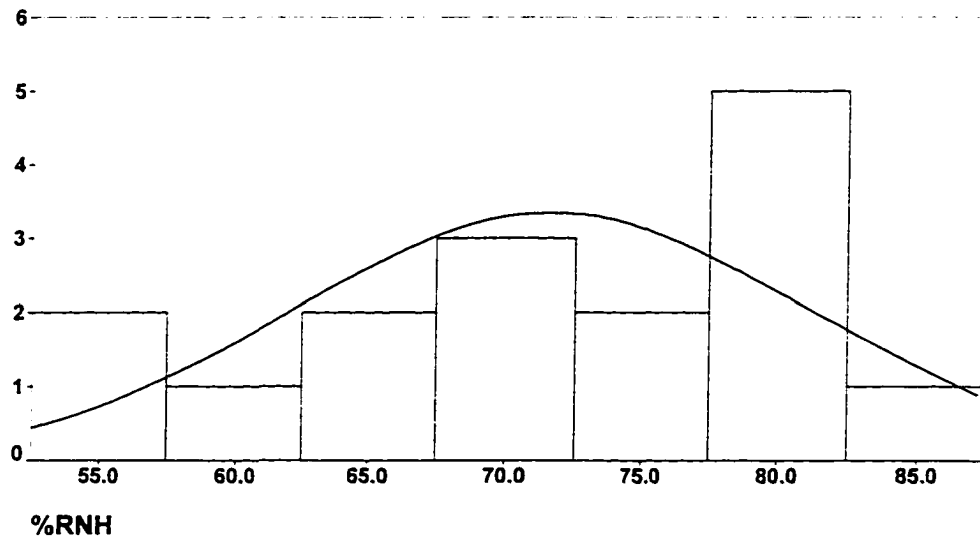
Figure F-14. Skill Mix 1(x axis.)

%(RNH+LPNH)
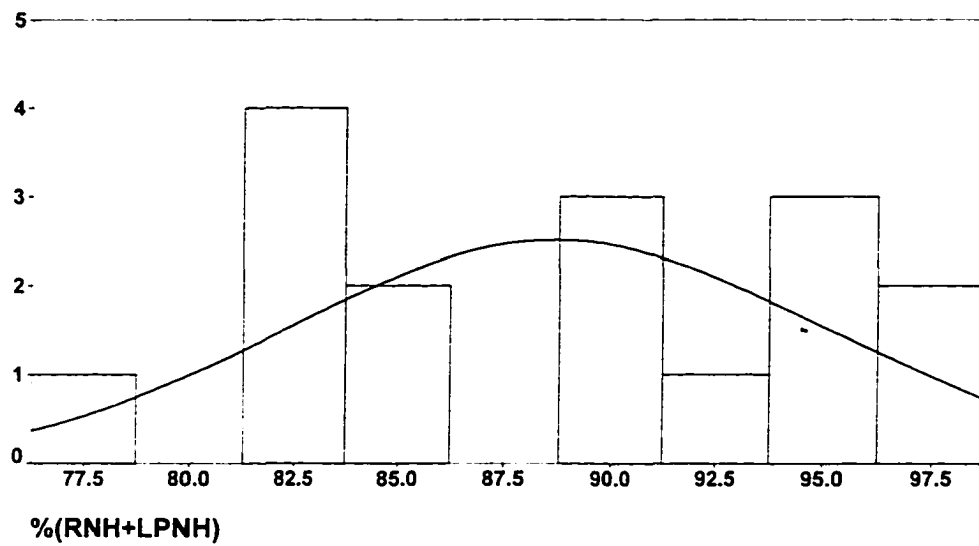
Figure F-15. Skill Mix 2 (x axis).

PS-G
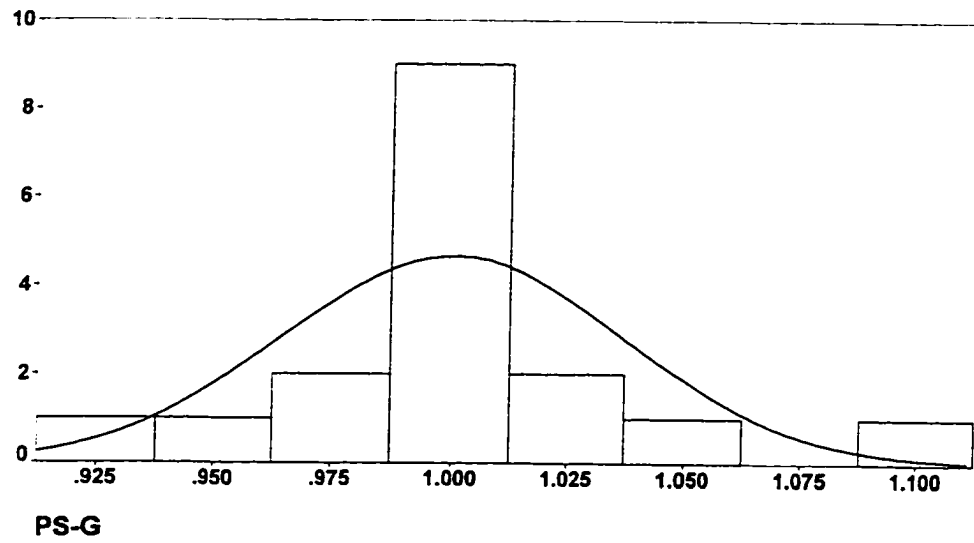
Figure F-16. Patient Satisfaction-Global Scores.

PS-NC
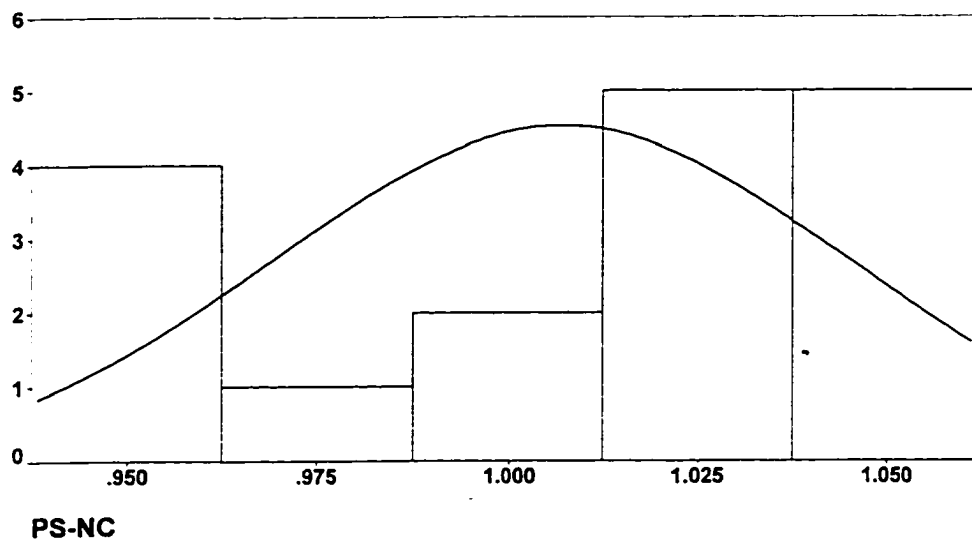
Figure F-17. Patient Satisfaction-Nursing Care Scores.
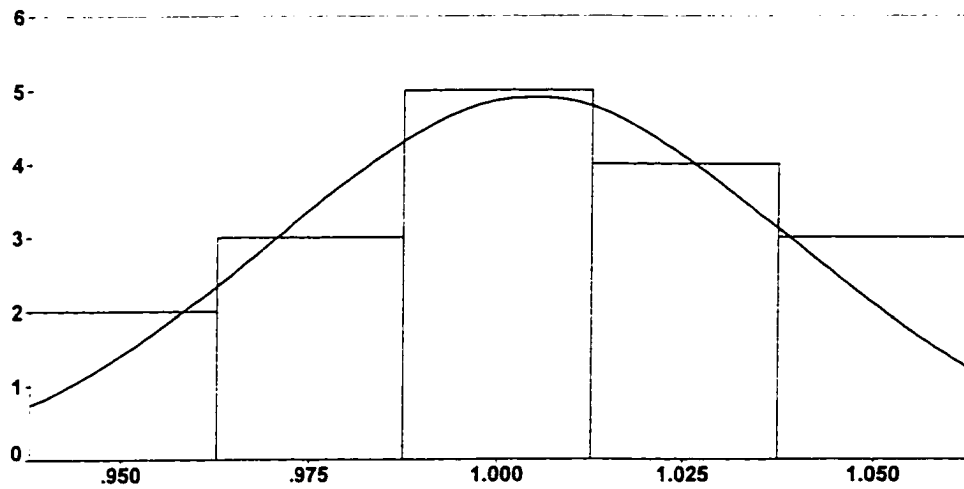
PS-IX

Figure F-18. Patient Satisfaction-Nursing Index Scores.
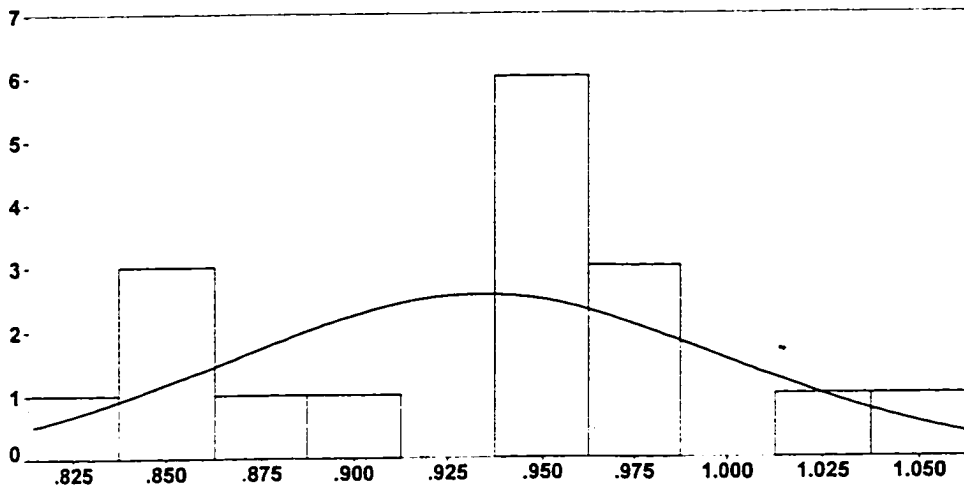
MORTALITY

Figure 19. Mortality Scores.

Appendix G

Box-and-Whisker Plots

Two sets of box-and-whisker plots are shown for each nursing resource and outcome variable. The first set, denoted with the letter 'a' is generated from actual data values. The second set of plots, denoted with the letter 'b' is generated from z-scores. The 'a' and 'b' boxplots for each variable diagram is presented on the same page to enable visual comparison. Selected nursing resource variables, and the outcome variables, are grouped together in the same page for illustrative purposes as well.

239
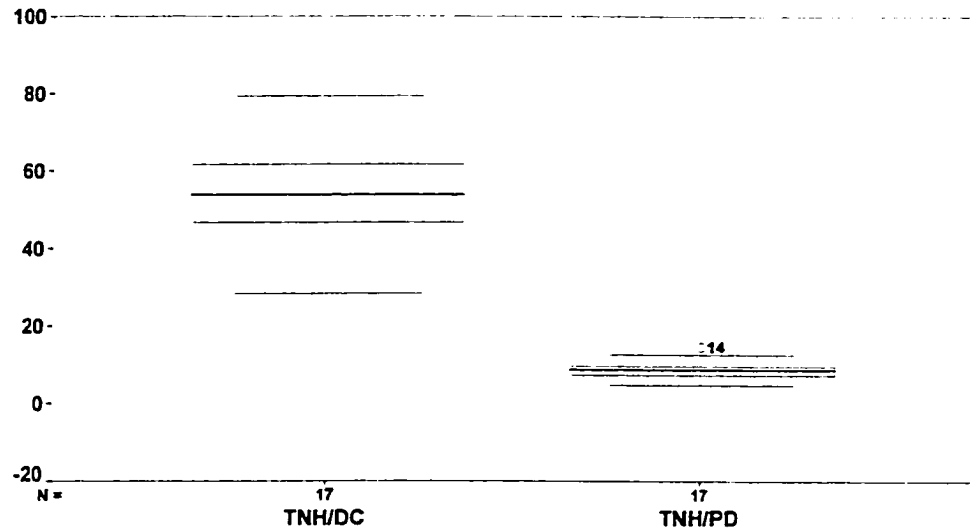
Figure G-1a. Total Nursing Hours per Volume Measures (actual values).
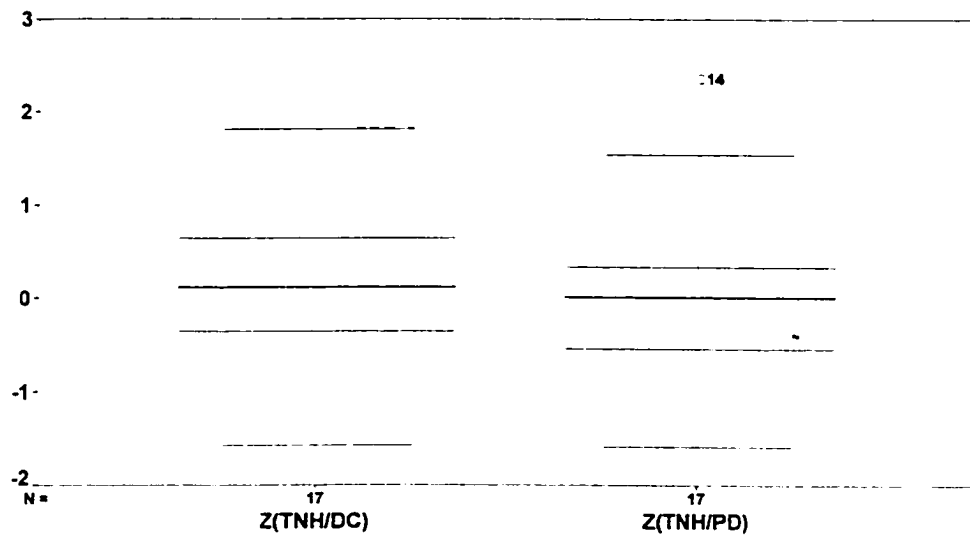
Figure G-1b. Total Nursing Hours per Volume Measures (z scores).
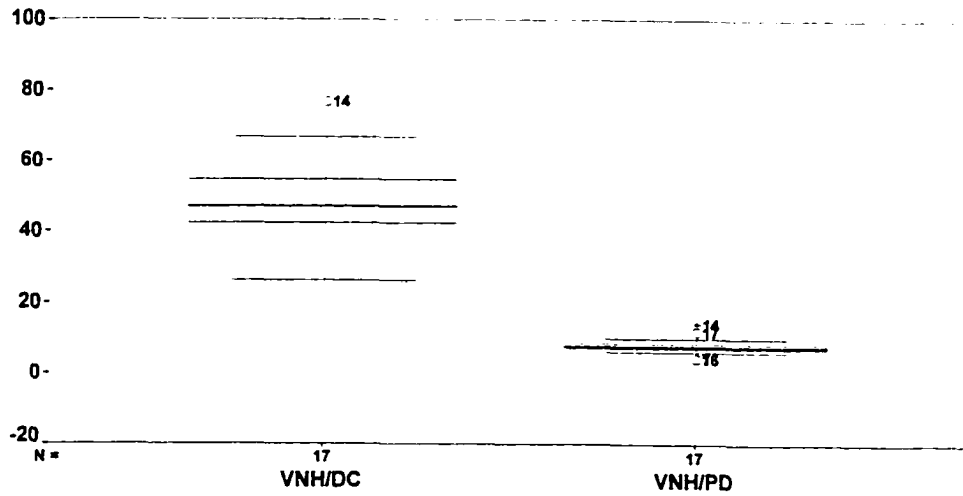
Figure G-2a. Variable (direct bedside)Nursing Hours per Volume Measures (actual values).
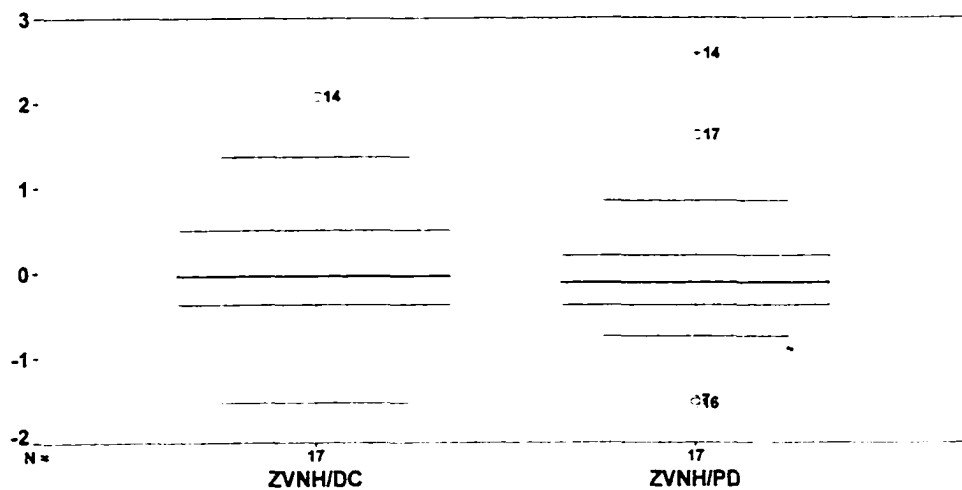
Figure G-2b. Variable (direct bedside)Nursing Hours per Volume Measures (z scores).

Figure G-3a. Registered Nurse Hours per Volume Measures (actual values)

Figure G-3b. Registered Nurse Hours per Volume Measures (z scores).
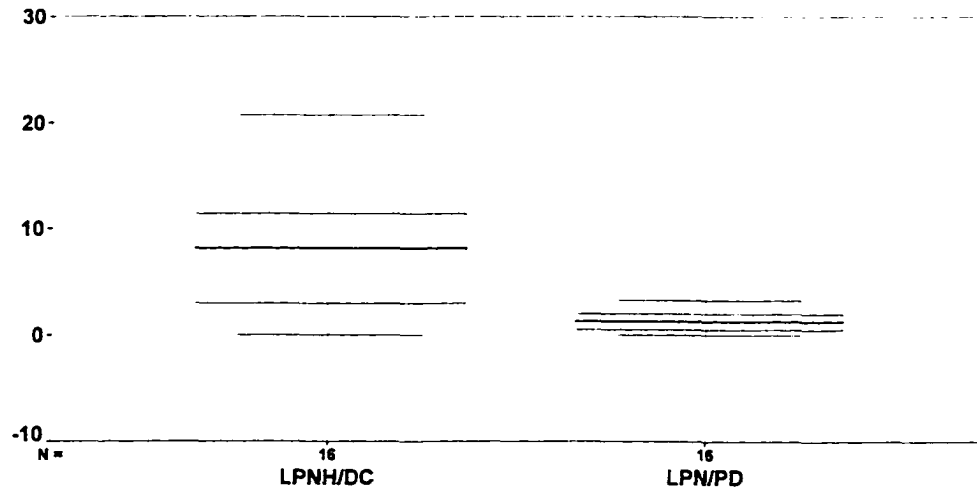
Figure G-4a. Licensed Practical Nurse Hours per Volume Measures (actual values).
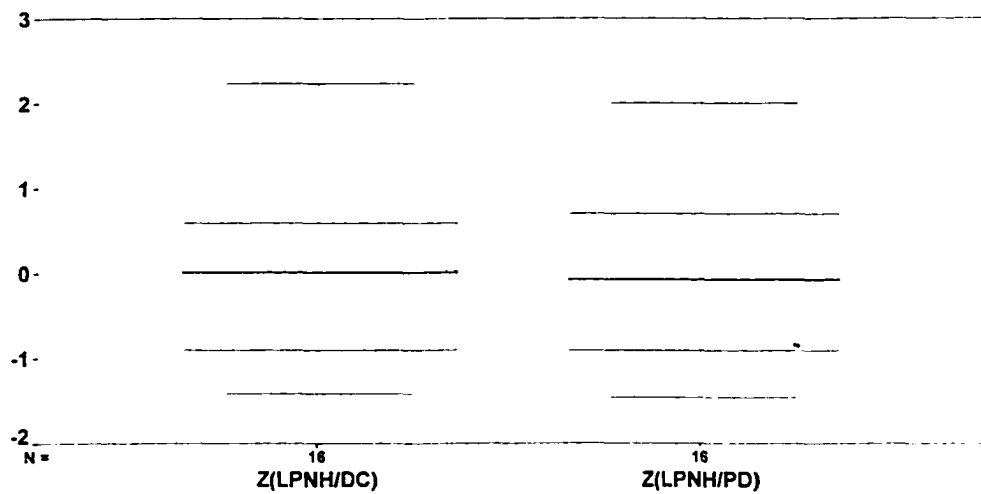
Figure G-4b. Licensed Practical Nurse Hours per Volume Measures (z scores).
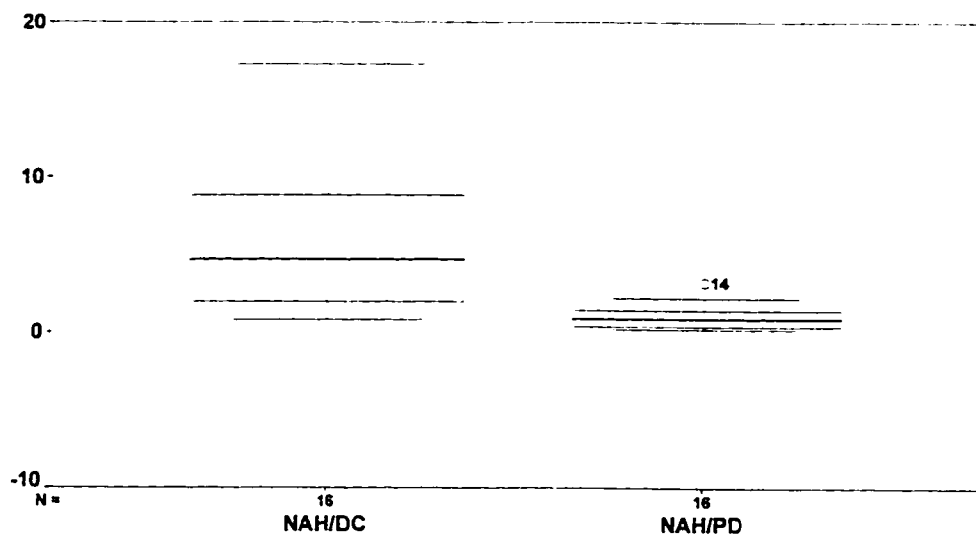
Figure G-5a. Nurse Aide Hours per Volume Measures (actual values).
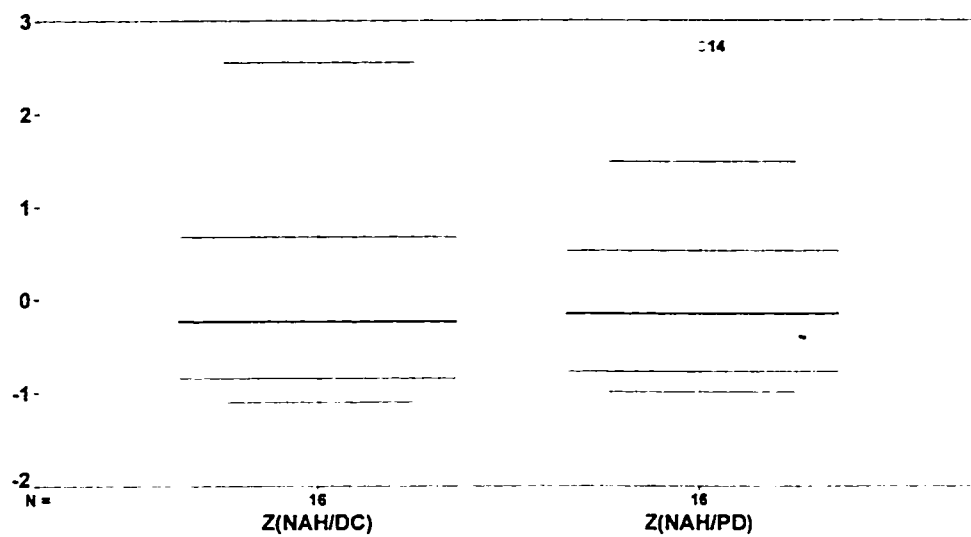
Figure G-5b. Nurse Aide Hours per Volume Measures (z scores).
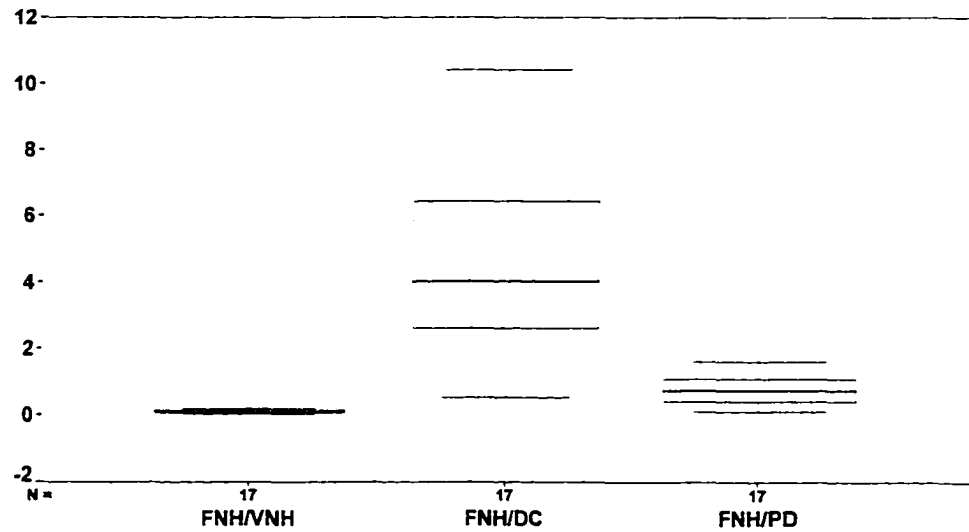
Figure G-6a. Fixed Nursing Hours Variables (actual values).
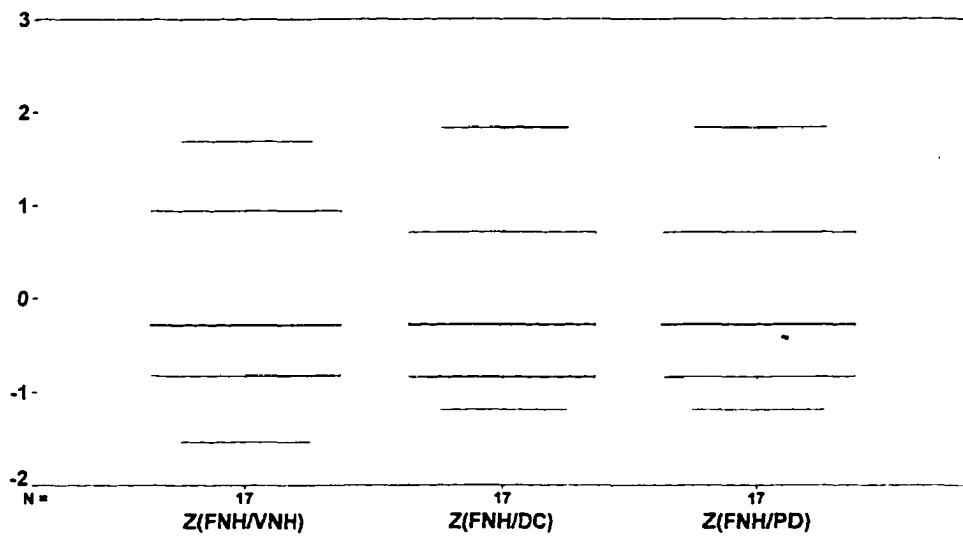
Figure G6b. Fixed Nursing Variables (z scores).
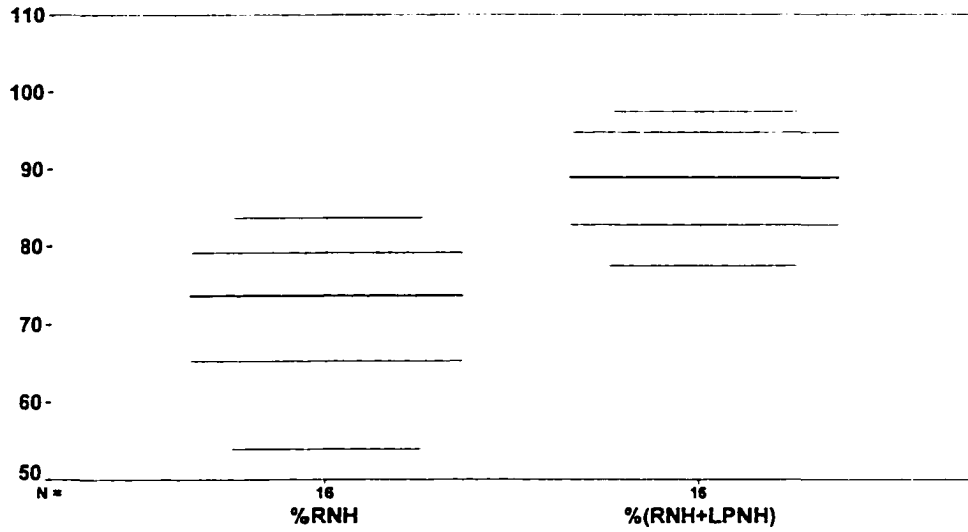
Figure G-7a. Skill Mix Variables (actual values).
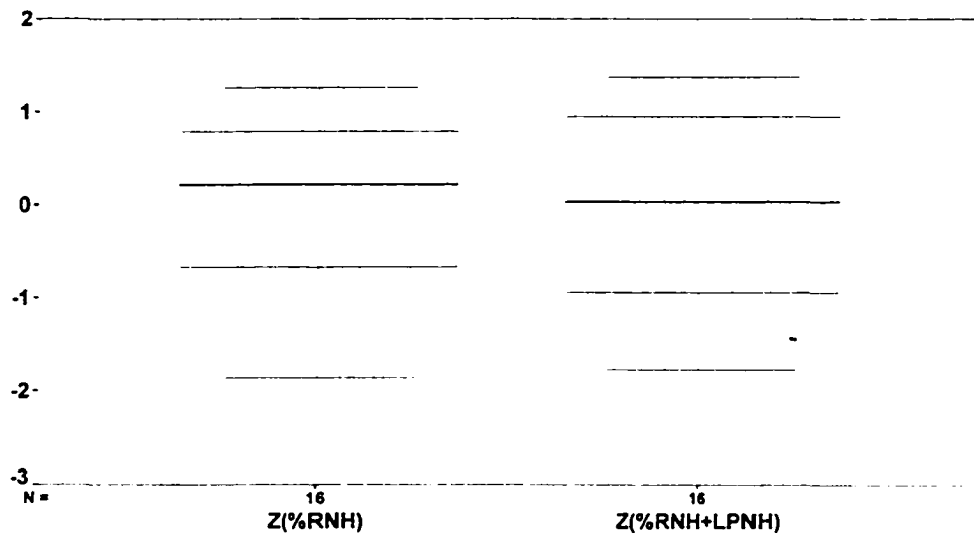
Figure G-7b. Skill Mix Variables (z scores).
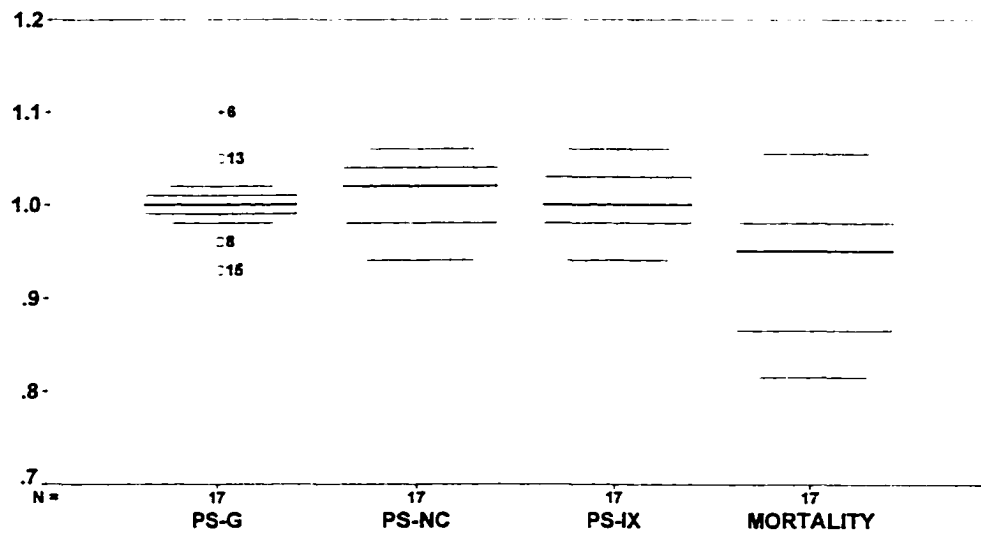
Figure G-8a. Outcome Variables (actual values).
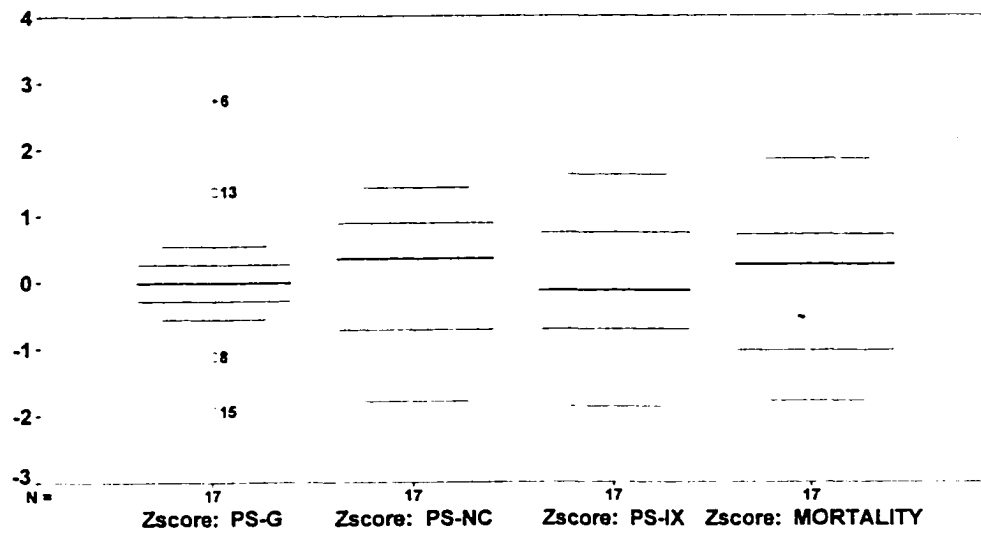
Figure G-8b. Outcome Variables (z scores).

Appendix H

Normal Q-Q Plots

This Appendix displays the Normal Q-Q Plots for all nursing resource and outcome

variables. The variables are presented in the same sequence as appears in the previous

Appendices.

248
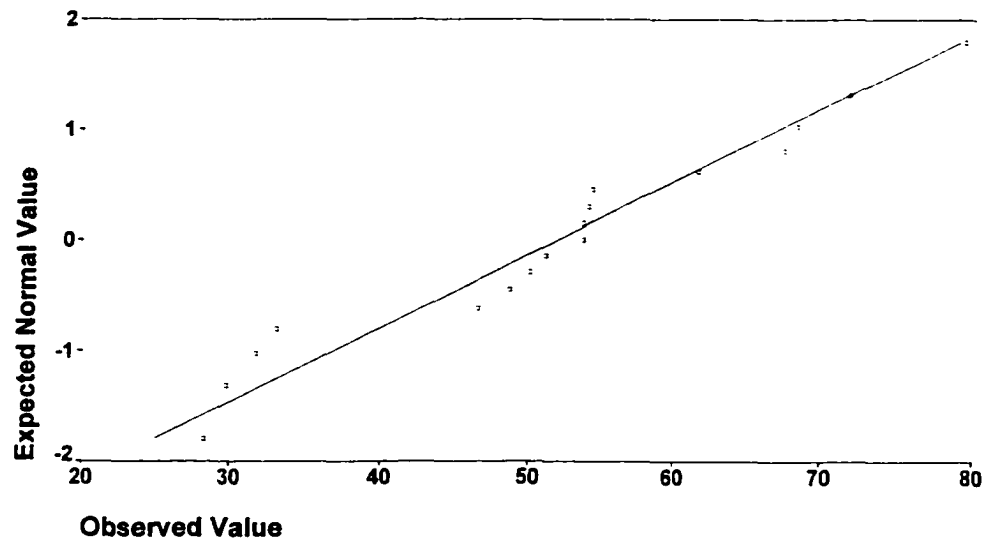
Figure H-1. Normal Q-Q Plot of TNH/DC.
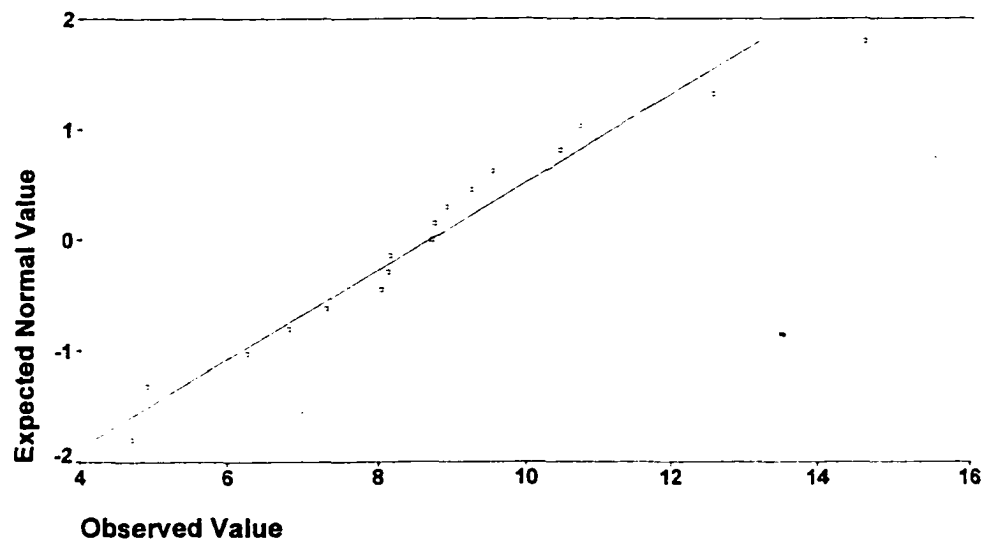
Figure H-2. Normal Q-Q Plot of TNH/PD
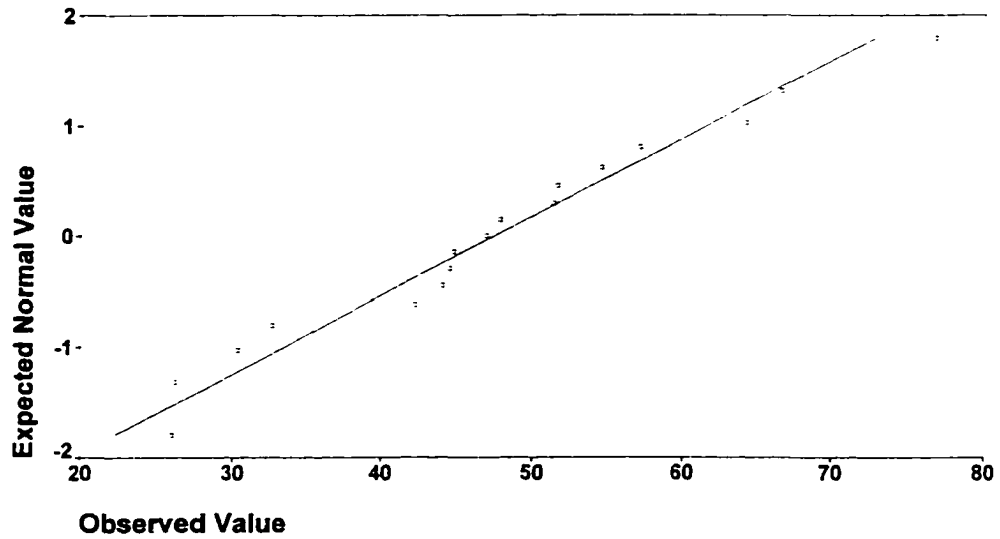
Figure H-3. Normal Q-Q Plot of VNH/DC.
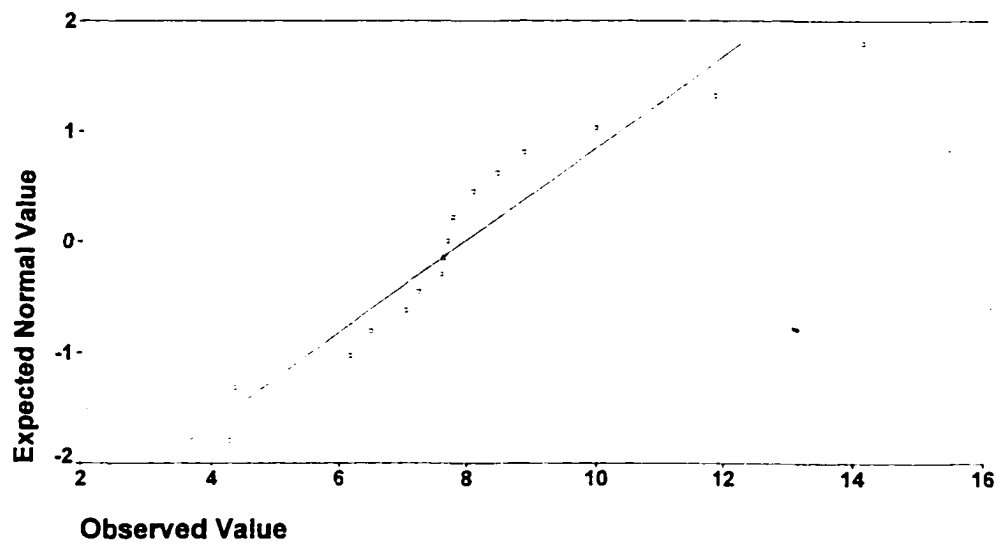
Figure H-4. Normal Q-Q Plot of VNH/PD.
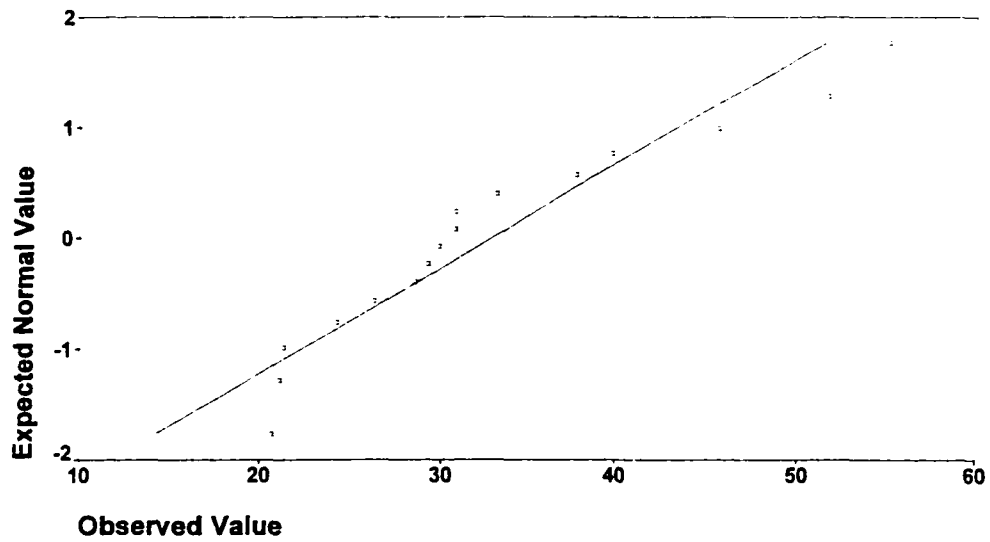
Figure H-5. Normal Q-Q Plot of RNH/DC.
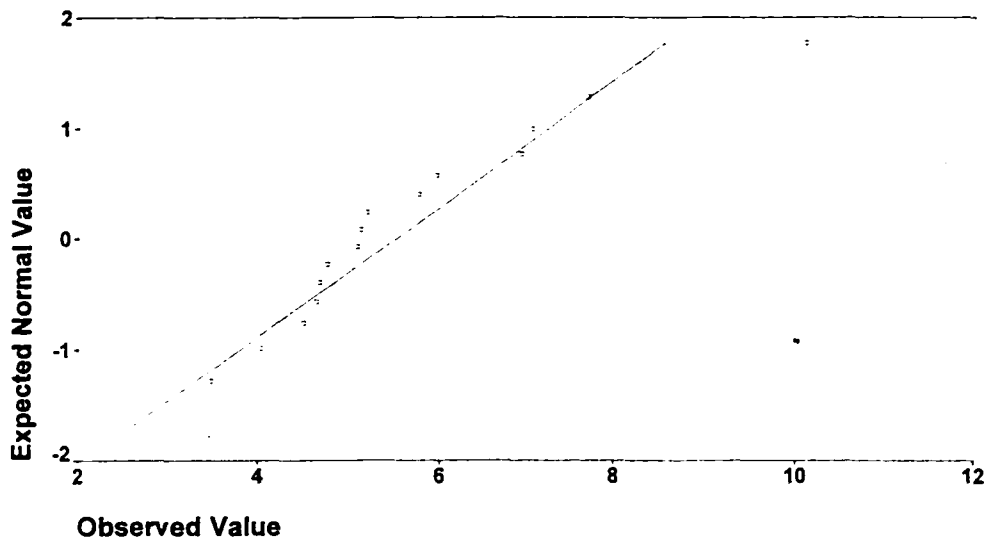
Figure H-6. Normal Q-Q Plot of RNH/PD.
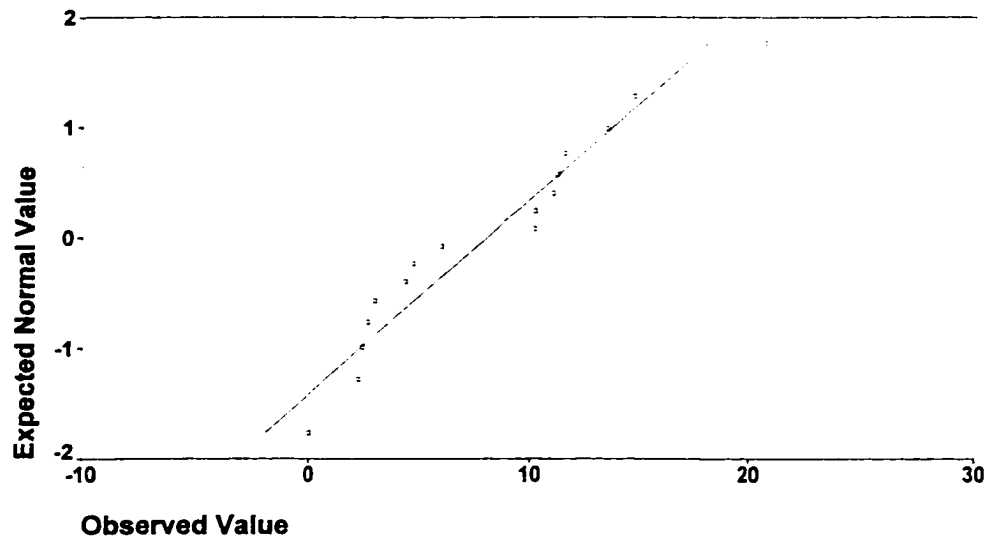
Figure H-7. Normal Q-Q Plot of LPNH/DC.
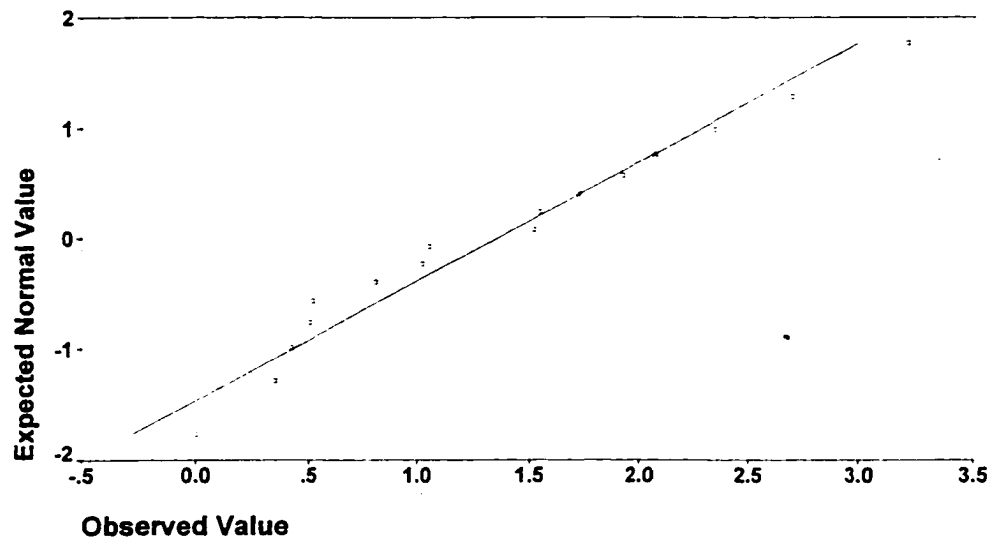
Figure H-8. Normal Q-Q Plot of LPNH/PD.
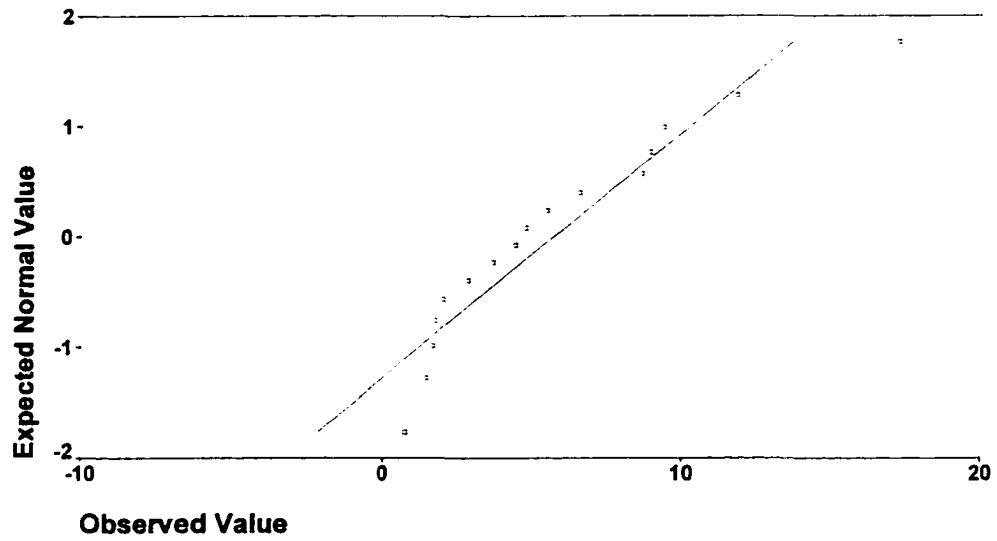
Figure H-9. Normal Q-Q Plot of NAH/DC.
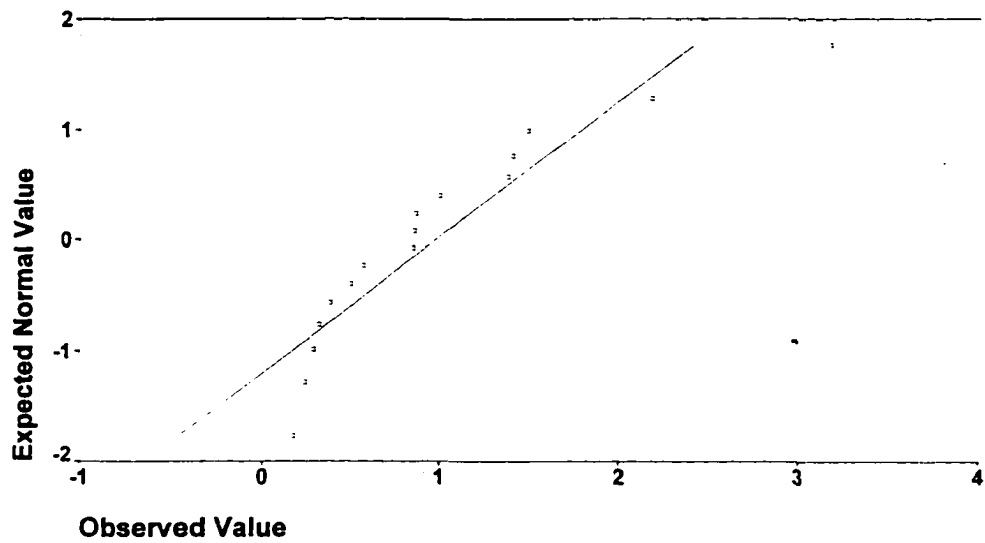
Figure H-10. Normal Q-Q Plot of NAH/PD.

Observed Value
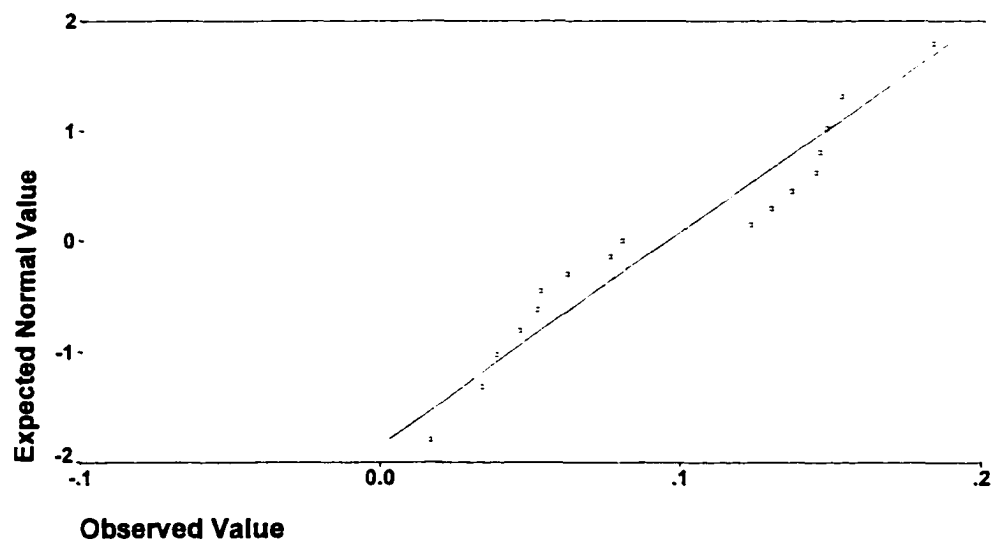
Figure H-11. Normal Q-Q Plot of FNH/VNH.
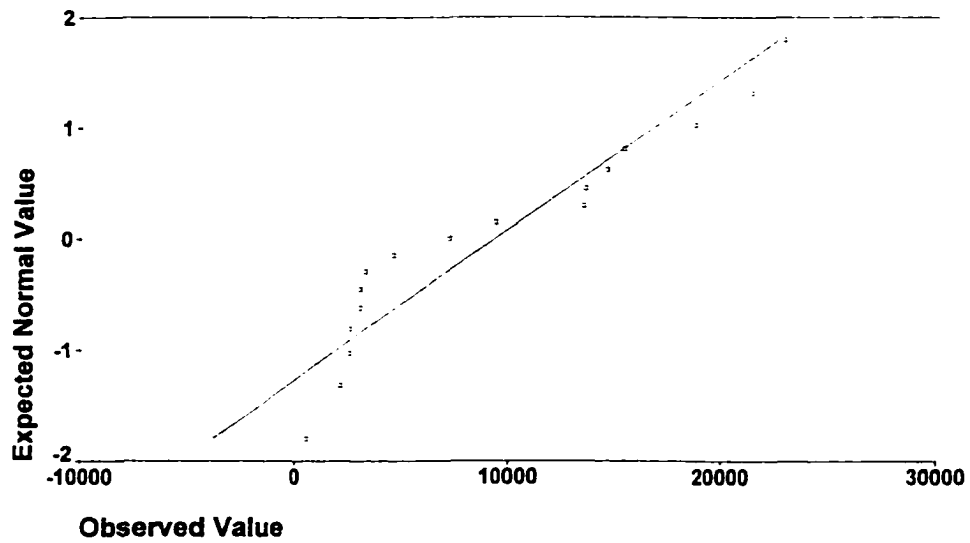
Figure H-12. Normal Q-Q Plot of FNH/DC.
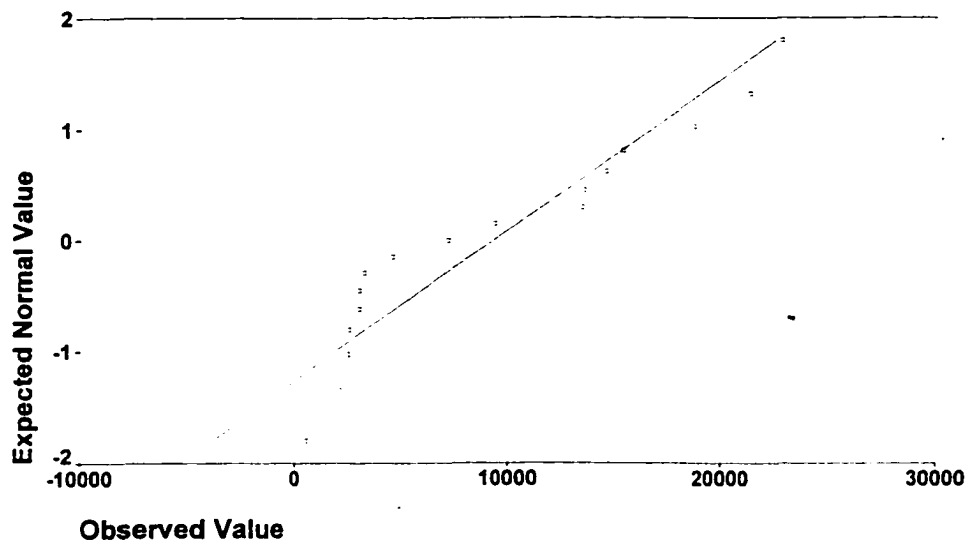
Figure H-13. Normal Q-Q Plot of FNH/PD.
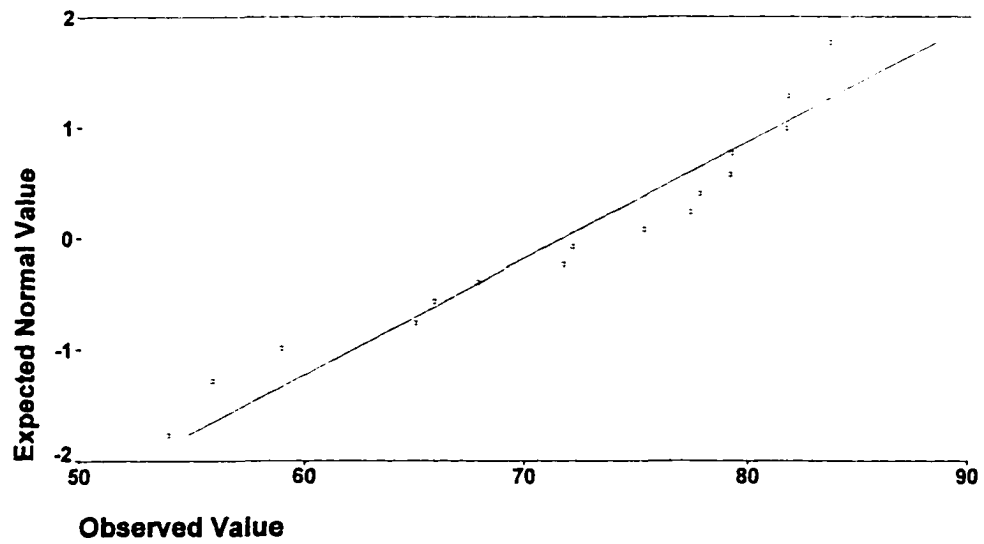
Figure H-14. Normal Q-Q Plot of %RNH (skill mix 1).
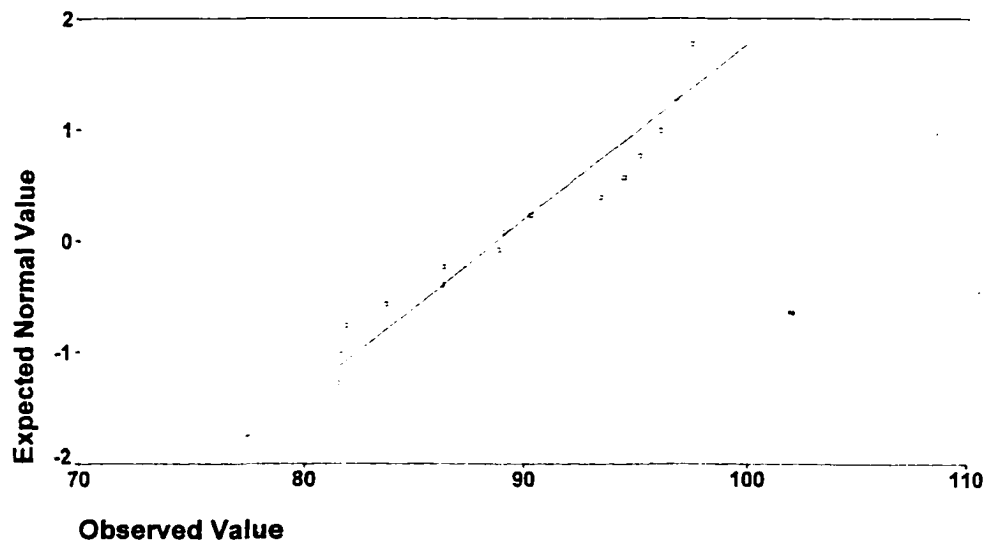
Figure H-15. Normal Q-Q Plot of %RNH+LPNH (skill mix 2).
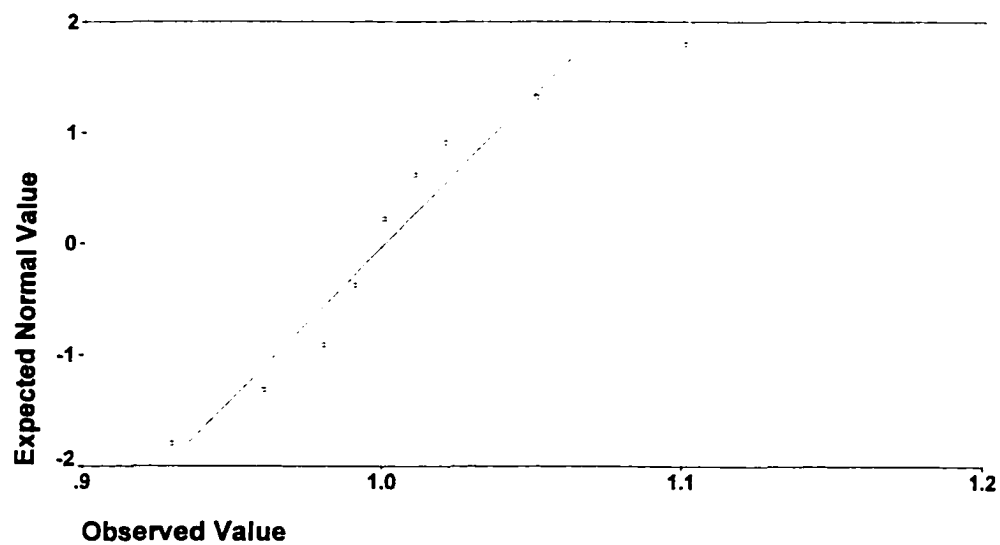
Figure H-16. Normal Q-Q Plot of Patient Satisfaction-Global.
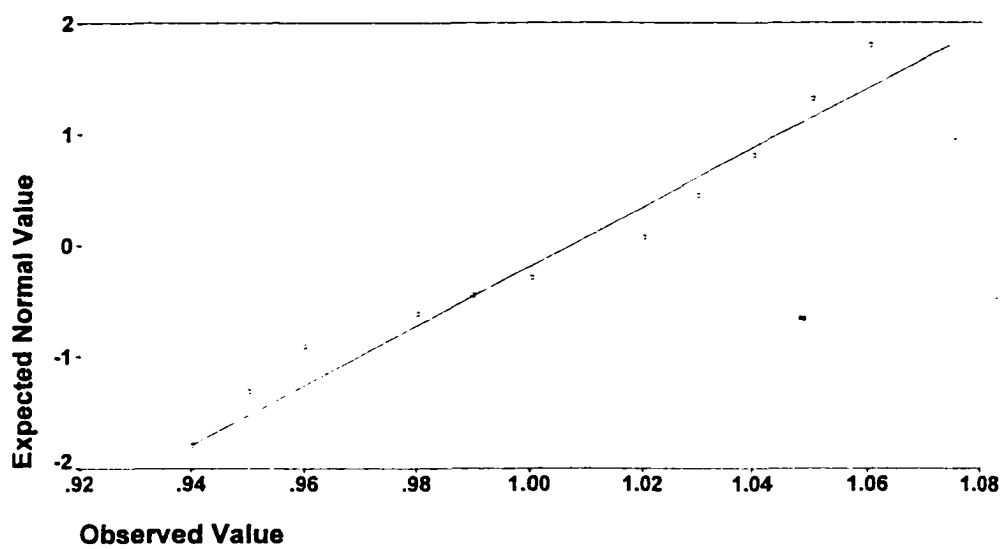
Figure H-17. Normal Q-Q Plot of Patient Satisfaction-Nursing Care.
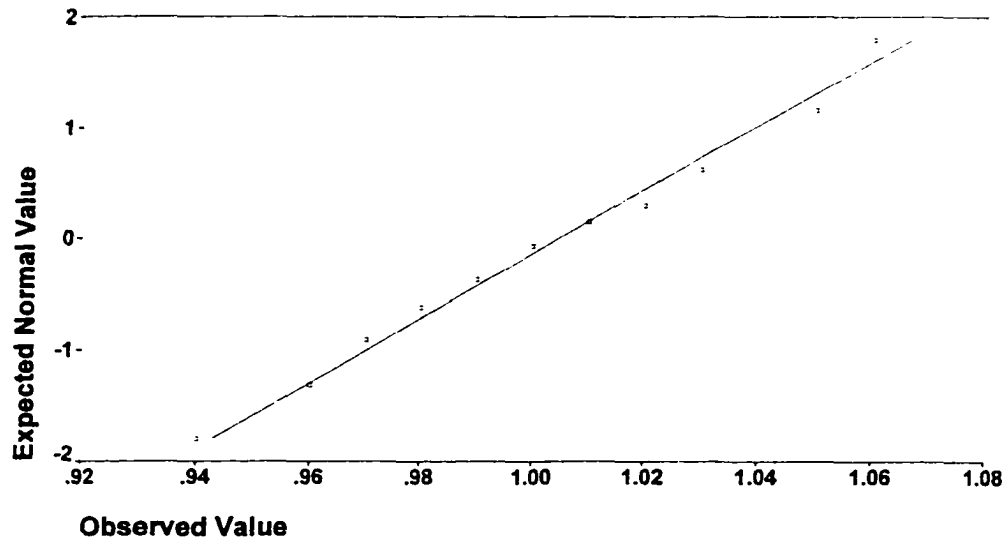
Figure H-18. Normal Q-Q Plot of Patient Satisfaction-Nursing Index.
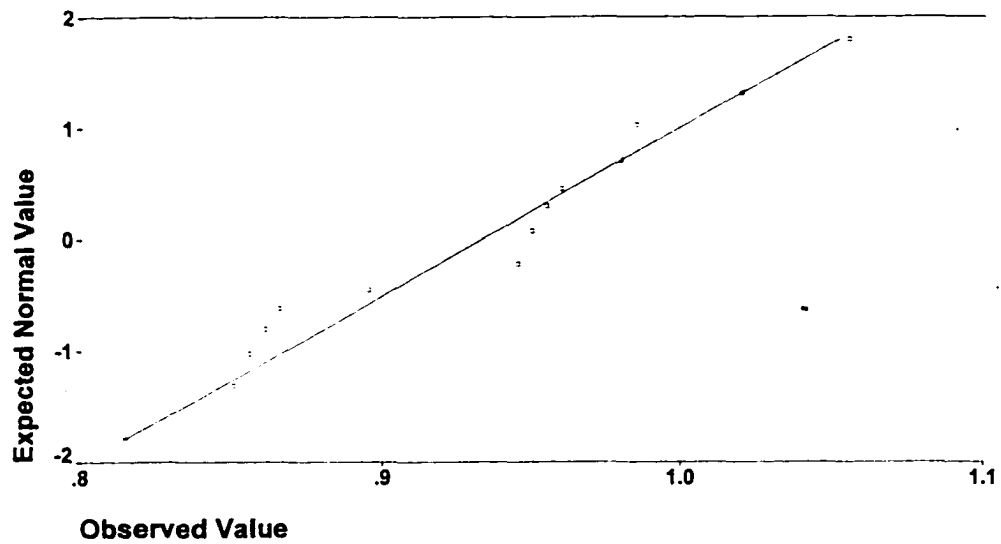
Figure H-19. Normal Q-Q Plot of Mortality.

Appendix I

Scatterplots with Linear Regression and Lowess Lines

This Appendix contains scatterplot diagrams for each nursing resource-hospital outcome relationship with overlaying linear regression (L.R.) and lowess (Lowess) lines on each scatterplot, as discussed in Chapter IV. The two scatterplots for each nursing resource-hospital outcome relationship are placed on the same page, with the L.R. diagram placed at the top and the Lowess diagram placed at the bottom of the page.

Figures denoted I-1 (letters 'a' through 'l') display the first outcome, Patient Satisfaction-Global (PS-G), and the nursing resource variables. Figures I-2 (letters 'a' through 'l') display the second outcome, Patient Satisfaction-Nursing Care (PS-NC), and the nursing resource variables. Figures labelled I-3 (letters 'a' through 'l') display the third outcome, Patient Satisfaction-Nursing Index (PS-IX), and the nursing resource variables. Figures I-4 (letters 'a' through 'l') display the fourth outcome, Mortality, and the nursing resource variables.
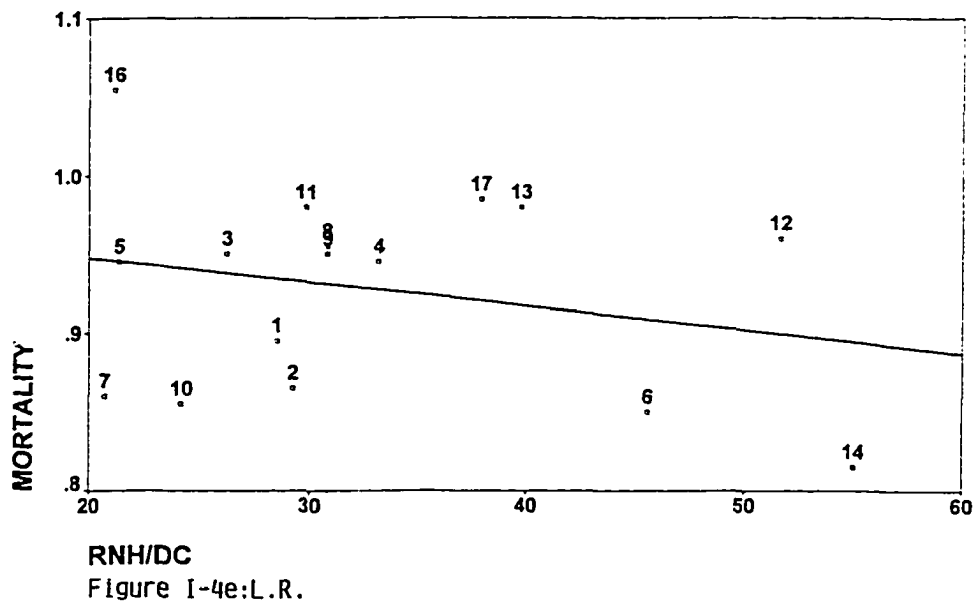
259

TNH/DC

Figure I-la:L.R.(linear regression)

TNH/DC

Figure I-la:Lowess

TNH/PD

Figure I-1b:L.R.

TNH/PD

Figure I-1b:Lowess

VNH/DC

Figure I-1c:L.R.

VNH/DC

Figure I-1c:Lowess

VNH/PD

Figure I-1d:L.R.

VNH/PD

Figure I-1d:Lowess

RNH/DC

Figure I-le:L.R.

RNH/DC

Figure I-le:Lowess

RNH/PD

Figure I-lf:L.R.

RNH/PD

Figure I-lf:Lowess

LPNH/DC

Figure I-1g:L.R.

LPNH/DC

Figure I-1g:Lowess

LPN/PD

Figure I-1h:L.R.

LPN/PD

Figure I-1h:Lowess

NAH/DC

Figure I-li:L.R.

NAH/DC

Figure I-li:Lowess

NAH/PD

Figure I-1j:L.R.

NAH/PD

Figure I-1j:Lowess

%RNH

Figure I-lk:L.R.

%RNH

Figure I-lk:Lowess

1.12

1.10-
6

1.08-

1.06-
13

1.04-

1.02-
14
4

1.00-
17
3
9
5
7
2
10
121
16
11

.98-

.96-
8

PS-G .94
70   80   90   100

%(RNH+LPNH)

Figure I-11:L.R.

1.12

1.10-
6

1.08-

1.06-
13

1.04-

1.02-
14
4
10

1.00-
17
3
9
6
7
2
121
16
11

.98-

.96-
8

PS-G .94
70   80   90   100

%(RNH+LPNH)

Figure I-11:Lowess

TNH/DC

Figure I-2a:L.R.

TNH/DC

Figure I-2a:Lowess

TNH/PD

Figure I-2b:L.R.

TNH/PD

Figure I-2b:Lowess

VNH/DC

Figure I-2c:L.R.

VNH/DC

Figure I-2c:Lowess

VNH/PD

Figure I-2d:L.R.

VNH/PD

Figure I-2d:Lowess

RNH/DC

Figure I-2e:L.R.

RNH/DC

Figure I-2e:Lowess

Figure I-2f:L.R.

Figure I-2f:Lowess

278

LPNH/DC

Figure I-2g:L.R.

LPNH/DC

Figure I-2g:Lowess

LPN/PD

Figure I-2h:L.R.

LPN/PD

Figure I-2h:Lowess

NAH/DC

Figure I-2i:L.R.

NAH/DC

Figure I-2i:Lowess

NAH/PD

Figure I-2j:L.R.

NAH/PD

Figure I-2j:Lowess

Figure I-2k:L.R.

Figure I-2k:Lowess

1.08

1.06

6

14

1.04

17

1.02

3

9

7

1110

2

16

1.00

4

12

.98

.96

13

8

1

PS-NC

.94

70

80

90

100

%(RNH+LPNH)

Figure I-21:L.R.

1.08

1.06

6

14

1.04

17

1110

2

1.02

3

9

7

16

1.00

4

12

.98

.96

13

8

1

PS-NC

.94

70

80

90

100

%(RNH+LPNH)

Figure I-21:Lowess

TNH/DC

Figure I-3a:L.R.

TNH/DC

Figure I-3a:Lowess

TNH/PD

Figure I-3b:L.R.

TNH/PD

Figure I-3b:Lowess

VNH/DC

Figure I-3c:L.R.

VNH/DC

Figure I-3c:Lowess

VNH/PD

Figure I-3d:L.R.

VNH/PD

Figure I-3d:Lowess

RNH/DC

Figure I-3e:L.R.

RNH/DC

Figure I-3e:Lowess

RNH/PD

Figure I-3f:L.R.

RNH/PD

Figure I-3f:Lowess

LPNH/DC

Figure I-3g:L.R.

LPNH/DC

Figure I-3g:Lowess

LPN/PD

Figure I-3h:L.R.

LPN/PD

Figure I-3h:Lowess

NAH/DC

Figure I-3i:L.R.

NAH/DC

Figure I-3i:Lowess

NAH/PD

Figure I-3j:L.R.

NAH/PD

Figure I-3j:Lowess

%RNH

Figure I-3k:L.R.

%RNH

Figure I-3k:Lowess

%(RNH+LPNH)

Figure I-3I:L.R...

%(RNH+LPNH)

Figure I-31:Lowess

TNH/DC

Figure I-4a:L.R.

TNH/DC

Figure I-4a:Lowess

TNH/PD

Figure I-4b:L.R.

TNH/PD

Figure I-4b:Lowess

VNH/DC

Figure I-4c:L.R.

VNH/DC

Figure I-4c:Lowess

VNH/PD

Figure I-4d:L.R.

VNH/PD

Figure I-4d:Lowess

RNH/DC

Figure I-4e:L.R.

RNH/DC

Figure I-4e:Lowess

Figure I-4f:L.R.

Figure I-4f:Lowess

LPNH/DC

Figure I-4g:L.R.

LPNH/DC

Figure I-4g:Lowess

LPN/PD

Figure I-4h:L.R.

LPN/PD

Figure I-4h:Lowess

NAH/DC

Figure I-4i:L.R.

NAH/DC

Figure I-4i:Lowess

NAH/PD

Figure I-4j:L.R.

NAH/PD

Figure I-4j:Lowess

Figure I-4k:L.R.

Figure I-4k:Lowess

%(RNH+LPNH)

Figure I-41:L.R.

%(RNH+LPNH)

Figure I-41:Lowess

Appendix J

Residual Analysis Diagrams

This Appendix contains the graphic displays of residual analysis pertaining to the three regression equations discussed in Chapter IV. Graphs (a to e) for each equation are grouped together, and then sequenced in order of the regression equations as numbered and discussed in the narrative text; i.e., 1a-1e, 2a-2e, 3a-3e. Standard SPSS default settings were used for the analyses.

308

Regression Standardized Residual
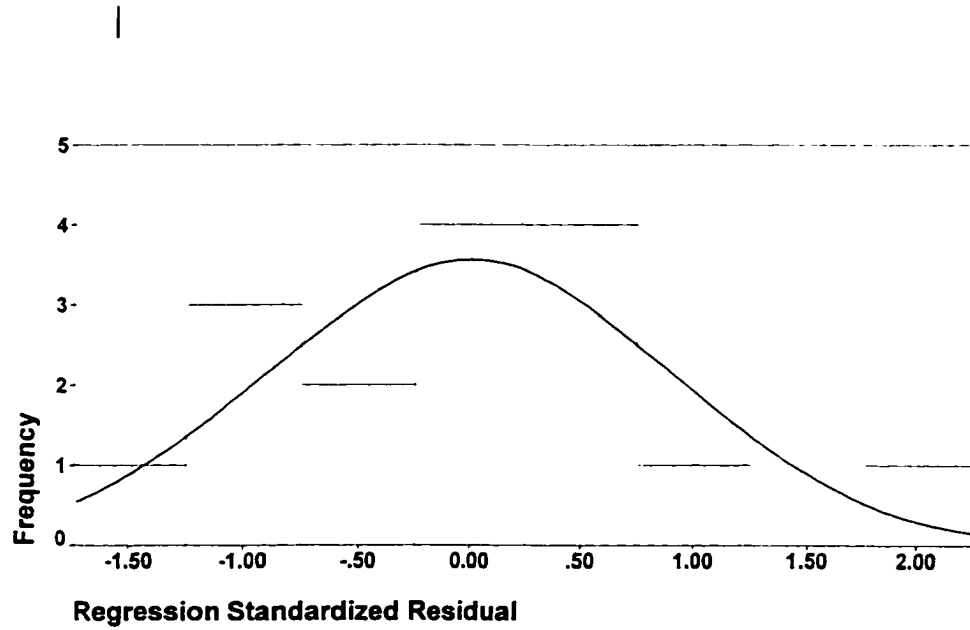
Figure J-1a. Residual Analysis Histogram: Patient Satisfaction-Global;
Equation 1

Observed Cum Prob
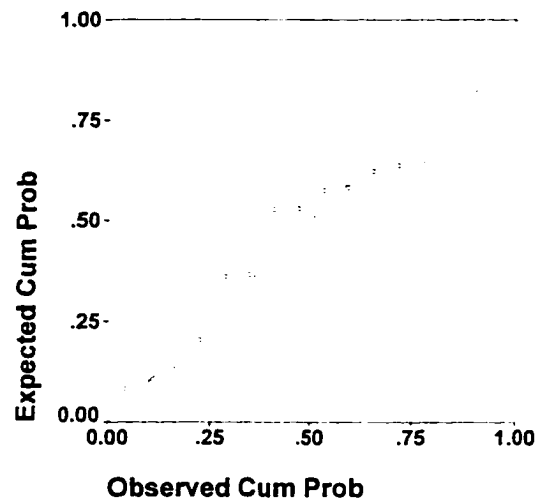
Figure J-1b. Standardized Residual Normal P-P Plot:
Patient Satisfaction-Global; Equation1.

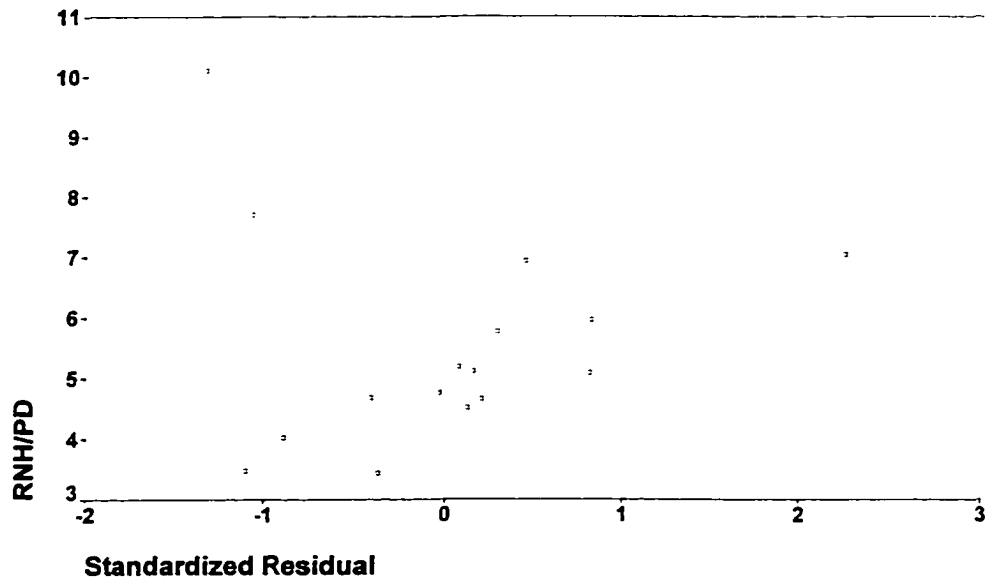**Standardized Residual**
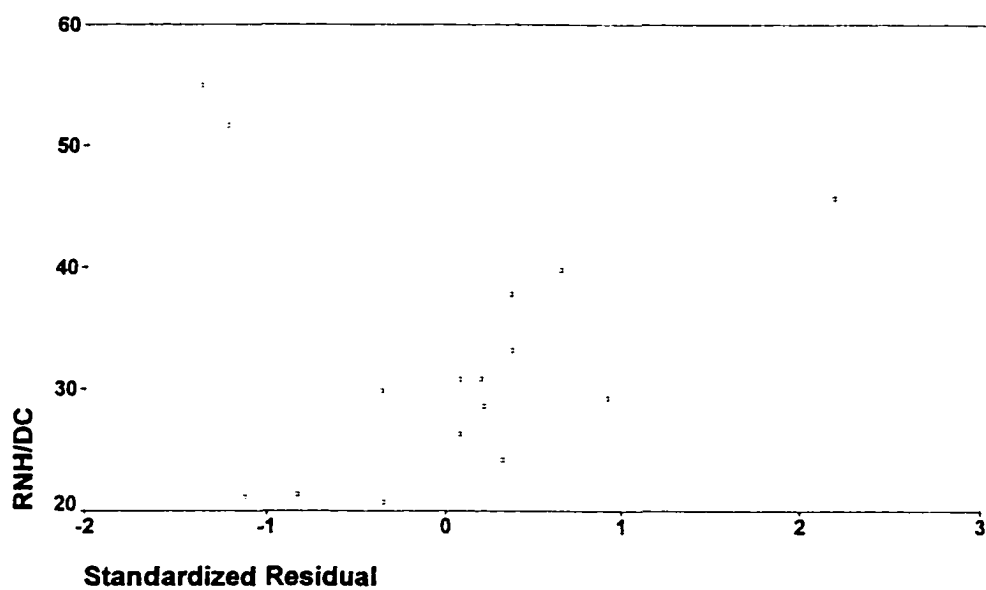
Figure J-1c. Equation 1.

Standardized Residual

Figure J-1d. Equation 1.

NAH/DC

20

10

0

-2   -1   0   1   2   3

Standardized Residual

Figure J-1e. Equation 1.

Predicted Outcome Value

1.06

1.04

1.02

1.00

.98

.96

.94

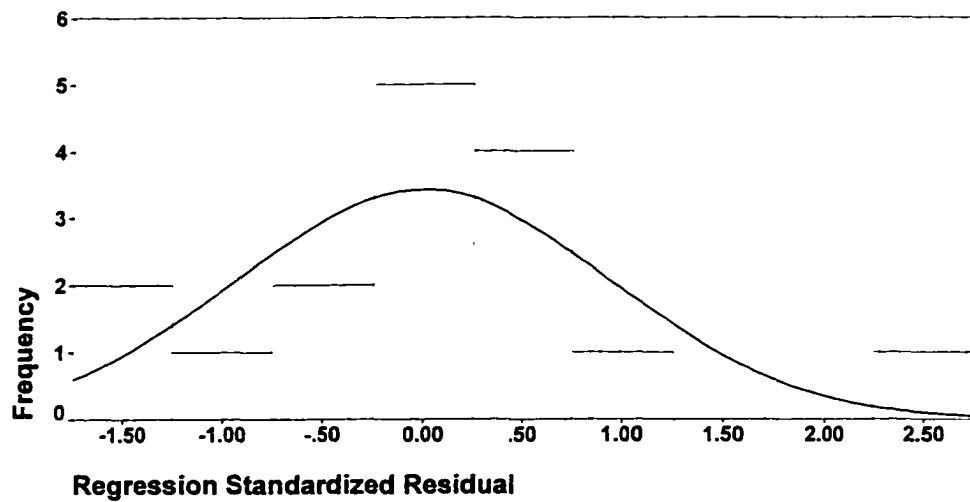-2   -1   0   1   2   3
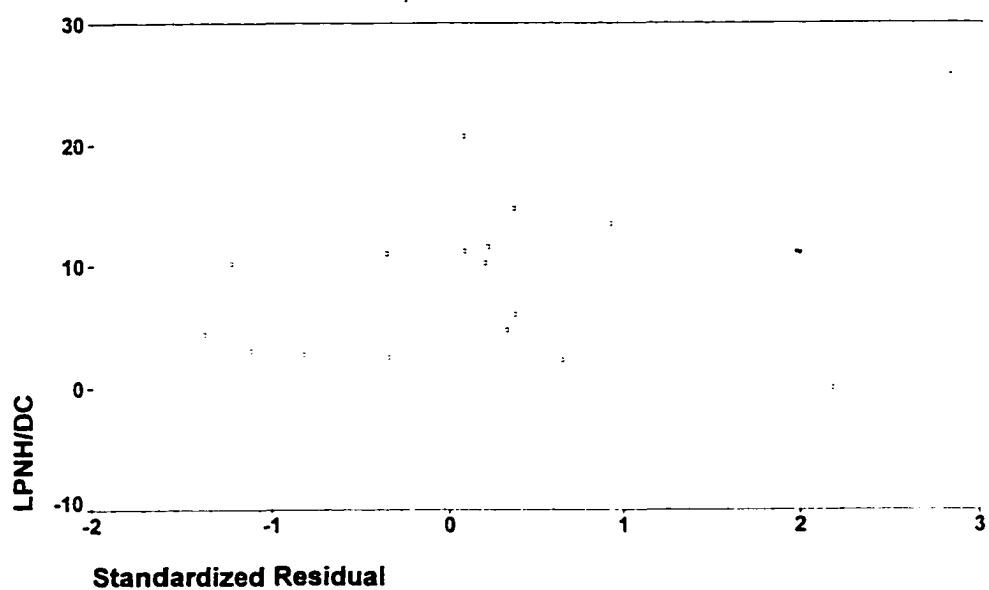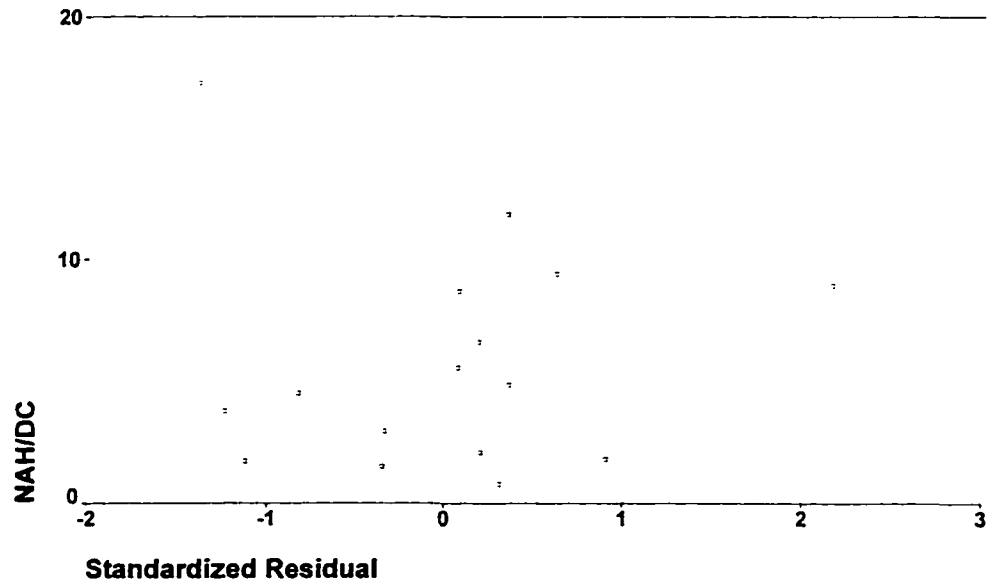
Regression Standardized Residual
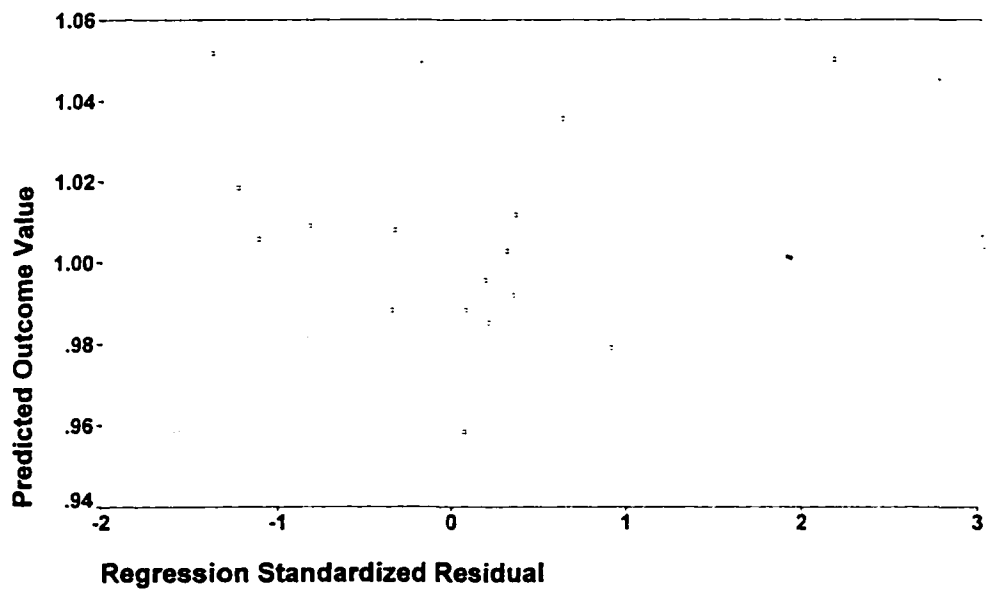
Figure J-1f. Equation 1.
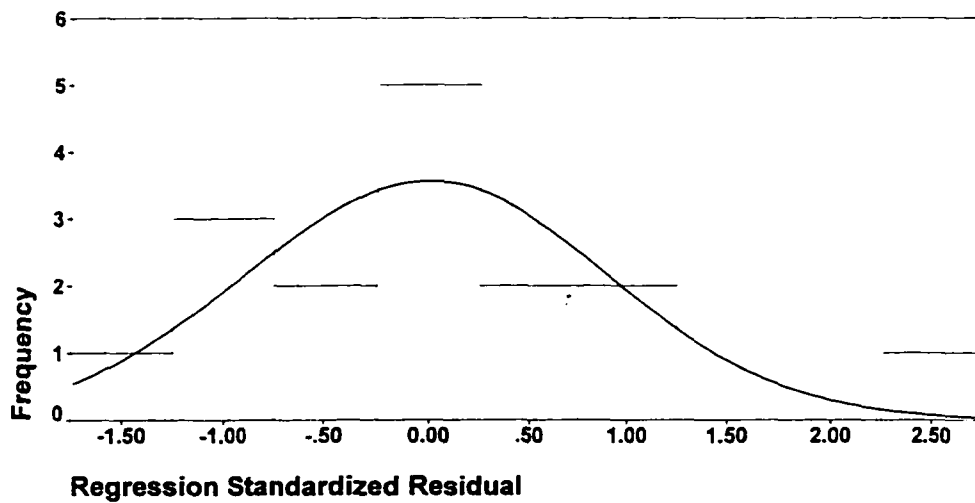
Regression Standardized Residual

Figure J-2a. Residual Analysis Histogram: Patient Satisfaction-Global; Equation2.
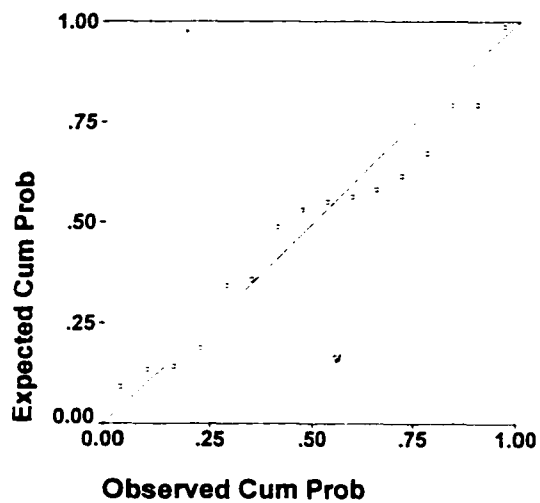
Observed Cum Prob

Figure J-2b. Standardized Residual Normal P-P Plot: Patient Satisfaction-Global; Equation 2

Standardized Residual

Figure J-2c. Equation 2.

Standardized Residual
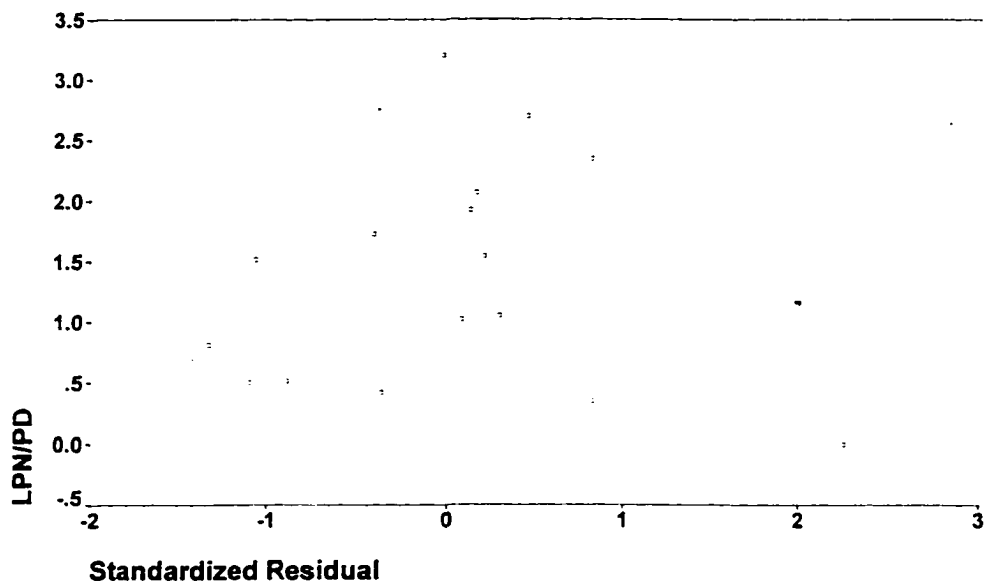
Figure J-2d. Equation 2.

Standardized Residual
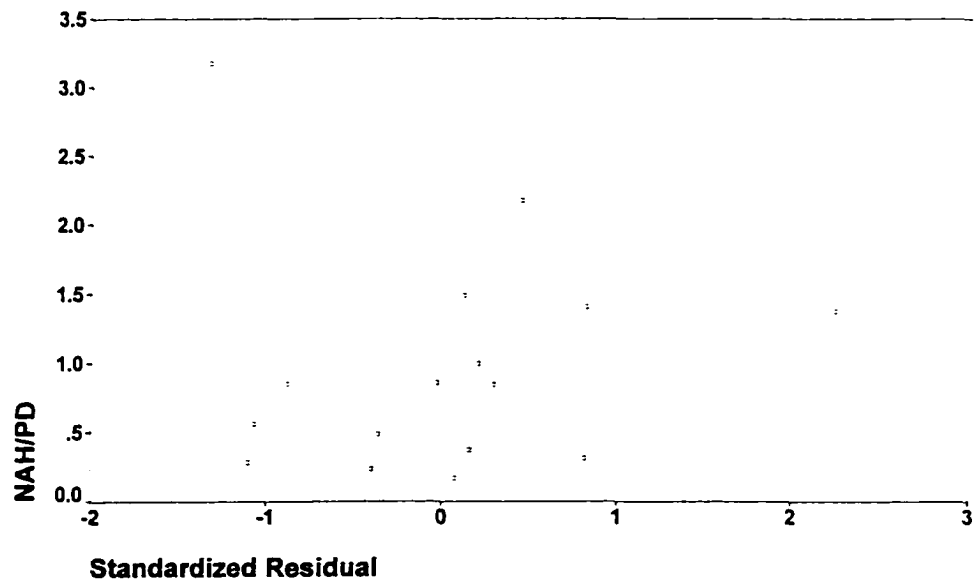
Figure J-2e. Equation 2.

Regression Standardized Residual
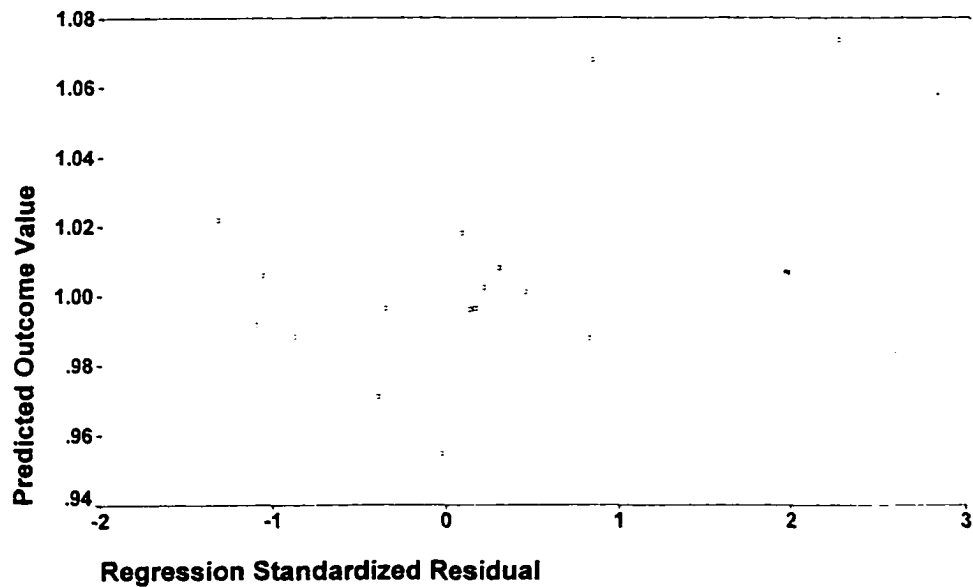
Figure J-2f. Equation 2.

Regression Standardized Residual

Figure J-3a. Residual Analysis Histogram: Patient Satisfaction-Global; Equation3.
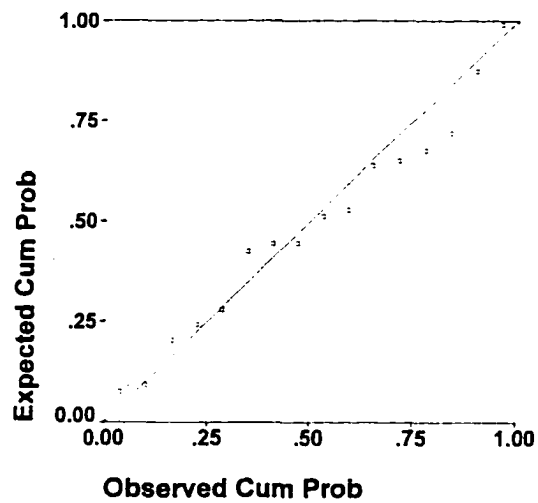
Observed Cum Prob

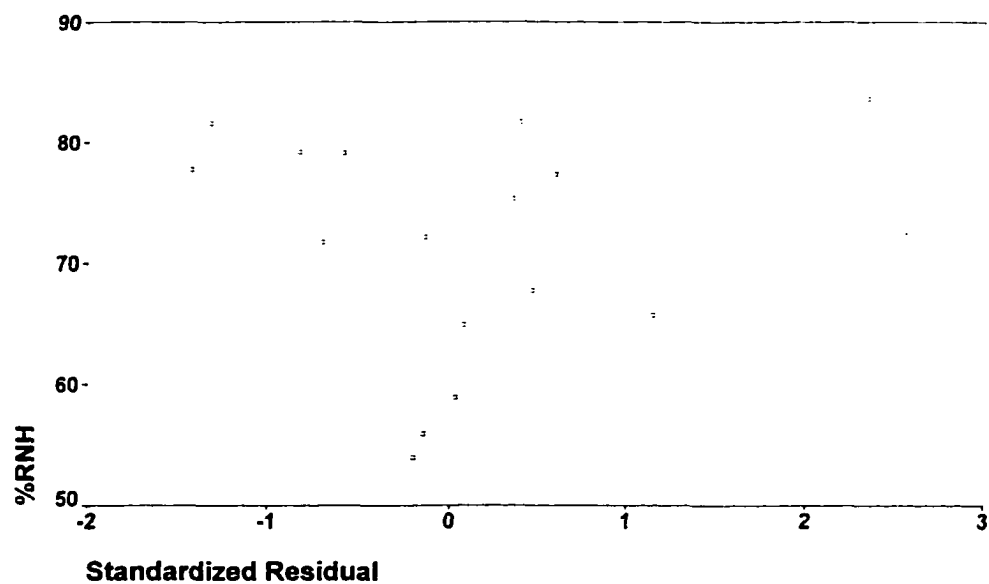Figure J-3b. Standardized Residual Normal P-P Plot: Patient Satisfaction-Global; Equation 3.

Standardized Residual
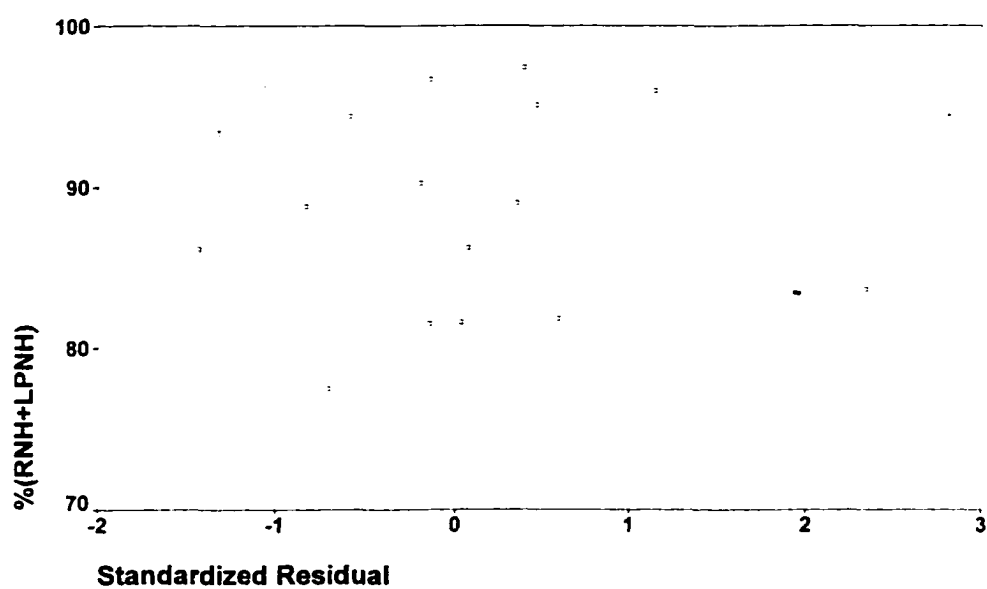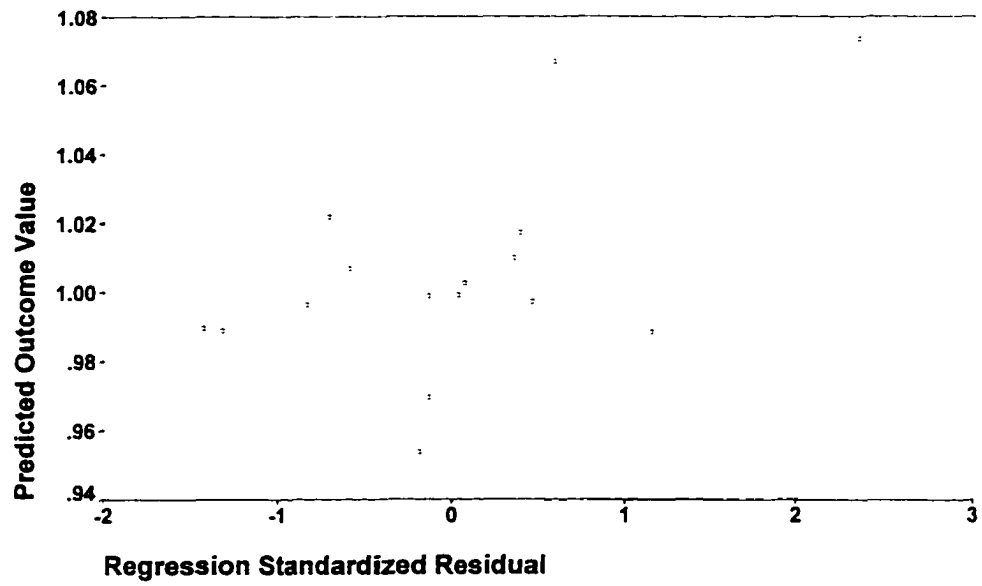
Figure J-3c. Equation 3.

Standardized Residual

Figure J-3d. Equation 3.

Figure J-3e. Equation 3.