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NURSING INTENSITY: RELATIONSHIP BETWEEN PREDICTED AND ACTUAL NURSING RESOURCE CONSUMPTION AND THE EFFECT ON PATIENT OUTCOMES

by

MARY E. VILLEMAIRE

DISSERTATION

Submitted in partial satisfaction of the requirements for the degree of

DOCTOR OF NURSING SCIENCE

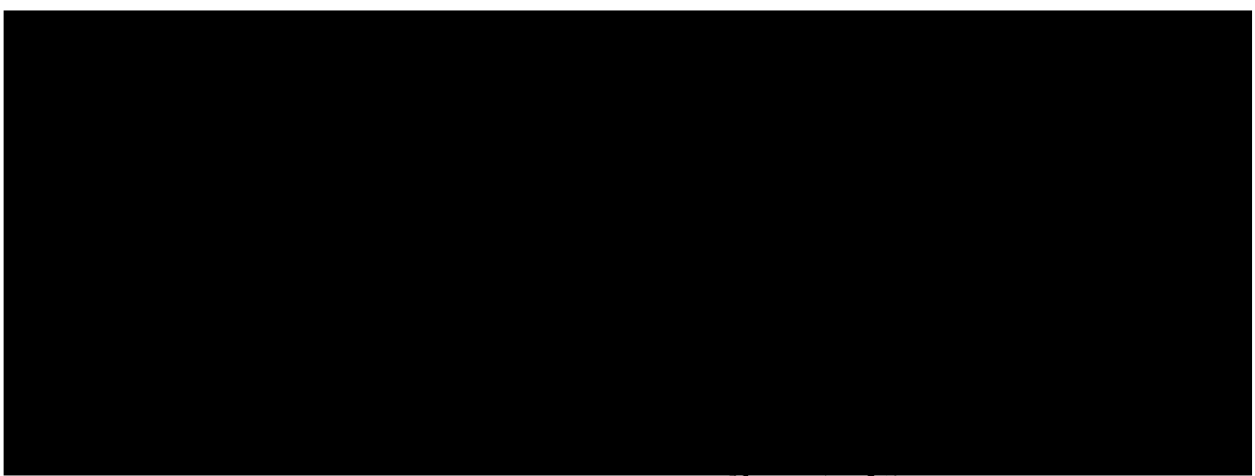
in the

GRADUATE DIVISION

of the

UNIVERSITY OF CALIFORNIA

San Francisco



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NURSING INTENSITY: RELATIONSHIP BETWEEN PREDICTED AND ACTUAL NURSING RESOURCE CONSUMPTION AND THE EFFECT ON PATIENT OUTCOMES

Mary E. Villemaire, R.N., D.N.Sc.

University of California, San Francisco, 1991

The purpose of this research was to determine the effect of providing predicted hours of nursing care on the outcomes of cost of nursing care and length of stay (LOS). A nursing intensity of patient care model was developed to provide the conceptual framework.

Data for this correlational study were collected at three acute care facilities in Northern California during October, 1989 for Phase I and from December, 1989 to July, 1990 for Phase II. During Phase I, predicted and actual hours provided to a sample of 120 patients were obtained on one medical and one surgical unit at each of the sites. Audits of the medical records provided the predicted and actual hours for each patient for each shift on four study days. Regression analysis found predicted hours explained 83.8% of the actual hours provided to individual patients. Predicted and actual unit hours for the six study units were highly correlated and ranged from (r=.795 to r=.995). Responses to a Perceptions of Staffing Adequacy Questionnaire were congruent with the individual and unit level of staffing.

During Phase II, data were collected on a total sample of 240 patients admitted to one of three study units with a diagnoses of one of the four selected Diagnosis Related Groups (DRGs). Records were audited until a sample of 20 patients in each DRG at each site was attained. Results of multiple regression of predicted and actual hours to LOS and cost of care were significant with respective R^2s of .927 and .930. However, significant differences were also found between the predicted and actual hours of care. Analysis of this variance between predicted and actual hours indicated patients who received the predicted hours of care had shorter lengths of stay and lower costs of nursing care. These relationships were dependent upon the hospital to which the patient was admitted, and the DRG assigned. Complex relationships were found between the hours of care, staff mix, LOS, and cost of care.

Standard costing techniques were defined and applied consistently across sites to determine cost ratios and the cost of care. Direct nursing costs accounted for 20% of DRG reimbursements and 25% of total hospital costs for this sample.

Virginia Cleland, PhD, RN

Dissertation Committee Chairman

Dedication

To nurses and the profession of nursing.

Acknowledgement

This dissertation represents the completion of my doctoral studies at the University of California, San Francisco (UCSF). My initial interest in developing methods for costing nursing care and analyzing the effects of nursing care began during my master's program at UCSF. It is impossible to acknowledge all who have provided direct and indirect knowledge, guidance, and support. However, certain individuals stand out and therefore deserve special recognition.

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Table of Contents

	Page
ABSTRACT	iii
LIST OF TABLES	xi
LIST OF ILLUSTRATIONS	xiii
CHAPTER I: THE STUDY PROBLEM	1
Introduction	1
Statement of the Problem	4
Purpose of the Study	6
Significance of the Study	7
CHAPTER II: LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK	10
Overview of Relevant Literature and Research	10
Historical Background	10
Significance	14
Cost of Care Terminology	17
Methods of Measurement of Resource Use	18
Cost of Nursing Care Based on Acuity	19
Cost of Care Based on Nursing Intensity	21
Conceptual Framework	23
Development of Nursing Intensity Models	23
Nursing Intensity of Patient Care Model	24
Patient's Need for Nursing	27
Complexity of Care	27
Severity of Illness	28
Assumptions	32
Research Questions and Study Hypothesis	33
Operational Definition of Terms	33
Chapter III: METHODOLOGY	36
Research Design	36
Description of the Research Setting	37
Sample	41
Human Subjects Assurance	41
Risks	41
Cost	42
Benefits	42
Nature and Size of Sample: Phase I	43
Criteria for Selection for Phase I	44
Nature and Size of Sample: Phase II	46
Criteria for Sample Selection for Phase II	47

Table of Contents: Continued

	Page
Data Collection Methods	48
Techniques	48
Instruments	49
St. Luke's Patient Classification	49
San Joaquin Patient Classification	49
Perception of Staffing Adequacy Form	50
Reliability and Validity	50
Research Procedures	51
Procedure Phase I	51
Procedure Phase II	55
Data Analysis	59
CHAPTER IV: RESULTS	61
Preliminary Analyses	61
Sample Characteristics	61
Analyses of The Research Questions	64
Phase I: Question 1	64
Patient Related Analyses	65
Unit Related Analyses	69
Phase I: Question 2	72
Phase I: Question 3	77
Phase II: Question 4	82
Data Reduction Techniques	83
Overview of DRGCOST Dataset	85
Analysis of Hours to Length of Stay	90
Cost Analysis	98
Analysis of Hours to Cost of Care	105
CHAPTER V: DISCUSSION	114
Interpretation and Significance of the Findings	114
Interpretation of Question 1 Results	115
Interpretation of Question 2 Results	118
Interpretation of Question 3 Results	119
Interpretation of Question 4 Results	120
Interpretation of Hours to LOS	122
Interpretation of Cost Analysis	123
Interpretation of Hours to Cost of Care	125
Limitations	128
Implications for Nursing Practice	129
Directions for Future Research	131

Table of Contents: Continued

		Page
REFERENCES		135
APPENDIX A:	Definitions of Costing Terminology	143
APPENDIX B:	Definitions of Patient Classification	147
APPENDIX C:	Consent to be a Research Subject	149
APPENDIX D:	St. Luke's Patient Classification Form	150
APPENDIX E:	San Joaquin Patient Classification Form	151
APPENDIX F:	Perception of Staffing Adequacy Form	152
APPENDIX G:	Method for Costing Nursing Care	154
APPENDIX H:	Phase I: Definition of Terms	157
APPENDIX I:	Summary of Patient and Unit Hour Means	160
APPENDIX J:	Phase I: Plot of Patient Hours	161
APPENDIX K:	Phase I: Correlation of Unit Variables	162
APPENDIX L:	Phase I: Plot of Unit Hours	163
APPENDIX M:	Phase II: Definition of Terms	164
APPENDIX N:	Phase II: Means of DRGCOST Data Set	167
APPENDIX O:	Plot of Residuals and Actual Hours	175
APPENDIX P:	Plots of ABDIF to TOTLOS by Hospital	177
APPENDIX Q:	Cost per Hour Report	179
APPENDIX R:	Summary Statistics of Cost Factors	182
APPENDIX S:	Plots of Actual Difference in Hours	183

List of Tables

		Page
TABLE 1	PCS, Hospital, and Unit	43
TABLE 2	Phase II: PCS, Hospital, and Unit	47
TABLE 3	Table for Assignment of Costs	58
TABLE 4	Descriptive Statistics for Age and Sex	63
TABLE 5	Summary of ANOVA of DRGs to AGE: Phase II	64
TABLE 6	Hours of Care Allocated to Levels of Classification	65
TABLE 7	Summary Statistics of Patient Hour Variables	66
TABLE 8	Correlation Coefficients of Predicted to Actual Hours	67
TABLE 9	Regression of Patient Hour Variables by Hospital	68
TABLE 10	Summary Statistics of Unit Hour Variables	70
TABLE 11	Correlations and Variance Between Predicted and Actual Unit Hours: Phase I	72
TABLE 12	PSAQ Inadequate Shifts and Contributing Factors by Hospital	74
TABLE 13	Number and Frequency of Patient and Shift Adequacy Levels	78
TABLE 14	Patient Care and Shift Level of Care	80
TABLE 15	Percentage of Predicted Care Provided	81
TABLE 16	Means for DRG, LOS, and Actual Hour Variables	86
Table 17	Phase II: Regression of Predicted Hours by Hospital and DRG	88
TABLE 18	Regression of Actual Difference in Hours by Hospital to LOS	91
TABLE 19	Regression of Absolute Difference and Hospital to LOS	93
TABLE 20	Regression of Absolute Difference in Hours and DRGs to LOS	95

List of Tables: Continued

		Page
TABLE 21	Components of Nursing Cost for Each Hospital	98
TABLE 22	Comparison of LOS, Actual Hours, HPPD, and Cost	99
TABLE 23	Summary of Total Charges, Costs, & Reimbursements	101
TABLE 24	Nursing Cost Ratios	103
TABLE 25	Regression of AHPPD and DRG to Total Direct Cost of Nursing Care	108
TABLE 26	Regression of Actual Difference in Hours and Hospital to Total Direct Cost	111

List of Illustrations

		Page
Figure 1	Nursing Intensity of Patient Care Model: Three Major Components	26
Figure 2	Nursing Intensity of Patient Care Model: Relationship of Variables	31

CHAPTER I

The Study Problem

Introduction

Patients are admitted to the acute-care setting to receive nursing care. Since the implementation of the prospective payment method of reimbursement based on diagnoses related groups (DRGs), several methods of providing health care have evolved as alternatives to hospitalization. Only those patients requiring continued nursing observation and interventions are admitted to the hospital. Those patients who are hospitalized are discharged earlier. As the intensity of nursing care increased, the necessity of cost containment has escalated. Providing quality patient care in a cost effective manner has been the primary principle expressed in the mission statements of acute care facilities across the country for many years. In keeping with this mission, nursing continues to struggle to find appropriate methods for measuring nursing outcomes and the cost of nursing care.

Although methods to quantify patients' needs for nursing care for staffing purposes were developed by Connor in the late 1950's (Connor, 1961), the actual cost of nursing care was not seriously considered until the introduction of the prospective payment system (Lampe, 1987). With the introduction of prospective payment (PPS) in 1984, studies

presenting cost allocation methods for determining the cost of nursing care based on the predicted patient needs emerged. More recently, nursing leaders identified the need to predict not only patient care requirements, but also to determine the amount and cost of nursing care patients actually receive. Current methods for measuring nursing productivity and outcomes of nursing care are inadequate because they define resource use in terms of predicted care in contrast to actual care, and make no provision for the measurement of the outcomes of care (Giovannetti, 1986). Confusion exists in the literature concerning the terminology used to define and differentiate patient classification methods. Questions remain as to whether hospitals actually provide the level of care recommended by the patient classification system (PCS).

Recent nursing literature differentiates between the concepts of **patient acuity** which determines the patient's needs as measured by a PCS and ***nursing intensity***. **Nursing intensity is the volume and value of nursing resources actually provided to individual patients generated by each patient's need for care.** Through a review of the literature describing the development of various workload measurements of nursing resource consumption, three major components of nursing intensity have been identified. These components are; the patient's need for nursing, the complexity of care, and the severity of illness. A nursing intensity of patient care conceptual framework based on the above concepts was developed to guide this dissertation.

Currently, efforts are being made to find acceptable cost accounting systems for hospital nursing services (Lynaugh & Fagin, 1988). Several methods to determine the cost of nursing care were

developed and reported, however numerous methodological problems were identified. Key problem areas identified by Edwardson and Giovannetti (1987) included lack of comparability of the information used, lack of uniform definitions of cost, and neglect of variables that affect nursing care in addition to patient care requirements and staff mix. Furthermore, most cost estimates that were derived were based on predicted rather than actual costs.

To date, few researchers have correlated patient care needs with nursing intensity in multi-site cost of nursing care studies. McKibbin, Brimmer, Galliher, Hartley, and Clinton (1985) examined the relationship between DRGs and both nursing resource utilization and nursing costs at two hospitals. These researchers found sufficient variation in nursing resource utilization and nursing costs to recommend further study of nursing care, length of stay (LOS), and DRGs. Two other multi-site studies evaluated the effect of providing nursing care hours on LOS, but did not calculate the cost of nursing care (Helt & Jelinek, 1988; Trofino, 1989).

The relationship between the cost effectiveness of nursing care and patient outcomes was seldom addressed. Helt and Jelinek (1988) examined the impact of cost-cutting measures on productivity and quality in a multi-hospital study of facilities using the Medicus PCS. Although they did not determine the cost of nursing care, they found average LOS decreased from 9.2 to 7.3 days and patient acuity rose approximately 10% between 1983 and 1985. With an increase in the percentage of registered nurses (RNs) used, productivity and quality of care also increased. None of the studies analyzed the effect of providing predicted hours of care on patient LOS and cost of care.

Statement of the Problem

Patient classification systems were originally developed as methods for allocating nursing resources to individual patients based on their need for care. Although efforts to increase the precision of these methods continued through the 1970's, classification systems have proliferated since the implementation of prospective payment. The most recent transition has been a move from predicting patient care needs, to quantifying nursing care actually provided. As stated earlier, confusion exists in the literature concerning the terminology used to define these methods. Clarification of terms is necessary.

Prospective payment has accentuated the need to appropriately allocate nursing resources and to identify the actual cost of nursing care associated with resource use. Nursing departments and nurse researchers based early costing studies on relating predicted hours of care to the hourly cost of care, without questioning if the predicted hours of care were actually provided. Predicted costs were assumed to reflect actual costs. Since the quantification of predicted hours of care is frequently converted to the estimated cost of care, establishing the relationship between predicted and actual hours of care is imperative.

Furthermore, the methods reported for converting hours of care to cost of care were inconsistent. Lack of uniform definitions of cost was cited as a key methodological problem by Edwardson and Giovannetti (1987). Several other authors have also discussed this problem (Dijkers, Paradise, & Maxwell, 1986; McCloskey, 1989; Sovie, 1988). Precise discussion of which nursing and ancillary staff members were

included in each aspect of costing was essential, yet often omitted from the description of the studies. Standard costing terminology and methods based on cost accounting principles are critical if comparison of results are made between studies and institutions.

The lack of nursing frameworks to guide research on patient classification systems and costing represents another challenge to the present study. Few of the studies reported in the literature described a theoretical or conceptual framework. Meleis and Jennings (1989) described a paucity of development and use of nursing theory in nursing administration. They challenged nursing administrators to develop theoretical foundations in nursing for use as frameworks for nursing research and practice (Meleis & Jennings, 1989).

The problem addressed by this study is the investigation of the relationship between individual patient needs for nursing care as predicted by a PCS and the nursing intensity of care actually received at different sites. Confounding factors that cause a discrepancy between predicted and actual hours of nursing care are identified and prioritized. After determining this relationship, specific patient care outcomes of cost of nursing care and length of stay (LOS) are examined for each hospital. Comparisons of the results between sites are analyzed.

Purpose of the Study

The primary goal of this research is to determine the effect of providing the predicted hours of nursing care on the patient care outcomes of cost of nursing care and length of stay during acute care hospitalization. Before this effect is determined, the relationship

between the level of care predicted by the PCS and the hours of care actually provided is examined. To date, few nursing researchers have dealt with correlating patient care needs with care actually provided or nursing resources consumed.

A nursing intensity of patient care model (NIPC) was conceptualized by this researcher to provided the framework for the study. Before attempting to articulate the entire model, there is the need to validate whether existing PCSs really predict the volume (hours of care) and value (cost per hour) of nursing care patients actually receive. Therefore, although this research acknowledges the three major components of the nursing intensity of patient care model, the principal area of investigation is to identify if there is a significant discrepancy between the patient's need for nursing and the care actually provided. Questions addressing the effect of severity of illness and detailed measurements of the complexity of nursing care are beyond the scope of this study.

Given these general aims, this study addresses the following specific goals:

1. Determine if a difference exists between the hours of care predicted and provided on medical units at three acute care facilities that utilize two different PCSs.
2. Determine the effect of varying staffing levels on the hours of care actually provided to patients on each unit.
3. Evaluate the relationship between the variance in patient care hours and total unit hours.

4. Identify the major causes of the variance between the predicted and actual nursing resource use considering patient, facility, nursing department, unit, and staff variables.
5. Determine the effect of providing the predicted level of care on the cost and length of hospital stay.
6. Define, apply, and report standard cost accounting techniques consistently across facilities to determine the cost of nursing care for patients at three specific sites.

This research focusing on nursing intensity provides a link between the PCS and the staffing system, to ultimately contribute more accurate data for determining the cost of nursing care.

Significance of the Study

Before the implementation of DRGs little attention was paid to the cost of nursing care. Since 1984, there has been a deluge of nursing costing studies, yet only recently have nursing leaders and researchers addressed the issue of determining the cost of nursing care based on nursing intensity measures, in contrast to patient acuity measures. The studies that have been presented have not clarified the relationship between predicted and actual levels of care, or the effect of the variance in hours on differences in LOS or cost of nursing care. The majority of studies were limited to one site.

When results were reported, inconsistent application of standard costing methods were often used. Difficulties in comparing the results from one study to another arose due to the above inconsistencies, and

also because different components of cost were presented. Frequently it was unclear specifically which staff members were included in the results reported (was the nurse manager and/or unit secretary included). Finally, few of the studies reported the use of a conceptual model or framework to guide the study.

This research is a beginning effort to determine the relationship between the level of care predicted by a PCS and the nursing intensity or actual hours of care provided to patients. The effect of providing the predicted levels are related to the LOS and cost of nursing care. The potential benefits of identifying this relationship utilizing a nursing intensity framework are to:

1. Provide a frame of reference for costing nursing care based on nursing intensity.
2. Determine the significance of the variance between the predicted and actual hours, and identify causes of the variance.
3. Provide a clarification of the use of classification and costing terminology.
4. Present a standard costing methodology that can be applied to other sites.
5. Display results from a multi-hospital study that can be compared to other studies reported in the literature.

Potential future applications include the capability for generalization of the findings to other acute care settings. The further implementation of the other components of the nursing intensity of patient care model can be explicated. The method of costing nursing

care can be applied to other situations and can be utilized by institutions for the purpose of:

1. Comparing the cost of nursing care for specific DRGs.
2. Providing cost effectiveness analysis for administrative decision making and clinical research.
3. Variable billing for nursing services.
4. Producing budgets and justifying variances in budget objectives.
5. Contrasting different nursing units at one site, or several nursing devisions in a multi-hospital system.

To summarize, this chapter has provided the study problem, the purpose of the study, and the need for the study. Chapter II will expand upon the prior relevant research and describe the conceptual framework in greater detail.

CHAPTER II

Literature Review and Conceptual Framework

Overview of Relevant Literature and Research

Literature relevant to this study relates costing reports to patient classification systems and the development of measurements of nursing intensity. To address this large body of literature, the background and significance of costing nursing is presented as an overview. Costing nursing refers to determining the costs attributed to nursing care. A discussion of costing terminology and a table of definitions of terms are presented. Subsequent sections review examples of studies that measured nursing costs based on patient acuity systems, concluding with studies that determined the cost of nursing care based on nursing intensity. Nursing intensity is the actual volume and value of the care provided by nurses at different skill levels (Devine & Werley, 1988), and the specific measure of each patient's consumption of nursing resources, generated by that patient's requirement for care (Prescott & Phillips, 1988).

Historical Background

Before 1950, nursing care was rarely singled out either as a cost or expense even though it was the central service provided in the hospital setting (Lynaugh & Fagin, 1988). As hospital-based schools of nursing closed and student labor was gradually withdrawn, concern over the rising cost of care was expressed. Before the development of measurements of individual patient needs, a per diem method was used to assign standard hours of care to all patients on the nursing unit. The

hours per patient day (HPPD) of nursing care were allocated to the unit based on patient census. No consideration was made for the variation in patient needs. Even though the use of a PCS to predict patient needs and assign nurses to meet these needs was developed in 1958 (Connor, 1961), some hospitals continue to use HPPD to assign nurses to care for patients. Most hospitals maintain the use of HPPD as the basis for budgeting nursing care and include the estimated cost of nursing HPPD in the daily room rate for billing purposes. Connor identified the concept of controlled variable staffing, recognizing that patient needs were variable, quantifiable, and could be predicted. Improved procedures for the measurement of patient needs and allocation of nursing resources resulted. This landmark work has provided the foundation for not only the multiple classification systems that have developed over the past 30 years, but also for the majority of the methods for costing of nursing care that have emerged.

Since the enactment of Title XVIII of the Social Security Act in 1965, health care costs began to escalate at an alarming rate (Freeland & Shendler, 1984). The creation of the Medicare system with the resultant governmental costs stimulated some interest in evaluating hospital costs. However, because hospitals were reimbursed retrospectively for the majority of the charges patients incurred, there was little incentive to determine specific hospital costs.

In spite of this lack of interest in costing, in 1971, Montana Deaconess Hospital put its entire internal operation on an absolute cost/charge bases in an attempt to set up proper revenue producing departments and to make each department financially self-supporting

(Holbrook, 1972). The basic assumption was that nursing care could be measured in terms of the amount of time needed to carry out various tasks and that patients could be categorized in terms of the different amounts of nursing time they required. The premise stated by Holbrook was that all potential revenue producing departments should be self-supporting and that costs and charges should be absolutely related. Patients should pay for what they received. Patients requiring less care should not be required to subsidize those requiring more care.

Although Holbrook provided a fairly detailed report on his methods and rationale, only one other report of costing and billing for nursing care in a general hospital setting was found that was published before the implementation of DRGs (Higgerson & Van Slyck, 1982). Even though nursing units became cost centers, the cost of nursing care was not identified. Retrospective reimbursement from third party payers continued to pay for the increasing care costs. Only since the introduction of prospective payment has nursing begun to seriously consider the actual costs and revenue of nursing care.

DRGs were originally developed for utilization review purposes to evaluate, compare, and provide relevant feedback regarding hospital performance (Trofino, 1989). In 1980, New Jersey implemented a prospective payment system (PPS) with reimbursement set in advance for an amount to be paid to hospitals for each DRG. In 1983, this system was established by the government to determine reimbursement for Medicare inpatients across the country.

Because of the lack of available data to calculate nursing costs at that time, Medicare assumed that all patients incurred the same nursing costs, on average, each day they were in the hospital

(Bachofer, 1987). To calculate the nursing portion of the DRG weights, routine and special care per diem costs were multiplied by each patient's routine and special care average length of stay (LOS) allowed for that patient's DRG assignment. No consideration was made for varying intensity. Using a per diem method to allocate nursing costs had few implications as long as reimbursement for care was retrospective. The hospital was paid for each day of the patient's LOS. With the PPS, the hospital is paid a set amount for each patient according to the DRG, no matter how long the stay. The PPS assumes that each patient will utilize nursing care in the same amount each day without consideration for varying intensity (Trofino, 1989). With the changes in the reimbursement method for Medicare patients, the incentives of prospective payment have led hospitals to examine more closely the process and cost of patient care (Price & Lake, 1988). Nursing services, along with all other area of inpatient care, became the target for cost cutting.

Since the implementation of DRGs until March, 1987, 68 articles and chapters of books were published that related attempts to cost nursing (McCloskey, Gardner, & Johnson, 1987). In addition, two edited books by Shaffer (1985; 1986) focused on papers on costing nursing and linking PCS criteria to hospital cost accounting systems. Kirk (1987) published a book on identifying costs and pricing nursing services. The Health Resources and Services Administration conducted a conference on costing nursing services and published two documents; a report of the conference and a second companion review of the pertinent literature (Lampe, 1987).

Significance

Only recently have nursing leaders and researchers addressed the issue of determining the cost of nursing care based on nursing intensity measures in contrast to patient acuity measures. Although the majority of the costing studies were based on cost analysis, the National Invitational Conference on Nursing Productivity (1986) published proceedings calling for a future research agenda of relating nursing inputs to not only outputs, but also to outcomes. Ingersoll, Hoffart, and Schultz (1990) assessed the current status of research in nursing and reported that 22.1% of the health services research completed in the 1980's focused on the cost of health care as the dependent or outcome variable.

As acute care facilities responded to the implementation of the PPS, the most immediate impact was a dramatic drop in the average LOS, with a resultant increase in the intensity and complexity of nursing care (Gross, 1987). These changes provided both hospital and nursing administration with compelling reasons to determine the costs associated with providing nursing care to individual patients (Sovie, 1988).

Lampe (1987) discussed the reasons for costing nursing services. She stated that because the cost of providing nursing care is the largest single cost component for almost every hospital "product", the importance of scrutinizing and controlling these costs is a priority for hospital executives. According to Lampe (1987), the method of budgeting based on predicting patient days and averaging hours of care according to service precludes identifying the patient mix upon which economically wise decisions depend. Budgets must not only predict the

acuity of the patient population, but also itemize the cost of care to be rendered, according to the degree of acuity.

Bargagliotti and Smith (1985) found nursing cost to vary significantly both within and among DRGs and to be less than 25% of the hospital care cost. They highlighted the need to know the costs of providing care for a specific DRG category in a given institution. Benefits cited by the authors follow. This information would furnish managers with a benchmark for assessing the effects of changes in nursing staff skill mix and practice patterns. Knowing costs allows the manager to be prepared to negotiate care contracts and implement feasible cost containment efforts. By determining costs, nurse managers can decide how many hours of care can be afforded by the institution. If the desired level can not be met, plans can be made to set priorities for the most important aspects of care and investigate methods to streamline or simplify work (Kirk, 1987).

Kirk (1987) discussed the impact that costing nursing has on the institution, the nursing department, and the patient. At present no realistic relationship exists between the cost of care and the respective charge for that care. Kirk (1987) stressed the need for institutions to identify costs so that they are able to properly set rates and manage revenue in the present environment, which incorporates a combination of charge based (normal) reimbursement and cost-based prospective reimbursement. A positive margin must be maintained between the cost of care and the reimbursement or the institution will not survive. Knowing what nursing costs allows for greater flexibility in planning for future changes in the method of reimbursement.

strategic planning decisions are based on cost information. Knowing fixed and variable costs allows for better management of operating costs and productivity systems. Cost information can be used for flexible budgeting which allows for performance evaluation of the manager by comparing actual performance to expected performance.

External uses of cost of nursing care knowledge provides information to the legislators, public, and third party payers concerning the true cost of nursing care. This information can be used to bill the patient for care and to support requests for increases in the DRG reimbursement (Mullinix, 1988). According to Kirk (1987), the patient benefits because the costing process ensures that a standard of care has been identified and approved. Nurses also benefit. Sovie and Smith (1986) stated that when patients are billed for their nursing care, nurses have economic accountability. They classify their patients and accurately account for the relevant critical indicators of the PCS, with retrievable documentation in the record. Identifying standards, related costs, and nursing's contribution to the profit margin will improve nursing's image and promote nursing's move to the positive side of the ledger (Sovie & Smith 1986).

The nursing profession can use costing information to pursue appropriate new roles for nurses and to address the financing of nursing education and research (Lampe, 1987). As the current shortage of nurses is addressed, determination of the worth of nursing care must be based on realistic cost data. Mitchell (1987) called for research to provide a link between cost and quality. In the proceedings of the Nursing Resources and Delivery of Patient Care Invitational Conference, Aiken (1988) identified the need for research to link more closely

nursing interventions and nursing resources with patient outcomes. As determining the cost effectiveness of nursing interventions becomes a priority research issue, accurate methods of measuring patient outcomes and the cost of nursing care are essential.

To summarize this section, Lampe (1987) emphasized the major areas of managements' use for cost data which included: 1) nursing cost per DRG, cost analysis, and cost control; 2) long range staffing and budgeting; 3) program development; and 4) establish nursing as a revenue or profit center. The introduction of DRGs has made it essential to identify all costs incurred in caring for patients. Costing nursing services enhances the ability of the nurse administrator to manage and control nursing resources and to negotiate and secure appropriate allocation of financial resources.

Cost of Care Terminology

Lack of uniform definitions of cost was cited as a key methodological problem by Edwardson and Giovannetti (1987). Thompson (1987) concluded that one of the most complex problems in using a PCS to determine cost was the identification and definition of direct, indirect, and administrative time and cost. There was a lack of consistency in the definition and use of costing terms by different authors. Many nursing administrators differ from cost accountants in their connotation on these term.

Therefore, before evaluating the costing studies presented in the literature, it is essential to define clearly the cost accounting terminology used. The definitions of the terms presented in Appendix A

are used for evaluating the published studies that follow. In Chapter III, a method for "costing nursing" based on the definitions is proposed. A discussion focusing on cost accounting with a differentiation of direct and indirect costs is provided. The relationship of costs to direct and indirect care is also presented.

Methods of Measurement of Resource Use

Although Connor developed a PCS in 1958 to predict patient needs and assign nurses to care for patients, some hospitals still continue to use HPPD to assign nursing care. The major thrust towards improving classification systems and costing nursing care was the implementation of DRGs. DRGs asserted all patients in a diagnostic category required the same average nursing hours of care per stay. Major criticisms of this case mix method of prospective payment were; it did not adequately measure the range of severity of illness (Smits, Fetter, and McMahon, 1984; Horn & Sharkey, 1983; and Panniers, 1987) or the nursing intensity of care differences within each diagnostic category (Caterinecchio, 1983; Jones, 1984; & Thompson, 1984). More recently, researchers have presented studies to measure nursing resource consumption based on patient acuity (Sovie, Tarcinale, Vanputte, & Studen, 1985), nursing intensity (Reitz, 1985; Gross, 1987; & Thompson, 1987), and nursing diagnosis (Halloran & Kiley, 1987).

To date, confusion exists regarding the terminology commonly used to define the various methods of measuring nursing resource consumption. To aid in clarifying these terms, definitions of the concepts found in the literature are presented in Appendix B.

Cost of Nursing Care Based on Patient Acuity

Walker's (1983) preliminary results of a pilot study was the first costing study reported following the introduction of the PPS. Nursing costs were separated into direct, indirect, and non-nursing costs to provide the cost of nursing as a percentage of daily room charges and total charges. In 1984, Mitchell, Miller, Welches, & Walker provided a more extensive report of this study. There was no discussion of tests for validity and reliability, or of methods used to determine the appropriate staff mix. No effort was made to verify that the needed hours matched the amount of actual care provided. Although these limitations restricted the generalizability of the study, this first attempt to relate nursing hours to DRGs showed a wide range of hours and large standard deviations within DRGs indicating similar resources were not used within DRGs.

As further studies were reported, methodological problems concerning the lack of comparability of the information, lack of uniform definitions, and neglect of variables that affect nursing care became apparent (Edwardson & Giovannetti, 1987). Riley and Shaefers (1983) reported total direct and indirect nursing costs as a ratio of total hospital charges. Lagona and Stritzel (1984) measured total direct nursing costs with no comparison to charges. Sovie et al. (1985) related direct nursing cost to DRGs and as a percentage of the room charge. Mowrey and Korpman (1985) calculated the relationship of nursing costs to DRG reimbursement. McKibbin, et al. (1985) determined hospital charges by type of service. Medicare cost reports for each of the two study hospitals were used to convert charges to costs using the ratio of costs to charges.

Further inconsistencies were found when the methods for defining and measuring nursing costs were reported. Confusion existed when direct and indirect costs were calculated. Financial accounting refers to direct costs as those related to providing care for patients. The costs for both indirect and direct nursing care are considered to be direct expenses; whereas other variables that influence the amount of nursing indirect expenses are those costs that are required for the functioning of the unit, but cannot be traced directly to an individual patient (Edwardson & Giovannetti, 1987). However, in reported measurements of the nursing workload, direct care hours were often equated with direct costs and indirect care related to indirect costs. It was frequently unclear if the nurse manager's time was considered as direct or indirect. Mitchell et al., (1984) included the unit secretary as a direct expense, while Sovie et al., (1985) defined this time as indirect. To add to the confusion, some studies reported direct costs only, others reported direct and indirect care, and still others included allocated costs such as utilities and depreciation. When clear operational definitions of the various nursing costs were included, the relationship between cost and charges or total costs could be determined. When these definitions were omitted, data could not be interpreted and cross institutional comparisons were impossible.

The background on the development, implementation, and validation of the various PCSs used to provide the hours of care was frequently omitted or glossed over. Since the hours of care provided one of the major quantification factors, the PCS must be credible if the results of the study are to be taken seriously. If comparisons were made

across institutions, standard terms and methods were required, while accounting and controlling for institution specific variables such as staff mix, physical layout of the unit, nursing delivery systems, and management philosophy.

Cost of Nursing Care Based on Nursing Intensity

Giovannetti (1986) and Dijkers, Paradise, & Maxwell (1986) discussed the problems encountered when adapting a PCS to measure nursing intensity and costs. Giovannetti questioned how successfully a PCS, which was designed to group patients according to their perceived care needs for the purpose of staffing, could be adapted to measure the care actually provided. Dijkers et al. (1986) also addressed this issue, stating that whenever there was a discrepancy between the amount of care a patient should receive and has received, a PCS could not be used to estimate costs of care. However, they offered suggestions on how to avoid the various pitfalls in utilizing a PCS in developing costing methods. These recommendations were followed in Chapter III.

Lucke and Lucke (1986) examined the relationship of nursing intensity, severity of illness, and LOS to DRG hospital costs. Although the term nursing intensity was actually the hours of care required, validity for the instrument was established by comparing the results with actual direct and indirect care provided. High correlations existed between nursing intensity and the severity of illness index. Nursing intensity and severity of illness significantly improved the predictors of LOS and hospital costs.

Although four other studies were reported that examined the differences in using patient acuity and actual hours to predict nursing

care hours and costs, inconsistent relationships were found between study results. Harrell (1986) found the total acuity level and total hours of care delivered to be highly correlated, and recommended that either could be used to predict nursing costs. However in her study, total hours of care were calculated from budgeted hours of care, not actual. Grohar, Myers, & McSweeny (1986) sought to develop a model for estimating direct nursing care requirements related to the patient's functional needs. Mean nursing resource use was found to vary within the acuity category and among the DRGs.

The McKibbin et al. (1985) study used the Medicus Classification System in two hospitals, but used both the 4-level and newer 5-level version. Data for both actual and recommended nursing hours of care were sampled, and the actual and recommended total hours of care over the LOS were found to be correlated at .99 for each of the 21 DRGs studied. However, Helt and Jelinek in their 1988 report on using the Medicus System in multi-hospital settings, specifically stated the two systems are not directly comparable.

Findings in the Helt and Jelinek study showed a significant drop in LOS, and an increase in patient acuity, productivity, and quality since the implementation of DRGs. Although patient acuity rose approximately 10%, fewer actual nursing hours were used to care for patients. Other studies comparing the information obtained through the use of two or more classification systems, in conjunction with a standard costing model, have not been reported. As can be seen by this summary of the four studies, inconsistent relationships were exhibited. Further investigation of the relationship between predicted and actual hours of care in multi-hospital studies is needed.

Conceptual Framework

Development of Nursing Intensity Models

As part of a Nursing Case Mix Management System, Gross (1987) developed a Nursing Care Intensity Index which measured all direct care by amount and type. The purpose of the system was to assess patient requirements, allocate staff, charge patients based on nursing care delivered, monitor the quality of care, and budget for the nursing case mix expected in each service area. Nursing interventions were separated into major divisions of care based on the required skill level of the provider and the complexity of the interventions. Nursing intensity was measured based on amount, type, and duration of care. Nursing resources actually provided were quantified to provide cost information on an individual per patient day or LOS basis, or aggregate data on nursing resource use per DRG.

Atwood, Hinshaw, and Chance (1986) completed a study identifying the links among complexity of nursing care requirements, cost of patient care, and charges under DRGs. A Nursing Resource Model was created to explain patterns of nursing care requirements as measured by PCS scores, nursing resources needed, and the rate of resource replacement within DRG categories. The model was conceptualized as consisting of four stages: 1) the patient's nursing task and complexity of care requirements, 2) predicted resources needed, 3) actual nursing resource consumption and charges for the nursing hours used, and 4) the rate of replacement which included the charges made to the patient based on his nursing care requirements, and the number and type of resources consumed.

While conceptually the model was ideal, limitations existed in using the results of the study. Nursing resource consumption was not operationalized due to lack of data organized by patient stay. The rate of replacement, though defined as the charges based on care requirements and the number and type of resources consumed, was in reality based on the type of room occupied.

Through the review of the literature, major concepts that influence the use of nursing resources have included 1) the patients need for nursing care, 2) the complexity of care, and 3) the severity of illness. The three major concepts provided the foundation for developing a beginning conceptual model for appraising the nursing intensity of patient care.

Nursing Intensity of Patient Care Model

The three major concepts or components also provided the foundation for the definition of nursing intensity. This researcher interpreted nursing intensity to be a specific measure of each patient's consumption of nursing resources generated by that patient's need based on the three major components of nursing intensity. The nursing intensity of patient care model (NIPC) incorporated the fundamental domain concepts of nursing which included person, environment, health, and nursing. The model developed by Atwood, et al. (1986) was similar, but they did not include severity of illness as a conceptual dimension.

The NIPC was adapted from the four conceptual dimensions of patient intensity presented by Prescott and Phillips (1988). Although all four concepts from Prescott and Phillips were included in the NIPC; the

patient's need for nursing, the complexity of care, and the severity of illness were considered to be the major components for determining the hours and type of care required. The fourth dimension, the hours of care actually provided, was considered to be an output measurement in the NIPC. Once hours of care required have been determined, the nursing department characteristics influenced the hours of care provided, the level of the caregiver, and the actual cost of nursing care. Prescott and Phillips' definition of the conceptual dimensions of complexity, patient's need for nursing, and severity of illness were clear and well defined. For this reason, these dimensions were used to adapt Prescott and Phillips' concepts to develop a conceptual model to guide this study.

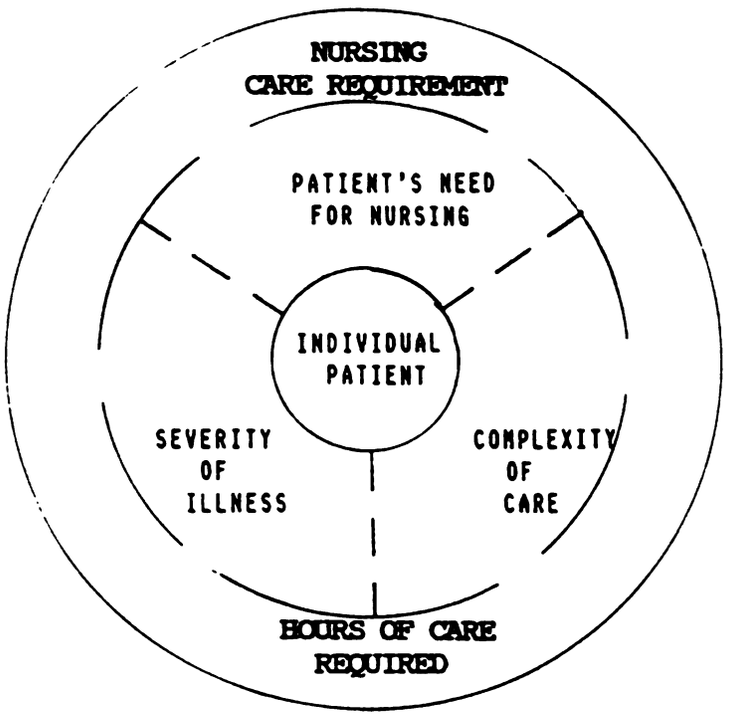
The NIPC consists of three concentric circles that form the basis for determining nursing intensity. The center core and main focus of the model is the individual patient. The patient has unique and varying needs for nursing care based on his individual goals, values, and expectations. These needs are determined by a combination of factors or characteristics. Patient characteristics that influence the patient's nursing needs upon entry into the health care system include variables such as age, sex, biophysical, psychological, socioeconomic, and ethnocultural status.

The second level or circle which includes the three major components of nursing intensity, surrounds the patient and is determined by the individual needs of the patient. These components are the complexity of care, the severity of illness, and the patient's need for nursing as defined in Appendix B. Each component is interrelated to and influenced by the others (see Figure 1).

Figure 1. Nursing Intensity.

NURSING INTENSITY OF PATIENT CARE MODEL

PATIENT'S NEED FOR NURSING
- ACTIVITIES OF DAILY LIVING
- MOBILITY
- PHYSIOLOGICAL STABILITY
- EMOTIONAL NEEDS
- TEACHING NEEDS
- SENSORY/COMMUNICATION/ COGNITIVE LIMITATIONS



SEVERITY OF ILLNESS
- GLOBAL SEVERITY
- COMPLICATIONS/COMORBIDITIES
- RESPONSE TO MEDICAL TREATMENT

COMPLEXITY OF CARE
- COMPLEXITY OF PROCEDURES
- COMPLEXITY OF NURSING PROCESS & LEVEL OF CARE PROVIDER NEEDED

Patient's Need for Nursing. The patient care needs reflect those needs commonly identified by the critical indicators of care used to determine patient acuity. These indicators represent the activities that have the greatest influence on nursing time. The amount of assistance needed in performing activities of daily living (ADL) such as bathing, eating, and toileting; and the degree of mobility is considered. The physiological stability determines the need for frequent vital signs, observations, and nursing interventions. The teaching and emotional needs vary dependent on the patient's diagnosis; social support system; ability to perform ADL; and sensory, communication, and cognitive limitations. Patient care needs are measured by acuity points assigned to each critical indicator and are considered to be the volume or hours of nursing care required and provided to individual patients.

Complexity of Care . The complexity of care required is related to the types of assessment and patient management decisions nurses must make. Prescott & Phillips (1988) expanded on the definition of complexity. Complexity of care was divided into two dimensions; 1) complexity of procedures or tasks which focused on the knowledge, skill, and experience required to perform the procedures and treatments the patient needs, and 2) the complexity of clinical judgments related to the nursing process and level of care provider needed to deal with the decision making processes required. The level of complexity was derived from the nature of the decisions to be made, from environmental factors, and from the knowledge, skills, and experience of the decision maker (Prescott & Phillips, 1988). The level of complexity is an added

dimension not usually considered in most intensity models. Complexity is not directly related to hours or volume of care, but is related to the skill level of the provider which determines the value or cost of the hours of care provided to the patient.

Severity of Illness. Severity of illness has been defined as an estimate of how ill a patient is in terms of threat to life and extensiveness of symptoms. Mitchell et al. (1984) and Prescott and Phillips (1988) have considered severity as an added dimension to determine the patient's consumption of nursing resources. Although Lucke & Lucke (1986) used the term nursing intensity to define nursing care required rather than care received, they combined measures of nursing care required and severity of illness in their model. They stated that by combining measures of either severity or nursing intensity with DRGs, the accuracy of prediction of treatment costs increased. However, they stated, a large portion of the costs remain uncaptured. Therefore, Lucke and Lucke determined the extent to which severity of illness, intensity of nursing, and DRG LOS predicted actual resource use. The combined model significantly improved the prediction of LOS and hospital costs for the sample studied. They recommended the use of both severity and intensity measures in future studies to predict the cost of care for patients.

The three areas of severity to be considered include; 1) the global severity of the disease process, 2) the presence and the effect of complications and comorbidities on the disease process, and 3) the patient's response to treatment (Horn & Sharkey 1983; Prescott &

Phillips, 1988). Although not directly controlled by the nursing process, severity of illness affects both the volume of nursing care and required skill level of the provider. Even though some overlap is anticipated between the severity of illness component and the other two major components, this investigator incorporated severity into the conceptual model. As future research plans are developed to fully operationalize the model, the validity of the component to increase the explanation of variance in nursing resource use will be tested.

The external or environmental forces are the patient characteristics on admission to the hospital which influence the three major components that determine the nursing intensity of care. These characteristics influence not only the admission needs, but also the care needed and provided as the patient progresses through the hospitalization period to discharge.

The outer circle or third level includes nursing care needs and hours of care required which are determined by a combination of the three major components. The nursing care required represents the level of the caregiver required. While the second level determines the needs, this outer level is influenced by the nursing characteristics present in the institution and by the patient classification and staffing systems. These variables will affect the determination of the level of the caregiver and the hours of care required (see Figure 2).

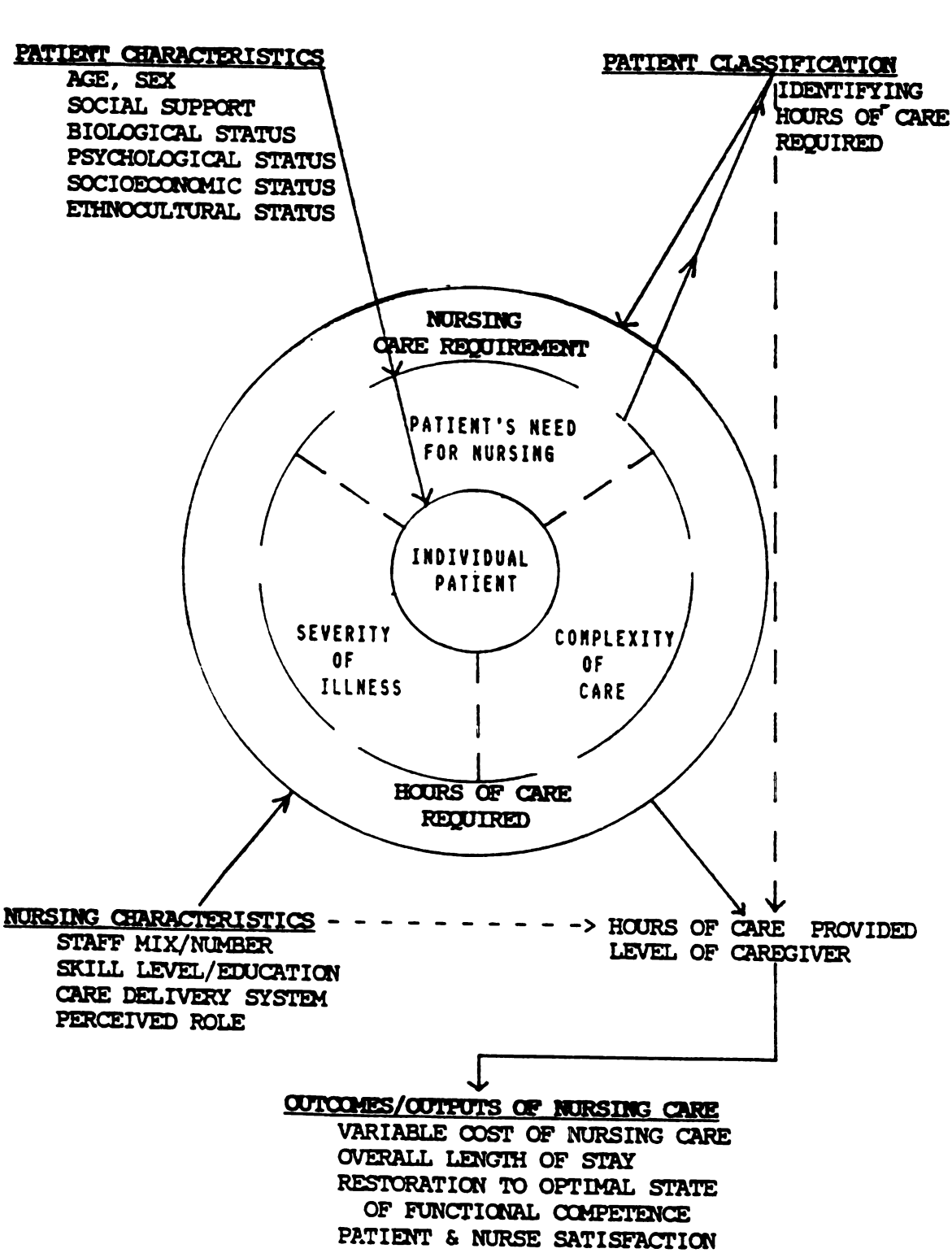
The nursing characteristics include the staff mix and number of nurses in the facility; the skill and educational level of the nursing staff; the type of nursing care delivery system used; and the perceived role of the nurse. These characteristics, while internal to the

organization, are affected by the external environment. The reputation of the facility, the supply of nurses in the area, the location and types of schools of nursing are a few of the variables that determine the skill mix, number, and level of nurses, and the type of delivery system the hospital can provide. These characteristics also affect the hours of care provided to individual patients.

The patient classification flows from the center of the model and is a vehicle for determining the hours of care required. It flows back to the center of the model to provide the nursing care needs, but can be influenced by a lack of appropriate staff to actually provide the hours of care required. If adequate staff is available to meet the patient needs, accurate hours of care provided and appropriate levels of care givers can be determined. The volume and value of nursing can be determined through consideration of the components of this proposed model (see Figure 2).

Although this model is conceptualized for use in an acute care setting, the basic concepts could be applied to any setting where nurses are providing care to individual patients. Concerns to be addressed in the future include: 1) how to realistically and economically determine the levels of severity and complexity of care; 2) how to merge these two components with an existing PCS to determine a more accurate measure of patient needs; 3) how to determine the appropriate staff mix and skill level required by patients; and 4) how to adjust for the discrepancies between the level of care required and the level of care actually provided to patients? Many questions remain unanswered and much work remains to be completed.

Figure 2. Nursing Intensity.



In summary, the purpose of patient classification systems has been discussed. Terminology associated with classification systems commonly used in the literature has been clarified and defined. Through a review of the literature that described the development of various workload measurements of nursing resource consumption, three major components of nursing intensity were identified. These components were utilized to develop a nursing intensity of patient care conceptual model for the purpose of determining the value and volume of nursing resources consumed by individual patients based upon their needs. While attempting to operationalize the entire model was beyond the scope of this initial research, the model served as the framework for the study. Therefore, the first step was to clarify the relationship between the patient's need for nursing and the hours of care actually provided.

Assumptions

The following general assumptions provided guidelines for this study. Other assumptions specific to data collection are discussed under the appropriate heading.

1. Predicted and actual hours of nursing care can be measured.
2. Variability exists in the way different PCSs predict and allocate nursing resources.
3. Variability exists in the degree of relationship between the predicted and actual hours of care provided at different sites.
4. High use DRGs are common across institutions.
5. Nursing care does make a difference in patient outcomes.

Research Questions and Study Hypothesis

Question 1. Is there a significant relationship between hours of care predicted and hours of care actually provided to patients on different units, at different hospitals, using different PCSs?

Question 2. What are the confounding factors that cause a variance between the predicted and actual nursing resource use?

Question 3. How does staffing effect the hours of care actually provided?

Question 4. What is the effect of providing predicted nursing resources on patient cost and LOS?

These questions will be addressed by analyzing the relationship between the predicted and actual hours of care on three medical units at different sites. The study hypothesis is: **As the difference between predicted and actual hours of nursing care for medical/surgical patients increases, the length of stay and total cost of nursing care will also increase.**.

Operational Definition of Terms

Confounding variables.

Those factors that may cause the variance between predicted and actual hours of care. The factors were identified through observation, discussion with administration and staff, and by analyzing the responses to the Perception of Staffing Adequacy Questionnaire (PSAQ).

Demographic Variables.

Age. The age of the patient at the time of the study was used.

Sex. The gender of the subject. Obtained from the medical record and documented as male or female.

Independent Variables

Predicted hours of care. The hours of care assigned to each level of the PCS which have been determined through prior work sampling studies. Predicted hours are a quantification of the amount of nursing care a patient should receive based on individual needs.

Hours of care provided. The direct hours of nursing care determined by chart audit of the nurses notes which document the care actually provided through the 8 hour shift. Classification indicators that have been provided and documented were audited and assigned hours of care based on the institutional specific PCS guidelines.

Patient Classification System (PCS). A nursing system that identifies and classifies patients into care groups or categories based on their individual needs, with a time quantification of each of the levels or categories. Used to predict and allocate nursing resources.

St. Luke's PCS. A factor evaluation type of system to predict patient needs and classify patients into five separate categories based on specific elements of care.

San Joaquin PCS. A prototype evaluation system to predict patient needs and classify patients into four ordinal levels based on a selection of descriptors or profiles that represent nursing care requirements of a typical patient in each category.

Nursing Intensity. For the purpose of this proposal, nursing intensity was limited to the volume and value of the care actually provided to individual patients. The volume was the number of hours of care and the value was the cost of care provided based on the average hourly salaries of the staff mix on a particular unit at each facility.

Shift. The 8 hour periods of time that were used by each site to staff with nurses who assumed responsibility for the direct care of patients. The use of the three shifts each day was consistent across facilities and was designated as Day Shift (D= 0700 to 1530), Evening Shift (E=1500 to 2330) and Night Shift (N=2300 to 0730).

Diagnosis Related Groupings (DRGs). The assignment or categorization of patients into a case mix classification based on the patient's principle diagnosis, secondary diagnosis, surgical procedures, and age. High use DRGs for this study were obtained by investigating each site's 10 most frequently cared for medical DRGs. From this listing for each facility, four common high use medical DRGs across facilities were selected based on discharge diagnosis.

Dependent Variables

Cost of nursing care. The dollar value of the hours of nursing care provided to individual patients based on the average salaries and benefits of a specific staff mix for a given nursing unit. Cost were measured in terms of Direct Care, Indirect Care, Direct Costs and Indirect Costs.

Length of Stay (LOS). The number of days an individual was hospitalized as an inpatient. A patient day is measured by the actual presence of the patient at the count of the midnight census.

To summarize this chapter, literature pertinent to the study problem was reviewed. From the review, the three conceptual components of nursing intensity were derived. A nursing intensity of patient care conceptual framework was developed. The research questions and hypothesis were stated, following the general assumptions that guided the study. Operational definitions for the variables were presented.

CHAPTER III

Methodology

Research Design

The primary research design utilized for this research was a correlational or passive observational approach. The purpose of the study was to discover the direction and magnitude of the relationship between the predicted and actual nursing resource utilization. The effect of providing appropriate hours of care to individual patients and to groups of patients in specific DRGs on the cost of care and overall LOS was analyzed.

To address the proposed questions and hypothesis, this study was divided into two separate phases. Phase I sought to answer Questions 1, 2, and 3. Phase I was a preliminary study developed to A) validate the two PCS tools in the three facilities, B) identify the confounding variables that influence the nursing resource consumption or nursing intensity of care, C) determine the effect of unit levels of staffing on the hours of care provided to individual patients, D) and most importantly, determine the magnitude of the variance between hours of care predicted and provided on each of the six nursing units selected.

During this preliminary study, a cross sectional correlational design was applied to answer **Question 1** which asked: **Is there a significant relationship between the predicted and actual hours of care for a random sample of 20 individual patient days on each of the units over a 14 day study period?** and **Question 3** which asks: **How does the staffing level affect the hours of care actually provided?**

A descriptive and exploratory design was used answer Question 2 which identified the confounding factors that influenced the hours of care provided. The use of the Perception of Staffing Adequacy Questionnaire (PSAQ) also provided insight about these factors from the viewpoint of the charge nurse or core staff. Qualitative data from this questionnaire were correlated with the quantitative data collected during Phase I to provide information to answer Question 2.

Phase II was the principal study which addressed Question 4 and the study hypothesis: **As the difference between predicted and actual hours of care provided to medical/surgical (M/S) patients increases, the LOS total cost of nursing care will also increase.** A longitudinal correlational design was utilized, with data collected on individual patients in selected DRGs for each day of their LOS. Question 4 examined the effect of providing predicted levels of care on patient LOS and nursing cost outcomes. After determining the high use DRGs for each unit, four DRGS were selected to provide more homogeneous groupings. Four common high use medical DRGs were selected for the medical units. Cost allocation techniques were applied to determine the cost of nursing care.

Description of the Research Setting

The research was conducted at three acute care facilities in Northern California. Two of the sites had implemented St. Luke's PCS, while the third site used the San Joaquin PCS to identify individual patient's needs for nursing care. Since access to financial data from each facility was imperative to complete this study, the names of the facilities and identifying demographic information must remain

confidential to all but my dissertation committee and the Committee on Human Research (CHR) at the University of California, San Francisco. Therefore, facilities are identified only as Hospitals 1, 2, and 3. Individual institutions may request identification after they review the results of the study.

Hospital 1 was a 220 bed not for profit, private hospital which belonged to a religious hospital corporation. Specialized services included cardiovascular surgery, neurosurgery, trauma services, and organ transplant programs. The full time equivalent (FTE) staff mix was approximately 75% RN, 15% licensed vocational nurse (LVN), and 5% nursing assistant. Recent and current shifts towards increasing the percentage of nursing assistants were due to cost containment efforts and the nursing shortage in the area. The RNs formed a Staff Nurse Association approximately 10 years ago to represent them in collective bargaining. A 6 week strike by the RNs in 1986 was significant in causing a great financial loss; and the replacement of the president, the vice-president for nursing services, and the four division nursing directors. The St. Luke's PCS was implemented 3 years ago. One medical and one surgical unit were selected as the setting for this study at Hospital 1 during Phase I. During the Phase II, only the medical unit was used for data collection due to the lack of common high use surgical DRGs across sites.

Hospital 2 was a 97 bed district hospital. Only 80 beds were considered operational, due to the recent closure of the 17 bed chemical dependency unit. General medical and surgical services were offered. Patients requiring specialized services were transferred to

other facilities. The nursing staff mix was approximately 85% RNs and 15% LVNs. On July 1, 1989 the California Nurses Association (CNA) became the official collective bargaining organization.

St Luke's PCS has been used to identify patient needs and staff the medical/surgical (M/SO units since 1982. Revalidation studies occurred in 1985 following major renovations that converted the two M/S units into four smaller modules. Recently, consultants from Ernst and Young reevaluated the hours of care predicted for each of the levels of the PCS. During the study period, two changes in staffing levels occurred which required adjustments in the hours of care analysis.

The units selected for the study in Hospital 2 during Phase I were the combined telemetry unit (12 beds) and the medical/surgical/ pediatric unit (MSP) (12 beds) for the medical patients. The medical/surgical/oncology unit (MSO) (12 beds) and the orthopedic unit (16 beds) were combined to evaluate the surgical patients. Since the smaller modules were grouped together in the same manner under Clinical Coordinators as responsibility centers, this combination was the logical choice. Although MSP accepted all pediatric patients, pediatric patients accounted for only 10 to 20% of the patients admitted to the unit. The majority of the patients had medical diagnoses. A similar situation existed on the oncology unit, with the majority of the patients having general surgical procedures. During Phase II, all of the M/S units were combined to allow for a more timely data collection period. Although financially solvent at the time, the organization was searching for additional means to reduce costs to offset the increased salary expenses projected due to the CNA contract.

Hospital 3 was a 235 bed community, not for profit facility. Major medical, surgical, and psychiatric services were offered. The staff mix was approximately 95% RN and 5% LVN. The RN staff nurses were represented by CNA. The relationship between the union and the facility was excellent. During the data collection period, the contract was successfully renewed. Major construction of a five story tower was completed in June, 1989 causing the nursing units to be moved for renovations during the data collection period.

The San Joaquin PCS was used to budget and justify nursing hours, but has not been implemented for staffing purposes as yet. The instrument was completed by the staff nurse caring for the patient each shift. Work sampling studies were completed when the PCS was introduced in the early 1980's and again in February of 1988. This investigator participated in the 1988 study. The patient care units selected as sites for Phase I included a 36 bed medical unit and a 47 bed surgical unit. During Phase II the medical unit was used for data collection. The facility was financially solvent.

Hospital 4 was a 145 bed county, university affiliated facility. After collecting data during Phase I, this site was eliminated from the study. The San Joaquin PCS was not implemented as anticipated due to a 3 week strike by the RNs. The internal validity of the study was threatened due to the disruption in normal services caused by the strike.

The study sites were selected based on 1) the use of either the St. Luke's or the San Joaquin PCS, 2) the diversity of the purpose and organizational structure, 3) the location, and 4) this investigator's ability to gain access to pertinent data.

Sample

Human Subjects Assurance

All consent procedures followed the guidelines established by the Committee on Human Research (CHR), University of California, San Francisco (UCSF). Although this research was administrative in nature, an expedited review and renewal was requested to cover the following minimal risks to subjects.

Risks. The financial data required to complete the study was sensitive information, due to competition in the current health care environment. Therefore, complete confidentiality was maintained regarding the selected sites, except for my Dissertation Committee and the CHR at UCSF.

The risk to the individual patient was minimal, because no contact was made with the patient. To guarantee that the information obtained from the patient records was confidential, no identifying information was maintained after the initial data gathering. The patient's name and record number were obtained for the raw data form for tracking purposes while collecting data. After the patient was assigned a study ID number and data were collected, the identifying features were destroyed.

The risk to the nurse completing the Perception of Staffing Adequacy questionnaire was considered. To assure honest completion of the form without fear of recrimination, the confidentiality of the nurse completing the form was maintained, the right to choose not to participate was given, and a signed consent to participate was obtained following the guidelines recommended by the CHR (see Appendix C).

Random sampling of the core/charge nurses assured the staff that they would not be identified. When correlating the predicted and actual hours of care with the questionnaire, no identifying dates or shifts were given. Another risk to the nurse was that he/she may experience frustration in completing the questionnaire if it was a particularly busy shift. The nurse was given the right to refuse to complete the form. Even though there were extremely busy shifts, every requested questionnaire was completed.

Cost. Although the cost to the facility was minimal, this was an added risk. The nurse's time to complete the PSAQ was approximately 10 minutes. On most shifts, time was available during the regular working hours. However, on busy shifts, overtime may have been needed to complete the form. Each of the sites was informed of the possible costs. Other costs considered were: 1) The time of employees from the Medical Records, DRG Coordination, Finance, Personnel, and the Staffing Office required to obtain records and share necessary data; and 2) The expense of the paper for copying a minimal amount of pertinent information. Approximately 4 hours were required from the personnel at each site to provide the required study information.

Benefits. There were several benefits to the institution. The validity and reliability of their PCS to predict actual resource use was strengthened. Extraneous and confounding variables that caused a variance in providing predicted levels of nursing care were identified. The impact of providing nursing hours of care on patient cost of nursing care and LOS was determined. A standardized method of costing individual patient's cost of nursing care was provided to the facility.

There were no immediate or direct benefit to the nurses completing the PSAQ or to the patients whose records were analyzed. However, this study has the potential to expand on the theoretical and conceptual knowledge concerning patient classification systems and nursing intensity measures. Identifying the extent of the variance between predicted and actual hours of care, and determining the effect of providing appropriate levels of care on the cost of care and patient LOS are clinically and administratively relevant.

Nature and Size of Sample: Phase I

Before discussing specific sample selection information, an outline of the facilities, units, and PCS used during Phase I is illustrated in Table 1.

Table 1
Phase I: PCS, Hospital, and Unit

St. Luke's PCS				San Joaquin PCS	
Hospital 1		Hospital 2		Hospital 3	
220 Bed		97 Bed		235 Bed	
Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6
32 Bed	31 Bed	24 Bed	28 Bed	36 Bed	47 Bed

The main population of interest was the patient who was admitted to or discharged from one of the study units at one of the three study sites. Since the purpose of this study was to determine the relationship between hours of predicted nursing care and the actual nursing intensity of care, patient records were the major source of data analyzed.

The Phase I sampling unit consists of a set of elements. The first selection decisions were the number and types of hospitals. The convenience sample of hospitals was of necessity a nonprobability sample. Four acute care hospitals that used one of two different PCSs were originally selected based on their diversity and location. Hospital types selected were 1) not for profit, private, and 2) tax supported. The size of the facilities ranged from 97 beds to 235 beds. The original selection was based on the availability of hospitals that utilized the same factor type PCS to compare with hospitals that utilized the same prototype system.

A convenience sample of patient care units was necessary because only one general medical and one general surgical unit existed at Hospital 1. Hospital 3 had two medical units and one large surgical unit, while at Hospital 2 combined modules were used as described earlier in the study setting section of this paper. Eight units, one mainly medical and one mainly surgical from each facility, were chosen to provide comparability and contrast between facilities. Data collected at Hospital 4 during Phase I were not analyzed due to threats to the validity caused by the delay in implementation of the PCS. The final sample for Phase I included six study units at three sites.

Criteria for Selection for Phase I

Subject selection was accomplished through simple random sampling during Phase I. Power analysis, following the guidelines presented by Cohen and Cohen (1983), resulted in a required n=18 to 20 patients for each of the eight units. Therefore predicted and actual hours of care were collected on a total of 160 patients during the 14 day preliminary

study, but analyzed on a sample of 120 patients. Data were collected on four randomly selected days on the two study units at each facility. Each data collection day, all patients who met the selection criteria were listed according to their occupied bed number. Using a random number table, five patient records were selected for review that day.

Any inpatient admitted to or discharged from one of the study units during the study period had an equal chance of being selected with the following exceptions. Criteria for omission from the sample included: 1) Patients who were scheduled for a lengthy (greater than 6 hour) absence from the unit during a 24 hour data collection day; 2) Patients who were anticipated discharges or transfers to another unit or facility during the data collection day; and 3) Patients who were assigned to the care of a student nurse during a 24 hour data collection period.

Because the PSAQ was administered to the core nurse/charge nurse and correlated with the results of the predicted and actual hours of care, a sample of nurses was needed. Six questionnaires were gathered from each unit for a total sample of 36 completed forms after Hospital 4 was deleted. To guarantee confidentiality for those completing the form, the nurses were randomly selected based on the shift worked. Each of the 4 days of data collection consisted of three shifts, with a total of 12 possible data collection points. Approximately 1 hour before the end of the shift, the charge nurse/core staff nurse on duty during the randomly selected shift was asked to complete the PSAQ before leaving the site. By being physically present at the request time and at the change of shift, 100% cooperation was attained.

Nature and Size of Sample: Phase II

After determining the high use DRGs for each unit, four DRGS were selected to provide more homogeneous groupings of patients. The original plan was to select two common high use medical DRGs for the medical units and two common surgical DRGs for the surgical units at the four hospitals. After analyzing the results from Phase I and obtaining lists of high use DRGs, this design was reevaluated. High use surgical DRGs were not common across study surgical units in the facilities. DRG 209 (major joint procedures) was included in the top 10 DRGs across sites. However, it was not feasible to include DRG 209 because Hospital 1 had a separate orthopedic unit, while the surgical study unit selected was a general surgical unit.

Therefore, with the approval of my dissertation committee, only medical units at three sites were used for data collection during Phase II. The patient sample for Phase II included all patients who were admitted to and discharged from one of the study units with a diagnoses of one of the four selected common high use medical DRGs. The patient medical records were analyzed concurrently and retrospectively.

Again, through power analyses, it was determined that a final sample of 20 patients in each DRG from each study unit was required to show a statistical significance of $p < .05$ if indeed there is a difference. Data on a total of 240 patients were collected. Table 2 illustrates the sample for Phase II.

Table 2
Phase II: PCS, Hospital, and Unit

	St. Luke's PCS								San Joaquin PCS			
	Hospital 1				Hospital 2				Hospital 3			
	220 Bed				97 Bed				235 Bed			
	Medical Unit 1				Medical Unit 2				Medical Unit 3			
	32 Bed				39 Bed				36 Bed			
	DRGs				DRGs				DRGs			
	127	14	89	96	127	14	89	96	127	14	89	96
n=	20	20	20	20	20	20	20	20	20	20	20	20
n per Hospital	80				80				80			

N=240

DRG 127 Heart failure and shock.
DRG 14 Specific cerebrovascular disorders except transient ischemic attack.
DRG 89 Simple pneumonia + pleurisy, age>69 and/or comorbid condition.
DRG 96 Bronchitis + asthma, age>69 and/or comorbid condition.

Criteria for sample selection for Phase II

During Phase II, the sample included all patients admitted to and discharged from a designated medical unit with a discharge coded by medical records as one of the selected medical DRGs. DRG outliers were included in the study as long as their final discharge DRG was one of the study DRGs. Patients who expired while hospitalized were also included if they met the above criteria.

Exclusions included: 1) Patients who were admitted with a study DRG, but whose discharge diagnosis changed to another DRG; 2) Patients who were transferred to another unit for greater than 25% of their LOS; and 3) Patients who were discharged from a different unit.

Data Collection Methods

The basic unit of analysis for Question 1, 2, and 3 was the difference between the daily hours of care predicted and provided on the six nursing units. Two levels of data included 1) predicted and actual hours of care for the patient sample on each study day, and 2) predicted and actual hours of care for the unit for each shift for each study day. For Question 4, the primary unit of analysis was the difference between the total hours of predicted and actual care provided to individual patients with a diagnosis of one of the study DRGs at each site.

Techniques

The major technique used for both phases was chart audit. During Phase I, after subjects were randomly selected from the current patient list, their medical records were reviewed. Pertinent demographic information was obtained. Hospitals 1 and 3 maintained written lists of the patient classification for each shift. Hospital 2 maintained a wipe-off board where patient classifications were written. The present shift classifications were obtained from these lists and compared to the documented classification on the nurses notes in the medical record. At each site, the nurse caring for the patient was responsible for classifying the patient and recording the level of classification on the nurses' notes.

The nurses' notes were reviewed along with other pertinent information such as physician's history and physical report, physician's progress notes, and medication and intravenous records to verify that the classification of the patient was valid. This audit

also provided a verification of the reliability of the staff in classifying their patients. The specific techniques used to convert the classification level to hours of care in each facility are discussed in the procedure section.

Predicted unit hours of care for the shift were obtained by summing the prior shift's total number of patients in each classification from the classification lists maintained on the units. The classifications were converted to the hours of care projected for each level for each unit and totaled. The total shift actual hours of care were obtained retrospectively from the productivity report provided by the nurse manager of the unit.

Instruments

St. Luke's Patient Classification Form. St. Luke's PCS was a factor evaluation instrument based on 44 critical indicators used to classify patients and staff units (see Appendix D). Indicators were first weighted and summed to provide ratio level information, but then this information was converted into interval classification level. This system has been used to determine the cost of nursing care and bill patients for the variable cost of nursing care at several hospitals (Higgerson & Van Slyck 1982). Work sampling and direct patient care time studies were completed at Hospital 1 and 2. Routine reliability testing was accomplished through concurrent chart audits on a bimonthly basis at Hospital 2. Reliability testing was not done routinely at Hospital 1.

San Joaquin Patient Classification Form. The San Joaquin PCS utilized a prototype evaluation instrument that rated patients' needs on an ordinal scale by level of care required for six general

categories of care (see Appendix E). Validation of the instrument was retested at Hospital C in 1988. Routine chart audits to test reliability were not done at the site. As stated earlier, the classification system was not used to determine staffing levels, but was used to project future budgets and to justify variances of past staffing discrepancies.

Perception of Staffing Adequacy Questionnaire. The PSAQ (see Appendix F). was adapted from the San Joaquin work sampling studies (Methods for Studying Nurse Staffing in a Patient Unit, 1978; De Groot, 1989). This questionnaire was revised and used extensively by Catalyst Systems, a consulting group in this area (H. A. DeGroot, personal communication, June 15, 1989). The PSAQ provided a subjective assessment of the adequacy of the staffing pattern. The PSAQ was used in 1988 in the validation study at Hospital 3. Permission to use the PSAQ was granted by Catalyst Systems.

Reliability and Validity. Validation studies were previously completed at each study site. However, problems existed at each site. Chart audits to test interrater reliability were not routinely done at Hospitals 1 and 3. Hospital 1 questioned the validity of the assignment of hours to classification levels provided by the consulting group who assisted in implementing the system. Adjustments to the hours assigned were made without reevaluating the validity of the allocation.

Hospital 2 made two reductions in hours allocated to classification levels based on the recommendation of Ernst and Young Consultants during the study period. However, the changes were made

before the implementation of recommended support systems which would allow the nurses to absorb the increased workload. Revalidation studies were not scheduled after the changes. Hospital 3 completed validation studies in 1981, 1984, and 1988. As stated earlier, Hospital 3 did not use the classification system for staffing.

In view of the questions associated with the validity and reliability of the systems in each facility, the Phase I preliminary study was imperative to establish validation of each system in the hospitals. The reliability of the data was increased by data being collected by one person and direct data entry into a laptop computer.

Research Procedures

Procedure Phase I

Three methods were used to answer Question 1: Are patient care needs being met by actually providing the level of care predicted by the PCS?

1). To obtain the predicted level of care for the randomly selected study days, site visits were made to selected units one hour before the end of each of the three shifts that day. Because data collection took approximately two hours to complete for the two units at one site, only one site was selected for a study day. When arriving for the first shift at approximately 5:30 AM, introductions were made to the charge nurse and the purpose of the study was explained. Each nurse manager had informed the staff that the study would occur, but the staff did not know which days would be study days. Prior introductions to the all of the staff had not been made. During the introduction, the

occupied bed list was requested. The charge nurse was asked for the names of anticipated discharges or transfers from the unit for that day. Those names were crossed off the bed list.

A random sample of seven patients on each of the site's study units was selected using a random number table. The extra subjects were obtained to insure a final sample of five patients at the end of the evening shift. The prior PM shift's predicted classification level, which was used to staff the night and day shift, was obtained. For this study, each 24 hour study period began at 2300 hours on one day and ended at 2300 hours of the following day. The date of the study day was listed as the 23 hour period which encompasses the majority of the period. The day shift predicted classification for the PM shift was obtained by visiting the site between 1400 and 1600 hours. 2). To obtain the actual hours of care, the selected patient charts were audited within 24 hours of the data collection day to prevent the need to retrieve the records from the medical records department. The actual classification level for each shift was entered onto the computer spreadsheet after the chart was audited to verify that the classification was accurate.

Total unit predicted hours were calculated by multiplying the number of patients in each category times the hours allocated to that classification level. Hours of care actually used for each shift on the study days for each unit were retrospectively obtained from the nurse manager's productivity report. Registry and overtime hours for the 24 hour period were included in the total hours used.
3). The PSAQ was completed as described in the sampling procedure. By visiting the unit before the end of the randomly selected study shift,

the purpose of the form could be explained, questions answered, and the nurse's written consent solicited. Each nurse agreed to complete the PSAQ, doing so within the last hour of the shift.

Assumptions and limitations related to Phase I follow. It was assumed that all patients would be classified before the end of the designated shifts. This information was required by the staffing offices to perform their staffing functions, therefore it was common practice. It was also assumed that documentation of nursing care provided would be completed by the end of the shift. This is a legal requirement of the facilities and of registered or licensed nursing staff. Registry nurses, who were unfamiliar with the documentation form, may inaccurately complete the form.

Although it was assumed that the nurse completing the PSAQ form will be objective and honest, it was recognized that a nurse may be frustrated by a very busy shift or have a personal agenda that could cause a biased response. This was an expectation since the form requests the perceived viewpoint of the nurse.

Question 2 was addressed primarily during Phase I, but added insight was gained throughout the study. Confounding variables that caused a variance between predicted and actual hours of care were identified through discussion with the nurse manager and the nurses completing the PSAQ. Because this question was exploratory in nature, the variables were listed on a shift by shift bases as they occurred.

It was anticipated that other variables would surface during Phase II. Variables were listed as they were identified. Frequency of occurrence and the impact on providing care were documented.

Comparisons were made to determine if there was consistency in the occurrence of frequent and high impact variables across units and institutions or if they were unit specific.

Question 3 addressed the relationship between the level of unit staffing and the provision of predicted hours of care to the individual patients on four randomly sampled days. The procedure for dealing with this question was statistical in nature, following the Chi-square requirements and assumptions. The three shifts studied in each institution were analyzed independently of the other shifts. Actual hours of care data collected while answering Question 1 were converted to categorical data. Adequate care provided was coded as equal to or greater than 95% of the predicted care for the individual patient for the study shift. Inadequate care provided was considered to be less than 95% of the predicted care provided.

Two levels of total unit staffing were evaluated. Level I was coded as equivalent to adequate unit staffing, which was defined as 95% or more of the total predicted total hours for the shift were provided for the study unit. Level II was considered as inadequate unit hours for the shift, and was defined as less than 95% of the predicted shift hours were provided.

Although the ideal situation would be to evaluate each shift on each unit independently, this was not possible due to the small sample. Because each facility used centralized staffing, the samples from the two units in each facility were combined to provide a total sample of 40, or 10 observations per cell to meet the assumption of independent observations and expected frequencies of 10 per cell with a 2 x 2 design with one degree of freedom (Munro, Visintainer, and Page (1986).

The analyses were completed for the 40 shift observations made on each shift in each facility. Three analyses were made for each facility and for the total sample. Assumptions and Limitations for Question 3 included:

1). It was assumed that the hours of care provided to individual patients in a specific site would vary dependent on the level of staffing for the unit for particular shifts.

2). It was also assumed that with centralized staffing, no one unit would be understaffed while others were overstaffed. Nursing resources would be distributed as evenly as possible across the institution.

The major limitation in addressing this question was the small sample for each facility when the statistical test requires independent observations. Ideally, the levels of staffing and the degree of adequacy of individual hours would be increased to a 3 x 4 design for each unit for each shift. However, the overall complexity and time involvement of this research restricted increasing the observations needed to meet the ideal.

Procedure Phase II

Data collection for Phase II addressed Question 4 and the study hypothesis. Data were collected concurrently and retrospectively until a final sample of 20 patients in each of the selected DRGs at each of the study sites was attained. Chart audits as described in Question 1 were completed for each patient for their entire LOS. Hours of care predicted and provided to each patient with a tentative diagnosis of one of the study DRGs were collected for each shift. Discrepancies between the predicted and actual hours were identified. Total

predicted and actual hours of care per day and LOS were calculated for each study patient after their discharge diagnosis was verified.

Visits were made to each site every 2 to 3 days. Patient lists were checked for admission diagnoses. When a patient had a preliminary diagnosis that was similar to or one of the study DRGs, the patient's chart would be reviewed. Admission information was examined to determine if the patient had been admitted to the study unit or transferred from another unit. If the patient record indicated the patient might have a study diagnosis, demographic and classification information was entered into the spreadsheet.

When the next visit occurred, study patient records were again pulled to verify that their diagnosis had not changed. When changes occurred, the patient was eliminated from the study. If no diagnosis changes were evident, classification level and hours of care information were retrieved. If study patients were discharged between site visits, their charts were pulled from Medical Records and the information was recovered. All patient records were retrieved before the end of the study to verify the final discharge diagnoses.

Daily costs of care were calculated for each day, and summed for the LOS following the procedure presented in Appendix G. The final classification level at the end of each shift, which indicated the level of care actually provided, was the basis for the calculation of costs. The steps to calculate costs presented in Appendix G were an example for one nursing unit. To determine costs for the remaining units, the steps were repeated using unit and site specific information.

Cost accounting techniques were applied to determine direct and indirect costs. Assignment of costs were made based on direct and indirect care components and standard accounting direct and indirect costs. Direct costs included salaries and employee benefits of the nursing staff who provided direct care. Direct costs also included other unit related time that was attributable to providing care to the patient. The general guideline used in determining direct costs was to consider all costs that were material and required as long as the unit was open. A cost item was a direct cost if it could be identified specifically with a single cost objective in an economically feasible manner.

Indirect costs were defined as those costs necessary for the operation of a unit, but which could not be traced to an individual patient. Indirect costs were separated into two components.

1) Indirect nursing costs were those other nursing costs that were allocated to the nursing unit based on a ratio of unit FTEs to total nursing FTEs. The costs of nonchargeable unit supplies were included as other nursing costs because they could not be specifically associated with a single cost objective in an economically feasible manner.

2) Other allocated costs were the overhead costs allocated from the non-revenue producing centers to the revenue producing centers using the Medicare stepdown allocation method. When determining other allocated costs, indirect nursing costs which were already allocated, were excluded from the step down allocation. The following Table for Assignment of Cost presents a breakdown of specific cost components (see Table 3).

Table 3

Table for Assignment of Costs

Direct Costs of Nursing Care

Direct care	Salaries and fringe benefits of RNs, LVNs, and nurses' aids who provide direct care.
	Nurse manager's clinical time.
	Salaries and fees for registry nurses.
	Float nurses, if time was charged to unit.
	Clinical nurse specialist, IV team, or enterostomal therapist time charged to unit.
Indirect Care	Nurse manager's administrative time.
	Unit secretary and monitor technician's time.
	Direct care givers time at off unit meetings.

Indirect Costs of Nursing Care

Other Nursing Costs Allocated based on ratio of unit FTEs to total nursing FTEs.	Nursing Administration (salaries and benefits)
	Nursing Education and Research
	Recruitment and orientation.
	Conference costs; Registration and travel.

Other Allocated Costs

Medicare Step Down Costs from Non-Revenue Cost Centers.	All non-revenue producing center costs such as hospital administration, personnel, dietary, and housekeeping, which are allocated to the revenue producing centers through the Medicare step down method. Costs are allocated to M/S units following the the Medicare step down.

Data Analysis

For Phase I analyses, descriptive statistics were identified which would describe the demographic characteristics of the sample. Means, ranges, and standard deviations of the variables were compared between units and hospitals. Specific statistical procedures used are presented for each question.

To answer Question 1, summary statistics displaying the actual and predicted hours of care for the individual patient days were correlated using the Pearson Product Moment Correlation Coefficient. Significant changes between the predicted and actual staffing levels were analyzed, and probable causes for the discrepancies were identified. Multiple Regression was performed to determine the relationship of predicted to actual hours of care for individual patients. Tests for the effect of the hospitals and any interaction between the predicted hours and the hospitals were performed. Total predicted and total actual unit hours were analyzed using Pearson's Correlations to identify relationships.

Question 2 was analyzed by tabulating the results of the PSAQ form completed by the random sample of 36 nurses. Basis descriptive statistics of the frequencies of responses helped to identify the confounding variables that caused discrepancies between predicted and actual levels of staffing.

Question 3 was analyzed using the Chi-square Statistic as described in the methods section. Fisher's Exact Test provided a test

of exact probabilities to correct for the small sample size for 2 X 2 tables as recommended by Munro, Visintainer, and Page (1986).

Question 4 was addressed using several statistical and accounting techniques. Cost accounting techniques were applied to determine direct and indirect costs and were used consistently across units. Assignment of costs were made based on direct and indirect care components. In reporting the data, both hours and cost of care were provided to increase comparability with other research efforts. Hours and costs between units were compared. Three different cost ratios were calculated for each DRG and site: 1) Direct nursing cost, 2) Direct and indirect nursing costs, and 3) Total nursing costs which included direct and indirect nursing costs, plus allocated costs.

Statistical analysis included descriptive statistics for the age and sex variables. Several multiple regressions were performed to determine significant relationships between predicted and actual hours of care, and their effect on cost and LOS. Hospital and DRG were effects coded and entered as categorical variables. When the effects coded categorical variables added significant levels of explained variance in the regression, post hoc contrasts were performed to determine the source of the differences. When appropriate, tests for interactions between the continuous independent variables and the categorical variables were computed.

All statistical tests were performed at an alpha level $p<.05$. Detailed descriptions of the various statistical analyses and their results are presented in Chapter IV.

CHAPTER IV

Results

This chapter presents the results of a two phase correlational study conducted to evaluate the effect of providing predicted hours of care to medical patients in three acute care hospitals. During Phase I, the relationships between predicted and actual hours of nursing provided to individual patients, and for all patients on the unit on randomly selected days were identified. Data collection for Phase I began on October 2, 1989 and was completed on October 30, 1989. Phase II identified the effect of providing predicted levels of nursing care on patient outcomes of LOS and the cost of nursing care. Data collection for Phase II began on December 4, 1989 and was concluded after verification of the discharge diagnosis for the final patient who was discharged on July 6, 1990.

Sample characteristics are presented in the first section of this chapter. The results of the analyses of the research questions and hypothesis are also presented in this chapter. The criterion for accepting statistical significance for all tests presented was $p<.05$. Data reduction techniques used to convert the extensive worksheets into final data files are described while discussing individual questions.

Preliminary Analyses

Sample Characteristics

A total of 240 patient records were audited to obtain the final sample of 120 subjects required for Phase I. As stated earlier, the

entire sample from Hospital 4 was deleted when serious validity questions surfaced. Seven patient records were audited each day of data collection to guarantee the final required sample of five subjects per data collection day on each unit. PSAQ forms were completed by a total of 36 nurses at the three sites.

During Phase II, a total sample of 367 patient records was required to attain the final sample of 240 subjects. The final sample was 65% of the charts audited. The most common reason for excluding patients was a change in the coded discharge diagnosis (n=118). Other reasons for deletion were; 1) over 25 % of their LOS spent on another unit (n=5), and 2) transfer off the unit (n=4). The final sample consisted of 20 patients with discharge diagnoses of one of the four study DRGs in each of the three hospitals.

Sample characteristics for the variables sex and age are presented for the three hospitals combined, followed by a breakdown by hospital (see Table 4). As anticipated, with an aging population, the majority of the patients for both phases were female (Phase I, 50.8%, Phase II, 60.4%). The mean age across hospitals for Phase I was 63 years, and for Phase II was 74.9 years.

An ANOVA of Age by Hospitals was performed for both phases. The results indicated no statistical difference for the variable age for either phase. However, when an ANOVA for Age between DRGs was performed on the Phase II sample, results indicated DRGs explained a significant amount of variance in age, R^2=.107; F=9.445; df3,236; p=<.001 (see Table 5). Respective means for age for the specific DRGs were DRG 127, 79.8; DRG 14, 77.6; DRG 89, 74.1; and DRG 96, 68.1 years.

Table 4
Descriptive Statistics for Age and Sex

Phase I

Descriptive Statistics AGE		Descriptives by Gender		
	Age		Count	Percentage
N of Cases	120			
Mean	63	Male	95	49.2
Standard Dev	18.5	Female	61	50.8

Phase II

Total Hospitals

Descriptive Statistics AGE		Descriptives by Gender		
	Age		Count	Percentage
N of Cases	240			
Mean	74.9	Male	95	39.6
Standard Dev	13.6	Female	145	60.4

By Hospital: Descriptive Statistics AGE

	Hospital 1	Hospital 2	Hospital 3
n of Cases	80	80	80
Mean	75.9	74.9	73.9
Standard Dev	10.2	13.8	16.4

By DRG Descriptive Statistics AGE

DRG	127	14	89	96
n of Cases	60	60	60	60
Mean	79.8	77.6	74.1	68.1
Standard Dev	9.2	9.8	13.1	17.7

Table 5

Summary of ANOVA of DRGs to AGE: Phase II

DEPENDENT VARIABLE AGE N = 240 MULTIPLE R: .327 SQUARED MULTIPLE R: .107

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
DRG	4703.912	3	1567.971	9.445	0.000
ERROR	39176.883	236	166.004		

Analyses Related to the Research Questions

Question 1: Phase I

Is there a significant relationship between the hours of care predicted and actually provided to individual patients on different units, in different institutions? To answer this question, both individual patient and unit variables were analyzed. There was a significant relationship between predicted and actual hours of care provided to the sample of individual patients for a study day. Individual hospitals did not vary significantly when predicting actual hours of care to the individual patient sample.

When analyzing the total unit sample, high correlations existed between the predicted and actual hours. However, study units in the hospitals were found to differ on their mean scores of the variance between predicted and actual hours. Therefore, Question 1 analyses are presented for individual patient and for unit relationships.

Patient Related Analyses. Predicted patient care levels for each shift were converted into hours based on the staffing guidelines for each site. Actual levels documented in the chart at the end of each study shift were also converted into hours of care. Respectively, the

hours of care for predicted and for actual hours were summed for the three shifts for the study day. The total predicted and actual hours of care for each patient day were used as variables for further study.

Class 1 hours are not presented in Table 6 because no patients were classified as Class 1. Hospital 1 assigned different hours to each level for each unit. Hospitals 2 and 3 used the same hours for both units. Hospital 1 and 2 used a 5 level system, while Hospital 3 used a 4 level system.

Table 6

Hours of Care Allocated to Levels of Classification

	Shift	Class II	Class III	Class IV	Class V
Hospital 1	Nite	1.11	1.32	1.42	1.83
Unit 1	Day	2.13	2.45	2.67	3.26
	PM	1.81	2.12	2.26	2.74
Unit2	Nite	1.00	1.13	1.30	1.70
	Day	1.86	2.10	2.43	3.17
	PM	1.48	1.67	1.92	2.50
Hospital 2	Nite	0.80	1.20	1.60	2.00
Units	Day	1.14	1.71	2.29	2.86
3 & 4	PM	0.94	1.41	1.88	2.35
Hospital 3	Nite	0.48	1.12	1.60	NA
Units	Day	0.80	2.16	3.12	NA
5 & 6	PM	0.64	1.54	2.40	NA

Definitions for the variable names assigned to Phase I variables are presented in Appendix H. The summary statistics for the all of the individual patient and unit variables included in the analysis of

Question 1 are presented in detail in Appendix I. Summary statistics for the final variables of interest are presented in Table 7.

Table 7

Summary Statistics of Patient Hour Variables

Total N = 120	TOPCHPPD[a]	TOACHPPD[b]	VARHPPD[c]	BUDGHPPD[d]
MEAN	5.908	5.722	-0.186	5.603
STANDARD DEV	1.131	1.163	0.487	0.249
Hospital 1, Unit 1				
MEAN	6.489	6.325	-0.164	5.900
STANDARD DEV	0.854	0.648	0.385	0.000
Hospital 1, Unit 2				
MEAN	5.185	5.134	-0.051	5.600
STANDARD DEV	0.825	0.806	0.268	0.000
Hospital 2, Unit 3				
MEAN	5.411	5.105	-0.306	5.800
STANDARD DEV	0.925	1.027	0.502	0.000
Hospital 2, Unit 4				
MEAN	6.036	5.812	-0.224	5.520
STANDARD DEV	1.173	1.413	0.664	0.402
Hospital 3, Unit 5				
MEAN	6.216	6.176	-0.040	5.400
STANDARD DEV	1.081	1.058	0.199	0.000
Hospital 3, Unit 6				
MEAN	6.112	5.780	-0.332	5.400
STANDARD DEV	1.370	1.363	0.670	0.000

[a]TOPCHPPD=Total predicted hours per patient day.
[b]TOACHPPD=Total actual hours per patient day.
[c]VARHPPD=Variance between predicted and actual hours per patient day.
[d]BUDHGPPD=Budgeted hours per patient day.

Correlations between the variables indicate a strong relationship between predicted and actual hours of care. Statistics are presented for the total sample, followed by unit correlations (see Table 8).

Table 8

Pearson Correlation Coefficients of Predicted to Actual Hours

	Correlation Coefficient		
Total Sample	.910		
Hospital 1, Unit 1	.904	Unit 2	.946
Hospital 2, Unit 3	.873	Unit 4	.885
Hospital 3, Unit 5	.983	Unit 6	.880

The correlations by units ranged from $r=0.873$ to $r=0.983$. The relationship between predicted and actual hours for the total sample was $r=0.910$. The Bartlett Test for Homogeneity of Group Variances results met the assumption that group variances do not significantly differ from each other for total predicted HPPD (Chi-square=7.485, *df* 5, *p* .187). A plot of the total predicted to actual HPPD displayed in Appendix J indicates a linear relationship between the variables.

As anticipated with the strong correlation coefficient, simple regression analysis indicated a high correlation between predicted and actual hours of care for the patient sample. The R^2 was .829, with 1,118 *df*, and an *F* of 571.467 which was significant at the $p=<.001$ level. Multiple regression was performed to test for the effects of the hospitals and to determine if there was an interaction between predicted hours and hospitals. The dependent variable was total actual hours, with total predicted hours as a continuous variable and hospital (effects coded) as the categorical variable. Again, a significant

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Table 9

Phase I

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relationship was found between predicted and actual hours, but hospitals and the interaction between hospital and predicted hours of care were not significant. Table 9 presents the results of multiple regression, with its ANOVA Summary Table.

Table 9

Phase I: Multiple Regression of Patient Hour Variables by Hospital

DEPENDENT VARIABLE: TOACHPPD N = 120 MULTIPLE R: .915 SQUARED MULTIPLE R: .838

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
TOPCHPPD	126.683	1	126.683	552.805	0.000
HOSP	1.104	2	0.552	2.409	0.094
TOPCHPPD*HOSP	0.865	2	0.432	1.887	0.156
ERROR	26.125	114	0.229		

To briefly summarize the results, a significant relationship existed between predicted and actual hours of care for a randomly selected sample of 120 patients in three hospitals during 4 independent days of care. Although different staffing matrices were used by the sites, the question did not address the issue of differences in total unit hours of care, but addressed the variance between predicted and actual hours for individual patients.

Mean scores for predicted hours ranged from a low of 5.185 for patients on Unit 3 to a high of 6.489 for patients on Unit 1. All units provided less care than predicted, but the amount was less than 30 minutes per day at all sites. Pearson correlation coefficients

between predicted and actual hours were highly correlated for all units, ranging from r=0.873 for Unit 3 to r=0.983 for Unit 5. A statistically significant relationship between predicted and actual hours of care was found with simple regression and multiple regression. The difference between hospitals was not found to be significant.

Unit Related Analyses. The second portion of Question 1 addressed the relationship between predicted and actual hours of care for the total unit sample of patients for the study days. Classification levels for all patients on each study unit were converted to hours per patient day. The sums of the predicted hours were assigned the variable name TOTPCHR. Actual hours, which were retrieved from each unit's cost center productivity reports, were designated with the variable name TOTACHR.

Caution must be used in interpreting the results due to various limitations. Only four study days were used for each unit. The size of the units varied, as did the occupancy rate. Hospitals 2 and 3 experienced low average occupancy rates of 54% and 52.5% respectively, while Hospital 1's average occupancy rate was 84%. Summary statistics of the variables of interest displayed in Table 10 provide means and standard deviations for the total sample and for each unit. Pearson correlation coefficients complete the table (see Table 10).

Table 10

Summary Statistics of Unit Hour Variables for Total Sample and by Unit

Total Sample Statistics

	AVCENSUS[a]	TOTPCHR[b]	TOTACHR[c]	TOTVARHR[d]
MEAN	20.733	124.431	128.605	4.174
STANDARD DEV	6.101	33.092	37.630	11.918

Hospital 1, Unit 1

	AVCENSUS	TOTPCHR	TOTACHR	TOTVARHR
MEAN	27.913	174.115	183.038	8.923
STANDARD DEV	1.352	5.352	5.206	3.387
Hospital 1, Unit 2				
MEAN	25.080	132.083	155.625	23.543
STANDARD DEV	2.423	8.627	7.319	2.387
Hospital 2, Unit 3				
MEAN	13.913	99.880	104.500	4.620
STANDARD DEV	3.255	16.380	19.232	3.388
Hospital 2, Unit 4				
MEAN	13.998	82.105	84.375	2.270
STANDARD DEV	2.307	12.720	14.606	2.634
Hospital 3, Unit 5				
MEAN	18.830	119.120	105.200	-13.920
STANDARD DEV	3.441	20.385	23.081	3.467
Hospital 3, Unit 6				
MEAN	24.668	139.285	138.895	-0.390
STANDARD DEV	2.582	21.623	20.631	7.265

Table 10: Continued

Correlation of Main Variables for All Units for Phase I

	AVCENSUS	TOTPCHR	TOTACHR	TOTVARHR
AVCENSUS	1.000			
TOTPCHR	0.943	1.000		
TOTACHR	0.942	0.951	1.000	
TOTVARHR	0.357	0.227	0.516	1.000

[a]AVCENSUS=Average census for the study days.

[b]TOTPCHR=Total predicted hours for all patients on unit for study day.

[c]TOTACHR=Total actual hours for all patients on unit for study day.

[d]TOTVARHR=Difference between TOTPCHR & TOTACHR.

The average variance between predicted and actual hours ranged from -13.920 to +23.543 which indicated that on average, Unit 5 was understaffed by approximately 14 hours on each of the study days, while Unit 2 was overstaffed by approximately 24 hours each day. With an average census of 19 patients on Unit 5, patients on average received 45 minutes less care than predicted per day. Patients on Unit 2 received an average of approximately 55 minutes more care than predicted per day. Examination of the causes of the discrepancies are discussed in Question 2.

Pearson correlation coefficients demonstrate the relationships between variables. When examining the correlations for the total sample (see Table 10), it is apparent that total predicted and actual hours are highly correlated (r=.951). Average census is highly correlated with both predicted hours (r=.943) and actual hours (r=.942).

Correlations for each unit are presented in Appendix J. Variance in correlations between predicted and actual hours range from r=.795 for Unit 1 to r=.995 for Unit 5. Individual unit correlations indicate stronger relationships between average census and predicted hours than between average census and actual hours. A wider range between actual hours and average census is revealed: Unit 1's r=.569 is moderate, while the remaining units correlations range from r=.883 to .990.

Visual representations of the relationship between predicted and actual hours are displayed in a plot for the total sample of unit hours for the study shifts (see Appendix L). A strong linear relationship between the variables was displayed. In view of the small sample, it was not possible to perform further analyses to determine the significance of the difference between predicted and actual hours. As discussed earlier, high correlations were found between predicted and actual hours for all units. The square of r allows calculation of the amount of variance accounted for. Table 11 summarizes the correlations by unit and presents the r^2 for the total predicted and actual hours.

Table 11

Correlations and Variance Between Predicted and Actual Unit Hours: Phase I

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit6
Correlation	.795	.968	.995	.991	.995	.942
Variance	63.2%	93.7%	99.0%	98.2%	99.0%	88.7%

Phase I: Question 2

What are the confounding factors that cause a variance between the predicted and actual nursing resource use? The primary method of addressing Question 2 was the tabulation of results of the PSAQ forms

completed by charge/core nurses during the Phase I data collection period. The random sample of 36 subjects completing the form was 50% of the total possible sample. PSAQ forms were completed on 6 of the 12 shifts for each the study unit over the 4 study days. The PSAQ assessed the perception of staffing adequacy and provided contributing factors and possible solutions for less than adequately staffed shifts (see Appendix F). The final section of the questionnaire addressed the adequacy levels of 10 areas of nursing service normally provided.

A Likert scale provided a range of adequacy from More than Adequate=5, to Inadequate=1. If Barely Adequate or Inadequate, the nurse was asked to identify which of the following factors seemed to best describe the situation. The list of responses to this question, the frequency of response for each shift, and the totals for each factor are listed in Table 12, following the presentation of the number and percent of shifts with perceived staffing less than adequate.

Of the 36 shifts rated, 8 were considered to be staffed less than adequately (22%). The major confounding factor was listed as "above average number of patients needing extensive care" (n=7). Three of the five comments listed under other (#8) expanded on their response for the need for extensive care. To support the comments of the staff as to the extensive care needs of the patients on the units, level of care for the 120 patient observations on each shift included no Class I patients. Of the 120 patients observed on the three shifts, only 9.1% of patients received Class II hours of care.

The next most frequent cause of inadequacy of staffing was census fluctuations. Two nurses commented in the "other" section about the

effect of admissions. Although classification systems should allow leeway for admissions and changes in patient conditions, from the responses made by this sample of nurses, the staffing systems in the three facilities did not allow for fluctuations in either patient condition or new admissions.

Overall, the proposed solutions to the identified problems were congruent. The most frequent request was for additional RN staff. Other requests focused on non nursing tasks. One request was made for a nursing assistant and unit secretary. Three requests were made for additional help from housekeeping. Two commented on the need for assistance in transporting patients.

Table 12

PSAQ Inadequate Shifts & Contributing Factors by Hospital

Number and Percent of Shifts with PSAQ Less Than Adequate

	Night	Day	PM
Hospital 1			
Number	0	1	0
Percent	0	25%	0
Total Forms	2	4	6
Hospital 2			
Number	1	0	2
Percent	50%	0	33%
Total Forms	2	4	6
Hospital 3			
Number	0	1	3
Percent	0	17%	75%
Total Forms	2	6	4

Table 12: Continued

Contributing Factors by Shift and Frequency	Nite	Day	PM	Total
1. Above average number of patients needing extensive nursing care, assistance, or surveillance.	1	2	4	7
2. Not enough staff on duty, e.g., too few scheduled, scheduled, but not on duty, transferred to another unit, or sent home early.	0	0	1	1
3. Staff unfamiliar with this unit and/or hospital.	0	0	0	0
4. Census fluctuations, e.g., above average number of admits this shift or previous shift, or above average number of transfers or discharges.	1	0	2	3
5. Not an optimum mix or ratio of personnel levels.	0	0	0	0
6. Staff unfamiliar with the type of patients on this unit	0	0	0	0
7. Above average number of patients needing escorting by nurses to other departments.	0	0	1	1
8. Other (please describe)_____	0	2	3	5
Total:	2	4	11	17

When asked to access the level of care provided by the staff under less than adequate conditions, the overall level was consistently at average or higher than average. On the eight shifts perceived as less than adequate, four questionnaires indicated average or above average care was provided. On the remaining four questionnaires, the following aspects of care were listed as below average; implementation of new orders without delay=2, mobility assistance=2, patient assessment and observation=2, vital signs taken as ordered=1, basic

feeding and toileting=1, basic hygiene=1, and communication with patient=1. The effects of inadequate staffing could indeed compromise patient outcomes.

Relationships between the PSAQ and the variance between predicted and actual hours are discussed. Hospital 1 exhibited the largest positive variance between total predicted and actual hours. Hospital 1 also had only one shift described as less than adequate for staffing, and that shift was understaffed by 0.98 hours. In contrast, Hospital 3 exhibited the largest negative variance, and also had the greatest number of shifts described as inadequate. For the four shifts, three were understaffed by 5.92, 4.66, and 8.74 hours respectively. One shift was overstaffed by 1.82 hours.

Hospital 2 displayed a positive variance for both units for the daily totals (mean=3.445 hours), but the amount was less than the mean 6.549 hour positive variance for Hospital 1, and considerably more than the mean 7.155 hour negative variance for Hospital 3. Three of the 12 shifts were described as inadequately staffed at Hospital 2. The three shifts were overstaffed by 2, 3.6, and 1.5 hours respectively. A possible cause for the perceptions of less than adequate care was the low census at the time of the study. During low census periods with the small module units, nurses frequently not only care for the patients on their unit, but also are responsible for the care of one or two additional patients from another unit.

To summarize this discussion, the PSAQ responses were consistent with the level of staffing in the hospitals. Inadequacy was listed most frequently in the hospital with the greatest negative hour variance and least frequently in the hospital with the greatest

positive variance. The most common confounding factor was the high acuity level of the patients. The most frequently offered solution was to provide additional RN staff. The level of care provided, even under inadequate conditions, was perceived to be average or above average for most shifts. The use of the PSAQ as a method for evaluating resource allocation provided insight into the confounding factors affecting patient care.

Phase I: Question 3

What is the relationship between the level of unit staffing and the provision of predicted hours of care to the individual patient? To examine this question, the Chi-square statistic was applied to the Phase I data set to determine if the **Adequacy of individual patient care** was dependent on the **Level** of unit staffing. As described in Chapter III, the three shifts studied were analyzed independently. The first series of shift evaluations included the total sample from the three hospitals. The second series included independent Chi-squares for each shift at each hospital.

The data were categorized into nominal levels. Two sets of variables were created. Care provided was coded as **A** for **Adequate** or I for **Inadequate**. Actual care hours for each patient for the shift were divided by the predicted hours to determine the percentage of predicted care provided. If the percentage of care provided was equal to or greater than 95%, care was coded as A; if the precentage was less than 95%, the care was coded as I.

In a similar manner, Shift Level of Care was created. The actual unit hours of care provided were divided by the predicted unit hours

for each shift. If the percent of unit hours provided was greater than or equal to 95%, the shift was coded as Level 1. If less than 95% of the predicted hours were provided, the shift was coded as Level 2.

The contingency table shows that on the night shift, only 75% of the patients received adequate care; in contrast to 83% on the day shift and 85% on the PM shift. The results indicated a decrease in providing predicted hours on the night shift, followed by an increase back to the predicted level on the day shift (see Table 13).

Table 13

Number & Frequency of Patient & Shift Adequacy Levels

Night Shift:	Level 1	Level 2	Total
Adequate	80	10	90(75%)
Inadequate	30	0	30(25%)
Total	110(92%)	10(8%)	120(100%)

Day Shift:	Level 1	Level 2	Total
Adequate	71	29	100(83%)
Inadequate	19	1	20(17%)
Total	90(75%)	30(25%)	120(100%)

PM Shift:	Level 1	Level 2	Total
Adequate	81	21	102(85%)
Inadequate	14	4	18(15%)
Total	95(79%)	25(21%)	120(100%)

The statistical question asked was: Was the Adequacy of individual patient care dependent on the Level of unit staffing? The null hypothesis was: If the level of unit staffing was high, patients would receive adequate hours of care, and if the level of unit staffing was low, patients would receive less than the predicted hours of care. There would be no statistical difference between the observed and the

expected frequencies. The null hypothesis was rejected if a $p<.05$ level of significance was reached. If the Pearson's Chi-square was significant, the Fisher Exact Test was calculated to determine the exact probabilities for 2 X 2 tables when the expected frequency was less than 10 in one or more cells.

The major assumptions of the Chi-square statistic were met. Data were converted to frequency data. Sample size was adequate for a 2 X 2 table. The measures were independent of each other. The categories developed were logical. However, the analyses presented a major weakness due to the lack of Level 2 shifts for four of the nine independent shift tests completed. The validity of the analysis is questioned. The Chi-square results are displayed in Table 14.

Results of the Chi-square tests indicated when the level of unit staffing was high, patients received adequate hours of care; when the level was low, patients received inadequate hours of care with two exceptions. The total sample of the three hospitals on the day shift, and the day shift sample for Hospital 3 showed a significant difference from the expected frequencies. Therefore, the null hypotheses were rejected for the two tests. The Adequacy of patient care was not dependent on the Level for the two significant tests. A significant difference existed between the adequacy of care and the predicted level of unit staffing for the total day shift sample, and the day shift at Hospital 3 (see Table 14). For the total day shift test, more patients received inadequate care on shifts that were Level 1 than expected. Fewer patients received inadequate care on Level 2 shifts than expected.

Table 14

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Table 14

Patient Care and Shift Level of Care

Total Hospitals

Shift	N	X^2	p	Fisher Exact Test
Night	120	3.636	.057	
Day	120	5.120	.024*	.024*
PM	120	0.025	.875	
Hospital 1				
Night	40	NA		
Day	40	NA		
PM	40	0.816	.366	
Hospital 2				
Night	40	NA		
Day	40	0.272	.602	
PM	40	NA		
Hospital 3				
Night	40	0.702	.420	
Day	40	5.405	.020*	.046*
PM	40	0.784	.376	

Note. NA = No Level 2 shifts found in specific shift sample.
*p<.05

Hospital 3, Day Shift was the only shift that reached significant probability levels, with a negative *Phi coefficient* of -.368. In contrast to the other hospitals, more shifts were coded as Level 2 than

Level 1, yet fewer patients were coded as receiving inadequate care. None of the patients received inadequate care on Level 2 shifts. The adequacy of care was not dependent on the level of staffing for the day shift at Hospital 3. However, the mean score for unit staffing was .91 which indicates that even though 68% of the day shifts at Hospital 3 were considered inadequate, 91% of the predicted hours were provided.

The results of this analysis must be used with caution. Of the independent Chi-squares completed for each shift at each hospital, 4 of the 9 tests had no Level 2 shifts. In view of the results presented, the means and standard deviations for the percentage of predicted care actually provided for patients and shifts for the hospitals are exhibited in Table 15.

Table 15

Percentage of Predicted Care Provided for Patients & Shifts

Hospital 1	Night Shift		Day Shift		PM Shift	
	Patient	Unit	Patient	Unit	Patient	Unit
Mean	.952	1.081	1.002	1.143	.992	1.111
SD	.114	.080	.091	.149	.070	.126
Hospital 2						
Mean	.920	1.079	.996	1.012	.987	1.038
SD	.168	.091	.184	.095	.184	.030
Hospital 3						
Mean	.978	1.004	.988	.910	.979	.938
SD	.101	.077	.110	.099	.262	.125

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In contrast to the findings from the Chi-squares, an examination of the means indicates the percentage of predicted care provided ranges from 92 to 100.4% for patients and from 91 to 114.3% for unit shifts. For future analyses, it is recommended coding Level 2 shifts as less than 90% of predicted care provided, and increasing the number of shifts sampled to allow for a more accurate and critical investigation.

In summary, Chi-square analyses indicated that when unit predicted levels of staff were provided, patients received adequate hours of care for the total sample night and PM shift. Four of the nine independent shift tests could not be estimated due to the lack of Level 2 shifts. The two significant Chi-square tests indicated adequacy of patient care was not dependent on levels of staffing for the total day shift sample and the day shift sample at Hospital 3. Overall, when coded as categorical data, 81% of the patients received care coded as adequate and 82% of the shifts were staffed at 95% or more of the predicted level.

Phase II: Question 4

What is the effect of providing predicted nursing resources on patient outcomes of length of stay and cost of nursing care? Question 4 was the primary study question. Analysis of this question was multifaceted. Data reduction techniques to convert the classification levels to hours of care per patient per shift, per day, and for the length of stay are presented. An overview of the data set, with comparisons between means and correlations of variables of interest as they relate to hospitals and DRGs are discussed. The third section presents the data analysis of predicted to actual hours of care

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relative to LOS. The fourth section discusses costing techniques and the relationship of the variance in care hours to the cost of nursing care. The chapter concludes with an explanation of the effects of the variance in hours of care on the study hypothesis.

Data reduction techniques. Raw data consisting of classification level and actual level of care were collected for each patient for each shift for the patient's LOS. The patient sample consisted of 20 patients in each of the four study DRGs for each hospital. As stated earlier, the final sample consisted of 240 patients, with a sample of 80 patients from each site. Across sites, there were 60 patients in each study DRG. Data collection ended after a final sample of 240 patient records with a verified discharge DRG was collected.

Levels of patient care per shift were converted to hours of care per shift using the Hours of Care Allocated to Levels of Classification presented in Table 6 on page 65. A difference score was calculated for each shift which indicated the positive or negative variance between the predicted and actual hours for that shift for each patient. Total predicted, total actual, and total variance hours were respectively summed for each day by adding the hours for the three shifts. The daily total predicted (ADPCHR), total actual (ADACHR), and total variance hours (ADDIFHR) were then summed for each day of the patient's LOS to produce the total predicted hours, total actual hours, and total variance hours for the LOS. Definitions for the final data set variables are provided in Appendix M. Appendix N presents the summary statistics for the entire data set.

Days of hospitalization were totaled to produce the variable total LOS (TOTLOS) for each patient. The mean DRG length of stay

(DRGLOS) for each study DRG was that published by the Health Care Financing Administration for the nation as a whole. The variable DIFLOS (difference between total LOS and DRGLOS) was calculated.

When determining the predicted (PHPPD) and actual hours per patient day (AHPPD), problems were apparent. Because patients were admitted on different shifts, by using the final total predicted and actual hours, and dividing those numbers by the TOTLOS, inaccuracies were noted. However, the total hours were needed for determining the total cost of nursing care. Therefore, two new variables were created. Because all patients would be present on the unit during the PM shift on the day of admission, hours for shifts prior to the PM shift on the day of admission were subtracted from the total hours. The new variables for the total predicted hours (TPHR) and actual hours (TACHR) minus shift hours before the PM shift were created for the sole purpose of determining predicted and actual HPPDs.

A second complication developed while attempting to evaluate the variance between predicted and actual hours. Because the variance (ADDIFHR) frequently was a combination of positive and negative numbers, it was not an accurate measurement of the actual variance accumulated over the three shifts or LOS. Therefore, the shift variances were converted to absolute numbers allowing a new variable (ABDIF) representing the total absolute variance of hours for the LOS to be determined. The variable ADDIFHR was retained to represent the positive or negative trend, and the difference between the total predicted and actual hours. Because problems exist when using change or difference scores as dependent variables (Cronbach & Furby, 1970),

the difference scores were only used as independent variables. Before multiple regressions were calculated with difference scores as independent variables, regressions using the total predicted and actual hours were run to establish significance.

The variables described are the variables of interest for the first series of analyses. The variables pertinent to costing care are defined in the final section of the analysis of Question 4.

Overview of DRGCOST dataset. Before examining the principal question, an analysis of the means, correlations, and relationships of the variables was completed. As discussed earlier, the average age for the sample was 74.9 years compared to the average age of 63 years during Phase I. This difference of 11.9 years was attributed to the larger sample and the selection of patients based on their DRG. Age did not reach moderate correlations with any of the variables.

DRGLOS and DRG reimbursement did not reach moderate correlations with any of the variables other than each other. The relationship between DRG reimbursement and total length of stay was r=.083. Total LOS and DRGLOS also had a very low correlation of r=.109. Respectively, the means for the total sample were DRGLOS, 6.775, TOTLOS, 5.773, and DIFLOS, -1.058. Mean LOSs by hospital were: Hospital 1, 6.325; Hospital 2, 5.575; and Hospital 3, 5.250. Table 16 presents a summary of DRG related variables along with the total actual hours of care for each DRG, and also for each DRG in each hospital.

Table 16

Means for DRG, LOS, and Actual Hour Variables

Total Hospitals

DRG	DRGLOS	TOTLOS	DIFLOS	ADACHR
127	6.200	4.867	-1.333	27.983
14	7.500	6.017	-1.483	39.806
89	7.300	6.300	-1.050	37.070
96	6.100	5.750	-0.367	32.840

By DRG and Hospital

DRG 127				
Hospital 1	6.200	4.650	-1.550	30.372
Hospital 2	6.200	5.400	-0.800	26.560
Hospital 3	6.200	4.550	-1.650	27.016
DRG 14				
Hospital 1	7.500	6.950	-0.550	47.602
Hospital 2	7.500	5.500	-2.000	32.520
Hospital 3	7.500	5.600	-1.900	39.296
DRG 89				
Hospital 1	7.300	7.150	-0.300	45.112
Hospital 2	7.300	5.550	-1.750	26.664
Hospital 3	7.300	6.200	-1.100	39.436
DRG 96				
Hospital 1	6.100	6.750	0.600	42.319
Hospital 2	6.100	5.850	-0.250	28.428
Hospital 3	6.100	4.650	-1.450	27.772

The results presented in this table demonstrate the variability f LOS for patients in different hospitals in the different DRGs.

Hospital 1 exhibits the greatest LOS for three of the four DRGS, exceeding the DRG mean LOS for DRG 96 by more than one half day. The shortest overall LOS was found at Hospital 3. This was due in part to the fact that DRG 96 patients were commonly admitted to a critical care step down unit. Therefore, the sample for DRG 96 at Hospital 3 did not include those patients with greater lengths of stay admitted to another unit. Results of one way ANOVAS of hospitals to LOS, and of DRGs to LOS were not statistically significant. Patients in the three hospitals and in distinct DRGs did not differ statistically in their LOS, although summary statistics showed differences in the means.

The final analysis performed before addressing the study question was to identify the relationship between predicted and actual hours. Were predicted hours actually provided to patients? Phase I analyses established a strong significant relationship between predicted and actual hours for individual patients (R^2=.829, $p<.001$). Pearson's correlation was r=.951 when relating unit predicted to unit actual hours. Although Phase I results provide an impressive argument to support the concept that predicted hours were provided, the sample size was small with data collected on 4 days over a 2 week period. Further analysis of the Phase II data was necessary to determine if the relationship continued with a larger sample of patients over their total LOS.

Results of simple regression of predicted to actual hours for the total sample indicated a near perfect correlation (R^2, .998, df 1,238, $p<.001$). Table 17 displays a multiple regression, adding Hospital (effects coded), DRG (effects coded) and interaction variables (Hospital * predicted hours and DRG * predicted hours) to actual hours.

Table 17
Phase II: Multiple Regression of Predicted Hours by Hospital & DRG

DEPENDENT VARIABLE: ADACHR N = 240 MULTIPLE R: .999 SQUARED MULTIPLE R: .998

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
ADPCHR	79976.711	1	79976.711	71273.405	0.000
DRG	3.523	3	1.174	1.047	0.373
HOSP	10.043	2	5.021	4.475	0.012
ADPCHR*DRG	1.032	3	0.344	0.306	0.821
ADPCHR*HOSP	8.402	2	4.201	3.744	0.025
ERROR	255.841	228	1.122		

Post hoc Contrasts of Hospitals for Predicted to Actual Hours

Hospital 1 to 3

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	7.269	1	7.269	6.478	0.012
ERROR	255.841	228	1.122		

Hospital 1 to 2

HYPOTHESIS	7.192	1	7.192	6.409	0.012
ERROR	255.841	228	1.122		

Hospital 2 to 3

HYPOTHESIS	0.034	1	0.034	0.030	0.862
ERROR	255.841	228	1.122		

The results inferred that not only was the variable Hospital significant ($F=4.475$, $p<.05$), but the interaction of Hospital and predicted hours was also significant ($F=3.744$, $p<.05$). The main effect of DRG and the interaction between DRG and predicted hours were not significant. Table 17 presents the results of the multiple regression and the accompanying ANOVA Summary Table. Table 17 also displays the contrasts between hospitals. From the results of the post hoc tests, it was apparent that the difference between predicted and actual hours was different between hospitals. The differences between Hospital 1 and 3 ($F,6.478$; df $1,228$; $p<.05$.), and between Hospital 1 and 2 ($F,6.409$; df $1,228$; $p<.05$.) were significant.

The plot of the residuals presented in Appendix O appears to form a horizontal band to indicate constant variance. Some outliers are apparent, but as stated earlier, outliers intentionally were not removed from the sample. The plots of the predicted to actual hours by hospital found in Appendix O, indicate a linear relationship. They also provide a visual display of the differences between hospitals. Respectively for hospitals, the number of patients having 100 or more hours of care were: Hospital 1, 6; Hospital 2, 1; and Hospital 3, 3.

In summary, Age was not related to increased nursing care hours or to LOS. Mean DRG LOS was not related to the actual LOS for this patient sample. Total LOS did not significantly vary dependent upon hospital or DRG. Simple regression of predicted to actual hours of care were almost perfectly correlated. Multiple regression and post hoc contrasts implied there was not only a significant relationship between predicted and actual hours, but that there was a statistically significant difference in this relationship between hospitals.

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Phase II: Analysis of Hours to Length of Stay. The first of the two outcome variables was LOS. The relationship between predicted and actual hours to LOS are presented in this section. The prior analysis indicated that patients in the three hospitals and in distinct DRGs did not differ in their LOS. However, a significant relationship existed between predicted and actual hours between hospitals. To address the relationship between hours of care and LOS, various statistical tests are presented.

The first analysis presented is a multiple regression of predicted and actual hours of care to LOS. Predicted and actual hours explained 92.7% of the variance in LOS. Both predicted and actual hours were significant at $p<.001$. To determine the effect of the variable ADDIFHR (difference between predicted and actual hours) on the LOS for patients, mean scores and correlation coefficients were first examined. The respective mean scores for the total sample for the variables total LOS (TOTLOS) and ADDIFHR are 5.733 days and -0.793 hours less care provided than predicted. Although the Pearson's correlation coefficient between these variables was low when examining the total sample ($r=-.235$), when comparisons are made between specific hospitals and DRGs, the r ranges from a positive $r=.131$ for DRG 96 in Hospital 3 to a negative $r=-.706$ for DRG 14 at Hospital 1. Therefore, multiple regression was used to examine the effects of the difference in hours, effects coded hospitals, and effects coded DRGs on LOS.

Because of the range of correlations, it was anticipated that DRGs would be significant. However, while difference in hours ($F=18.947$; df 1,233; $p<.001$) and hospitals ($F=5.086$; df 2,233; $p<.001$)

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were significant, DRGs were not. The amount of explained variance was R^2=.11. Therefore, a second multiple regression was calculated deleting DRGs from the equation but adding an interaction between ADDIFHR and Hospitals. When DRGs were removed from the equation and the interaction between ADDIFHR and Hospital added, surprising results occurred. Variance due to Hospitals was no longer significant, but the interaction between ADDIFHR and Hospital was significant (F=14.358; df 2,234; p<.001). The amount of explained variance increased from R^2=.11 for the first regression to R^2=.194 when DRGs were removed and the interaction added. Table 18 displays the results of the test.

Table 18
Regression of Actual Difference in Hours by Hospital on LOS

DEPENDENT VARIABLE: TOTLOS N = 240 MULTIPLE R: .440 SQUARED MULTIPLE R: .194

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
ADDIFHR	426.842	1	426.842	39.538	0.000
HOSP	33.432	2	16.716	1.548	0.215
ADDIFHR*HOSP	310.010	2	155.005	14.358	0.000
ERROR	2526.221	234	10.796		

Post hoc contrasts between hospitals were not significant. These results indicated a significant relationship between the difference in hours. The significant interaction between ADDIFHR and Hospital infers that the difference between ADDIFHR and LOS varies depending on the hospital to which the patient was admitted. Referring back to the mean scores, mean scores for the variable ADDIFHR were: Hospital 1, -.371; Hospital 2, -1.330; and Hospital 3, -.678. Respective mean LOS for the

relationship between ABDIF and LOS is not only dependent on which hospital the patient is at, but also on the interaction between the absolute difference and hospital. Post hoc test are presented in Table 19, following the regression and its ANOVA Summary Table.

Table 19

Multiple Regression of Absolute Difference & Hospital to LOS

DEPENDENT VARIABLE; TOTLOS N = 240 MULTIPLE R: .689 SQUARED MULTIPLE R: .474

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
ABDIF	938.488	1	938.488	133.350	0.000
HOSP	148.182	2	74.091	10.528	0.000
ABDIF*HOSP	429.788	2	214.894	30.534	0.000
ERROR	1646.841	234	7.038		

Post hoc Contrasts of Hospitals for Absolute Difference to LOS

Hospital 1 to 3

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	79.144	1	79.144	11.246	0.001
ERROR	1646.841	234	7.038		

Hospital 1 to 2

HYPOTHESIS	18.197	1	18.197	2.586	0.109
ERROR	1646.841	234	7.038		

Hospital 2 to 3

HYPOTHESIS	128.970	1	128.970	18.325	0.000
ERROR	1646.841	234	7.038		

Table 20

Regression of Absolute Difference in Hours and DRGS on Total LOS

DEPENDENT VARIABLE: TOTLOS N = 240 MULTIPLE R: .595 SQUARED MULTIPLE R: .354

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
ABDIF	779.932	1	779.932	89.392	0.000
DRG	112.621	3	37.540	4.303	0.006
ABDIF*DRG	213.875	3	71.292	8.171	0.000
ERROR	2024.175	232	8.725		

Post Hoc Tests of Hypotheses

Contrast of DRG 127 to DRG 89

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	52.064	1	52.064	5.967	0.015
ERROR	2024.175	232	8.725		

Contrast of DRG 14 to 96

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	56.694	1	56.694	6.498	0.011
ERROR	2024.175	232	8.725		

The second post hoc test which indicated a significant difference was the test between DRG 14 and DRG 96 ($F=6.498$; df 1,232, $p<.05$). Patients in DRG 14 had the second largest LOS, but the second lowest ABDIF; while patients in DRG 96 had the second shortest LOS, with the second highest absolute difference in hours of care.

Results of this regression indicated the combination of ABDIF, DRGs, and the interaction between ABDIF and DRGS explained a significant amount of the variance in LOS ($R^2=.354$). It was apparent that the relationship of ABDIF to LOS was different dependent on which diagnosis the patient had. Post hoc contrasts exhibited the significant combinations of DRGs.

The analyses of the variables related to LOS in this section yielded the following conclusions. Multiple regression examined the effects of difference in hours (ADDIFHR), Hospitals, and DRGs on LOS. A significant relationships was identified between ADDIFHR and Hospitals, but no relationship was found with DRGs. When DRGs were removed from the equation, and the interaction between ADDIFHR and Hospitals added, Hospitals were no longer significant, but the interaction was (see Table 18). This interaction indicated that the difference in LOS varied dependent upon the relationship between ADDIFHR and Hospital.

When the absolute difference score (ABDIF) was used as the continuous variable, with effects coded Hospital, more explicit results were apparent (see Table 19). Again the difference score was significantly related to LOS. The multiple regression testing the effect of ABDIF and Hospital on LOS explained 47.4% of the variance in

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LOS. The increase in the amount of explained variance may be due to the larger difference accumulated for patients who have longer LOSs. However, patients at Hospital 1 had the least variance in hours and the longest LOS. Post hoc contrasts indicated that the interaction between ABDIF and Hospitals was due to the differences between Hospital 1 and 3, and the between Hospital 2 and 3.

The second regression calculated the effect of ABDIF and DRGs on LOS (see Table 20). Again, a significant amount of variance was explained (R^2=.354). Results imply the relationship between ABDIF and DRG was not only dependent on which DRG the patient was in, but also on the interaction between the absolute difference and the DRG.

A linear relationship exists between the difference in predicted and actual hours of nursing care and LOS. This relationship was significant for both of the created difference variables (ADDIFHR and ABDIF). As the difference between predicted and actual hours increased, the LOS increased. When relating the results of this series of analyses to the study hypothesis, the first component of the hypothesis is accepted. Individual patients who received the hours of care predicted by a PCS had a shorter LOS. However, when mean scores of the difference in providing predicted hours were compared for patients at specific hospitals, patients who had the least variance in hours of care had the greatest LOS. The multiple regressions indicated that the amount of variance in LOS explained by hours of care was different for patients, dependent on which hospital they were admitted to.

Cost Analysis. This section presents the application of the costing techniques developed and explained in Chapter III, Appendix G. Costs were allocated to the three sites in a consistent manner. The various nursing costs are presented for each site. The ratios of nursing costs formulated were also compared across sites. Definitions of the six nursing cost factors calculated for each of the hospitals are presented in Appendix M with the definitions of the terms for the final data worksheet. Specific costs of interest for each site are displayed in Table 21. A complete listing of the nursing costs for each site is presented in Appendix Q.

Table 21
Components of Nursing Cost for Each Hospital

Cost Component	Hospital 1	Hospital 2	Hospital 3
Direct Care Cost per hour	$21.59	$27.26	$31.59
Indirect Care Cost PPD[a]	15.59	10.73	15.95
Indirect Cost PPD	13.49	18.87	18.54
Other Allocated Cost PPD	138.79	202.89	111.02
	$167.87	$232.49	$145.51

[a]Per Patient Day

The components of nursing costs were applied to each sample to calculate the final nursing cost categories. Direct Care Costs (DCARCOST) were combined with Indirect Care Costs (ICARCOST) to product Total Direct Costs (TDCOST). Indirect Unit Costs (IUCOST) and Other Allocated Costs (ALLOCOST) were added to the Total Direct Costs to determine the Total Unit Nursing Costs (TUCOST) which included all

nursing costs. Appendix R displays the summary statistics for each category of cost for the total sample, by Hospital, and by DRG.

The sample mean total Direct Care Cost was $908, with the means at individual hospitals ranging from $778 at Hospital 2 to $1,054 at Hospital 3. Although the direct care cost per hour of $21.59 was less at Hospital 1 when compared to $27.26 at Hospital 2 and $31.59 at Hospital 3, the sample mean at Hospital 1 was $893 due to a greater mean LOS and a higher mean HPPD. The low cost per hour for direct care at Hospital 1 was attributed to a larger proportion of LVNs and Nursing Assistants to RNs. The high cost per hour for direct care at Hospital 3 was attributed to the higher salaries prevalent in that location. To clarify this comparison of the direct care costs, the relationship between the hospital's LOS, total actual hours of care and actual HPPD are provided in Table 22.

Table 22
Comparison of LOS, Actual Hours, HPPD, and Cost

	Total LOS	Actual Hours	Actual HPPD	Direct Care Cost	Direct Cost
Hospital 1					
MEAN	6.38	41.35	6.04	$892.77	$994.07
STANDARD DEV	4.58	31.41	0.79	678.04	750.19
Hospital 2					
MEAN	5.58	28.54	4.81	$778.01	$837.83
STANDARD DEV	3.13	18.12	1.02	493.91	525.00
Hospital 3					
MEAN	5.25	33.38	5.83	$1054.47	$1138.21
STANDARD DEV	2.88	20.49	1.06	647.38	691.33

Even though there was variation in the amount of indirect care costs, the total direct costs remained highest at Hospital 3 ($1138) and lowest at Hospital 2 ($838). When indirect costs were added to provide the total cost of nursing care, respectively the total cost of care was: Hospital 1, $1965; Hospital 2, $2074; and Hospital 3, $1818. This extreme shifting was due to the drastic variance in the allocated costs. Allocated costs per patient day ranged from $111 per patient day for Hospital 3, $139 for Hospital 1, and $203 for Hospital 3. Because allocated costs are based on square footage, the nurse manager has no control over them. Therefore, the results of the calculations for total cost of nursing care were presented, but were not used for further comparisons between hospitals.

When total direct costs were compared between DRGs, the mean scores exhibited in Appendix R included the combined patients from the three hospitals for each DRG. The mean direct care costs ranged from $744 for Drg 127 which had a mean LOS of 4.88 days, to $1,052 for DRG 14 which had a mean LOS of 6.02 days. In contrast, DRG 89 had the longest LOS, but direct care costs were $982. More total hours of care per patient day were provided to patients in DRG 14 than DRG 89

As described in Chapter III, total hospital charges and the Medicare DRG reimbursement for the patient for the LOS were obtained. At Hospital 1, the information was obtained from the Medical Records Department. At Hospital 2, the accounts receivable bill for each patient was accessed from the Accounting Department's computerized system. The Case Management Department at Hospital 3 allowed this researcher access to their computerized patient record system.

Because most hospitals, including study sites, do not compute true cost information for individual patients, a total cost factor was calculated following the method used by Medicare. The Medicare cost to charge ratio was obtained from the chief financial officer at each site. This ratio was applied to the total hospital charges for each patient to obtain an approximate total hospital cost for that patient's hospitalization. Three distinct total hospital cost factors were derived for each patient; 1) Total charges (CHARGES), 2) DRG reimbursement (DRGREIM), and 3) Hospital cost (HOSPCOST). Two difference variables were created: 1) The difference between hospital charges and DRG reimbursement (DRGCGDIF), and 2) The difference between hospital cost and DRG reimbursement (DRGCODIF). A Summary Table of Total Charges and Costs is displayed in Table 23.

Table 23
Summary of Total Charges, Costs, and Reimbursements

Total Hospital	CHARGES	HOSPCOST	DRGREIM	DRGCGDIF	DRGCODIF
MEAN	6601.25	4078.96	4931.50	-1677.17	852.53
STANDARD DEV	4141.85	2577.53	515.88	4104.62	2566.14
Hospital = 1					
MEAN	6463.37	3600.10	4838.75	-1624.62	1238.65
STANDARD DEV	4389.13	2444.74	492.02	4341.09	2418.76
Hospital = 2					
MEAN	6721.68	4493.50	4838.75	-1882.93	345.24
STANDARD DEV	4125.65	2758.03	492.02	4177.25	2823.72
Hospital = 3					
MEAN	6618.68	4143.29	5117.00	-1523.97	973.70
STANDARD DEV	3947.09	2470.87	518.38	3821.82	2381.52

Table 23: Continued

Summary of Total Charges, Costs, and Reimbursements by DRG

DRG 127	CHARGES	HOSPCOST	DRGREIM	DRGCGDIF	DRGCODIF
MEAN	5305.60	3300.59	4519.00	-786.60	1218.41
STANDARD DEV	2973.14	1926.04	96.97	2978.97	1931.84
DRG = 14					
MEAN	6694.26	4119.11	5427.33	-1266.93	1308.22
STANDARD DEV	4886.65	2944.99	87.47	4889.18	2946.58
DRG = 89					
MEAN	7637.80	4706.72	5420.66	-2246.85	713.94
STANDARD DEV	4689.45	2946.48	203.46	4638.09	2916.08
DRG = 96					
MEAN	6767.33	4189.45	4359.00	-2408.33	169.54
STANDARD DEV	3456.24	2194.81	141.18	3479.44	2217.19

Total charges ranged from $6,463 at Hospital 1 to $6,721 at Hospital 2. Average cost per patient day across hospitals was $1,151. The mean DRG reimbursement of $4,839 was the same for Hospitals 1 and 2, but was $278 higher at Hospital 3. Hospital 3 also had the highest labor cost. The largest deviation in DRG reimbursement was for DRG 89. Hospitals 1 and 2 received $203 less than Hospital 3 when caring for patients in DRG 89. Further cost analyses of hospital cost and charge relationships will be discussed in the final section of this chapter. Three sets of cost ratios were calculated to determine the ratios of nursing cost to the total hospital charges, costs, and reimbursement. The three sets are presented to allow for future comparison with other costing studies found in the literature (see Table 24).

Table 24
Nursing Cost Ratios

	Hospital 1			Hospital 2			Hospital 3		
	Dir Care to Chg[a]	Dir Cost to Chg[b]	Tot Cost to Chg[c]	Dir Care to Chg	Dir Cost to Chg	Tot Cost to Chg	Dir Care to Chg	Dir Cost to Chg	Tot Cost to Chg
MINIMUM	0.08	0.09	0.17	0.06	0.06	0.14	0.08	0.09	0.13
MAXIMUM	0.21	0.23	0.46	0.23	0.24	0.55	0.27	0.29	0.45
MEAN	0.14	0.15	0.30	0.12	0.13	0.32	0.16	0.17	0.28
STANDARD DEV	0.03	0.03	0.06	0.03	0.04	0.09	0.04	0.04	0.06

	Hospital 1			Hospital 2			Hospital 3		
	Dir Care to Reim[d]	Dir Cost to Reim[e]	Tot Cost to Reim[f]	Dir Care to Reim.	Dir Cost to Reim.	Tot Cost to Reim.	Dir Care to Reim.	Dir Cost to Reim.	Tot Cost to Reim.
MINIMUM	0.03	0.03	0.06	0.03	0.03	0.07	0.04	0.05	0.07
MAXIMUM	0.79	0.86	1.60	0.63	0.66	1.41	0.64	0.68	1.04
MEAN	0.18	0.21	0.41	0.16	0.17	0.43	0.20	0.22	0.35
STANDARD DEV	0.13	0.15	0.29	0.10	0.11	0.25	0.11	0.12	0.19

	Hospital 1			Hospital 2			Hospital 3		
	Dir Care to Cost[g]	Dir Cost to Cost[h]	Tot Cost to Cost[i]	Dir Care to Cost	Dir Cost to Cost	Tot Cost to Cost	Dir Care to Cost	Dir Cost to Cost	Tot Cost to Cost
MINIMUM	0.14	0.16	0.31	0.08	0.09	0.21	0.13	0.14	0.22
MAXIMUM	0.38	0.42	0.83	0.34	0.36	0.83	0.44	0.47	0.71
MEAN	0.24	0.27	0.54	0.18	0.19	0.49	0.26	0.28	0.44
STANDARD DEV	0.05	0.05	0.10	0.05	0.06	0.13	0.07	0.07	0.10

[a]Direct Care Cost to Charges
[b]Direct Cost to Charges
[c]Total Cost to Charges
[d]Direct Care Cost to Reimbursement
[e]Direct Cost to Reimbursement
[f]Total Cost to Reimbursement
[g]Direct Care Cost to Hospital Cost
[h]Direct Cost to Hospital Cost
[i]Total Cost to Hospital Cost

The mean cost of direct nursing care ranges from 12% to 16% of the total hospital charges for the three study sites. The minimum cost of direct care to hospital charges was 6% and the maximum was 27%. Mean total direct costs ranged from 13% to 17%. Hospital 2 had the lowest care to cost ratio and Hospital 3 had the largest. When the indirect costs including allocated costs were added, nursing care amounted to 30% of the total charges across hospitals.

The range of direct care to DRG reimbursement was 3% to 79%, with respective means for the sites of 18% for Hospital 1, 16% for Hospital 2, and 20% for Hospital 3. The ratio of direct nursing costs to DRG reimbursement ranged from a minimum of 3% to a maximum of 86%. The mean percentage of total nursing costs to DRG reimbursement was 40% across hospitals, with a range of 6% to 160% of the DRG allowance.

The final series of ratios related to the total hospital cost. Average direct care to hospital cost percentages ranged from 18% at Hospital 2 to 26% at Hospital 3. Direct care to hospital cost for individual patients ranged from a minimum of 8% to a maximum of 44%. Total direct nursing costs to hospital costs were: Hospital 1, 27%; Hospital 2, 19%; and Hospital 3, 28%. Respectively, mean total nursing costs to hospital cost were Hospital 1, 54%; Hospital 2, 49%; and Hospital 3, 44%.

Caution must be used in interpreting this final series of ratios. The allocated costs to nursing are based on square footage allotment over which nursing has little control. The total hospital cost derived from the cost to charge ratio was an estimate. Most departments in most hospitals have not developed standard cost estimates. However,

this ratio did provide a method for comparing the cost of nursing care to the total hospital cost for individual patients.

To summarize, standard costing techniques were applied to the sample of patient data for the purpose of defining and calculating the nursing cost categories for patients at the three study sites. Three series of nursing cost ratios were computed to provide the percentage of average nursing care for total hospital costs and charges. The next section will utilize the cost data to analyze the relationship of providing predicted levels of nursing care to the cost of care.

Analysis of hours to cost of care. The final component of Question 4 to be answered is "What is the effect of providing predicted hours on the cost of nursing care?". After determining this effect, the study hypothesis is addressed. Because of the large variance in the cost of care per hour and actual HPPD between hospitals, these variables are included when presenting the results of the relationship of hours on cost. The relationship between the difference scores of actual difference (ADDIFHR) and absolute difference (ABDIF) to actual hours of care provided and cost are analyzed.

The overall results indicated there was a complex relationship between providing predicted levels of care and the overall cost of nursing care. The outcome variable utilized was the total direct cost of nursing care, rather than the total cost of nursing care including the allocated cost. The reasons for this decision were the large variances in the allocated cost between hospitals, and the lack of control over this cost by nursing.

Hospital 1 came closest to providing the predicted level of care (ADDIFHR= -0.371 hours), yet had the midrange mean direct cost per LOS ($994) and a mean direct nursing cost of $155.93 per day of care. Hospital 1 used the highest HPPD of the three hospitals, yet had the lowest hourly cost of direct care. Hospital 2 showed the most variance in predicted to actual hours (ADDIFHR= -1.330 hours), but had the lowest HPPD and the lowest direct cost of nursing care ($837). Hospital 2's mean direct nursing cost per patient day was the lowest ($150.29).

In contrast, Hospital 3 displayed the midrange variance in hours (ADDIFHR= -0.678 hours), but had the highest mean direct nursing cost ($1,138) and an average cost per patient day of $216.80. The ranges in the absolute difference scores corresponded to the ADDIFHR ranges between hospitals. Through examination of the means and standard deviations, results indicated providing predicted hours of care did decrease the cost of nursing care for individual patients, but did not decrease the cost of care when the mean scores in hospitals were considered. Further statistical tests will analyze the relationship between the various hour variables and the direct cost of nursing care.

As presented in the overview of the DRGCOST data set, the relationship between predicted and actual hours was significant ($p<.001$) with an $R^2=.998$. As anticipated, when a simple regression examined the relationship between actual hours and direct nursing cost, actual hours of care explained 93% of the variance in direct cost. When Hospital (effects coded) and the interaction between actual hours and Hospital were added to the regression equation, results showed the

multiple R^2 increased to 1.000. However, while the unique contribution of Hospital was not significant ($p>.05$), the interaction was significant ($p<.001$). Respective mean actual hours provided over the LOS were Hospital 1, 41.35; Hospital 2, 28.54; and Hospital 3, 33.38 hours. Actual hours of care explained a large amount of the variance in the direct cost of nursing. The amount of variance differed dependent on the interaction between the hours of care and hospital.

Because most acute care facilities express relationships in terms of HPPDs, rather than total hours of care provided for a LOS, this variable was analyzed. By replacing the actual hours for the LOS with actual hours per patient day (AHPPD), this researcher anticipated the amount of explained variance would decrease to a more realistic level. Multiple regression of AHPPD, Hospital (effects coded), and the interaction to total direct cost was significant for AHPPD ($R^2=.20$; df 5,234; $p<.001$), but not for Hospitals or the interaction between AHPPD and Hospital ($p>.05$). With a range of mean HPPDs between hospitals from 4.809 to 6.042 hours, a significant result for hospitals was expected. A second regression was computed to determine the relationship of AHPPD, DRG, and the interaction between AHPPD and DRG to total direct costs. Results indicated significant relationships for AHPPD, DRG (effects coded), and the interaction ($R^2=.265$, $p<.001$). DRGs and the interaction increased the amount of explained variance from the prior regression by 6.5%. Post hoc contrasts of the variable DRG indicated significant differences between DRGs 127 and DRG 89, DRG 127 to DRG 14, and DRG 14 to DRG 96 (see Table 25).

Table 25
Regression of AHPPD & DRG to Total Direct Cost of Nursing Care

DEPENDENT VARIABLE: TDCOST N = 240 MULTIPLE R: .515 SQUARED MULTIPLE R: .265

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
AHPPD	.190543E+08	1	.190543E+08	55.897	0.000
DRG	7112592.149	3	2370864.050	6.955	0.000
AHPPD*DRG	8132382.177	3	2710794.059	7.952	0.000
ERROR	.790849E+08	232	340883.324		

Post Hoc Contrasts:

HPPD to Direct Cost, DRG 127 to DRG 14

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	6610960.370	1	6610960.370	19.394	0.000
ERROR	.790849E+08	232	340883.324		

HPPD to Direct cost, DRG 127 to DRG 89

HYPOTHESIS	1458477.239	1	1458477.239	4.279	0.040
ERROR	.790849E+08	232	340883.324		

HPPD to Direct Cost, DRG 14 to DRG 96

HYPOTHESIS	4267282.434	1	4267282.434	12.518	0.000
ERROR	.790849E+08	232	340883.324		

Several conclusions were derived from this series of analyses. Actual HPPD of nursing care provided to individual patients were significantly related to the total direct cost of care, but were not dependent on which hospital the patient was at. The relationship was

significantly increased when DRGs were considered. A significant difference was found when comparisons between the various DRGS were made. Patients with a diagnosis of congestive heart failure (DRG 127) had a significantly lower cost of care ($813) than those with a diagnosis of cerebral vascular accident (DRG 14 = $1,138). Simple calculations dividing the total mean cost for patients in specific DRGs by their mean LOS provided daily costs of direct care of $167 for patients in DRG 127 and $189 for DRG 14.

The second significant contrast indicated differences between DRG 127 and DRG 89. Total direct mean costs for DRG 89 were $1,072 per stay and $170 per day. Although there was a large difference in total cost, when daily costs were compared, the amount of variance was just $3.00 per day. The third significant contrast was between DRG 14 and DRG 96. Direct costs were $936 per stay and $163 per day, contrasted to per stay costs of $1,138 and per day costs of $189 for DRG 14. It was clear from these results that the direct cost of nursing care varied considerably, dependent on the patient's diagnosis for this sample of patients.

Before reporting the results from the final series of analyses, the results from a multiple regression of the absolute difference score (ABDIF) to direct cost are presented. Regression of ABDIF to total direct cost was significant (R^2=.162; *df* 1,238, $p<.001$). When Hospital and the interaction of ABDIF and Hospital were added, the amount of explained variance increased to 37.5%. The variables Hospital (effects coded) and the interaction were significant at $p<.001$. Because the final series of regressions analyzed the actual difference in hours, and in view of the fact that the separate analyses of ADDIFHR and ABDIF

provided similar information, further results are limited to the relationship of actual difference in hours (ADDIFHR) and total direct nursing cost of care.

Simple regressions of ADDIFHR to Hospital (R^2=.130, $p<.001$,) and ADDIFHR to DRG (R^2=.026, $p>.05$) were calculated. The following multiple regressions provided similar results. The relationship of ADDIFHR, Hospital (coded for effects), and the interaction to total direct cost was significant (see Table 26). When the regression was computed with DRGs and their interaction, ADDIFHR explained a significant amount of the variance in total direct cost, but DRGs did not. Plots of the residuals and of the actual difference in hours for individual sites are presented in Appendix S.

The results of the multiple regression of ADDIFHR, Hospital, and the interaction between ADDIFHR and Hospital to total direct cost indicated the equation accounted for 16.1% of the variance in total direct cost (see Table 26). The level of significance for the each of the three independent variables was $p<.001$. The post hoc contrast between Hospitals 1 and 3 ($p<.01$) and between Hospitals 2 and 3 ($p<.001$) are explained when mean direct care costs are compared. Respective mean total direct costs of care over the LOS for the three hospitals were: Hospital 1, $990; Hospital 2, $837; and Hospital 3; $1,138. Mean differences in cost were $144 per stay between Hospitals 1 and 3, and $301 per stay between Hospitals 2 and 3. When these costs were divided by the mean LOS for each site, direct nursing costs per day were Hospital 1, $156; Hospital 2, $150; and Hospital 3, $217.

Table 26

Regression of Actual Difference in Hours & Hospital to Total Direct Cost

DEPENDENT VARIABLE: TDCOST N = 240 MULTIPLE R: .401 SQUARED MULTIPLE R: .161

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
ADDIFHR	8949025.091	1	8949025.091	23.198	0.000
HOSP	7101940.848	2	3550970.424	9.205	0.000
HOSP*ADDIFHR	9453364.812	2	4726682.406	12.253	0.000
ERROR	.902677E+08	234	385759.246		

Post Hoc Contrast Hospital 1 to 3

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	3902015.040	1	3902015.040	10.115	0.002
ERROR	.902677E+08	234	385759.246		

Post Hoc Contrast Hospital 2 to 3

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	6037019.438	1	6037019.438	15.650	0.000
ERROR	.902677E+08	234	385759.246		

The results of this final regression and the calculation of daily nursing direct costs inferred the variability of cost was due to the hourly differences in salaries, the large variance in HPPDs, and the dissimilarity of LOS between sites. While Hospital 1 had the longest LOS and the lowest hourly salary, the direct costs were midrange. Hospital 3 had the shortest LOS, but due to higher salary costs, had the highest nursing cost.

To summarize the statistical analyses presented related the provision of predicted hours of care to the cost of nursing care. Total predicted hours of care were highly correlated with actual hours. Although regression of actual hours combined with effects coded Hospitals indicated total actual hours were significantly related to direct cost of nursing care, significant differences between hospitals were not found. Analysis of the effect of actual hours per patient day on direct costs resulted in significant relationships for actual HPPD and DRGs, but not for hospitals. Results indicated the variance between HPPDs and cost was not dependent on which hospital the patient was at, but which discharge diagnosis the patient was treated for.

In contrast, analyses of the difference scores (ABDIF and ADDIFHR) between predicted and actual hours of care implied that the difference in direct nursing cost was dependent on which hospital the patient was at, but was not dependent on the patient's diagnosis. The cost of care increased with the increase in direct costs, however the hospital with the greatest variance had the lowest cost, and the hospital with the smallest variance had the midrange cost of care.

In view of the complex relationship between direct nursing costs and differences in LOS between hospitals, the study hypothesis was accepted for individual patients, but rejected when comparing patients in different hospitals. The patients in hospitals who had the least variance between predicted and actual hours, had the greatest LOS and the midrange direct cost of nursing care. They also had the highest hours per patient day, but the percentage of RNs (staff mix) to other

nursing staff and average salary cost per hour was the lowest of the three sites. The hospital with the lowest direct costs for the patient's LOS had the greatest variance in hours, midrange salary costs per hour, and the midrange LOS. Hospital 3 had the midrange variance in hours, the highest cost of care for the LOS, the shortest average LOS, but the highest salary cost per hour of care.

Therefore, the results of this study indicated that individual patients who received predicted hours of care had lower costs and shorter lengths of stay. However, when the patients were grouped by hospital, the results changed. The patients at the hospital with the least variance in hours, had the greatest LOS and the midrange direct cost of nursing care. Further discussion of the results of the statistical analyses and the implications for practice are presented in Chapter V.

CHAPTER V

Discussion

The primary purpose of this research was to determine if providing predicted hours of nursing care to patients affected their LOS and cost of nursing care. Before this effect could be analyzed, several steps were required. The initial requirement was to determine if predicted hours of care were actually provided. The degree of variance between predicted and actual hours was identified. Predicted and actual resource use was compared between sites. Definitions of the classification and costing terminology were provided based on a review of the literature and standard costing principles. A method of costing nursing care was presented and consistently applied across sites. A nursing intensity of patient care model provided a conceptual framework for the research. After determining the relationship between predicted hours and nursing intensity through multiple regression, the specific outcomes of LOS and cost of care were examined for each site and for each of the four study DRGs.

The results of the research were discussed in the previous chapter. Further interpretation of the findings, the significance of the results, the limitations of the research, and the implications for future research and nursing practice are presented in this chapter. Because a significant difference between predicted and actual hours of care was identified, the arguments supporting the need for additional investigation and development of the nursing intensity of patient care (NIPC) model are offered.

Interpretation and Significance of the Findings

Interpretation and Significance of Question 1 Results

A significant relationship was found between predicted and actual hours of care for the sample of patients during both Phase I and Phase II. During Phase I, high Pearson's correlations between predicted and actual hours for individual patients were found for each of the six units at the three sites (range of $r=.873$ to $r=.983$). Multiple regression of predicted hours of care and effects coded Hospital to actual hours indicated **83.8% of the actual hours provided to individual patients were explained by the hours predicted by the PCS during the Phase I study.** However, this regression did not indicate a significant difference in hours of individual patient care between specific hospitals. The difference between predicted and actual hours per patient day ranged from a negative .04 to .332 hours per patient day.

Examination of the relationship between predicted and actual **total unit hours** was limited to simple correlations due to the brief study period for Phase I. However, a high correlation between predicted and actual unit hours of care ($r=.951$) was found for the total sample of units. Specific unit correlations between predicted and actual hours ranged from $r=.795$ to $r=.995$. Unit 2 at Hospital 1 had the lowest correlation, and was overstaffed by 23.5 hours per day. The explanations for this variance were the number of unscheduled admissions who were not included in the predicted hours and the availability of staff to be reassigned to the unit after the shifts began. Unit 2 frequently had no unit secretary assigned. On those shifts, the charge nurse and staff nurse were responsible for providing

the secretarial services in addition to their other required duties. Correlations for the five remaining units were all high, with $r>.94$ between predicted and actual unit hours.

Although the actual hours of care provided to the sample of individual patients were less than the predicted hours, when the total unit hours were analyzed, the opposite results were found for two of the three hospitals. Hospitals 1 and 2 provided more unit hours of care than predicted, while Hospital 3 provided fewer total unit hours than predicted by their PCS. As discussed earlier, Hospital 3 did not staff according to the PCS, but used the classification data for justification of variances.

When a similar multiple regression analysis was performed for the data from Phase II, results indicated a near perfect relationship between predicted and actual hours for the larger sample of patients over their entire LOS ($R^2=.998$). Significant differences were found between hospitals in providing predicted hours of care. The significant interaction between predicted hours and hospitals indicated the difference in the relationship between predicted and actual hours was different dependent on the hospital to which the patient was admitted. Post hoc contrasts indicated significant differences between Hospitals 1 and 2, and between Hospitals 1 and 3. However, when Hospitals 1 and 2 were coded to contrast to Hospital 3 for the purpose of analyzing the difference between classification systems, no significant differences were found. Respective mean actual hours per patient day for hospitals were: Hospital 1, 6.04; Hospital 2, 4.81; and Hospital 3, 5.83 HPPDs.

The two hospitals that used the St. Luke's PCS to allocate resources provided more total unit hours than predicted in contrast to Hospital 3. Hospital 3 provided fewer hours than predicted by the San Joaquin PCS. High correlations were found between predicted and actual hours for individual patients for both phases of the study. However, during Phase II when the difference scores or variance in hours were examined for significance, the amount of explained variance for the difference scores was also significant.

The conclusion reached after examining the results of the statistical tests addressing Question 1 was: **There was a significant relationship between predicted and actual hours provided to individual patients at the study sites. However, multiple regression showed there was a significant difference between predicted and actual hours in different hospitals.** Hospital 1 had the least variance in hours, Hospital 2 had the greatest. In contrast to the other hospitals, Hospital 2 continuously adjusted the number of staff during the course of an 8 hour shift. Registry, and some staff nurses were often assigned to 4 hour shifts. Because of the close proximity of the units, nurses frequently were assigned patients on the next unit. The staff assignments were made according to total classification points to balance the assignments between nurses.

The findings support the use of patient classification systems to predict hours of care. However, the findings also identified limitations in the ability of the PCS to fully account for the patients' requirements for nursing care. **No significant difference was found in the ability of the two different PCSs to provide predicted hours.**

Interpretation and Significance of Question 2 Results

The most frequently identified confounding factor that caused a variance between predicted and actual hours was an above average number of patients needing extensive or intensive care. The hours of care allocated by the PCS were not sufficient to manage changes in patient conditions. During the study period, no patients were classified as Class I at any site. Only 9.1 % of Phase I patients were classified as Class II patients. Other factors identified were related to the fluctuating census and need for ancillary service support.

Of the 36 shifts rated with the Perceptions of Adequacy Questionnaire (PSAQ), 22% were perceived to be staffed less than adequately. However, when nurses were asked to access the level of care provided by the staff under less than adequate conditions, the overall score on a 10 point scale was consistently at average or above average. Specific aspects of care were rated below average on four of the eight questionnaires completed on less than adequate shifts.

The PSAQ responses were congruent with the level of staffing at the hospitals. Inadequacy was listed most frequently in the hospital with the greatest negative hour variance and least frequently in the hospital with the greatest positive variance. The most common solution offered to solve the problems of inadequacy was to provide more RNs.

Other factors that influenced providing predicted hours during the course of the study were related to relocation or remodeling of units, changes in the budgeted hours and hours allocated to the PCS staffing matrix, and changes in staff mix. The majority of the factors were related to the staffing policy at the sites. Hospital 1 had

increased the proportion of LVNs and nursing assistants to RNs. They reduced their cost per hour of care, but the HPPDs and total cost of care provided to patients increased. As more acute care facilities consider decreasing the percentage of RNs to contain costs, the need for research to track the effect of the reduction on patient care and cost is needed. The use of registry nurses and the presence of collective bargaining contracts did not influence levels of care.

The primary confounding factor identified by the staff nurses was the increased acuity of the patient. The responses of nurses to the PSAQ indicated that the resources allocated by the PCS do not always allow for coping with changes in patients conditions, increased severity of illness, and fluctuations in census.

Interpretation and Significance of Question 3 Results

The relationship between the level of unit staffing and the provision of individual patient hours of care was examined using the Chi-square statistic. Hours of care were converted into nominal level data with adequate care considered to be 95% or more of the predicted level provided. Unit hours were converted in a similar manner, with Level 1 or adequate shifts considered to be staffed with 95% or more of the predicted hours. Significant relationships were found for the day shift for the total sample from the three hospitals, and for the day shift at Hospital 3. A serious limitation occurred in applying the statistic. Four of the nine independent Chi-squares examining shift relationships for the specific hospitals had no shifts coded as Level 2 (<95% of predicted unit hours provided). Therefore, only five of the independent shift tests provided results that could be analyzed with the

Chi-square. The results from the combined hospital samples must be suspect because of the lack of independent shift results. Another limitation in the analyses was the unequal distribution of frequencies in the cells. Most shifts were coded as Level 1, and the majority of the patients received adequate hours of care.

The null hypothesis was accepted for four of the five viable independent hospital shift tests and two of the three total sample shift test. Acceptance of the null hypothesis indicated a relationship between the level of unit staffing and the adequacy of individual patient hours. There was **no significant difference between the unit levels of staffing and the individual patient level of care, except for the total day shift sample and the day shift at Hospital 3.** To provide more valid results, the sample size must be increased to allow for a greater number of observations for each cell of the contingency table.

However, analysis of the means of the percentage of care provided and of the level of unit staffing provided interesting results. Table 21 provided results that indicated the percentage of predicted care provided for individual patients ranged from 92% to 100.2%. The percentage of predicted care provided for unit shifts ranged from 91% to 114.3%. For future analyses, it is recommended coding Level 2 shifts and inadequate patient levels at 90% of the predicted, and increasing the number of shifts sampled to allow for a more accurate and critical examination of this question.

Interpretation and Significance of Question 4 Results

Before discussing the specific question concerning the effect of providing predicted hours on LOS and cost of care, interpretations of

analyses of other variables are presented. As would be expected, Age was not statistically related to hospitals for either phase of the study. Age was not significantly related to the hours of care, LOS, or cost of care. Older patients did not consume more nursing resources. The patients' age was similar across sites. However, a simple regression of effects coded DRG to age implied DRGs explained a significant amount of the variance in age. Although patients in DRG 96 were the youngest with a mean age of 68.1 years, their range of years was the largest. DRG 96 patients included the youngest and the oldest patients in the study. Patients with DRG 127 were the oldest group with a mean age of 79.8 years.

Results of one-way ANOVAs of Hospital to LOS and DRG to LOS were not statistically significant. There was no significant relationship among the three hospitals or the four DRGs to LOS. On average, patients in this sample had one day shorter LOS than the Medicare mean DRG LOS. Patients in DRG 96 at Hospital 1 were the only group to exceed the DRG LOS. As hospitals continue to attempt to decrease patients' LOS as a means of maximizing revenue, there is a growing concern over the effects of early discharge on patient outcomes.

DRG LOS was not correlated with any of the study variables other than the reimbursement. The Medicare DRG LOS correlation with the sample LOS was $r=.109$. However, when the study DRGs were a component of determining the effect of the absolute difference between hours of care and LOS, a significant relationship was found which is discussed in the following section. During the preliminary analyses of the Phase II data set, DRGs and the Medicare DRG LOS were not beneficial predictors of resource consumption.

Interpretation of Hours of Care to LOS. A multiple regression of predicted and actual hours of care to LOS was significant (R^2=.927). Two series of multiple regression were computed to analyze the relationship between providing predicted hours of care on LOS. The two difference scores created for the data set served as the respective continuous independent variables for the regressions. The actual difference score (ADDIFHR) with Hospital added as a categorical variable explained 19.4% of the variance in LOS. Individual hospitals did not increase the explained variance, but the interaction between ADDIFHR and Hospital did. Complex relationships between the interaction variables indicated the hospital with the smallest variance in hours had the longest mean LOS. In contrast, the hospital with the greatest variance in hours had the midrange LOS; and the hospital with the midrange variance in hours had the shortest LOS. The difference in mean LOS between Hospital 1 and Hospital 3 was greater than one day.

The absolute difference score (ABDIF) was used as the continuous independent variable in the second series of analyses. When multiple regression was computed using ABDIF, effects coded Hospital, and the interaction as the independent variables; 47.4% of the variance in LOS was explained. The relationship between ABDIF and LOS was dependent on not only to which hospital the patient was admitted, but also on the interaction between the absolute difference and the hospital. A similar regression was calculated replacing the variable Hospital with effects coded DRGs. This regression of ABDIF, DRG, and the interaction to LOS implied 35.4% of the variance in LOS was explained by the combination of ABDIF and DRGs, with significant p values for the

variables and their interaction. Patients with DRG 127 had the shortest LOS and the smallest variance in hours, while patients with DRG 89 had the longest LOS and the greatest mean variance in hours.

For this sample of patients, results can be interpreted to indicate that patients within specific DRGs who receive predicted hours of care have a shorter LOS than those who receive less than the predicted hours. Results do not indicate that patients at specific hospitals who receive the predicted hours have a shorter LOS. Patients at Hospital 1 had the least variance in hours of care, but the longest LOS. Patients at Hospital 3 had the midrange variance in hours and the shortest LOS. However, the results do indicate that individual patients who receive predicted levels of care have a shorter LOS. As the variance in hours of care increased, the LOS increased. For this study, actually providing predicted levels of nursing care to patients was significantly related to the outcome of a shorter LOS.

Interpretation of the Results of the Cost Analysis. Costing techniques as described in Chapter III and Chapter IV were applied consistently to nursing hours of care for each site. The direct cost of care varied between sites. The hospital with the lowest hourly cost of direct care ($21.59) had the lowest ratio of RNs to other nursing staff. The hospital with the highest hourly cost of care ($31.59) had the highest proportion of RNs to LVN, assigned no nursing assistants to the study unit, and was located in an area with higher prevailing salaries. The indirect care cost and the other indirect nursing costs did not vary greatly between sites. However, the daily allocated hospital costs ranged from $111 to $203 due to the size of the unit in

relation to the total square footage of the hospital. Therefore, although all aspects of nursing costs were calculated and presented in Table 24, the decision was made to use the direct cost of nursing care (sum of direct and indirect unit care) for analyses of the statistical relationship between the variance in hours to the cost of nursing care.

Even though the cost per hour of care was lowest at Hospital 1, their mean direct cost of care ($994) was midrange due to their high hours of care (6.043 HPPD) and greater LOS. Hospital 2 had the midrange LOS and the lowest mean direct cost of care for the LOS. Hospital 2 also used the fewest HPPD of the three sites studied (4.809). Hospital 3's direct cost of care was highest ($1,138) in view of their high cost per hour for direct care, yet their HPPD were midrange (5.828) and their LOS was the shortest. **It is clear from this data, hours of care must be provided along with cost of care when reporting the results of costing studies.**

The results of the analysis allowed comparisons of cost of care for patients in specific DRGs. Patients in DRG 14 consumed the greatest number of hours of care and incurred the highest cost of nursing care, even though average charges for DRG 89 were approximately $1,000 higher per patient than charges for patients in DRG 14. The greatest mean per patient difference between charges and DRG reimbursement occurred with patients in DRG 96 ($2,408) and DRG 89 ($2,247). This example illustrates the fact that actual nursing care costs are not captured by the current billing system at most hospitals.

The cost ratios presented in Table 24 provided comparisons of the percentages of the three components of nursing care costs to charges, DRG reimbursement, and hospital cost for each hospital. Wide ranges

and standard deviations existed for the hospitals when ratios of nursing costs to DRG reimbursement were calculated. Mean direct nursing cost to mean DRG reimbursement ranges for the respective hospitals were: Hospital 1, 21%; Hospital 2, 17%, and Hospital 3, 22%. The minimum direct cost to reimbursement percentage was 3% and the maximum was 86%.

The results of the ratios relating total nursing cost to total hospital cost were presented in Chapter IV, but caution is advised in using the results based on total nursing costs due to the large difference in allocated costs found among the three facilities. Presentation of a costing method incorporating the multiple components of nursing cost utilizing standard costing principles provided a method for consistently comparing cost factors in different facilities. The cost of nursing care ratios provided similar results when compared to other costing studies. Direct nursing costs accounted for a small percentage of the total hospital cost, charge, and DRG reimbursement. Nursing costs varied between institutions dependent on hourly salary, the nursing staff mix, actual hours provided, the actual LOS, and the allocation method.

Interpretation of Hours of Care to Cost of Nursing Care. A complex relationship was found when analyzing the effect of providing predicted hours of care to patients on the cost of nursing care. As described above, the hourly cost of care and actual hours of care per patient day varied between hospitals.

Total actual hours of care explained a large amount of the variance (93%) in the direct cost of nursing care for individual

patients. Total actual hours of care in specific hospitals were not significantly related to the cost of care, but there was a significant interaction between hours of care and hospitals. The cost of care varied among patients, dependent on the interaction between hours of care and the hospital to which the patient was admitted.

Multiple regression examining the relationship of actual HPPDs and hospitals accounted for 20% of the explained variance in direct cost of nursing care. No difference was found between hospitals in this analysis of HPPDs to cost of care. When DRGs were substituted for Hospital in the equation, the amount of variance explained by actual HPPDs increased to 26.5%. The regression of actual HPPDs and effects coded DRGs indicated significant differences in the cost of care between DRGs. Daily costs of nursing care for the respective DRGs were: DRG 127, $167; DRG 14, $189; DRG 89, $170; and DRG 96, $163. The cost of care varied significantly according the hours provided per patient day for patients in different DRGs. Hours of nursing care provided per patient day were not the same across hospitals for any of the four study DRGs.

The results of regressions for two difference scores (ABDIF and ADDIFHR) were similar. Simple regression of the absolute difference in hours to direct cost explained 16.2% of the variance in direct cost. Simple regression of the actual difference in hours (ADDIFHR) to direct cost explained 13% of the variance. Although multiple regression of ADDIFHR and DRGs to the cost of care was significant for ADDIFHR, DRGs were not significant in increasing the amount of explained variance in the cost of care. The cost of care did not vary significantly

dependent upon the actual difference of hours of care provided to patients in different DRGs. Multiple regression of the ADDIFHR and Hospitals to direct cost of care indicated significant relationships between the independent variables and the cost of care (R^2=.161). Post hoc contrasts found differences between Hospitals 1 and 3, and between Hospitals 2 and 3. Mean direct nursing care costs for the LOS for the hospitals were: Hospital 1, $990; Hospital 2, $837; and Hospital 3 $1,138. Explanations for the differences in total direct nursing costs between hospitals were dependent on the actual hours of care provided, the staff mix, the hourly cost of care, and the patients' LOS.

The results from the series of analyses relating to the cost of care indicated a linear relationship between the cost of nursing care and the independent variables of total actual hours, actual hours per patient day, and both of the difference scores. These results indicate individual patients who received the predicted hours of care had lower costs of nursing care, while patients who received less than the predicted level had higher costs of care. When patients were grouped by specific hospitals, the relationships became obscure due to the significant interactions between providing predicted levels and the cost of nursing care.

In summary, the relationships among hospitals and among DRGs identified complex interactions apparently caused by variances in LOS, the nursing staff mix, actual hours per patient day, actual hourly costs of direct nursing care, and the allocation methods. Further research focusing on the effect of different staff mixes on the outcomes of LOS and total direct cost of nursing care would be desirable.

The provision of classification terminology derived from patient classification and costing literature provided differentiation of the concepts and the development of a conceptual framework to guide this research and future research. The relationship of the first of the three components of the nursing intensity of patient care model was established.

The most significant finding of the research was accepting the study hypothesis. Providing predicted hours of care did make a difference in patient care outcomes. Individual patients who received the predicted hours of care did have shorter lengths of stay and a lower cost of nursing care. Hospitals using a higher proportion of RNs to other nursing staff used fewer hours of care and had shorter LOSs. Although this study did not analyze the amount of total hospital cost reduction related to the decreased length of stay, when considering the $711 daily average hospital cost, the savings would be significant.

Limitations

A major limitation of this study is the inability to generalize the findings to other types of hospitals. Although four sites were originally selected, only three were used. Generalizations are limited to community hospitals due to the exclusion of a county hospital and a large medical center. The facilities were all located in Northern California. To partially address this problem, the hours of care were reported along with the cost information. However, the known variance in LOS across the nation will remain a problem. The restriction of the

type of unit to general medical units also limits application of the results to other clinical services, as does the selection of only four DRGs.

The lack of ongoing testing of interrater reliability could threaten the validity of the study. However, every effort was made during the chart audits to identify discrepancies between the documented level of classification and the actual care documented in the medical record.

Implications for Nursing

This research was an effort to identify the effect of providing predicted nursing resources to individual patients on the outcomes of length of stay and cost of nursing care. The results have important implications for nursing, acute care facilities, and the health care system.

Providing predicted levels of care to medical patients in three acute care facilities did make a difference in the individual patient's total length of stay and cost of care. The implications for cost savings for the nursing department, hospitals, and the health care system are extensive. Although the cost of nursing care will continue to rise with inflation and advances in care technology; by providing the needed hours of care the day to day cost may be higher, but the total cost for the patient will be less. When predicted hours of nursing care were not provided to patients, the total cost of nursing care increased.

The results of this study provide strong support to the nurse executive in the acute care setting to justify the need for not only adequate hours of nursing care for patients, but also an appropriate mix of nursing staff. As further anticipated decreases in reimbursement are introduced, additional cost reduction in hospitals will be mandatory. However, the deleterious effects of reducing hours of patient care or changing the staff mix on the institutional costs are obvious. These findings can be used by nurse executives to maintain nursing resources and control costs.

The total actual hours of care provided to this sample of patients ranged from 5.04 to 195.5. Actual hours per patient day ranged from 2.153 to 7.444 hours. These results document the need for institutions to discontinue the practice of budgeting and allocating nursing resources based on an average HPPD.

Vital information related to the hours and cost of care for patients on specific units or in distinct DRGs can assist the institution in planning and decision making for the future. Cost and hour variances can be identified for different groups of patients and can be analyzed and corrected. High resource use DRGs such as DRG 14 can be identified. Appropriate government agencies can be made aware of the documented inequities observed.

Since the predicted and actual hours of care were highly correlated, the classification level for patients can be used to develop predicted costs for nursing care. Removing nursing from the room rate and charging for nursing care independently as a professional service has been identified by nursing leaders as an important step to

enable nursing to better control the provision of services. Charging patients for the services they receive allows for improved accountability. Variable billing for nursing services increases the power of the nursing department, enhances productivity, provides improved budget control, establishes the nursing department as a revenue producing center, and places a price value on the services provided (Flarey, 1990).

Nurse executives should consider reevaluating the PCS used at their facilities. Classification systems were developed to group patients into levels dependent on the need for care. The expectation was that the number of patients at each level would form a normal curve, with the majority of the patients classified at Class III in a five level system. The present patient sample for this study included no Class I patients, and few Class II patients. The question arises concerning the ability of the PCS to predict needed resources as the concentration of patients shift to the higher required levels of care.

Directions for Future Research

This research produced many new questions. Although significant relationships between predicted and actual hours were established, the variances between these hours were also significant. The principal cause of the variance identified was the increased number of patients requiring extensive care. Incorporation of the remaining two components of the nursing intensity of patient care model may provide a more accurate predictive system for classifying patients. The complexity of care and the severity of illness concepts adapted from

Prescott and Phillips (1988) and included in the nursing intensity of patient care model needs evaluation in future research. A recent study by Bostrom and Mitchell (1991) found variance in nursing resource use within DRGs. The intensity of nursing resource demand was associated with the severity of illness. Bostrom and Mitchell also found the use of Horn's Severity of Illness Index in addition to the DRG system of classification produced more homogeneous groups in terms of total nursing resource demand.

Complexity of care, as defined in Chapter III, is related to the complexity of procedures or tasks required and the complexity of the clinical judgments required. Complexity is not directly related to the hours or volume of care. Complexity is related to the skill level of the provider, which determines the value or cost of the hours of care provided. Further delineation of the concept of complexity is needed. Complexity of the procedures is related to the technical skill level required to perform the procedures and treatments the patient needs. This technical skill level is not necessarily related to the educational preparation of the nurse. The complexity of clinical judgments required to deal with effective decision making concerning the nursing process is related to the educational level of the nurse. For this reason, complexity should be divided into these two distinct components; the complexity of procedures required by the patient and the complexity of the clinical judgments required for appropriate decision making. Therefore the second level or circle of the nursing intensity of care model would be expanded to include four major components.

The results of this research indicated that the staff mix varied between sites. As anticipated, a lower percentage of RNs to other nursing staff resulted in lower hourly costs. However, the findings indicated the hospital with fewer RNs used more hours of care per patient day. Patients at this site had the longest LOSs and the greatest total hours of nursing care over the LOS. The measurement of the complexity of care was not evaluated in this study. However, based on the findings, any future research must analyze the complexity of care to determine the relationship between complexity and the actual educational and skill level of nurses required.

Two additional characteristic not originally included in the nursing intensity model, which influenced the nursing intensity requirements were identified during the study. Evaluation of impact of physician practice patterns and the economic and legal external constraints on the consumption of nursing resources would provide added insight on the outcomes of cost of nursing care and length of stay.

Research determining the effect of various nursing interventions on patient outcomes must include a cost effectiveness analysis before institutions will consider implementing the intervention. The standard cost method presented can be used in clinical research studies to compare the cost of nursing care for experimental and control groups. If the intervention reduces nursing care hours, length of stay, or total hospital costs, the likelihood of implementation at other facilities will increase.

To conclude, a summary of the recommendations for future research is presented. Researchers investigating nursing resource allocation,

consumption, and cost of care must reach agreement on definitions of terms, units of analyses, and standard methods of costing. Further examination of the relationship and variance between predicted and actual hours of nursing care is necessary. The inclusion of additional study DRGs would provide added knowledge about the variability of nursing resource consumption between DRGs. Therefore, future research examining nursing intensity should include: 1) Development of methods to measure the severity of illness and expand on the complexity of care components of the nursing intensity of patient care conceptual model; 2) Integration of these measurements with existing patient classification systems to determine if the amount of variance between predicted and actual hours is reduced; 3) Examination of the relationship between the level of care required based on complexity of care and the actual staff mix provided; and 4) Additional study of these factors at more diverse sites, with a larger sample of DRGs, which will provide a more comprehensive examination of the effect of providing predicted individual patient and unit hours of nursing care on patient care outcomes.

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Appendix A

Definitions of Costing Terminology

Term & Source	Definition	Example
Cost Suver & Neuman (1985) Horngren & Foster (1987)	The outlay or expenditures made to acquire or produce goods and services. Resources sacrificed or forgone to achieve a specific objective.	Cost per hour of nursing care.
Cost Accounting Neuman, Suver, & Zelman (1984); Meigs & Meigs (1981)	Process of classifying, summarizing, recording, reporting, & allocating for the purpose of determining the cost of a product or unit of service. Product costing includes job order or process costing.	Cost per patient stay
Cost Allocation Suver & Neuman (1985) Horngren & Foster, (1987)	The process of apportioning costs from one account to several accounts, to several products, activities, or to several periods. The assignment and reassignment of a cost or group of costs to one or more cost objectives.	Direct & indirect overhead costs.
Cost Finding Neuman, Suver & Zelman (1984)	A special type of cost allocation for the purpose of determining full costs for rate setting and reimbursement reports. Apportion costs of nonrevenue producing departments to each other, and then to the revenue producing departments on the basis of statistical data that measures the amount of service rendered.	Daily room rate.
Costing Neuman, Suver & Zelman (1984)	The process of determining the cost of activities, products, or services	Costing nursing care.
Charge Lampe (1987)	The amount set by the producer for for purchase of the product. Usually set to cover all direct costs, a portion of the indirect costs, and a percentage of profit.	A debit to an account or to bill a patient.
Direct Care Edwardson & Giovannetti (1987)	Patient centered activities that are carried out directly with the patient/family. Time spent giving care in the presence of the patient.	Admission, assessments, hygiene, medications, etc.

Appendix A: Continued

Direct Cost Hoffman (1984)	Costs which can be specifically identified and assigned to a patient, procedure, or service. Cost of direct labor, direct materials, & variable overhead.	Direct and indirect hours of care (Salaries & benefits of caregivers).
Expenses Hirsch & Louderback (1986)	The cost of the goods and services used up in the process of obtaining revenue in the current accounting period.	Salaries, depreciation, & supplies
Fixed Cost Hoffman (1984)	An expenditure or expense that does not vary with patient census or volume of activity within a specified range.	Rent, mortgage payments, & maintenance. Core nursing staff.
Full-time Equivalent (FTE) Finkler (1984)	Conversion of hours to a standard base of one employee working 8 hours a day, 5 days per week, 52 weeks per year including benefit time.	Equal to 2080 hours per year.
Hours per patient day (HPPD) Finkler (1984)	Total paid hours divided by total patient days. Is also calculated for a daily, pay period, monthly or annual HPPD for budgeting & control purposes.	Nursing HPPD Hospital HPPD
Income Meigs & Meigs (1981)	Excess of revenues over expenses for a period. Net income is the excess of the price of the goods sold or the services rendered over the cost of goods or services used up.	Profits.
Indirect Care Lampe (1987)	Those activities performed by the nurse which are related to the patient but not in direct contact with the patient. Hours can be divided into 3 categories; indirect care, personal time, & unit-related activities.	Charting, preparing meds, communication with others concerning the patient.
Indirect Cost Lampe (1987)	Costs which are not uniquely tied to one product or patient, but are spread over many items or patients.	Supervisor's salary, overhead.
Job Order Costing Meigs & Meigs (1981)	Determining the cost of each unit or or batch of units produced.	Cost per patient stay; Cost per DRG.

Appendix A Continued

Overhead Meigs & Meigs (1981)	All costs besides direct materials and labor. Usually the indirect costs that are uncontrollable by the department manager, but are allocated to the department for the purpose of rate setting and determining the full cost.	Building & grounds maintenance & depreciation, Administrative costs.
Personal Time Lampe (1987)	Nonproductive paid time.	Breaks, personal errands, or hygiene.
Process Costing Berman, Weeks, & Kukla (1986)	Collecting the costs of all the products as they are produced by a defined production area during a given accounting period, and determines the unit cost by dividing total costs by the total number of units. Cost per unit of output is done on an averaging basis.	Homogeneous products, produced in a department such as laboratory or radiology. Per diem cost of nursing.
Responsibility Costing or Accounting Berman et al. (1986)	Organizing costs by control areas. Specifies a boundary of authority, assigns control to an identifiable individual, and distinguishes between the managers controllable uncontrollable costs.	Nurse Manager responsible for nursing unit costs can be controlled.
Revenue Hirsch & Louderback (1986)	The dollar amount or price of goods sold and services rendered to customers. Revenue is recognized at the time services are rendered.	Accounts receivable.
Semi-variable or Step-fixed Costs Lampe (1987)	A cost which is affected by the amount produced but not in direct proportion. Are usually separated into variable and fixed components.	Unit secretary, some utilities & maintenance.
Standard Cost Meigs & Meigs (1981)	A predetermined cost estimate for materials, labor, & overhead which serves as benchmarks against which actual costs can be compared.	Budgeted salary per hour, cost of supplies.

Appendix A: Continued

Unit Constant Time Lampe (1987)	Time spent on general management, coordination, and organization of unit. Devised for each unit by adding the average unit-related hours per patient day to the average personal hours per patient day. Each patient receives an equal assignment of unit constant time.	Nurse Managers non-clinical time, secretary & telemetry technicians time.
Variable Cost Neuman et al. (1984)	Costs that change at a linear rate as the activity levels change. Fluctuate on a day-to-day basis with changes in patient census.	Supplies, staff, linen, & food.
Variance Finkler (1984)	The difference between what is expected and what actually happened.	Census is 20% higher than expected
Variance Analysis Neuman et al. (1984)	Analysis of the causes of changes the between planned and actual.	Volume, price, quantity, and acuity variance

Appendix B

Definitions of Patient Classification Terms

TERM	DEFINITION	SCALE OR INSTRUMENT	REFERENCE
Patient Classification System (PCS)	Identification & classification of patients into care groups or categories, with the quantification of these categories.	Prototype evaluation; subjective levels Factor evaluation; more objective ratio levels.	Giovannetti, 1979; 1986
Workload	Quantity of work which pertains to the direct and indirect provision of nursing care determined by a PCS	Varies depending on on type of PCS.	St. Germain & Meyers, 1984
Nursing Resource Consumption	The time and value of the nursing personnel used in providing patient care.	Determined by hours of care & salary of staff on patient, unit, or facility basis.	Lampe, 1987
Severity of Illness	An estimate of how ill a patient is in terms of threat to life and and extensiveness of symptoms.	Horn's Severity of Illness Index	Horn & Sharkey, 1983
Patient Acuity	Level of classification or relative amount of nursing care required, based on dependency, and used to predict patient needs for nursing.	Sum of PCS indicator weights either 1) reduced to rank order levels or 2) used as continuous data.	Sovie et al., 1985 Van Slyck, 1987
Complexity of Care	Clinical judgment. The amount of information needed, alternative courses of action, and # of persons to be considered in making the decision.	Complexity of clinical judgment; 5 levels ranging from Not Complex to Highly Complex.	Prescott & Phillips, 1988
	Procedure & task complexity. The knowledge, skill, & experience needed to perform procedures with varying levels of complication.	Task/Procedure; 5 levels ranging from Basic to Highly Specialized.	
Staff Mix	The proportion of each of the levels of care providers to the total in a facility. Levels usually considered are RN, LVN, & nursing assistant.	Usually expressed as a percentage or ratio.	Devine & Werley, 1988

Appendix B: Continued

Skill Level	Refers to the educational preparation & speciality skills or certifications such as Medical Intensive Care, Nursing, Chemotherapy, & Advanced Cardiac Life Support.	Degree attained or successful completion of certification exam.	Prescott & Phillips, 1988
Direct verses Indirect Hours of Care	Direct care includes all patient care activities carried out directly with with the patient/family. Indirect care includes those activities performed by the nurse which are related to patient care, but are not in direct contact with the patient.	Varies with PCS & facility. Indirect care hours are usually assigned as a constant, measured by work sampling and added to direct care hours to provide total hours of nursing care.	Lampe, 1987
Nursing Intensity	Specific measure of each patient's consumption of nursing resources generated by that patient's requirements. Includes the three major components of complexity of care, severity of illness, & patient need for nursing as measured by an acuity system.	Nursing Intensity Index Nursing Resource Model Patient Intensity for Nursing Index	Reitz, 1985 Atwood et al. 1986 Prescott & Phillips, 1988
Allocation Statistic	Measurement & assignment of relative weights representing the intensity & cost of nursing care received by individual patients within a DRG.	RIMs; case-mix measure of resource use. Beta coefficient representing nursing intensity.	Caterinicchio 1983 Thompson, 1987

Appendix C

Consent to be a Research Subject

Mary Villemaire is a doctoral candidate in nursing at the University of California, San Francisco. She is studying the effects of providing predicted hours of nursing care on patient costs and length of stay. This nursing unit and this hospital have been selected as study sites. One of the methods to be used is the completion of the Perceptions of Staffing Adequacy Questionnaire by randomly selected nurses on randomly selected shifts. This information will be compared to the levels of care predicted by the patient classification system and the hours of care that were actually provided on this shift for a group of patients. Complete confidentiality of the nurse is assured.

I have been selected to participate in this study. If I agree to be in the study, I will complete the questionnaire within the last hour of this shift, or before I leave the hospital. The questionnaire will take approximately 10 to 15 minutes to complete.

Filling out the questionnaire may be an inconvenience to me, however I may fill it out at my convenience before I leave the hospital. My name will remain confidential, and only Mrs. Villemaire will have access to this consent form. I will not be required to sign the questionnaire. After the study has been completed, this consent will be destroyed.

There will be no direct benefit to me and I will not be paid for my participation. It is anticipated that this study will provide knowledge of predicted and actual hours of nursing care and the effect of providing appropriate levels of care on patient outcomes.

I have had the opportunity to talk with Mary Villemaire about this study before agreeing to participate. I have also been offered a copy of this consent form to keep.

I have the right to refuse to participate in this study. My decision as to whether or not to participate in this study will have no influence on my present or future status as an employee at this hospital.

Subject Signature_____

Date_____

Appendix D

DIET	%	B	L	D

	ACUITY A	N	D	E
DIET	DIET CHECK	2	2	2
	NPO	2	2	2
	SELF	2	2	2
	ASSIST ≤ TRAY	5	5	5
	SIPS/CHIPS	5	5	5
	INTAKE OUTPUT (FORCE LIMIT)	5	5	5
	ASSIST FEED	8	8	8
	TOTAL FEED	8	8	8
	● GAVAGE FEEDING	8	8	8
	● TEACHING FEED	8	8	8
	● COMPLEX TOTAL FEED	8	8	8
BATH/LINEN	ENVIRONMENTAL CHECK	1	1	1
	TUB ≤ HELP	1	1	1
	BATH ≤ HELP	1	1	1
	SHOWER ≤ HELP	1	1	1
	SELF-HELP BEDSIDE	2	2	2
	HS CARE	2	2	2
	TUB ≤ OCCASIONAL CHECK	2	2	2
	SHOWER ≤ OCCASIONAL CHECK	2	2	2
	COMPLEX HS CARE	4	4	4
	PARTIAL BATH	4	4	4
	COMPLETE BATH	4	4	4
	● COMPLEX BATH/SHOWER	5	5	5
	● TEACHING BATH/SHOWER	5	5	5
	● MULTIPLE BATHS	5	5	5
MOBILITY	SLEEPING REST DURING ROUNDS	2	2	2
	UP AD LIB	2	2	2
	CHAIR	2	2	2
	BRP	2	2	2
	● AMBULATE ≤ HELP	5	5	5
	● BRP ≤ HELP	5	5	5
	● CHAIR ≤ HELP	5	5	5
	BEDREST ≤ BPR/COMMODE ≤ HELP	5	5	5
	BEDREST	5	5	5
	RESTRICTIVE BEDREST	8	8	8
	● COMPLEX ACTIVITY	8	8	8
	● TEACHING ACTIVITY	8	8	8
	● THERAPEUTIC REPOSITIONING	8	8	8
	● SOFT/LEATHER RESTRAINTS	10	10	10
	SUB-TOTAL ACUITY 'A'			

POINTS	LEVEL		N	D	E
26 - 37	1	SUB-TOTAL ACUITY 'A'			
38 - 55	2	SUB-TOTAL ACUITY 'B'			
56 - 70	3	SUB-TOTAL ACUITY 'C'			
71 - 83	4	TOTAL POINTS			
84 - 103	5	ACUITY LEVEL			
DATE		INTERMEDIATE CARE			

SIGNATURES		
N		
D		
E		

● REQUIRES DOCUMENTATION

	ACUITY B	N	D	E
MEDICATIONS	MEDICATION KARDEX CHECK	5	5	5
	ROUTINE ≤ IV'S	8	8	8
	ROUTINE ≥ IV'S	15	15	15
	MULTIPLE MEDS	15	15	15
	HEPARIN LOCK	15	15	15
	● TEACHING MEDICATIONS	15	15	15
	MULTIPLE PIGGYBACKS	20	20	20
	● BLOOD TRANFSUSIONS/OBSERVATION	25	25	25
	● ADMINISTRATIVE FREQUENT INTERVENTION	25	25	25
BEHAVIOR	RESPONSIVE TO CARE	5	5	5
	● NEW ADMIT/TRANSFER/DEPENDENT PSYCHOLOGICALLY	10	10	10
	● MULTIPLE REQUESTS	10	10	10
	ALTERED STATES OF AWARENESS			
	● LETHARGIC	10	10	10
	● DISORIENTED	12	12	12
	● HALLUCINATIONS/DELUSIONS	15	15	15
	● BARRIERS TO CARE	15	15	15
	● ATTENTION SEEKING BEHAVIOR	15	15	15
	● DISRUPTIVE	15	15	15
	● THREATENING PHYSICAL HARM	15	15	15
STATE	RESPONSIBLE FOR PERSONAL CARE	4	4	4
	● SHORT TERM TEACHING/COUNSELING	7	7	7
	ASSISTANCE WITH ADL	7	7	7
	● RESTRICTIONS	7	7	7
	PRE-OP PREPARATIONS	11	11	11
	● ADMISSION/COMPLEX TRANSFER	11	11	11
	POST-OP/POST-ICU/POST PARTUM (24 HOURS)	11	11	11
	● DISCHARGE PLANNING/TEACHING/CARE PLANNING	11	11	11
	● PHYSIOLOGICALLY UNSTABLE	15	15	15
	● COMMUNICATION BARRIER/ SENSORY IMPAIRMENT	15	15	15
	● EXTENSIVE NURSING CARE	20	20	20
	SUB-TOTAL ACUITY 'B'			

	ACUITY C	N	D	E
TREATMENT/PROCEDURE	ITEMS/FREQUENCY TIMES			
	SUB-TOTAL ACUITY 'C' (7-14-20)			

NURSING CARE RECORD

APPENDIX E

San Joaquin Patient Classification Form

	Care Indicators	Date	Day Shift			
	1. Activity Independent		( )			
	2. Bath Partial Assist			( )	( )	
or	3. Position, Partial Assist			( )	( )	
or	4. Position, Complete Assist				( )	( )
or	5. Diet, Partial Assist			( )	( )	
or	6. Diet, Complete Assist				( )	( )
	7. IV, IVPB, Hep lock etc.			( )	( )	( )
	8. Assess/Intervene, Routine		( )	( )		
or	9. Assess/Intervene, Above Average				( )	( )
	10.* Assess/Intervene, Frequently					( )
	Weighting Factor		(X)	(X)	(.5)	
	Total					
	Patient Classification		I	II	III	IV
	Comment/Signature * If Checked, Evaluate for ICU					

Appendix F

PERCEPTION OF STAFFING ADEQUACY

Hospital___ Unit___ Shift___ Date_____

Total number of patients in each classification at the beginning of this shift:

I	II	III	IV	V	IMC
___	___	___	___	___	___

Staff on Shift_____

Number	Total Hours

I. In general, did you feel that staffing for this shift was:

More than adequate	Comfortable	Adequate	Barely Adequate	Inadequate
5( )	4( )	3( )	2( )	1( )

2. If barely adequate or inadequate, which of the following factors seemed to best describe the situation? (Check the one(s) that apply):

2.1 Above average number of patients needing extensive nursing care, assistance, or surveillance. _____

2.2 Not enough staff on duty, e.g., too few scheduled, scheduled but not on duty, transferred to another unit, or sent home early. _____

2.3 Staff unfamiliar with this unit and/or hospital. _____

2.4 Census fluctuations, e.g., above average number of admits this shift or previous shift, or above average number of transfers or discharges. _____

2.5 Not an optimum mix or ratio of personnel levels. _____

2.6 Staff unfamiliar with the type of patients on this unit. _____

2.7 Above average number of patients needing escorting by nurses to other departments. _____

2.8 Other (please describe)_____

3. In your judgment, if staffing was barely adequate or inadequate, what would have best helped in the situation: (Please answer Questions 3.1 to 3.3)

3.1 Replacing certain staff levels with other staffing levels: (Circle one) YES NO

* If you answered yes to 3.1, indicate staff to be replaced and level of replacement.

Replace:		With:	
_____	Charge Nurse	_____	Charge Nurse
_____	Staff RN	_____	Staff RN
_____	LVN	_____	LVN
_____	NA	_____	NA
_____	US	_____	US
_____	Other (describe)	_____	Other (describe)

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Appendix F: Continued

3.2 Additional staff was necessary: (Circle one) Yes No

* If you answered yes to 3.2, indicate the actual number of staff and staff level desired and whether they were required for part or all of the shift.

for: Part of the Shift	for: All of the Shift
____ RN(s)	____ RN(s)
____ LVN(s)	____ LVN(s)
____ NA(s)	____ NA(s)
____ US(s)	____ US(s)
____ Other(s)	____ Other(s)

3.3 Other types of assistance or support was necessary: (Circle one) Yes No

* If you answered yes to 3.3 indicate the departments from which improved support serice was required:

____ Laboratory	____ Dietary
____ Pharmacy	____ Housekeeping
____ Central Supply/Materials	____ Other (describe)

4. Please judge the following aspects of care according to your best knowledge of the nursing services given to at least 90% of the patients during this shift. Consider factors such as safety, accuracy, patient comfort and satisfaction, and agreement with medical and nursing plans of care. (Check the value that best applies using the following scale):

5 = Excellent	3 = Average	1 = Poor
4 = Above Average	2 = Below Average	NA = Not Applicable

4.1 Basic hygiene care (Bathing, clean linen, oral hygiene, skin care):
5____ 4____ 3____ 2____ 1____ NA____

4.2 Basic feeding and toileting (Assistance with meals if needed, fluids forced prompt care of elimination needs):
5____ 4____ 3____ 2____ 1____ NA____

4.3 Mobility (turned as needed, ambulation, assistance in getting out of bed as needed, up in chair, positioning):
5____ 4____ 3____ 2____ 1____ NA____

4.4 Medications, IV's (given as ordered and within time limits):
5____ 4____ 3____ 2____ 1____ NA____

4.5 Communication with patient and/or family (explanation of procedures, teaching, orientation, "therapeutic socialising"):
5____ 4____ 3____ 2____ 1____ NA____

4.6 Special procedures (oxygen maintained, dressing changed as needed, irrigations, catheter care, etc.):
5____ 4____ 3____ 2____ 1____ NA____

4.7 Patient assessment and/or observation (as often as ordered or required):
5____ 4____ 3____ 2____ 1____ NA____

4.8 Vital signs (taken as indicated or ordered):
5____ 4____ 3____ 2____ 1____ NA____

4.9 Assisting MD or others with exam/procedures:
5____ 4____ 3____ 2____ 1____ NA____

4.10 Implementation of new orders without undue delay (routine or stat orders):
5____ 4____ 3____ 2____ 1____ NA____

Appendix G

Step by Step Method for Costing Nursing Care

Step 1. Develop a hours per shift matrix for each acuity level.

Hours of Care Allocated to Levels of Classification

	Shift	ClassII	ClassIII	ClassIV	ClassV
Hospital 1	Nite	1.11	1.32	1.42	1.83
Unit 1	Day	2.13	2.45	2.67	3.26
	PM	1.81	2.12	2.26	2.74
Total HPPD for each Classification		5.05	5.89	6.35	7.83

Step 2. Compute the direct nursing care costs for one hour.

1. Obtain the total direct care hours and salaries including overtime from the unit's productivity report for the period. Do not include the unit secretary, monitor tech, registry, or Nurse Manager hours or salaries at this step. The period may be per pay period, per quarter, or per year. Add the total salaries for each level of care giver to obtain the total salaries for Direct Care. Sum the hours for the direct care staff to determine the total hours. Divide the total salaries by the total hours to obtain the direct care cost per hour for the hospital's nursing staff.

   Example:

Level	Salaries	Hours
RN	$655,354	39,177
LVN	296,581	21,098
NA	33,262	4,086
	$985,179	64,361

   Divide $1,145,701 by 64,361 hours = $15.31 per hour.

2. Obtain the total salaries and hours for registry nurses from the productivity report. Divide the total cost by the total hours to obtain the average cost per hour.
   Example: $160,504 / 4,938.60 hours = $32.50 per hour.

3. Add the total salaries for hospital nurses and registry nurses. Add the total hours for both groups. Divide the total cost by the total hours to product the total cost per hour for the unit.
   Example: $1,145,701 / 6,9299.6 = $16.53 Total salary cost per hour.

4. Obtain the total benefit cost for direct care providers for the period. and divide that amount by the total hospital direct care hours to obtain a cost per hour for vacation, sick, tax, and insurance benefits.
   Example: $325,666.66 / 64,361 hours = $5.06 per hour benefit cost.

5. Add the total hourly salary cost from Step 2-3 and hourly benefit cost from Step 2-4 to obtain the Total Direct Care Cost per hour.
   Example: $16.53 + $5.06 = $21.59 Direct Care Cost per Hour.

Appendix G: Continued

Step 3. Calculate the indirect care costs per patient day.

1. To obtain the indirect care costs to allocate to each patient day, divide the total benefited salaries for Unit Nursing Management and Unit Secretary /Monitor Technician respectively. Divide each of the total costs by the number of patient days for the period.
   Example: Unit Nurse Management costs / total patient days
   $99,408 / 9,874 patient days = $10.07 per patient day
   Unit Secretary costs / total patient days
   $57,461 / 9,874 patient days = $5.82 per patient day
   $10.07 + $5.82 = $15.89 Indirect Care Cost per Patient Day

Step 4. Calculate the Other Indirect Nursing Costs.

1. Divide the remaining unit expenses for Materials and Supplies, and for Other Expenses by the total number of patient days for the period to compute the indirect costs for Materials and Supplies = $3.51 per patient day and Other Expense = $3.74 per patient day.

2. Add the total FTEs used by the unit and divide that number by the total FTEs used by nursing.
   Example: Total unit FTEs = 38.08 / Total nursing FTEs = 453.8
   Percent of FTEs = 8.39%

3. Multiply this percentage of FTEs times the total cost for Nursing Administration, Education and Research, Recruitment and Orientation for the past fiscal year to determine the total indirect Nursing Administration and Education cost to be allocated to the unit.

4. Divide the total indirect nursing administration and education costs by the total patient days to calculate the total indirect nursing administration and education cost per patient day.

5. Add the cost per patient for each of the indirect nursing cost categories.

Example:		
	Materials & Supplies	$3.51 ppd
	Other Unit Expenses	3.74 ppd
	Nursing Administration	4.10 ppd
	Nursing Education	2.14 ppd
	Total Indirect Unit Costs per Patient Day before applying Hospital Allocated Costs	$13.49

Step 5. Compute the allocated indirect expenses.

1. Subtract the amount of indirect nursing cost already allocated to the unit from the amount of allocated overhead costs assigned to the unit after the first step of the fiscal year Medicare Step Down Report.
2. Divide this amount by the number of patient days for the past fiscal year to calculate the other allocated costs per patient day.
   Example: Allocated Expense = $138.79 per patient day.

Note: Actual total dollars not presented to protect confidentiality.

Appendix G: Continued

Step 6. Calculate the direct nursing care costs per patient stay.

1. Sum the total hours of care for each day of the patient's stay by adding the actual hours provided for each shift based on the patient's classification level.

2. Add the daily total hours for the number of days of LOS for the patient.

3. Multiply the direct cost per care hour times the total hours for the LOS to determine the direct care cost for each patient.
   Example: Total hours X Direct Care Cost/hour = Direct Care Cost
   35 hours X $21.59 = $755.65 Direct Care Cost

Step 7. Calculate the total direct costs per patient stay.

1. Multiply the indirect nursing care cost per patient day from Step 2 times the patient's LOS.
   Example: Indirect Care Cost per day X LOS
   $15.89 X 6 days = $95.34

2. Add this amount to the direct nursing care costs from Step 6 to obtain the total direct nursing costs for the patient's stay.
   Example: $755.65 Direct Care Cost + $95.34 Indirect Care Cost
   = $850.99 Total Direct Cost for Patient Stay.

Step 8. Compute the direct and indirect nursing costs excluding other allocated costs per patient stay.

1. Multiply the indirect nursing costs per day times the patient's LOS.
   Example: $13.49 X 6 days = $80.94 Total indirect nursing costs.

2. Add this amount to the total direct nursing cost for the patient to obtain the direct and indirect nursing costs excluding the other allocated costs.
   Example: $850.99 Total Direct + $80.94 Total Indirect
   = $931.93 Total Cost of Care excluding Hospital Allocations.

Step 9. Compute the total nursing costs per patient stay.

1. Multiply the other allocated costs per patient day times the patient's LOS.
   Example: $138.79 Allocated Costs X 6 days = $832.74 Total Allocated Costs

2. Add this amount to the direct and indirect nursing costs from Step 8 to obtain the total cost of nursing care per patient stay.
   Example: $931.93 + $832.74 = $1,764.67 Total Nursing Cost for patient.

Appendix H

Definition of Terms

Dataset: Phase 1 Data Collection Worksheet

Variables

ID	Identification number for individual patients. 1 to 40 Hospital 1, 41 to 80 Hospital 2, 81 to 120 Hospital 3.
Hospital	Hospital 1=220 bed private, non profit. Hospital 2=97 bed district. Hospital 3=235 bed community, non profit.
Unit	Unit 1=Hospital 1, 32 bed medical unit. Unit 2=Hospital 1, 31 bed surgical unit. Unit 3=Hospital 2, 24 bed combined orthopedic and pediatric units. Unit 4=Hospital 2, 28 bed combined oncology and telemetry units. Unit 5=Hospital 3, 36 bed medical unit. Unit 6=Hospital 3, 47 bed surgical unit.
Age	Age in years on day of data collection.
Sex	Male=1, Female=2
PCHRNITE	Predicted hours of care, night shift for subject.
PCHRDAY	Predicted hours of care, day shift for subject.
PCHRPM	Predicted hours of care, evening shift for subject.
ACHRNITE	Actual hours of care, night shift for subject.
ACHRDAY	Actual hours of care, day shift for subject.
ACHRPM	Actual hours of care, evening shift for subject.

Appendix H: Continued

TOPCHPPD Total predicted hours of care per patient day.

ACHPPD Actual hours of care per patient day.

VARHPPD Variance between predicted and actual hours per patient day.

BUDGHPPD Budgeted hours of patient care per patient day.

UNPCNITE Total unit predicted hours of care for all patients for night shift on data collection date.

UNPCDAY Total unit predicted hours of care for all patients for day shift on data collection date.

UNPCPM Total unit predicted hours of care for all patients for evening shift on data collection date.

UNACNITE Total unit actual hours of care provided to all patients for night shift on data collection date.

UNACDAY Total unit actual hours of care provided to all patients for day shift on data collection date.

UNACPM Total unit actual hours of care provided to all patients for evening shift on data collection date.

ADMNITE Number of admits or transfers to unit on night shift.

ADMDAY Number of admits or transfers to unit on day shift.

ADMPM Number of admits or transfers to unit on evening shift.

DCNITE Number of discharges or transfers from unit on night shift.

DCDAY Number of discharges or transfers from unit on day shift.

DCPM Number of discharges or transfers from unit on evening shift.

AVCENSUS Average census for date of data collection.

Appendix H: Continued

UVARNITE Variance between total predicted and actual hours for all unit patients for night shift of data collection date.

UVARDAY Variance between total predicted and actual hours for all unit patients for day shift of data collection date.

UVARPM Variance between total predicted and actual hours for all unit patients for evening shift of data collection date.

SKLEVEL Skill level of nursing care provider.

PSAQDAY Perception of Staffing Adequacy Questionnaire overall score for day shift, 5=More than adequate, 4=Comfortable, 3=Adequate, 2=Barely Adequate, 1=Inadequate.

PSAQPM Perception of Staffing Adequacy Questionnaire overall score for evening shift.

PSAQNITE Perception of Staffing Adequacy Questionnaire overall score for night shift.

ASRDAY Perception of Staffing Adequacy average service rating for day shift, 5=Excellent, 4=Above Average, 3=Average, 2=Below Average, 1=Poor.

ASRPM Perception of Staffing Adequacy average service rating for evening shift.

ASRNITE Perception of Staffing Adequacy average service rating for night shift.

Appendix I

Summary Statistics of Patient Hour Variables

N=120

	PCHRNITE	PCHRDAY	PCHRPM	ACHRNITE	ACHRDAY
MINIMUM	0.800	0.800	0.640	0.480	0.800
MAXIMUM	2.000	3.260	2.740	2.000	3.260
MEAN	1.455	2.499	1.954	1.379	2.447
STANDARD DEV	0.285	0.519	0.459	0.317	0.535

	ACHRPM	NITEVAR	DAYVAR	PMVAR	TOPCHPPD
MINIMUM	0.640	-0.800	-1.150	-1.000	2.560
MAXIMUM	2.740	0.510	0.960	0.940	7.830
MEAN	1.896	-0.076	-0.052	-0.058	5.908
STANDARD DEV	0.451	0.193	0.325	0.289	1.131

	TOACHPPD	VARHPPD	BUDGHPPD
MINIMUM	1.920	-2.320	5.200
MAXIMUM	7.420	0.980	6.000
MEAN	5.722	-0.186	5.603
STANDARD DEV	1.163	0.487	0.249

Summary Statistics of Unit Hour Variables

	UNPCNITE	UNACNITE	UVARNITE	ADMNITE	DCNITE
MINIMUM	12.400	16.000	-3.680	0.000	0.000
MAXIMUM	41.390	43.500	5.390	2.000	2.000
MEAN	29.356	30.683	1.327	0.375	0.083
STANDARD DEV	6.954	6.842	2.319	0.566	0.401

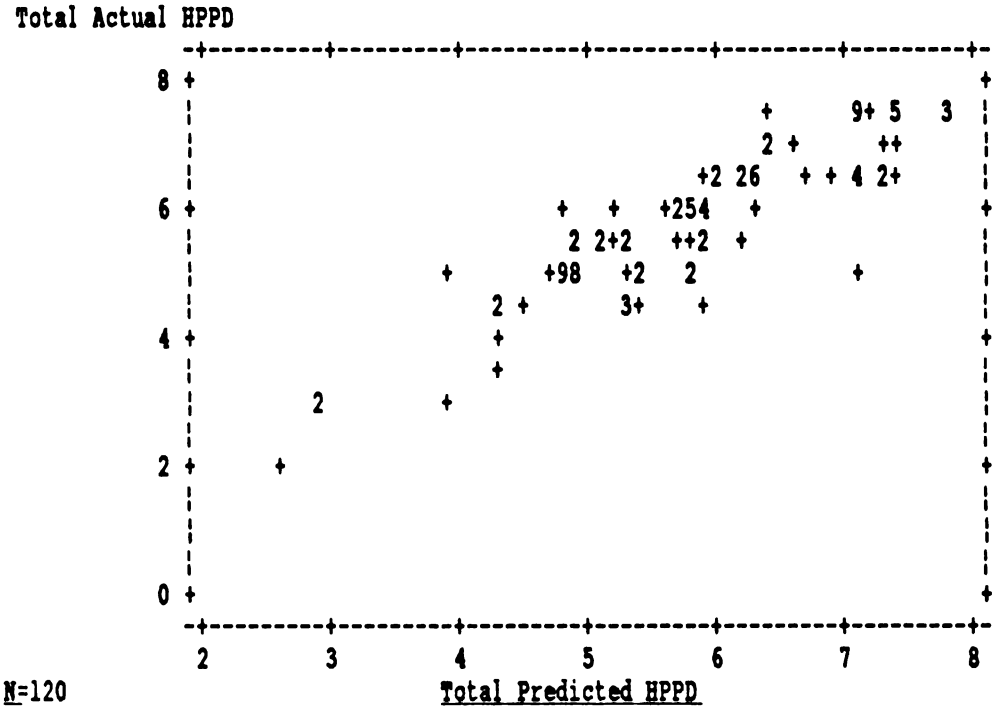
	UNPCDAY	UNACDAY	UVARDAY	ADMDAY	DCDAY
MINIMUM	28.600	24.000	-12.640	0.000	1.000
MAXIMUM	75.970	80.750	22.390	7.000	8.000
MEAN	53.386	54.673	1.287	3.125	4.250
STANDARD DEV	14.744	16.989	7.793	1.698	2.095

	UNPCPM	UNACPM	UVARPM	ADMPM	DCPM
MINIMUM	20.500	20.500	-9.120	0.000	0.000
MAXIMUM	63.690	72.000	16.590	4.000	5.000
MEAN	41.690	43.250	1.574	1.417	1.042
STANDARD DEV	12.987	15.508	5.423	1.294	1.343

	AVCENSUS	TOTPCHR	TOTACHR	TOTVARHR
MINIMUM	9.000	62.000	62.500	-18.800
MAXIMUM	29.660	180.170	189.750	26.030
MEAN	20.733	124.431	128.605	4.174
STANDARD DEV	6.101	33.092	37.630	11.918

Appendix J

Phase 1: Plot of Total Predicted to Actual Hours Per Patient Day



Note: Numbers inside plot indicate number of subjects at each point.

Appendix K

Correlation of Main Variables by Unit for Phase I

Hospital 1, Unit 1

	AVCENSUS[a]	TOTPCHR[b]	TOTACHR[c]	TOTVARHR[d]
AVCENSUS	1.000			
TOTPCHR	0.944	1.000		
TOTACHR	0.569	0.795	1.000	
TOTVARHR	-0.617	-0.359	0.282	1.000

Hospital 1, Unit 2

	AVCENSUS	TOTPCHR	TOTACHR	TOTVARHR
AVCENSUS	1.000			
TOTPCHR	0.971	1.000		
TOTACHR	0.883	0.968	1.000	
TOTVARHR	-0.805	-0.645	-0.434	1.000

Hospital 2, Unit 3

	AVCENSUS	TOTPCHR	TOTACHR	TOTVARHR
AVCENSUS	1.000			
TOTPCHR	0.996	1.000		
TOTACHR	0.991	0.995	1.000	
TOTVARHR	0.810	0.812	0.868	1.000

Hospital 2, Unit 4

	AVCENSUS	TOTPCHR	TOTACHR	TOTVARHR
AVCENSUS	1.000			
TOTPCHR	0.997	1.000		
TOTACHR	0.990	0.991	1.000	
TOTVARHR	0.676	0.666	0.666	1.000

Hospital 3, Unit 5

	AVCENSUS	TOTPCHR	TOTACHR	TOTVARHR
AVCENSUS	1.000			
TOTPCHR	0.981	1.000		
TOTACHR	0.960	0.995	1.000	
TOTVARHR	0.622	0.744	0.807	1.000

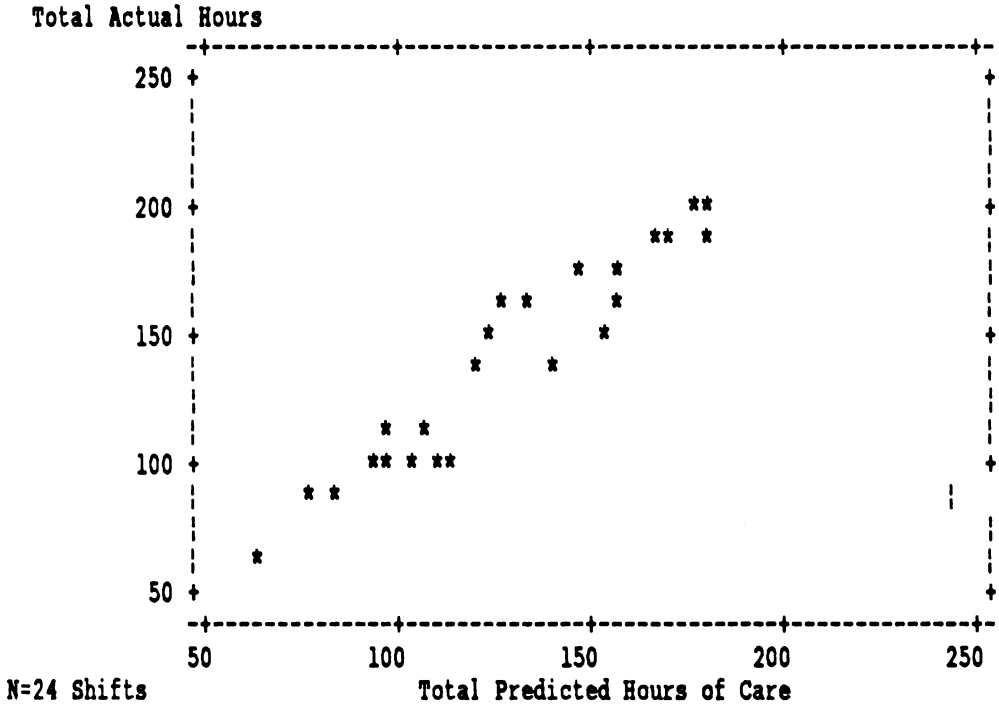
Hospital 3, Unit 6

	AVCENSUS	TOTPCHR	TOTACHR	TOTVARHR
AVCENSUS	1.000			
TOTPCHR	0.976	1.000		
TOTACHR	0.979	0.942	1.000	
TOTVARHR	-0.126	-0.301	0.036	1.000

[a]AVCENSUS=Average census for the study days.
[b]TOTPCHR=Total predicted hours for all patients on unit for study day.
[c]TOTACHR=Total actual hours for all patients on unit for study day.
[d]TOTVARHR=Difference between TOTPCHR & TOTACHR.

Appendix L

Plot of Unit Predicted to Actual Hours: Phase I



Appendix M

Phase II: Definition of Terms

Variables

ID	Identification number for individual patients. 101 to 180 Hospital 1, 201 to 280 Hospital 2, 301 to 380 Hospital 3. DRG 127=X01 to X20, DRG 14=X21 to X40, DRG 89=X41 to X60, and DRG 96=X61 to X80
Hospital	Identified as 1, 2, or 3 for three hospital sites.
DRG	Diagnosis Related Groups. Four DRGs studied include: DRG 127=Heart Failure and Shock DRG 14 =Specific Cerebrovascular Disorder except transient ischemic attacks DRG 89 =Simple Pneumonia or pleurisy, age greater than 17 years, with complicating condition DRG 96 =Bronchitis or asthma, age greater than 17 years, with complicating condition
Age	Age in years as of admission date to hospital
Sex	Male=1, Female=2
DRGLOS	Mean DRG length of stay provided by Medicare for each DRG.
TOTLOS	Number of days of hospitalization for individual patient counted from the midnight census.
DIFLOS	Difference between the DRGLOS and the TOTLOS. Negative number indicates less than mean DRGLOS.
ADPCHR	Total predicted hours of care for patient.
ADACHR	Total actual hours of care for patient.
ADDIFHR	Difference between ADPCHR and ADACHR. Negative numbers equal less than predicted level provided. NOTE: Positive and negative daily hours cancel each other out, therefore the + or - is important, not the amount.
TPHR	Total predicted hours for LOS for patient starting with PM shift of admit day and ending with day shift of discharge day.

Appendix M: Continued

TACHR	Total actual hours of care provided starting with PM shift of admit day and ending with day shift of discharge day.
ABDIF	Absolute value of daily difference between TPHR and TACHR.
PHPPD	Predicted hours per patient day=TPHR/LOS.
AHPPD	Actual hours per patient day=ACHR/LOS.
QDAVDIF	Average daily difference between predicted and actual hours=ADDIFHR/LOS.
QDABDIF	Average daily absolute difference between predicted and actual hours=ABDIF/LOS.
DCARCOST	Total direct care cost for patient for LOS. Hours of care times cost of direct care per hour including benefits for each facility.
ICARCOST	Total indirect care cost. Includes Nurse Manager, Unit Secretary, and Telemetry Technicians cost per patient day.
TDCOST	Total direct cost. Sum of direct and indirect care cost.
IUCOST	Indirect unit cost. Includes unit materials, supplies, and allocated nursing administration and education costs based on total unit FTEs divided by total nursing FTEs. Assigned as a per patient day cost.
ALLOCOST	Allocated cost from non revenue cost centers based on Medicare stepdown. Per patient day cost multiplied by LOS for each patient.
TUNCOST	Sum of TDCOST, IUCOST, and ALLOCOST equals total nursing cost for each patient for the LOS.
ACPERDAY	Average cost per day for individual patient.
CHARGES	Total hospital charges for each patient.
DRGREIM	Total Medicare reimbursement allowed to hospital for patient in specific DRG.
DRGCGDIF	Difference between hospital charges and DRG reimbursement.
HOSPCOST	Total cost of hospitalization for patient based on cost to charge ratio for each site.
DRGCODIF	Difference between DRG reimbursement and hospital cost.

Appendix M: Continued

DCATOCG	Percentage of direct nursing care cost to total charges.
DCOTOCG	Percentage of direct (direct and indirect care) cost to total charges.
TCOTOCG	Percentage of total nursing cost to total charges.
DCATORE	Percentage of direct nursing care cost to reimbursement.
DCOTORE	Percentage of direct (direct and indirect care) cost to reimbursement.
TCOTORE	Percentage of total nursing cost to reimbursement.
DCATOCO	Percentage of direct nursing care cost to total cost.
DCOTOCO	Percentage of direct (direct and indirect care) cost to total cost.
TCOTOCO	Percentage of total nursing cost to total cost.

Appendix N

Summary Statistics of Total Sample for DRGCOST Data

N=240

	AGE	DRGLOS	TOTLOS	DIFLOS	ADPCHR
MINIMUM	21.000	6.100	1.000	-6.500	5.330
MAXIMUM	102.000	7.500	26.000	18.500	197.140
MEAN	74.904	6.775	5.733	-1.058	35.223
STANDARD DEV	13.550	0.631	3.621	3.596	24.699

	ADACHR	ADDIFHR	TPHR	TACHR	ABDIF
MINIMUM	5.040	-4.480	3.700	2.870	0.000
MAXIMUM	195.500	3.120	197.140	195.500	13.050
MEAN	34.425	-0.793	33.569	32.752	2.503
STANDARD DEV	24.523	1.111	24.805	24.603	2.113

	PHPPD	AHPPD	QDAVGDIF	QDABDIF	DCARCOST
MINIMUM	2.153	2.153	-1.600	0.000	137.097
MAXIMUM	8.051	7.744	0.650	2.060	4220.845
MEAN	5.725	5.559	-0.165	0.472	908.418
STANDARD DEV	1.049	1.098	0.264	0.372	619.717

	ICARCOST	TDCOST	IUCOST	ALLOCOST	TUNCOST
MINIMUM	10.730	148.109	13.490	111.020	305.267
MAXIMUM	413.140	4633.985	350.740	3652.105	8593.265
MEAN	81.619	990.037	96.175	866.260	1952.472
STANDARD DEV	55.724	670.983	58.402	591.965	1241.820

	ACPERDAY	CHARGES	HOSPCOST	DRGREIM	DRGCGDIF
MINIMUM	250.810	1013.000	564.241	4260.000	-19638.000
MAXIMUM	454.280	25344.000	15865.344	5706.000	3817.000
MEAN	342.352	6601.250	4078.969	4931.500	-1677.179
STANDARD DEV	38.884	4141.859	2577.533	515.889	4104.621

	DRGCODIF	DCATOCG	DCOTOCG	TCOTOCG	DCATORE
MINIMUM	-10159.344	0.056	0.060	0.135	0.026
MAXIMUM	4380.667	0.274	0.293	0.554	0.787
MEAN	852.531	0.139	0.152	0.301	0.184
STANDARD DEV	2566.141	0.038	0.041	0.073	0.118

	DCOTORE	TCOTORE	DCATOCO	DCOTOCO	TCOTOCO
MINIMUM	0.029	0.057	0.083	0.090	0.207
MAXIMUM	0.864	1.601	0.438	0.468	0.829
MEAN	0.200	0.398	0.227	0.248	0.490
STANDARD DEV	0.128	0.247	0.064	0.070	0.119

Appendix N: Continued

Summary Statistics for DRGCOST DATA by Hospital

Hospital = 1

n=80

	AGE	DRGLOS	TOTLOS	DIFLOS	ADPCHR
MINIMUM	42.000	6.100	1.000	-6.500	6.350
MAXIMUM	100.000	7.500	26.000	18.500	197.140
MEAN	75.850	6.775	6.375	-0.450	41.784
STANDARD DEV	10.191	0.634	4.577	4.515	31.822

	ADACHR	ADDIFHR	TPHR	TACHR	ABDIF
MINIMUM	6.350	-3.310	5.040	5.360	0.000
MAXIMUM	195.500	1.410	197.140	195.500	13.050
MEAN	41.351	-0.371	40.108	39.712	1.956
STANDARD DEV	31.405	0.774	32.158	31.702	2.104

	PHPPD	AHPPD	QDAVGDIF	QDABDIF	DCARCOST
MINIMUM	2.153	2.153	-0.320	0.000	137.097
MAXIMUM	7.582	7.519	0.320	0.785	4220.845
MEAN	6.093	6.042	-0.050	0.291	892.768
STANDARD DEV	0.815	0.785	0.129	0.183	678.043

	ICARCOST	TDCOST	IUCOST	ALLOCOST	TUNCOST
MINIMUM	15.890	152.987	13.490	138.790	305.267
MAXIMUM	413.140	4633.985	350.740	3608.540	8593.265
MEAN	101.299	994.067	85.999	884.786	1964.852
STANDARD DEV	72.724	750.192	61.740	635.200	1444.548

	ACPERDAY	CHARGES	HOSPCOST	DRGREIM	DRGCGDIF
MINIMUM	271.298	1013.000	564.241	4260.000	-19312.000
MAXIMUM	353.628	24678.000	13745.646	5366.000	3597.000
MEAN	307.747	6463.375	3600.100	4838.750	-1624.625
STANDARD DEV	14.370	4389.135	2444.748	492.021	4341.092

	DRGCODIF	DCATOCG	DCOTOCG	TCOTOCG	DCATORE
MINIMUM	-8379.646	0.077	0.086	0.173	0.026
MAXIMUM	4380.667	0.211	0.232	0.462	0.787
MEAN	1238.650	0.136	0.152	0.301	0.184
STANDARD DEV	2418.763	0.026	0.029	0.057	0.135

	DCOTORE	TCOTORE	DCATOCO	DCOTOCO	TCOTOCO
MINIMUM	0.029	0.057	0.139	0.155	0.310
MAXIMUM	0.864	1.601	0.378	0.416	0.829
MEAN	0.205	0.406	0.245	0.273	0.541
STANDARD DEV	0.149	0.289	0.047	0.051	0.102

Appendix N: Continued

Hospital 2

n=80

	AGE	DRGLOS	TOTLOS	DIFLOS	ADPCHR
MINIMUM	30.000	6.100	1.000	-6.500	5.330
MAXIMUM	95.000	7.500	18.000	10.500	126.680
MEAN	74.950	6.775	5.575	-1.200	29.873
STANDARD DEV	13.446	0.634	3.125	3.201	18.500

	ADACHR	ADDIFHR	TPHR	TACHR	ABDIF
MINIMUM	5.040	-4.130	3.700	2.870	0.000
MAXIMUM	123.440	1.950	126.680	123.440	8.300
MEAN	28.543	-1.330	28.643	27.265	3.408
STANDARD DEV	18.120	1.096	18.683	18.279	1.975

	PHPPD	AHPPD	QDAVGDIF	QDABDIF	DCARCOST
MINIMUM	3.115	2.870	-1.080	0.000	137.379
MAXIMUM	8.051	7.719	0.650	2.060	3364.690
MEAN	5.088	4.809	-0.278	0.638	778.013
STANDARD DEV	1.007	1.016	0.266	0.327	493.914

	ICARCOST	TDCOST	IUCOST	ALLOCOST	TUNCOST
MINIMUM	10.730	148.109	18.868	202.895	369.872
MAXIMUM	193.140	3557.830	339.633	3652.105	7549.568
MEAN	59.820	837.833	105.192	1131.138	2074.163
STANDARD DEV	33.533	524.995	58.967	634.073	1197.368

	ACPERDAY	CHARGES	HOSPCOST	DRGREIM	DRGCGDIF
MINIMUM	323.943	1549.000	1035.521	4260.000	-14966.000
MAXIMUM	454.280	20332.000	13592.127	5366.000	3817.000
MEAN	373.945	6721.688	4493.509	4838.750	-1882.938
STANDARD DEV	29.774	4125.653	2758.037	492.021	4177.252

	DRGCODIF	DCATOCG	DCOTOCG	TCOTOCG	DCATORE
MINIMUM	-8226.127	0.056	0.060	0.138	0.027
MAXIMUM	4330.479	0.225	0.238	0.554	0.627
MEAN	345.241	0.121	0.130	0.324	0.162
STANDARD DEV	2823.724	0.035	0.037	0.087	0.099

	DCOTORE	TCOTORE	DCATOCO	DCOTOCO	TCOTOCO
MINIMUM	0.029	0.070	0.083	0.090	0.207
MAXIMUM	0.663	1.407	0.337	0.356	0.829
MEAN	0.174	0.433	0.181	0.195	0.485
STANDARD DEV	0.106	0.248	0.052	0.055	0.130

Appendix N: Continued

Hospital = 3

n=80

	AGE	DRGLOS	TOTLOS	DIFLOS	ADPCHR
MINIMUM	21.000	6.100	1.000	-6.300	9.280
MAXIMUM	102.000	7.500	16.000	8.700	116.320
MEAN	73.913	6.775	5.250	-1.525	34.014
STANDARD DEV	16.399	0.634	2.875	2.807	20.410

	ADACHR	ADDIFHR	TPHR	TACHR	ABDIF
MINIMUM	7.920	-4.480	7.120	5.520	0.000
MAXIMUM	114.880	3.120	113.920	112.480	10.320
MEAN	33.380	-0.678	31.957	31.279	2.144
STANDARD DEV	20.493	1.203	20.192	20.258	1.978

	PHPPD	AHPPD	QDAVGDIF	QDABDIF	DCARCOST
MINIMUM	2.880	3.120	-1.600	0.000	250.193
MAXIMUM	7.744	7.744	0.520	1.952	3629.059
MEAN	5.994	5.828	-0.167	0.489	1054.474
STANDARD DEV	1.017	1.057	0.312	0.466	647.384

	ICARCOST	TDCOST	IUCOST	ALLOCOST	TUNCOST
MINIMUM	15.950	266.143	18.540	111.020	395.703
MAXIMUM	255.200	3884.259	296.640	1776.320	5957.219
MEAN	83.738	1138.212	97.335	582.855	1818.402
STANDARD DEV	45.857	691.329	53.303	319.186	1054.337

	ACPERDAY	CHARGES	HOSPCOST	DRGREIM	DRGCGDIF
MINIMUM	250.810	2374.000	1486.124	4557.000	-19638.000
MAXIMUM	408.339	25344.000	15865.344	5706.000	3246.000
MEAN	345.364	6618.688	4143.298	5117.000	-1523.975
STANDARD DEV	35.336	3947.090	2470.878	518.385	3821.822

	DRGCODIF	DCATOCG	DCOTOCG	TCOTOCG	DCATORE
MINIMUM	-10159.344	0.080	0.086	0.135	0.044
MAXIMUM	4166.040	0.274	0.293	0.447	0.636
MEAN	973.702	0.160	0.173	0.278	0.204
STANDARD DEV	2381.526	0.041	0.044	0.064	0.115

	DCOTORE	TCOTORE	DCATOCO	DCOTOCO	TCOTOCO
MINIMUM	0.047	0.069	0.127	0.137	0.216
MAXIMUM	0.681	1.044	0.438	0.468	0.715
MEAN	0.221	0.353	0.255	0.276	0.443
STANDARD DEV	0.123	0.188	0.066	0.070	0.103

Appendix N: Continued

Summary Statistics of Drgcost Data by DRG

DRG 127

n=60

	AGE	DRGLOS	TOTLOS	DIFLOS	ADPCHR
MINIMUM	59.000	6.200	1.000	-5.200	7.860
MAXIMUM	96.000	6.200	15.000	8.800	93.420
MEAN	79.783	6.200	4.867	-1.333	28.624
STANDARD DEV	9.191	0.000	2.843	2.843	15.251

	ADACHR	ADDIFHR	TPHR	TACHR	ABDIF
MINIMUM	6.600	-3.550	4.530	3.770	0.000
MAXIMUM	90.880	1.410	93.420	90.880	6.900
MEAN	27.983	-0.673	26.225	25.534	2.124
STANDARD DEV	15.005	1.105	15.858	15.520	1.771

	PHPPD	AHPPD	QDAVGDIF	QDABDIF	DCARCOST
MINIMUM	2.153	2.153	-0.830	0.000	173.152
MAXIMUM	7.547	7.660	0.320	2.060	1962.099
MEAN	5.443	5.293	-0.150	0.452	744.377
STANDARD DEV	1.097	1.121	0.266	0.361	378.942

	ICARCOST	TDCOST	IUCOST	ALLOCOST	TUMCOST
MINIMUM	10.730	189.042	13.490	138.790	341.322
MAXIMUM	238.350	2200.449	245.290	2637.631	4484.649
MEAN	68.134	812.511	82.992	748.715	1644.219
STANDARD DEV	40.711	416.459	49.199	522.265	922.287

	ACPERDAY	CHARGES	HOSPCOST	DRGREIM	DRGCGDIF
MINIMUM	287.665	1013.000	564.241	4451.000	-11436.000
MAXIMUM	431.474	15887.000	10620.604	4655.000	3438.000
MEAN	342.905	5305.600	3300.590	4519.000	-786.600
STANDARD DEV	37.562	2973.143	1926.044	96.978	2978.978

	DRGCODIF	DCATOCG	DCOTOCG	TCOTOCG	DCATORE
MINIMUM	-6169.604	0.064	0.067	0.135	0.039
MAXIMUM	3886.759	0.239	0.261	0.474	0.441
MEAN	1218.410	0.145	0.158	0.313	0.164
STANDARD DEV	1931.848	0.039	0.042	0.077	0.084

	DCOTORE	TCOTORE	DCATOCO	DCOTOCO	TCOTOCO
MINIMUM	0.042	0.077	0.095	0.100	0.207
MAXIMUM	0.494	1.008	0.382	0.416	0.829
MEAN	0.180	0.364	0.236	0.258	0.508
STANDARD DEV	0.092	0.207	0.066	0.072	0.123

Appendix N: Continued

DRG = 14

n=60

	AGE	DRGLOS	TOTLOS	DIFLOS	ADPCHR
MINIMUM	46.000	7.500	1.000	-6.500	5.330
MAXIMUM	100.000	7.500	26.000	18.500	197.140
MEAN	77.633	7.500	6.017	-1.483	40.431
STANDARD DEV	9.777	0.000	4.789	4.789	35.478

	ADACHR	ADDIFHR	TPHR	TACHR	ABDIF
MINIMUM	5.330	-3.310	5.330	5.330	0.000
MAXIMUM	195.500	0.880	197.140	195.500	13.050
MEAN	39.806	-0.601	39.095	38.489	2.398
STANDARD DEV	35.145	0.923	35.315	34.939	2.213

	PHPPD	AHPPD	QDAVGDIF	QDABDIF	DCARCOST
MINIMUM	3.668	3.355	-0.585	0.000	137.097
MAXIMUM	8.051	7.744	0.253	1.227	4220.845
MEAN	6.185	6.078	-0.106	0.426	1051.836
STANDARD DEV	0.940	0.954	0.167	0.291	855.645

	ICARCOST	TDCOST	IUCOST	ALLOCOST	TUNCOST
MINIMUM	10.730	152.987	13.490	138.790	305.267
MAXIMUM	413.140	4633.985	350.740	3652.105	8593.265
MEAN	86.257	1138.093	100.452	900.741	2139.286
STANDARD DEV	73.786	924.910	73.628	753.962	1692.524

	ACPERDAY	CHARGES	HOSPCOST	DRGREIM	DRGCGDIF
MINIMUM	271.298	1549.000	985.333	5366.000	-19312.000
MAXIMUM	454.280	24678.000	13745.646	5550.000	3817.000
MEAN	352.566	6694.267	4119.111	5427.333	-1266.933
STANDARD DEV	41.972	4886.654	2944.990	87.470	4889.184

	DRGCODIF	DCATOCG	DCOTOCG	TCOTOCG	DCATORE
MINIMUM	-8379.646	0.070	0.075	0.165	0.026
MAXIMUM	4380.667	0.274	0.293	0.554	0.787
MEAN	1308.222	0.153	0.166	0.319	0.193
STANDARD DEV	2946.589	0.046	0.048	0.086	0.158

	DCOTORE	TCOTORE	DCATOCO	DCOTOCO	TCOTOCO
MINIMUM	0.029	0.057	0.104	0.112	0.264
MAXIMUM	0.864	1.601	0.438	0.468	0.829
MEAN	0.209	0.394	0.248	0.269	0.517
STANDARD DEV	0.171	0.314	0.073	0.078	0.132

Appendix N: Continued

DRG = 89

n=60

	AGE	DRGLOS	TOTLOS	DIFLOS	ADPCHR
MINIMUM	33.000	7.300	1.000	-6.300	9.520
MAXIMUM	99.000	7.300	16.000	8.700	116.320
MEAN	74.117	7.300	6.300	-1.050	38.159
STANDARD DEV	13.112	0.000	3.361	3.343	23.006

	ADACHR	ADDIFHR	TPHR	TACHR	ABDIF
MINIMUM	7.920	-3.600	7.120	5.520	0.000
MAXIMUM	114.880	0.720	113.920	112.480	7.850
MEAN	37.070	-1.070	36.706	35.589	2.786
STANDARD DEV	23.064	1.030	23.098	23.171	1.884

	PHPPD	AHPPD	QDAVGDIF	QDABDIF	DCARCOST
MINIMUM	3.641	3.445	-1.600	0.000	250.193
MAXIMUM	7.702	7.680	0.140	1.655	3629.059
MEAN	5.736	5.497	-0.240	0.528	982.175
STANDARD DEV	1.020	1.081	0.296	0.395	657.459

	ICARCOST	TDCOST	IUCOST	ALLOCOST	TUNCOST
MINIMUM	15.950	266.143	18.540	111.020	395.703
MAXIMUM	255.200	3884.259	296.640	2231.842	5957.219
MEAN	90.685	1072.860	105.374	935.579	2113.814
STANDARD DEV	54.351	707.070	57.902	506.869	1163.252

	ACPERDAY	CHARGES	HOSPCOST	DRGREIM	DRGCGDIF
MINIMUM	289.974	2250.000	1504.146	5278.000	-19638.000
MAXIMUM	427.440	25344.000	15865.344	5706.000	3246.000
MEAN	338.768	7637.800	4706.724	5420.667	-2246.850
STANDARD DEV	36.586	4689.455	2946.481	203.464	4638.097

	DRGCODIF	DCATOCG	DCOTOCG	TCOTOCG	DCATORE
MINIMUM	-10159.344	0.061	0.067	0.161	0.044
MAXIMUM	4166.040	0.202	0.221	0.480	0.636
MEAN	713.942	0.130	0.142	0.288	0.180
STANDARD DEV	2916.085	0.026	0.028	0.060	0.116

	DCOTORE	TCOTORE	DCATOCO	DCOTOCO	TCOTOCO
MINIMUM	0.047	0.069	0.092	0.101	0.257
MAXIMUM	0.681	1.044	0.323	0.353	0.717
MEAN	0.197	0.390	0.212	0.232	0.469
STANDARD DEV	0.125	0.212	0.047	0.053	0.101

Appendix N: Continued

DRG = 96

n=60

	AGE	DRGLOS	TOTLOS	DIFLOS	ADPCHR
MINIMUM	21.000	6.100	1.000	-5.100	5.870
MAXIMUM	102.000	6.100	16.000	9.900	99.750
MEAN	68.083	6.100	5.750	-0.367	33.680
STANDARD DEV	17.664	0.000	3.101	3.075	19.172

	ADACHR	ADDIFHR	TPHR	TACHR	ABDIF
MINIMUM	5.040	-4.480	3.700	2.870	0.000
MAXIMUM	98.960	3.120	95.660	94.870	10.320
MEAN	32.840	-0.828	32.251	31.396	2.703
STANDARD DEV	19.039	1.317	19.041	18.895	2.495

	PHPPD	AHPPD	QDAVGDIF	QDABDIF	DCARCOST
MINIMUM	2.880	2.870	-1.000	0.000	137.379
MAXIMUM	7.318	7.324	0.650	1.952	2136.546
MEAN	5.536	5.371	-0.163	0.483	855.285
STANDARD DEV	1.000	1.077	0.296	0.428	437.105

	ICARCOST	TDCOST	IUCOST	ALLOCOST	TUNCOST
MINIMUM	10.730	148.109	18.868	202.895	369.872
MAXIMUM	254.240	2390.786	215.840	2231.842	4827.266
MEAN	81.399	936.684	95.883	880.003	1912.570
STANDARD DEV	47.246	480.321	48.382	548.666	1009.088

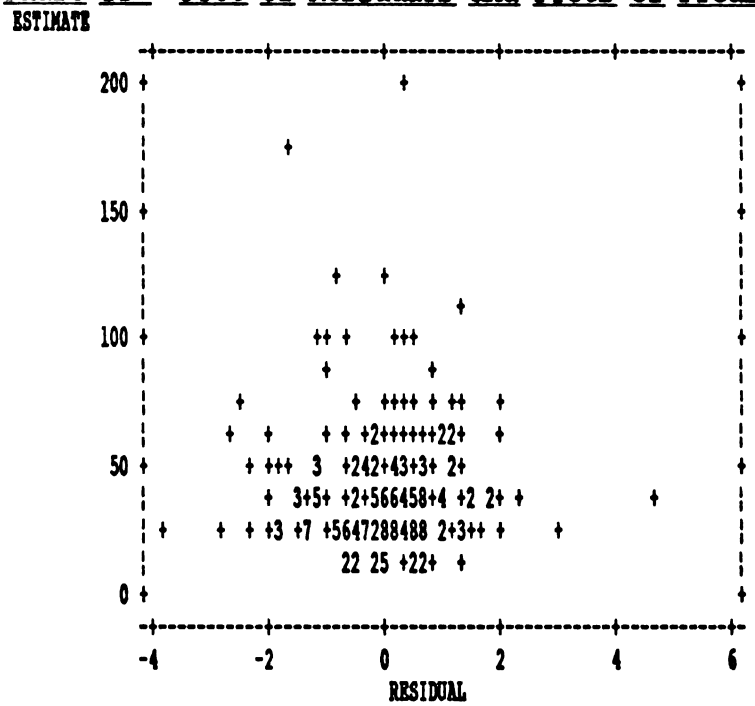
	ACPERDAY	CHARGES	HOSPCOST	DRGREIM	DRGCGDIF
MINIMUM	250.810	2036.000	1347.940	4260.000	-12778.000
MAXIMUM	432.020	17038.000	11390.058	4557.000	2224.000
MEAN	335.169	6767.333	4189.451	4359.000	-2408.333
STANDARD DEV	37.971	3456.248	2194.815	141.189	3479.448

	DRGCODIF	DCATOCG	DCOTOCG	TCOTOCG	DCATORE
MINIMUM	-7130.058	0.056	0.060	0.150	0.032
MAXIMUM	2948.180	0.243	0.259	0.435	0.502
MEAN	169.549	0.129	0.141	0.285	0.196
STANDARD DEV	2217.196	0.034	0.037	0.059	0.101

	DCOTORE	TCOTORE	DCATOCO	DCOTOCO	TCOTOCO
MINIMUM	0.035	0.087	0.083	0.090	0.225
MAXIMUM	0.561	1.133	0.388	0.416	0.781
MEAN	0.215	0.441	0.211	0.232	0.465
STANDARD DEV	0.111	0.238	0.062	0.068	0.111

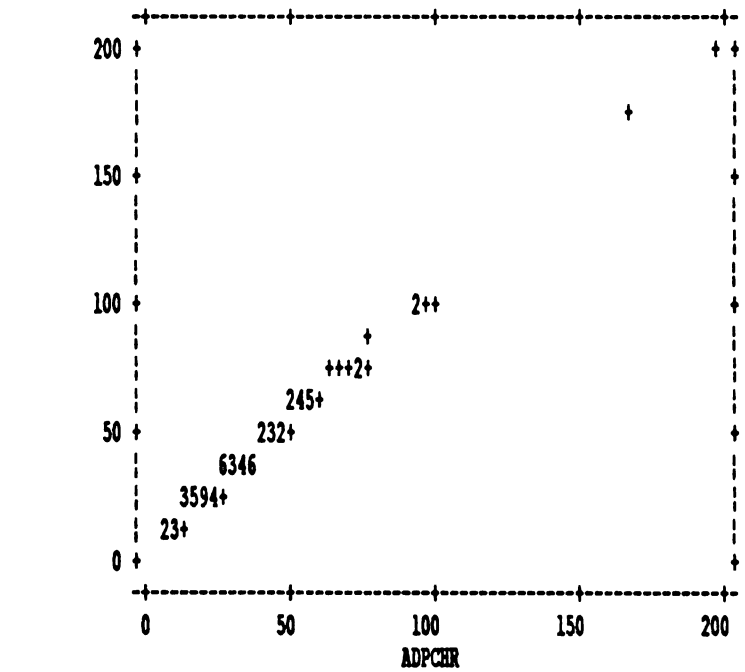
Appendix O

Phase II: Plot of Residuals and Plots of Predicted to Actual Hours



Plot of Actual Hours by Predicted Hours

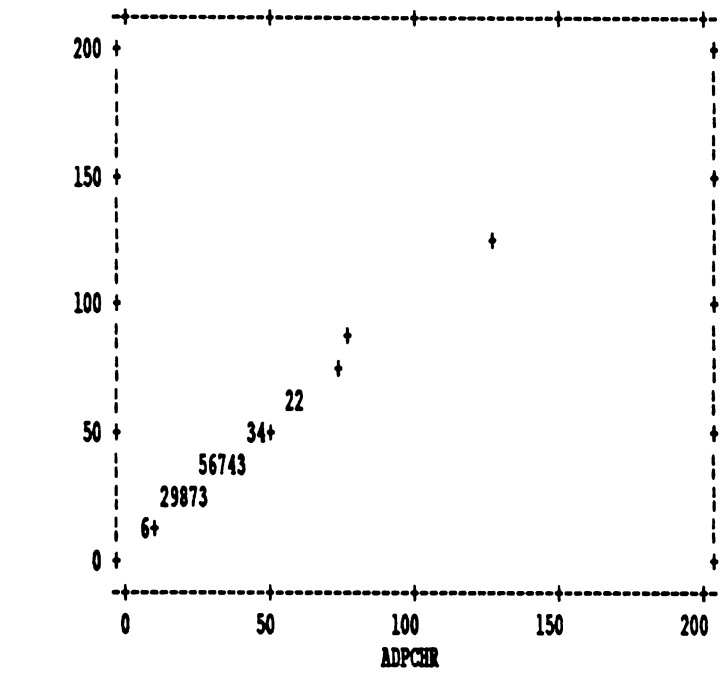
Results for Hospital 1



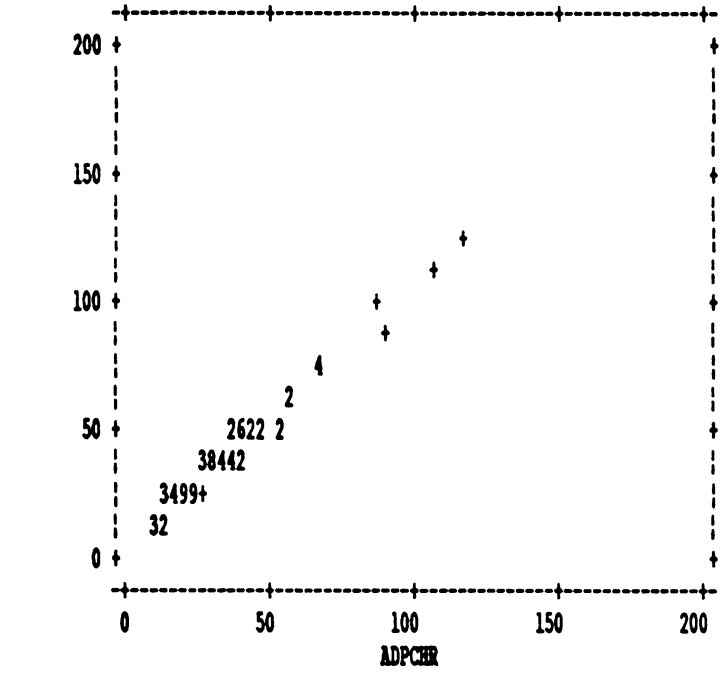
Appendix O: Continued

Plot of Actual Hours by Predicted Hours

Results for Hospital 2



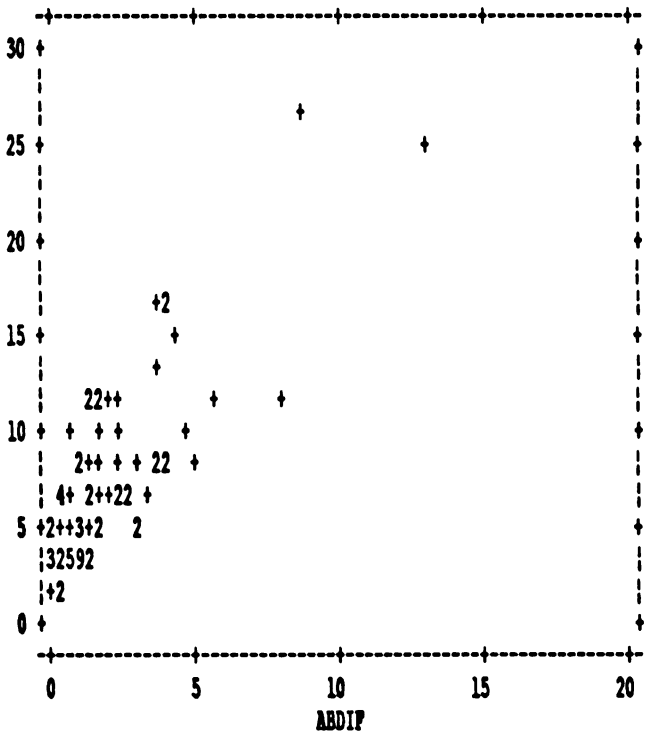
Results for Hospital 3



Appendix P

Phase II: Plots of ABDIF to TOTLOS by Hospital

Hospital 1[a]



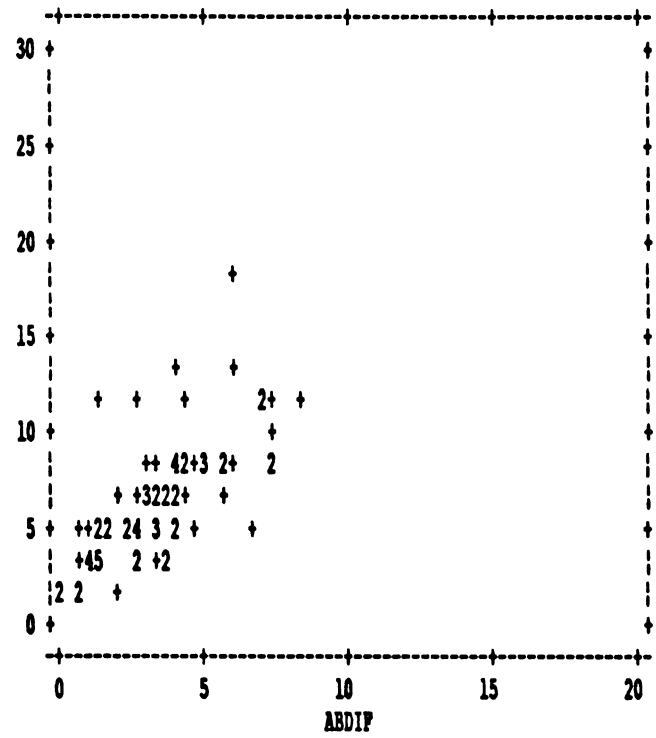
[a]ABDIF=Absolute difference between predicted and actual hours.

[b]TOTLOS=Total length of stay for each patient.

Appendix P: Continued

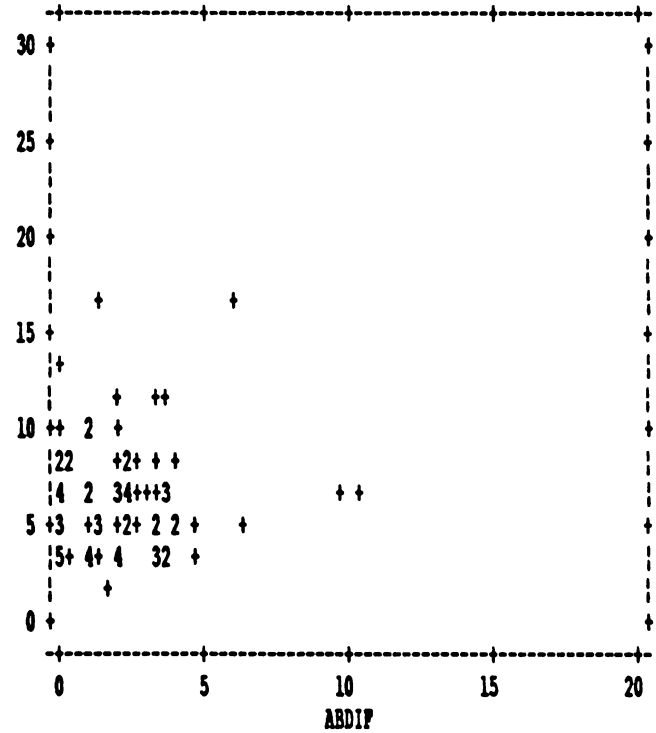
Hospital 2

TOTLOS



Hospital 3

TOTLOS



Appendix Q

HOSPITAL 1, COST PER HOUR REPORT

		AVERAGE
DIRECT COSTS PER CARE HOUR		
COST/DIRECT HOUR		$15.31
COST/DIRECT WITH REGISTRY		$16.53
SICK, VAC, TAX & INS/HR		$5.06
TOTAL DIRECT CARE COST/HOUR		$21.59
INDIRECT CARE COST PPD		
NURSE MANAGER/ASSISTANT NM		$10.07
UNIT SECRETARY/TELE TECH		$5.82
TOTAL INDIRECT CARE COST PPD		$15.89
INDIRECT COSTS PER PT DAY		**AVERAGE**
MAT. & SUPPLIES/PPD		$3.51
OTHER EXPENSE/PPD		$3.74
OTHER NURSING COSTS		
	NURSING ADM	$4.10
	NURSING ED.	$2.14
TOTAL INDIRECT COST PER PT DAY		$13.49
TOTAL ALLOCATED COST PER PT DAY		$138.79
ALLOCATED COSTS=1,370,379/9874		

REVENUE	$4,343,474.00
DIRECT EXPENSE	$1,777,678.00
ALLOCATED EXPENSE	$1,370,379.00
PATIENT DAYS	9,874
COST TO CHARGE RATIO	0.4092

(TOTAL UNIT FTE'S=38.08)
(TOTAL NURSING FTE'S=453.80)
ALLOCATION % OF N ADM
TO MEDICAL UNIT=8.39%
AVERAGE PATIENTS PER DAY=27.05

Appendix Q: Continued

HOSPITAL 2, COST PER HOUR REPORT

		AVERAGE
DIRECT COSTS PER CARE HOUR: FINAL AVERAGE FOR MEDICAL UNITS		
COST/DIRECT HOUR		$18.12
COST/DIRECT WITH REGISTRY		$18.90
TAX & INSURANCE/HR		$8.36
TOTAL DIRECT CARE COST PER HOUR		$27.26
INDIRECT CARE COST PER PATIENT DAY		
NURSE MANAGER		$3.14
UNIT SECRETARY/TELE TECH		$7.59
TOTAL DIRECT COST PER PATIENT DAY		$10.73
INDIRECT COSTS PER PT DAY		AVERAGE
MAT. & SUPPLIES/PPD		$4.95
OTHER EXPENSE/PPD		$0.66
OTHER NURSING COSTS		
	NURSING ADM	$9.58
	NURSING ED.	$3.68
TOTAL OTHER NURSING/PPD		$18.87
TOTAL ALLOCATED INDIRECT COSTS PER PATIENT DAY		$202.89

REVENUE	$4,566,577.00
EXPENSE	$1,962,505.00
ALLOCATED EXPENSE FOR YEAR	$2,303,392.12
MINUS NURSING ADM & ED	$2,106,046.98
ALLOCATED EXPENSE PER PATIENT DAY	$202.89
COST TO CHARGE RATIO	0.669
ANNUAL PATIENT DAYS	10,380.00

(TOTAL M/S FTE'S=42.4)
(TOTAL NURSING FTE'S=110.67)
ALLOCATION % OF N ADM
TO M/S UNITS=39%
PATIENTS/DAY M/S=28.44

Appendix Q: Continued

HOSPITAL 3, COST PER HOUR REPORT

		AVERAGE
DIRECT COSTS PER CARE HOUR MEDICAL UNIT		
COST/DIRECT HOUR		$22.59
COST/DIRECT WITH REGISTRY		$23.15
SICK, VAC, TAX & INS/HR		$8.44
TOTAL DIRECT CARE COST/HOUR		$31.59
INDIRECT CARE COST PPD		
NURSE MANAGER/ASSIST		$8.51
UNIT SECRETARY/TELE TECH		$7.44
TOTAL INDIRECT CARE COST PPD		$15.95
INDIRECT COSTS PER PT DAY		AVERAGE
MAT. & SUPPLIES/PPD		$6.47
OTHER EXPENSE/PPD		$4.12
OTHER NURSING COSTS		
	NURSING ADM	$5.48
	NURSING ED.	$2.47
TOTAL INDIRECT COST PER PT DAY		$18.54
TOTAL ALLOCATED COST PER PT DAY		$111.02
ALLOCATED COSTS=1,458,756/13,139		

REVENUE	$7,107,803.00
DIRECT EXPENSE	$2,967,351.00
ALLOCATED EXPENSE	$1,458,756.00
COST TO CHARGE RATIO	0.4174
PATIENT DAYS=13,139	13,139

TOTAL M/S FTE'S=48.85) (TOTAL NURSING FTE'S=405.65)
ALLOCATION % OF N ADM TO M/S UNITS=12%
PATIENTS/DAY MEDICAL UNIT=35.43

Appendix R

Summary Statistics of Nursing Cost Factors

Total Hospital Sample N=240

	DCARCOST	ICARCOST	TDCOST	IUCOST	ALLOCOST	TUNCOST
MINIMUM	137.10	10.73	148.11	13.49	111.02	305.27
MAXIMUM	4220.85	413.14	4633.99	350.74	3652.10	8593.27
MEAN	908.42	81.62	990.04	96.18	866.26	1952.47
STANDARD DEV	619.72	55.72	670.98	58.40	591.96	1241.82

Hospital 1 n=80 for each Hospital

	DCARCOST	ICARCOST	TDCOST	IUCOST	ALLOCOST	TUNCOST
MINIMUM	137.10	15.89	152.99	13.49	138.79	305.27
MAXIMUM	4220.85	413.14	4633.99	350.74	3608.54	8593.27
MEAN	892.77	101.30	994.07	86.00	884.79	1964.85
STANDARD DEV	678.04	72.72	750.19	61.74	635.20	1444.55

Hospital 2

MINIMUM	137.38	10.73	148.11	18.87	202.89	369.87
MAXIMUM	3364.69	193.14	3557.83	339.63	3652.10	7549.57
MEAN	778.01	59.82	837.83	105.19	1131.14	2074.16
STANDARD DEV	493.91	33.53	525.00	58.97	634.07	1197.37

Hospital 3

MINIMUM	250.19	15.95	266.14	18.54	111.02	395.70
MAXIMUM	3629.06	255.20	3884.26	296.64	1776.32	5957.22
MEAN	1054.47	83.74	1138.21	97.34	582.86	1818.40
STANDARD DEV	647.38	45.86	691.33	53.30	319.19	1054.34

DRG 127 n=60 for each DRG

	DCARCOST	ICARCOST	TDCOST	IUCOST	ALLOCOST	TUNCOST
MINIMUM	173.15	10.73	189.04	13.49	138.79	341.32
MAXIMUM	1962.10	238.35	2200.45	245.29	2637.63	4484.65
MEAN	744.38	68.13	812.51	82.99	748.72	1644.22
STANDARD DEV	378.94	40.71	416.46	49.20	522.26	922.29

DRG 14

MINIMUM	137.10	10.73	152.99	13.49	138.79	305.27
MAXIMUM	4220.85	413.14	4633.99	350.74	3652.10	8593.27
MEAN	1051.84	86.26	1138.09	100.45	900.74	2139.29
STANDARD DEV	855.64	73.79	924.91	73.63	753.96	1692.52

DRG 89

MINIMUM	250.19	15.95	266.14	18.54	111.02	395.70
MAXIMUM	3629.06	255.20	3884.26	296.64	2231.84	5957.22
MEAN	982.18	90.69	1072.86	105.37	935.58	2113.81
STANDARD DEV	657.46	54.35	707.07	57.90	506.87	1163.25

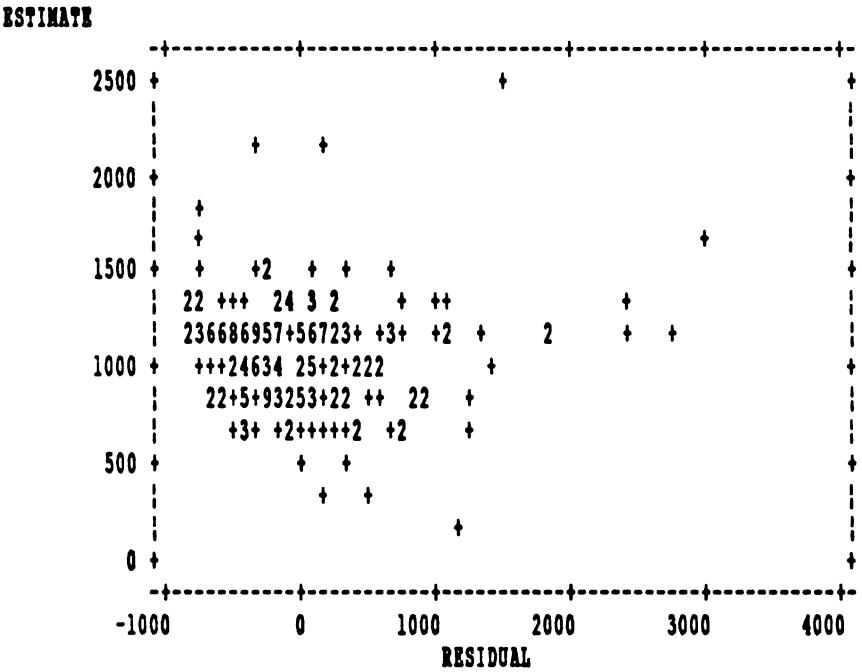
DRG 96

MINIMUM	137.38	10.73	148.11	18.87	202.89	369.87
MAXIMUM	2136.55	254.24	2390.79	215.84	2231.84	4827.27
MEAN	855.29	81.40	936.68	95.88	880.00	1912.57
STANDARD DEV	437.11	47.25	480.32	48.38	548.67	1009.09

Appendix S

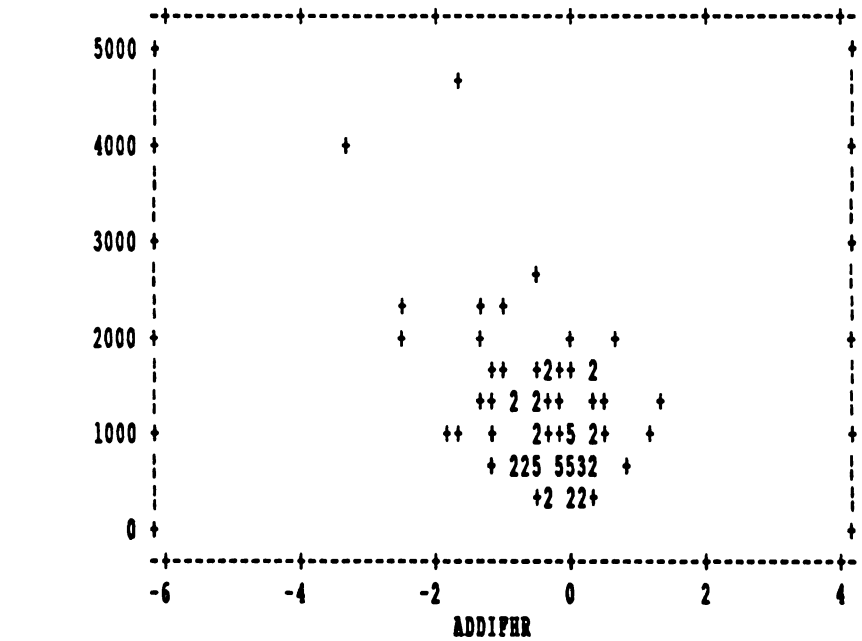
Plot of Residuals and Plots of Actual Difference in Hours to Cost

Plot of Residuals Actual Difference in Hours to Total Direct Cost



Plots of Actual Difference in Hours to Total Direct Cost By Hospitals

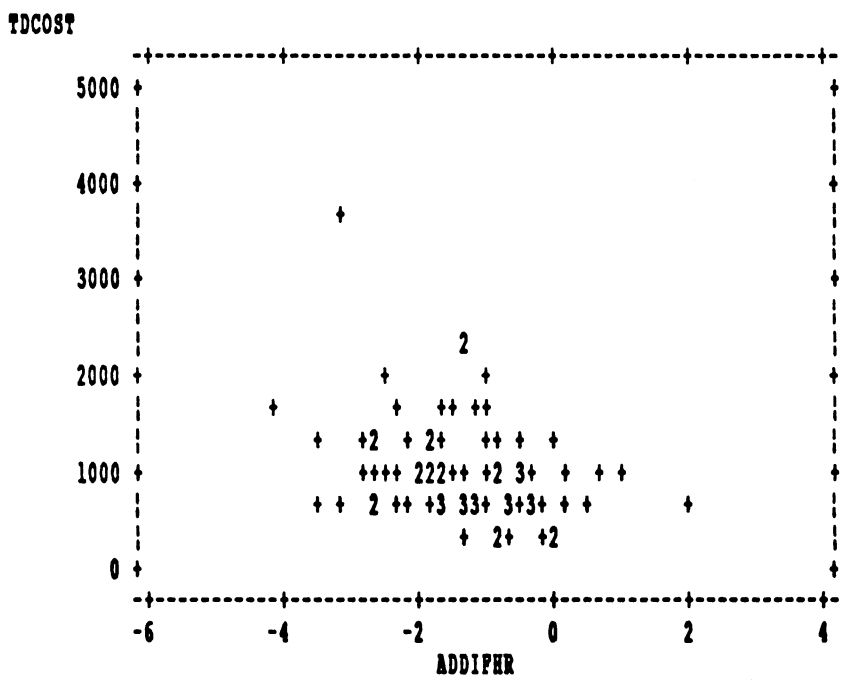
Hospital 1



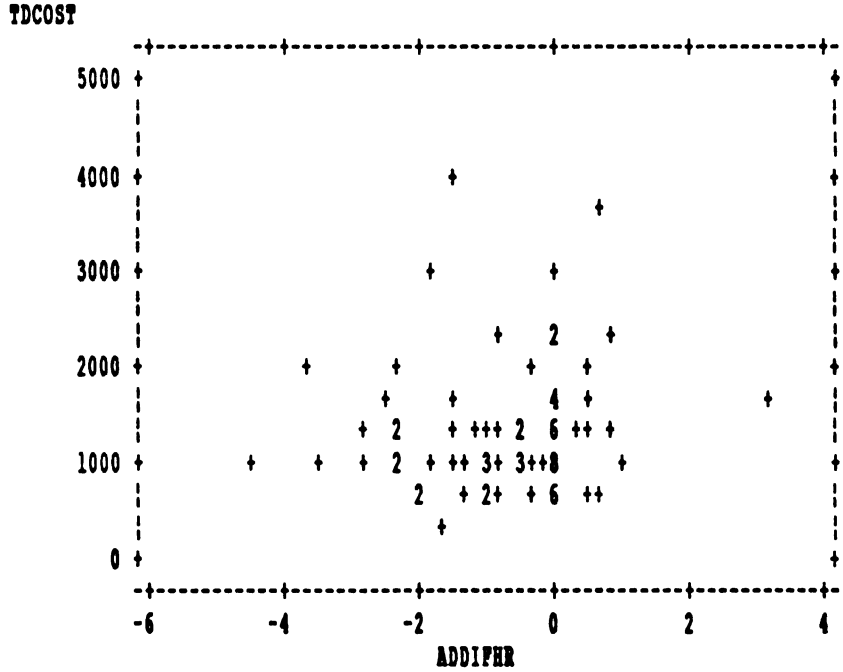
Appendix S: Continued

Plots of Actual Difference in Hours to Total Direct Cost By Hospitals

Hospital 2



Hospital 3



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