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Measurement of Hospital Performance: Environmental and Organizational Factors Associated with Cost

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MEASUREMENT OF HOSPITAL PERFORMANCE:

ENVIRONMENTAL AND ORGANIZATIONAL FACTORS

ASSOCIATED WITH COST

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ABSTRACT

MEASUREMENT OF HOSPITAL PERFORMANCE:
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ASSOCIATED WITH COST

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As U.S. health care expenditures top the $1 trillion mark, there is increased interest in measuring the performance of health care providers. For bottom line oriented payors such as government and business, the focus is on measuring cost. As hospitals account for over one-third of health care expenses, hospital cost per admission is a common measure of performance.

Many environmental and organizational factors come into play in determining hospital cost per admission. This research examines several of these factors, using Raymond Zammuto's model of organizational effectiveness assessment. Using Zammuto's framework, this research looks at the relationship of social, physical, and biological factors to cost per admission. Social factors include: hospital teaching status; ownership; patient socioeconomic status; and community poverty level. Physical factors include: hospital location; bed size; staff size; number of services offered; presence of specialty and tertiary services; and presence of obstetrical services. Biological factors are patient age and community elderly.

Although it is generally accepted that hospital cost per admission should be adjusted to account for differences among hospitals in patient complexity (i.e., case mix) and outpatient volume, not all adjustment methodologies take cost of living differences into account. To test the impact of adjusting for cost of living differences in addition to case mix

and outpatient volume differences, this research uses three versions of the dependent variable: 1) cost per admission adjusted for case mix, outpatient volume, and cost of living; 2) cost per admission adjusted for case mix and outpatient volume only; and 3) unadjusted cost.

The study population consists of 85 general acute care hospitals in the Commonwealth of Virginia. 1994 Annual Historical Filing data submitted to the former Virginia Health Services Cost Review Council (now Virginia Health Information) were used.

Multivariate linear regression analysis of the cost per admission adjusted for case mix, outpatient volume, and cost of living indicates that patient age (percent of hospital patients age 65+), the presence of obstetrical services, and hospital bed size are significant variables. Larger hospital bed size is related to higher cost per admission. Larger percent of hospital patients age 65+ and the presence of obstetrics are related to lower cost per admission.

Bivariate and multivariate analyses demonstrate that variables such as hospital location and community poverty level have a great impact on cost per admission when adjusted for case mix and outpatient volume only. If a cost of living adjustment is also made to the cost per admission calculation, the location related variables are not significant due to the relationship between those variables and cost of living. It is concluded that a cost of living adjustment should be made in addition to case mix and outpatient volume adjustments when studying hospital cost per admission.

The multivariate linear regression model for cost per admission adjusted for case mix, outpatient volume, and cost of living accounts for 30.9% of the cost per admission variance. Other factors such as physician practice patterns and hospital management policies play an important role in hospital performance. These factors have been beyond the scope of this study but merit additional research.

DEDICATION

Planners and evaluators are liable for the consequences of the actions they generate; the effects can matter a great deal to the people that are touched by those actions.

Rittel and Weber, 1973

ACKNOWLEDGMENTS

Many sacrifices were made by my family during the completion of this work. I would like to acknowledge my husband, Chuck, and my two daughters, Christina and Lara, and thank them for their understanding and support.

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CHAPTER I: INTRODUCTION

Research Overview

In today's health care environment, there is a tremendous amount of interest in the cost of hospital care. This interest comes from hospitals' constituents such as businesses and governments as well as from the hospitals themselves. While businesses and governments are concerned about the amount of money they spend on health services, hospitals are concerned about their ability to remain competitive in the market place while continuing to provide needed services.

Cost has become a key indicator of hospital performance. A number of complex factors influence cost. If hospitals are to be measured based upon their costs, it is important to identify these factors and to understand the reasons for the differences in cost among hospitals. The purpose of this study is to examine some of the reasons why hospitals differ in their costs. What role do environmental factors play in determining a hospital's cost? What relationship do organizational factors have to cost? Do some of these environmental and organizational factors add to hospital cost but yet have an important societal role? If cost is to be used as a performance measure, should the cost performance measure be adjusted in some manner based upon these environmental and organizational factors?

Further impetus for this research is the concern that an overwhelming focus on hospital cost may have a negative impact upon the health care system in areas such as access to care, quality, service, medical education, and research. A better understanding of the relationships of environmental and organizational factors to hospital cost should assist in the

development of improved performance measurement methods.

Background

Businesses' and Governments' Concerns about Health Care Costs

Total U.S. health care expenditures climbed from $26.9 billion in 1960 to $1.035 trillion in 1996. The 1996 expenditure is equivalent to $219.3 billion when converted to 1960 dollars to adjust for inflation (A. Long, personal communication, March 5, 1998). Adjusting for inflation, national health expenditures increased by 715% from 1960 to 1996. Health care expenditures accounted for 5.1% of the Gross Domestic Product (GDP) in 1960; this increased to 13.6% in 1996 (Levit, Lazenby, Braden and the National Health Accounts Team, 1998). A National Coalition on Health Care study projects that health spending will rise to $1.5 trillion in 2002 and will account for 15 percent of the GDP ("Health Spending Projected", 1997).

During the past three decades, the amount that businesses have spent on health care increased significantly both in real dollars as well as in percent of total national health care expenditures and percent of total employee compensation. In 1970, businesses accounted for 19.8% of health care services and supplies expenditures; by 1991, this increased to 28.2% (Health United States 1995, 1996). For private industry, health insurance expenditures as a percent of payroll increased from 3.5% in 1970 to 8.3% in 1989 (P. Feldstein, 1994).

The amount that governments have spent on health care also has climbed. As shown in Figure 1, in 1960, the federal, state, and local governments accounted for 24.8% of total health care expenditures ($6.6 billion). This amount increased to 46.7% of the total by 1996 or $483.1 billion. 1996 Health Care Financing Administration data showed that the federal government is the fastest growing payor of health care.

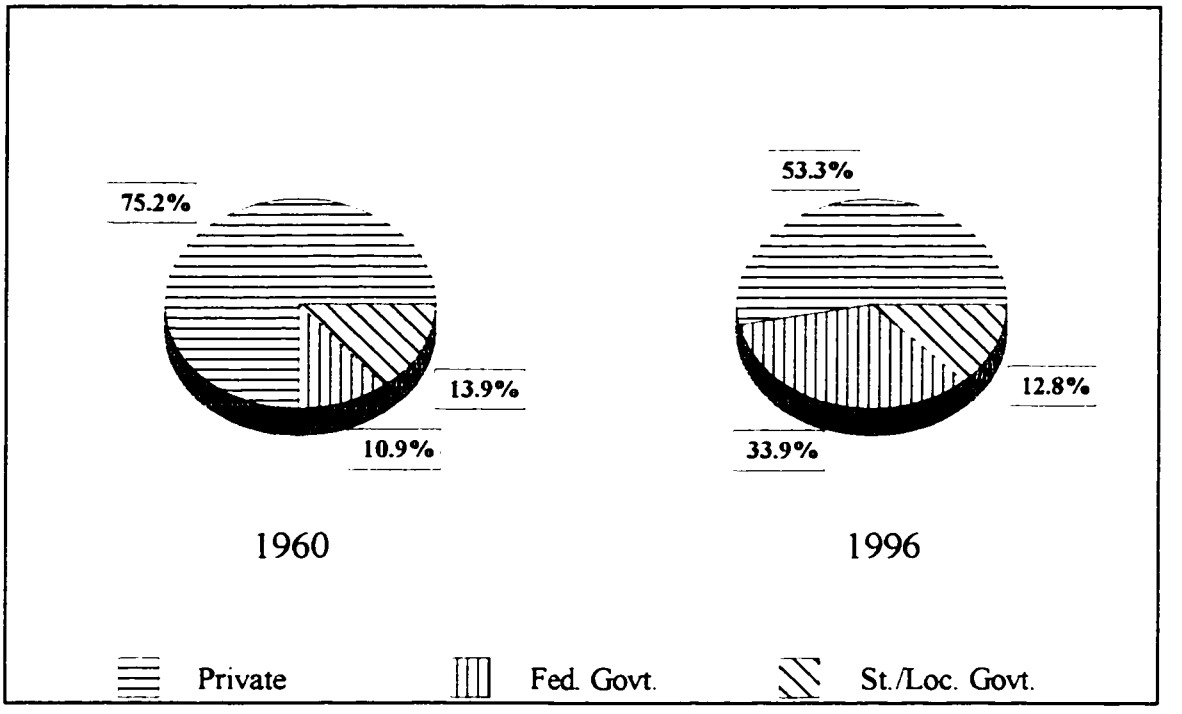

Figure 1
National Health Expenditures

Source: Health Care Financing Administration

Interest in Value

Businesses and governments are important stakeholders in health care. As the amount that businesses and governments spend on health care has grown, so have their demands for measurements of health care providers' performance. The term value-based purchasing has come into use, meaning that purchasers, such as businesses and governments, seek to obtain maximum value for their health care dollar (Casey, 1993).

Although cost is an important component of value, the term value also includes an element dealing with outcomes or quality, as noted in the formula below (Wetzler, 1994):

Value = Outcomes (or Quality) Costs

In other words, value can be defined as cost effectiveness. In identifying value for the purpose of their health care purchasing, businesses and governments have generally focused on the costs part of the equation. There are several potential reasons for this focus: businesses and governments are very much financially driven; financial measurements are generally well defined and are often validated through audits; outcomes and quality measurements are generally not well defined, cannot be measured well, and are somewhat subjective in nature; and businesses in general believe that quality does not suffer as a result of cost cutting ("Is Cost Everything?", 1996).

Focus on Hospitals

Most of the focus of the concern about health care costs has been on hospitals. This has occurred for a number of reasons. First, hospitals are the largest single component of expenditures accounting for $364.5 billion or 36.1% of the total amount of health care expenditures (Dimmitt, 1996). Second, the types of procedures which are extremely costly and are often highly visible to the general public through the media (such as transplants) generally take place in hospitals. Third, due to various licensing, reporting, and billing

requirements, hospital data are more readily available than data from other sources such as physician offices, home health agencies, or ambulatory care centers. Finally, there are relatively a small number of hospitals when compared to the number of other types of providers such as physicians or nursing homes. A small number of facilities accounts for a large part of the cost.

Measurement of hospital performance is not new. In the past, the purpose of these efforts was to enable hospitals to measure financial standing, to develop and monitor quality assurance programs, to determine areas for improvement, to identify trends, and generally to communicate information to internal audiences such as hospital staff, medical staff, and Board members. Measurement indicators have focused on specific dimensions of hospital performance, such as financial performance or quality, rather than a single, overall measurement of performance.

The factor that has brought new interest to the field of performance measurement is the demand by external audiences such as businesses and governments for performance data, specifically data which demonstrate the cost effectiveness and efficiency of hospital services. As Gerald Burke, M.D. (1995), professor of medicine at Rush Medical College in Chicago, notes, "...hospitals need to accept the reality that accountability has replaced trust as the byword of health care delivery". According to the Random House Dictionary, accountable is defined as subject to the obligation to report, explain, or justify something. Hospitals increasingly are being requested to report, explain, and justify costs, quality, outcomes, value, cost effectiveness, and efficiency. Increasingly payors are searching for a measurement of hospital performance that will differentiate the efficient providers from the inefficient. This search for performance measures has resulted in the development of report cards, as indicated in the following excerpt from an American Hospital Association newsletter article

("Measuring and Reporting Quality", 1994).

> Report cards are in. Public accountability of hospital performance is part of every major national health reform proposal and purchasers and major insurance companies are using performance information to forge provider networks and negotiate provider contracts. With annual health care costs approaching $1 trillion this comes as no surprise. Consumers and purchasers of care want to know that they are receiving appropriate, quality care. (p. 1)

Growing Interest in Performance Measurement

The first edition of Health Care Report Cards (1995) identified almost three dozen health care report cards, patient satisfaction surveys, performance reports, and shopping guides published by HMOs, consumer groups, state governments, and business coalitions. More recent editions in 1996 and 1997 have identified over four dozen cards and guides. This demonstrates the increasing interest in measuring health care providers' performance in order that external audiences may use the information to make health services purchasing decisions.

Performance Measurement Initiatives

A number of initiatives are underway across the country to measure the performance of hospitals as well as nursing homes, physicians, and health plans. Some initiatives are driven by health care business coalitions, provider accreditation bodies, or provider associations. Still others are offered by commercial firms who have recognized the growing popularity of report cards. Other initiatives have been spearheaded by the federal government. Some state governments are now leading efforts in the belief that providing health care purchasers and consumers with health care data is an appropriate state role.

Health Care Business Coalition Initiatives

Health care coalitions, comprised of businesses alone or businesses and providers together, are active in many communities across the United States. Many coalitions have turned to acquiring and providing data to their members to improve their decision making on their health care purchasing.

One notable example of this is Cleveland Health Quality Choice, a coalition of businesses, hospitals, and physicians formed in 1989. The coalition publishes "The Cleveland Area Hospital Quality Outcome Measurements and Patient Satisfaction Report". This report includes information in these six areas: patient satisfaction (hospital patient satisfaction in medical and surgical care and hospital patient satisfaction in obstetrics); general medical outcomes (mortality and length of stay for selected medical diagnoses); general surgical outcomes; intensive care outcomes (hospital mortality and length of stay for intensive care patients); Caesarean section and vaginal birth after Caesarean rates; and outcomes by clinical services (hospital patient satisfaction, mortality, length of stay, mortality for intensive care patients).

Another example can be found in the St. Louis Area Business Health Coalition. This coalition was formed by area employers in 1982. Annually, the group publishes the "St. Louis Area Hospitals: Industry Financial and Statistical Overview". This report includes information on hospital performance (analyses of operating income, expenses and revenues, hospital margins, patient days, bad debt), utilization trends (inpatient utilization, length of stay, managed care market share), hospital charges (Diagnostic Related Group [DRG] charges and volumes for such groups as cardiovascular, gastrointestinal, orthopedic, obstetric, and gynecological), and other hospital and health care trend information.

Initiatives by Provider Accreditation Bodies

The Joint Commission on the Accreditation of Healthcare Organizations (JCAHO), which was formerly known as the Joint Commission on the Accreditation of Hospitals (JCAH), has played an important role in assessing hospital care since the 1950's. Over the past 40 years this private organization has surveyed hospitals on a voluntary basis to determine their compliance with the organization's standards. Depending upon the level of compliance, a hospital may receive accreditation with commendation, accreditation, accreditation with recommendations for improvement, provisional accreditation, conditional accreditation, or may not receive accreditation at all. The organization accredits more than 5,000 hospitals. In 1994, as part of its Agenda for Change, this organization started publishing profiles of individual hospitals. These Hospital Performance Reports assign each hospital an overall score between 0 and 100. This report lists 28 performance areas: patient care functions (assessment of patients, medication use, operative procedures, patient/family education, patient rights); service providers and staff (medical staff, nursing, staff training); physical environment and safety (infection control, safety); organizational leadership and management (organizational leadership, governing body, management and administration, management of information, improving organizational performance); and department/ service specific requirements in 13 areas (Joint Commission on Healthcare Organizations, 1994). The organization undertook this new role in response to external demand for hospital report cards. According to President Dennis O'Leary M.D., public disclosure is a major customer service initiative for the Commission (Kenkel, 1995). JCAHO currently has a new initiative underway; ORYX is a new program whereby performance indicator data are provided by the hospital to JCAHO through JCAHO-approved third party vendors. Specific indicators are selected by each organization from an approved list; potential indicators include complication

rates, readmission rates, mortality rates, and Caesarean section rates. ORYX PLUS is an expansion of that program in which facility comparative data may be released to the public.

An additional performance evaluation effort being undertaken by an accreditation body is the development of report cards on health maintenance organizations (HMOs). The National Committee for Quality Assurance (NCQA) is an HMO accreditation organization which has developed a standard data set, called Health Plan Employer Data and Information Set (HEDIS), on which to base evaluations of performance of HMOs (National Committee for Quality Assurance, 1993). Since 1996, NCQA has published "Quality Compass" which provided HEDIS 2.5 and accreditation information on over 200 health plans. HEDIS 2.5 was a core set of 177 performance measures divided into five sections: quality of care (health promotion, preventive care); member access and satisfaction (physician acceptance of new members, wait times, satisfaction survey results); membership and utilization (enrollment, disenrollment, utilization by DRG); finance (rate trends, financial stability, financial efficiency); and health plan management and activity (physician credentials, clinical management). Health plans are now reporting data using the most recent release of the data set, HEDIS 3.0 (NCQA, 1997). This version is more outcomes oriented and addresses the full continuum of health care. HEDIS appears to be gaining acceptance as the preferred data set for the reporting of health plan performance. As Medicare and Medicaid turn to managed care, mandatory reporting requirements are being put into place for HMOs; HEDIS, or customized versions of it, increasingly is being adopted as the accepted measurement for HMOs and is used by health care purchasers such as business and individual consumers.

Provider Associations

Efforts to measure hospital performance have also been driven and directed by the hospital industry. The Maryland Hospital Association (MHA) Quality Indicator Project is

an example of hospital performance measurement efforts (Kazandjian, Lawthers, Cernak, and Pipesh, 1993). This project is designed to measure and provide feedback to hospitals on various indicators of inpatient, ambulatory, and emergency care. Indicators measure events such as: hospital acquired infections; surgical wound infections; inpatient mortality; neonatal mortality; Caesarean sections; unscheduled readmissions; unscheduled returns to a special care unit or to the operating room or to the emergency department; registered patients in the emergency department more than six hours; cancellation of an ambulatory procedure on the day of the procedure; and others. These data are designed for internal audiences (i.e., hospital staff) for the purpose of performance improvement rather than external audiences (such as businesses); the individual hospital data are not available to the public.

Across the country, many state hospital associations have played important roles in the development of a statewide patient level data base and in providing data back to hospitals to assist in measuring performance and benchmarking. For example, the Virginia Hospital and Healthcare Association (formerly known as the Virginia Hospital Association) implemented a patient level data base for Virginia hospitals in 1992 (Virginia Hospital Association, 1992).

Some hospitals have recognized that external audiences are searching for measurement of value and have produced their own report cards. In 1994, Mercy Hospital Medical Center in Iowa published its "Mercy Hospital Quality Care Report" to assist in its managed care contracting efforts (Montet, 1994). In its report card, Methodist Hospital of Indianapolis includes information on charges, severity of patients, length of stay, morbidity, mortality, infection rates, and other factors. Boone Hospital Center in Columbia, Missouri publishes "Health Care: Your Right to Know", a report card showing Boone's performance in patient satisfaction as well as charges for a number of DRGs.

Commercial Firms

Health care information firms and consulting firms have discovered that there is a growing market for hospital performance measurements. Each year since 1993, Health Care Investment Analysts, Inc. (HCIA), a Baltimore based health care information company, and William M. Mercer, Inc., a human resources management consulting firm, have released "100 Top Hospitals: Benchmarks for Success". The top hospitals are chosen using eight different indicators: expense per adjusted discharge; cash-flow margin; long-term growth in equity; return on assets; severity adjusted average length of stay; index of outpatient activity; risk-adjusted mortality; and risk-adjusted complications (see Table 3 in Chapter II for a complete description of the indicators). An adjustment is made to the expense per adjusted discharge indicator which takes into account the specific hospital's patient complexity (using the Medicare case mix index), outpatient volume, and cost of living (using the Health Care Financing Administration [HCFA] wage index) (HCIA, Inc. and William M. Mercer, Inc., 1995).

The consulting firm KPMG Peat Marwick also has published results of their research on hospitals, including their rankings of the top hospitals in the country in managing their costs (Guide to Hospital Performance, 1995). KPMG Peat Marwick has developed a data base of information on over 3,700 U.S. hospitals. In 1996, KPMG Peat Marwick published "The Impact of Managed Care on U.S. Markets" using information from their extensive data base. Performance measures used in this report included: cost per case; length of stay; and mortality. The cost per case measure was adjusted for patient severity and cost of living; the cost of living was adjusted using the hospital's HCFA wage index.

An additional commercial initiative is the publication of the Medicare mortality data which previously had been distributed by the Health Care Financing Administration, the

federal agency responsible for the Medicare program. The Washington D.C. based Center for the Study of Services, a not-for-profit consumer protection oriented organization, has published a consumer guidebook containing the Medicare mortality rates for each hospital. This organization also publishes Consumer Checkbook magazines which rate quality and prices of local services, including hospitals (Brown, 1994).

Federal Government

Over the years, the role of the federal government in disseminating performance information has changed. It is not now actively involved in publishing data on hospital performance. However, from 1987 through 1992, HCFA published the hospital Medicare patients' mortality rates. Some newspapers published the data and ranked hospitals according to the "best" and "worst" (United States Government Accounting Office, 1994). The validity of these data and the value of the information was questioned and HCFA no longer publishes the information. These data are available commercially as indicated in the previous section.

However, with respect to federal government efforts, measurement of the performance at the health plan (consisting of multiple providers, including hospitals, physicians, outpatient facilities, etc.) level and publication of those measurements was one of the foundations of the proposed but unapproved Clinton health care reform strategy. In conjunction with this focus, the United States General Accounting Office published a report in September 1994 entitled, "Health Care Reform: 'Report Cards' Are Useful but Significant Issues Need to Be Addressed". Many of these same issues are relevant to the task of measuring performance at the hospital level. Their major findings were:

- Various organizations with an interest in health care are developing report cards, i.e., health plans, government agencies, hospitals.
- Experts disagree about what a report card should include.

- Report cards may be based on inaccurate, misleading, or incomplete information.
- Measures selected may not reflect quality.
- Standardized formulas for calculating results have not been developed.
- Report card results are not verified.
- Different stakeholders gain different benefits from report cards.

Notably, one of the conclusions of this study is that report cards might have some unintended adverse consequences. While the report is focused at measurement of health plans, this point is also appropriate for hospitals: "Some experts also are concerned that administrators will place all their organizations' resources in areas that are being measured. Areas that are not highlighted in report cards will be ignored" (p. 55).

State Governments

A number of states are utilizing health care data to measure performance of health care providers. Over the past decade, about 40 state legislatures have passed laws requiring health officials to collect and analyze data from hospitals (Thomas, 1995). One of the goals is to help employers and others who purchase group care to choose the hospitals with which they want to deal. In some states, this information is also available as report cards that consumers can use when shopping for themselves.

In Pennsylvania and New York, consumers have access to information about the volume of coronary artery bypass grafting (CABG) procedures performed at hospitals each year. Since 1991, both states have published annual CABG data for cardiac surgeons practicing within their borders (Thomas, 1995). In addition, the Pennsylvania Health Care Cost Containment Council has published the Hospital Effectiveness Report, which provides inpatient charge and treatment effectiveness information on all acute care hospitals in the state with more than 100 beds (Atlantic Information Services, 1995). Another example is the

Colorado Health Data Commission's publication of Colorado Hospital Outcomes: Mortality, Length of Stay and Charges for Cardiovascular and Other Diseases.

Virginia

A number of initiatives are underway in Virginia to provide information to health care consumers to improve their abilities to make knowledgeable health care decisions. In Virginia, the Joint Commission on Health Care, a state government health policy agency, was active in pursuing legislation to accomplish this. The Joint Commission believed that one of the fundamental problems with the health care market was that consumers were unable to compare the cost and quality of the health care services they purchase. The problem existed because there was a lack of publicly available, user-friendly information on the performance of health care providers. The Joint Commission believed that the result was that purchasers had a limited ability to shop among health care providers for the best value in terms of both cost and quality. The Joint Commission also felt that without this market force, providers had less of an incentive to reduce their costs and improve their quality (Joint Commission on Health Care, 1993).

In 1992, the Virginia General Assembly passed legislation to address this problem. Senate Bill 518 (see Appendix A) required that the Virginia Health Services Cost Review Council (VHSCRC) establish a methodology for the review and measurement of the efficiency and productivity of health care institutions. As stated in the accompanying Senate Joint Resolution 118 (see Appendix B), this methodology was to improve the identification of the most efficient providers of high quality health care within the Commonwealth.

Over a period of two years, this methodology was developed and in December 1994, the Cost Review Council published its first report card of Virginia hospitals. These report cards or profiles, based upon 1993 data, were published in the Cost Review Council's 1994

Annual Report. The profiles included information on hospital charges, costs, productivity, financial viability, and community support activities. As stated in the Report's Methodology Overview, "... the Council's underlying assumption is that consumers - broadly defined to include individuals and families, traditional health insurance companies, managed care companies, employers, and other business groups - can improve their purchasing decisions regarding health care. Thus, the role of the government in this approach is to ensure that the market place has efficient access to accurate information about hospitals" (p. iii).

The Annual Report provided a profile for each of the 90 acute care hospitals in the Commonwealth. The profile included information on 18 different indicators within five categories. Table 1 shows these indicators along with their desired direction, as defined by the Council.

The 1995 report, entitled Buyer's Guide to Efficient and Productive Hospitals and Nursing Homes, based upon 1994 fiscal year data, was released by the Cost Review Council in March 1996. The 1996 Buyer's Guide, containing 1995 data, was published by Virginia Health Information, in June 1997. In December 1997, the 1996 data edition was released, with a revised title as an Industry Guide. Virginia Health Information intends to continue publishing hospital data on an annual basis and is studying potential modification to the indicators and report.

One of the issues before the General Assembly in 1996 was the future of the Virginia Health Services Cost Review Council. A study conducted by the Joint Commission on Health Care found that many of the reports published by the Council were not being utilized and were not viewed as producing value. However, the report card was the one Council report valued by the constituencies surveyed in the study (Joint Commission on Health Care, 1995). Legislation passed in 1996 eliminated the Cost Review Council but provided for the continued

publication of the report card by a different organization, Virginia Health Information (known as VHI). VHI is a private organization governed by a board consisting of business, provider, government, and consumer representatives. Under contract with the Virginia Department of Health, VHI administers the statewide patient level data base and other data initiatives.

Table 1
Hospital Efficiency and Productivity Profile Indicators
1995 Buyer's Guide to Efficient and Productive Hospitals and Nursing Homes
Virginia Health Services Cost Review Council

Category	Description	Desired Direction
Charges	1. Gross Patient Revenue per Adjusted Admission ($)	⇓
	2. Net Patient Revenue per Adjusted Admission ($)	⇓
Costs	3. Cost per Adjusted Admission ($)	⇓
	4. Labor Cost per Adjusted Admission ($)	⇓
	5. Non-Labor Cost per Adjusted Admission ($)	⇓
	6. Capital Cost per Adjusted Admission ($)	⇓
Productivity/ Utilization	7. Full-Time Equivalents per Adjusted Occupied Bed	⇓
	8. Paid Hours per Adjusted Admission	⇓
	9. Staffed Beds Occupancy (%)	⇑
	10. Licensed Beds Occupancy (%)	⇑
	11. Special Service Utilization (%)	⇑
	12. Case-Mix Adjusted Average Length of Stay	⇓
Financial Viability	13. Cash Debt Coverage	⇑
	14. Total Margin (%)	⇑
	15. Return on Assets (%)	⇑
	16. Fixed Asset Financing Ratio	⇓
Community Support Activities	17. Charity, Bad Debt, and Taxes (%)	⇑
	18. Medicaid Participation (%)	⇑

Summary of Indicators

This section has discussed a number of performance measurement initiatives. A variety of indicators are being used to measure performance. Table 2 summarizes the types of indicators currently used to measure performance of hospitals.

Table 2
Hospital Performance Indicators

Category	Indicators
Utilization	Occupancy rate for hospital - licensed beds, staffed beds Volume of patients - all patients, for specific Diagnostic Related Groups (DRGs), for specific procedures such as open heart surgery Average length of stay - for all patients, for specific DRGs, for specific procedures Caesarean Section rates and Vaginal Birth after Caesarean rates Special services utilization (such as operating room)
Clinical outcomes	Mortality - all patients, for specific Diagnostic Related Groups (DRGs), for specific diseases or procedures Infection rates - hospital acquired, surgical wound, other Readmission rates - unscheduled, other Complications - overall, specific types Functional status of patients after discharge
Patient satisfaction	Survey results
Financial	Average charge (gross revenue) per patient Average net revenue per patient Average cost per patient (overall, labor, non-labor, capital) Cash flow margin Return on assets Cash debt coverage Fixed asset financing ratio Charity, bad debt, taxes Medicaid participation
Productivity	Full time equivalents per bed Paid hours per admission
Structure	Facility accreditations, licensure, certification Staff credentials
Process	Assessment of patients Training

Importance of Adjustment Methodologies

Many of the indicators used to measure performance are adjusted in some manner to facilitate comparison. For example, length of stay indicators are often adjusted to account for the different complexity or severity of illness of patients. Mortality indicators are often adjusted for the risk factors of patients. Cost indicators are also adjusted in a variety of ways.

Generally the cost per admission indicator is adjusted in some manner to take into account the differences in hospitals' case mixes (which measures the complexity of hospital patients based on the Diagnostic Related Group [DRG] case weight as determined by the Health Care Financing Administration). The cost per admission indicator is also adjusted in some manner to ensure that the cost reflects inpatient and outpatient cost and that the admission reflects both inpatient and outpatient activity. Each of these adjustments is made in an effort to take into account the differences that are related to those factors, allowing the cost per admission indicator to reflect the differences that are not related to those factors.

Another type of adjustment that can be made to cost per admission adjusts for the differences in hospitals' cost of living. This adjustment is not as common as case mix and outpatient adjustments but can be made using the hospital's area wage index as determined by the Health Care Financing Administration. At this time, there is no one standard method of cost adjustment.

Shortcomings in Current Hospital Performance Measurement

Factors to Consider in Assessing Performance

The notion of using hospital performance information to make health services purchasing decisions has merit. However, it assumes that the performance of a facility can be appropriately and accurately measured and compared with the performance of other

facilities. Given the complexities of the hospital, the health system, and the environment, development of a methodology to identify the performance of a hospital is a difficult undertaking. Scott and Shortell (1988) identify two classes of factors that must be considered in assessing organizational performance: conceptual and measurement.

Conceptual Factors

There are a number of conceptual factors to consider in assessing organizational performance. These can be categorized as: the nature of organizations; the dimension of activity; the level of evaluation; constituencies of an organization; and time considerations.

Nature of organizations. Scott and Shortell observe that of the many factors that affect one's concept of organizational performance, none is more important than the view adopted of the fundamental nature of organizations. For example, if organizations are viewed as rationally designed instruments for the attainment of specific goals, then performance measures are likely to focus on goal attainment. If organizations are viewed as primarily oriented toward their own survival, performance measures are likely to focus on system maintenance. The type of performance measurement used depends upon one's view of the concept of organizations.

Dimension of activity. Another conceptual factor is the dimension of activity to be evaluated. Most complex organizations are multipurpose systems serving a variety of objectives. Hospitals not only provide a variety of patient care services; many pursue educational goals, research goals, and prevention and community service goals. The same organization may perform extremely well on one set of activities but relatively poorly on another.

Level of evaluation. The level of evaluation is another important conceptual factor. Organizations are composed of units and subunits and themselves are a subunit of a larger

system. In the case of hospitals, evaluations can take place at the hospital level, department level, health system level (in the case of multi-hospital systems), health plan level, etc. High performance at one level does not necessarily indicate high performance at another level.

Constituencies of an organization. Another conceptual factor to consider is constituencies. Organizations have a number of different constituencies. Scott and Shortell state, "The history of organizations over recent decades is partly a story of the recognition and increased legitimation of the varying interests of their multiple constituencies" (p. 423). The importance of constituencies has been recognized by other researchers and forms the basis for the constituency model of measuring organizational performance. For example, Cyert and March note that organizations are viewed as shifting coalitions of interest groups, some internal and some external. These interest groups are constantly engaged in negotiating the conditions of their participation in the organization. They note that in most organizations, power is more widely dispersed today than in the past. More diverse constituencies are perceived to be legitimate stakeholders in the enterprise. Moreover, these constituencies have multiple and sometimes conflicting interests. For example, employers that pay for all or part of an employee's health insurance premium are interested in keeping the cost low. Physicians and other health professionals are most interested in providing high quality health care for their patients. The constituency model of measuring organizational performance is extremely relevant for hospitals given the large number of hospital constituencies and the importance of these constituencies to hospitals.

Time considerations. A final factor to address with respect to the conceptual nature of organizational performance assessment is time. Time is a consideration in various ways. The point at which performance is assessed may greatly influence the judgment reached. In addition, the constituencies of an organization and the constituencies' interests vary over time.

Issues that are important in 1998 may not be important in the year 2003, and vice versa.

Measurement Factors

In addition to the conceptual factors, there are important measurement factors to consider in assessing organizational performance. Scott and Shortell categorize these as follows: sophistication of indicators; multiple indicators vs. single indicator; and reactivity.

Sophistication of indicators. Indicators of organizational performance are still relatively unsophisticated. At the present time, financial measures are relatively more well defined than measures of quality and outcomes. Quality and outcomes measures generally address clinical aspects of patient care. Often, there is not widespread agreement on what to measure and how to measure it. Also, the data elements may not be collected in a manner conducive to statistical analysis. As an example of the lack of sophistication of outcomes measures, a patient's complications may not be documented in the chart or may not be coded by medical records staff. In addition, a patient's functional status after hospital discharge is generally not measured or incorporated into the patient's medical record. The sophistication of indicators, however, is improving. The sophistication of financial indicators is also increasing as adjustments are made for factors such as cost of living, patient complexity, etc..

Multiple indicators vs. single indicator. Another measurement factor to consider is the issue of multiple indicators vs. single indicator. Scott and Shortell (1988) advocate a multiple indicator approach to identifying performance levels on various dimensions. In contrast, Nash (1983) states that it is wrong to assert that there is no best quantitative measure of corporate performance, that the best measure is profit. Even though businesses and governments that are searching for value in health care recognize that cost is not the only measurement criterion, in practice, cost is often utilized as the primary criterion ("Is Cost Everything?", 1996).

Reactivity. Scott and Shortell also identify the element of reactivity in measurement. Efforts to evaluate performance can be expected to affect that performance. The purpose of an evaluation system is to influence the performance of the participants. It is important to recognize that there are unintended effects of performance evaluations in addition to the intended effects. A performance evaluation based on hospital cost causes a number of reactions in hospitals; these reactions can impact the entire health care system. These reactions may be positive (such as reduced costs for consumers) or negative (such as reduced access to services). It is the potential negative reactions and effects that are the impetus for this research.

Potential Negative Impacts of Measurement

Focus of measurement. Currently, a primary interest of businesses and government is the cost of health care. This interest has driven insurers to negotiate with providers for significant price discounts. In the case of governmental programs such as Medicare and Medicaid, reimbursement rates are pre-established, generally at low levels which may not cover the actual cost of the care being provided. These initiatives by health care purchasers have driven providers to attempt to reduce their actual cost of providing care. Providers are looking at ways to improve operational efficiency and to improve the patient care process by lowering labor, supply, and other costs.

These efforts have a great deal of potential for improving the patient care process and outcomes. However, there are also several potential negative impacts possible as a result of this focus on cost. An increased emphasis by a hospital on cost savings may lead to decreased emphasis in areas such as quality, service, medical education, research, access, and community service.

Impact on quality and service. As an example of a potential negative impact of

measurement, hospitals striving to receive high scores on performance measurement methodologies which focus on the efficiency dimension may make sacrifices in quality and service of care in order to reduce costs. Researcher Barbara McNeil, chair of the Harvard Medical School health care policy department notes, "There's great concern among patients, providers, and policy makers that financial pressures could lead to scrimping on patient care in the interest of saving money" (Thomas, 1995, p. 9).

Impact on medical education and medical research. Furthermore, medical education and medical research may be negatively impacted by measurement. Hospitals may make reductions in their teaching and research programs in the effort to reduce costs. Academic institutions have been increasingly vocal about their concerns of the impact of cost containment strategies on their programs ("Can Academic Medical Centers Survive?', p. 7). Academic medical centers are impacted by the reduction in revenues from physician practice plans, decline in inpatient utilization, and reductions in government funding (Rovner, 1996). Nationally, expenditures on noncommercial research were only 1.6% of the total of national health care spending in 1993 as compared to 2.6% of the total in 1970 (Health United States 1994, 1995).

Impact on access to care and community service. Measurement efforts might negatively impact access to care and community service in different ways. If facilities such as those in inner city areas receive low performance scores and are eliminated from insurance plans as a result, the facilities undoubtedly will suffer financial distress. Financial distress could lead to hospital closure or elimination of services. This in turn could result in reduced access to health care services for the community at large, especially the uninsured. Another example of the impact on access to care and community service is the reduction or elimination of health screening, health promotion, and community education programs. As a hospital

becomes more concerned with cost control, it may eliminate or reduce funding for these types of community programs.

Impact on participation in health plans, insurance networks, and contracts. Hospitals receiving low performance scores may be excluded from participation in governmental or business health plans, insurance networks, and contracting. Blue Cross of California announced it would give lower-cost hospitals preferred contracting status. Customers selecting Aetna Health Plans of Ohio's narrow-gate network (i.e., a network of 11 hospitals which received higher report card scores) instead of its standard 33 hospital network received a 25% price discount; the narrow-gate facilities scored higher on cost effectiveness and quality, as measured by the third report card from the Cleveland Health Quality Choice project.

Purpose of the Study

Measurement of hospital performance is an extremely complex issue. The idea of using performance measures to distinguish the efficient and effective hospitals from others is very appealing. Hospitals that are inefficient or ineffective in some way should be identified in order that improvements can be made. However, a risk of any measurement methodology is validity and reliability. Some efficient hospitals may be mistakenly labeled as inefficient and some inefficient hospitals labeled as efficient. The use of hospital performance measurements has serious short term and long term implications. Many factors impact hospital performance and it is important to have a clear understanding of what they are. Some of the factors may be outside of the control of the organization. Other factors may serve a broader societal purpose. An understanding of the factors that impact hospital performance is necessary in order to develop performance measurement methods that serve to promote improvements in

the health care system rather than lead to unanticipated negative impacts on the system.

In the current health care environment, important constituencies such as businesses and governments consider low cost to be the definition of effective and efficient organizational performance. Given the importance of the cost issue, there is a need for further research on factors that impact cost and for research on different adjustment methods used to define cost. This study will examine the relationships between various environmental and organizational factors and cost within the theoretical framework of Zammuto. To develop a better understanding of the implications of cost adjustment, this research will also study cost that is: 1) adjusted for hospital case mix as a measure of patient complexity and severity, hospital outpatient volume, and area cost of living; 2) adjusted for hospital case mix and hospital outpatient volume only; and 3) unadjusted.

Overview of Theoretical Framework

As Scott and Shortell note, one of the important conceptual factors to consider in organizational performance measurement is constituencies. One school of organizational performance measurement theory is built on this factor, the constituency model approach. This approach is particularly appropriate for health care and hospitals because of the large number of internal and external constituencies. This research will utilize the constituency model approach focusing on Raymond Zammuto's theoretical framework (Zammuto, 1982). Zammuto's framework has been selected because it recognizes the impact of the environment on organization performance.

Zammuto notes that each organization occupies a unique niche within the environment. This niche is defined by various social, physical, and biological factors. These factors shape and constrain the organization's actions. Since they serve as constraints on the

organization's performance, they need to be taken into consideration when assessing the performance of the organization. In the context of Zammuto's theory, this research will examine various social, physical, and biological factors that may impact hospital performance. These factors include:

Social factors:	Teaching status; type of ownership; patient socioeconomic status; community poverty level; managed care participation
Physical factors:	Location; size; services offered by the facility
Biological factors:	Patient age; community elderly population

Research Questions

This research attempts to address the basic question, "What environmental and organizational factors are related to hospital cost?" Specific questions that this study will address include:

- How are social factors, such as community poverty level, related to cost?
- What relationships exist between cost and physical factors, such as hospital size?
- Are biological factors, such as patient age, related to cost?
- How do these social, physical, and biological factors interact to impact cost?
- How does adjusting cost for different factors (cost of living, patient complexity, outpatient volume) affect the relationship between cost and these factors?

Significance of the Study

Importance of Understanding the Relationships of Environmental and Organizational Factors to Hospital Cost

The purpose of this study is to examine the relationships between various environmental and organizational factors to hospital cost. Knowledge of these relationships is necessary in order to understand existing performance measurement methods and to develop improved methods. As businesses and governments assess the performance of hospitals, a major focus is on cost. If there is a significant relationship between certain hospital environmental or organizational factors to the cost of care, this should be recognized in the calculation and interpretation of performance measures. To the extent that these factors cannot be controlled by the hospital, they are constraints which should be considered in the measurement of their performance. If these factors are not taken into account, it is possible that decisions may be made which may have negative short term and long term impacts on hospitals and the communities they serve and on the health care system as a whole.

Importance of Understanding the Impact of Different Cost Adjustment Methods

It is also important to understand the implications of adjusting hospital cost per admission for factors such as cost of living, patient complexity, and outpatient volume. At this time, there is no one standard approach to adjusting costs for environmental or organizational factors. For example, there are questions about the need to adjust for cost of living. While most adjustment methods take patient complexity and outpatient volume into account, some adjust for cost of living while others do not. This study will examine the differences in using three different measures of cost: 1) cost adjusted for hospital case mix (as a measure of patient complexity and severity), hospital outpatient volume, and area cost of living; 2) cost adjusted for hospital case mix and hospital outpatient volume only; and 3)

unadjusted cost.

Important Impact on Urban Hospitals and Residents

This study has special significance for urban facilities and residents. Many urban hospitals play a key role in their communities by providing services to the uninsured individuals who are at high risk of health problems due to their socioeconomic status. Urban hospitals also often play an important role in medical education and research, services which can be costly to provide. If these facilities are viewed as high cost and are forced to close or downsize as a result, there can be multiple negative impacts on the communities served by the facilities such as reduced availability of and accessibility to health care services. Therefore, when measuring the performance of urban facilities, it is particularly important to understand the relationship that various environmental and organizational factors have on their performance scores.

Limitations

Impact of Other Factors on Cost

Limitations are inherent in this study. This study is not attempting to identify all possible determinants of hospital cost, but rather has focused on the relationship of selected environmental and organizational characteristics to cost, using Zammuto's model. Therefore it is important to note that there are other environmental and organizational factors such as medical staff characteristics and hospital management characteristics that have an impact on hospital cost but have not been within the scope of this research. The literature has identified other factors, such as patient characteristics, which are important to consider when measuring hospital performance. Although case mix attempts to account for patient characteristics such as diagnosis and age, characteristics such as patient compliance with treatment regimen and

genetic predisposition are beyond the scope of this study.

Other Dimensions of Performance

It is also important to note that this research has focused on cost as a measure of performance since this is a prime concern of the business and government constituencies. However, there are a number of other dimensions of performance. These dimensions, such as quality of care, health outcomes, medical research, and community service, are extremely important and need to be considered in a full model of hospital performance.

CHAPTER II: LITERATURE REVIEW

Introduction

To understand the theoretical framework upon which this research is based, this chapter will examine the multiple constituency approach of measuring organizational performance, focusing on Raymond Zammuto's "evolutionary" model. Following this discussion, past research relating social, physical, and biological factors to cost will then be reviewed. The use of cost adjustment methods in previous research will then be addressed. The chapter will conclude with a discussion of the limitations of previous research and the rationale for the current research.

Theoretical Framework for Measurement of Organizational Performance: Raymond Zammuto's Evolutionary Model of Organizational Effectiveness Assessment

Relevancy of Model

With the large number and variety of interest groups in health care, the multiple constituency model of organizational effectiveness assessment is extremely relevant to and appropriate for health care providers in general and to hospitals in particular. Hospitals have a number of constituencies, some within the organization (internal) and some outside the organization (external). Internal and external constituencies may include:

- Patients - inpatients, outpatients, emergency patients, home care patients, etc.
- General Public - individuals as well as organized groups
- Government - local, state, federal governments and their various departments and

elected/other officials

- Business Community - specific employers as well as business associations
- Insurers and Managed Care Organizations, including health maintenance organizations, preferred provider organizations, indemnity insurers, etc.
- Accreditation Bodies - of the hospital, of departments within the hospital
- Physicians - individual physicians as well as organized groups and associations
- Hospital Employees
- Other Health Professionals
- Hospital Auxiliary and Volunteers
- Vendors

These constituencies have different interests. Some constituencies' interests overlap while others conflict. For example, insurers are concerned about the costs of care. On the other hand, physicians and other health professionals are more concerned about the quality and outcomes of care. Some constituencies are more visible and more vocal in their discussion about their expectations for hospitals. At this time, businesses and governments are powerful constituencies who are extremely vocal about their concern on one particular aspect of hospital performance, i.e., the cost of providing services.

Basis for Zammuto's Approach

This research will utilize Raymond Zammuto's "evolutionary" model of organizational effectiveness assessment. This model is depicted in Figure 2.

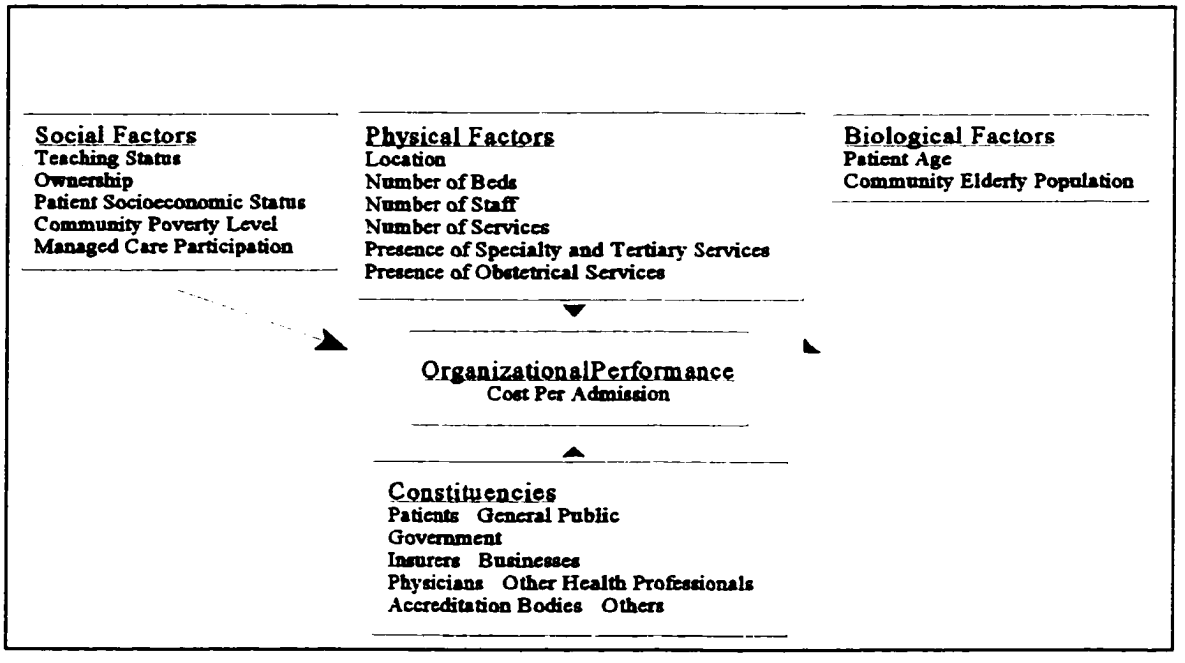

Figure 2
Zammuto's Model Applied to Hospital Performance

In 1982, Raymond F. Zammuto published a book entitled, Assessing Organizational Effectiveness: Systems Change, Adaptation, and Strategy. Borrowing the phraseology of Rittel and Weber (1973), he identified the assessment of organizational effectiveness as a wicked problem. Rittel and Weber identified two types of problems that professionals such as planners, evaluators, and managers encounter: tame problems and wicked problems. Tame problems were those which are clearly definable and have a solution. Wicked problems were those that are not clearly definable; they can be defined in many ways. Furthermore, wicked problems do not have a clear solution; rather, there are many possible answers. Zammuto believed that other models did not recognize the wickedness of the problem of assessing organizational effectiveness and proposed an evolutionary model which he believed did recognize this wickedness.

Like other constituency models, the basis for Zammuto's approach is the recognition that organizations have relationships with a number of parties. These parties can be inside or outside the organization. Various names exist for these parties: interest groups; stakeholders; constituencies; constituent groups. Regardless of the terminology used, these parties have an exchange relationship with the organization. In other words, the parties receive some benefit from the organization and the organization receives some benefit from the parties. The organization and the constituencies rely upon each other. The organization relies on its relationships with its constituencies for its survival.

Like other constituency models, a basis for Zammuto's approach is the recognition that different constituencies judge different aspects of organizational performance and have varying and sometimes conflicting interests. The 1967 research of Friedlander and Pickle demonstrates this. In their research, effectiveness criteria assumed to be important to several types of interested parties were assessed across 97 small business organizations. Performance

scores as measured by the multiple criteria revealed a pattern of low and often negative correlations. To do well on a criterion favored by one constituency was to do poorly on a criterion favored by another. They concluded that organizations find it difficult to fulfill simultaneously the variety of demands made upon them.

Using the constituency approach, an assessment of an organization's performance begins with identifying the organization's constituencies. The next step is to identify the goals or expectations of the various constituencies. These goals then serve as the criteria by which the organization is evaluated. This is the point at which different schools of multiple constituency theory part ways. The power school believes that the values of the most dominant constituent should be used as the basis for evaluation. The social justice school believes that the values of the least advantaged constituent should be utilized as the basis for measurement. Zammuto's model advocates that no single constituent perspective should be raised to a position above those of other constituencies. In his theoretical framework all constituents have a legitimate stake in the functioning of an organization but none has a predominant set of interests. Each constituent views performance from the perspective of its relationship with the organization. The perspective of each of these constituents must be taken into account in order to have an overall assessment.

Zammuto's Focus on the Organization's Environment

Zammuto's theoretical framework differs from other constituency theories in his belief that the environment within which an organization exists must be understood in order to create a definition of effectiveness for that particular organization. According to the evolutionary model, each organization exists within its own niche in the environment. The niche is defined by social, physical, and biological factors. These factors serve as constraints which can be informally or formally imposed on organizations. For the social factor, informal

constraints would include local customs and protocols; formal constraints would include laws and regulations. Applied to the health care field, an example of an informal social constraint could be physician practice patterns. An example of a formal constraint could be State licensure regulations for hospitals. Physical factors are generally related to the physical limits of organizational performance. The availability of materials, energy, personnel, and similar issues, places physical limits on the extent to which an organization can perform in a particular manner. Examples in the health care setting could include the types of medical equipment a hospital has or the types of patient units. Biological factors are limits placed on performance by characteristics of the biosphere. Examples of biological constraints would be characteristics or limitations of the human body. Examples pertinent to the health care field could include a patient's genetic makeup or the number and types of disease processes (such as heart problems, diabetes, vascular disease, etc.) present in a specific patient.

In other words, these social, physical, and biological factors construct the environment within which the organization operates. These factors have an impact on the actions of the organization; they serve as constraints on the possible actions that the organization can take. It is important to recognize that the combination of these factors is different for each organization, i.e., each organization's niche is unique.

Evolutionary Nature of Zammuto's Theoretical Framework

As stated previously, each organization has multiple constituencies each of whom have varying expectations of the organization. The constituencies, their expectations, as well as the constraints, all change over time. Other models view evaluations as discrete events providing definitive judgments of effectiveness. Zammuto's framework views evaluations as episodes of assessment. The question of what is effective performance continues through time because preferences and constraints are continually changing.

Zammuto's framework is termed evolutionary because it deals with the concept of social evolution. It addresses the role that the preferences of constituents have in defining the preferred direction of social evolution. Zammuto purports that other models do not adequately take into account the fact that organizational performance changes the niche within which an organization operates. Social institutions change through evolution as do biological populations. The evolutionary pattern consists of three processes: variation; selection; and retention. For social institutions, variation can include responses to changes in technology, the regulatory environment, etc. Selection processes include evaluation, planning, and forecasting. These selection processes can reflect human values. The final process in the evolutionary pattern is retention; variations which are perceived as desirable are retained. As a selection process, evaluations of performance and determinations of effectiveness play an important role in guiding future organizational action. Adjustments are made in organizational performance on the basis of the evaluative information. Therefore, it is an evolutionary process.

Zammuto's Theoretical Framework - Summary

To summarize Zammuto's theoretical framework, although he defines an effective organization as one that satisfies the expectations of its constituencies, he goes further to assert that an organization operates under a number of constraints. These social, physical, and biological factors impact the organization's ability to satisfy those expectations. These factors are constraints that define the limits of the organization's performance. Therefore, an assessment of that organization's effectiveness must take those constraints into consideration. Examining the satisfaction of constituent preferences is not enough. It is important to understand the niche in which the organization exists.

Current Concerns about Environmental Constraints

Consideration of environmental constraints is evident in some concerns expressed about current measurement efforts. Scott Stratton, an officer of the not-for-profit insurer Group Health Inc., warns that outcomes report cards could reward plans that have "the best sociodemographics" and penalize those that deal with the groups most in need of care. As an example, it would be inappropriate to compare the child immunization rate for a state program intended to reach uninsured children in areas of poverty with the rate of a program serving an affluent area. He suggests that outcomes should be adjusted for demographic differences and assessed in terms of changes in the plan population's health status over time.

In a similar manner, Margaret O'Kane, President of the National Committee for Quality Assurance (NCQA), a Washington D.C. based managed care accrediting body, has noted that the performance of a plan sometimes has more to do with its patient population than what the plan actually does. A population that is socioeconomically well off tends to have better outcomes and use care more appropriately than lower income groups. She asserts that this difference must be taken into account when using data to compare plan performance.

Similarly, Laurens Sartoris, Virginia Hospital and Healthcare Association President, indicated prior to the release of the first hospital report card in the Virginia Health Services Cost Review Council Annual Report that the report needs to be interpreted in tandem with quality information, the hospital's mission, the local market place conditions, and the economic environment (Virginia Hospital Association, 1994). The Annual Report included a singular Efficiency and Productivity Score for each hospital in the state, along with a profile comprised of various measures. However, the methodology did not consider numerous environmental and organizational factors, such as area poverty rate, teaching status, etc.

Whether discussing the organizational performance of a health plan or a hospital, each

of these observations reflects a recognition that aspects of the environment should be taken into account in evaluating the performance of an organization.

Relationship of Environmental and Organizational Factors to Cost

Over the past several years, a number of researchers have studied the relationship of various environmental and organizational factors to cost. For the purpose of this literature review, the findings of this previous research will be discussed according to the specific factor (i.e., variable) under study. Using Zammuto's theoretical framework, these factors have been grouped into these categories: social; physical; and biological.

Social Factors

Factors categorized as social for the purpose of this research include: hospital teaching status; hospital ownership; patient socioeconomic status; community poverty level; and hospital managed care participation. Extensive research has been conducted on the relationships of teaching status and cost and ownership and cost. Very little research has been conducted to date on patient socioeconomic status and cost or community poverty level and cost. A limited but growing amount of research has been conducted on managed care participation and cost.

Teaching status. Many hospitals play an important role in the teaching of medical doctors. While hospitals are also active in the education of nurses and other health professionals, research has focused on the impact of physician education on hospital costs. Teaching status can be defined in various ways: 1) hospitals that are members of the Council of Teaching Hospitals of the Association of American Medical Colleges (approximately 6.1%

of all community hospitals); 2) hospitals affiliated with a medical school (approximately 17.7% of all hospitals); and 3) hospitals approved to participate in one or more residency training programs by the Accreditation Council for Graduate Medical Education (approximately 18.0% of all hospitals) (1994/95 AHA Hospital Statistics, 204). Generally, major teaching hospitals are defined as those that are members of the Council of Teaching Hospitals, although some researchers define major according to the number of residency programs offered or by the resident to bed ratio.

However defined, most research has demonstrated that participation in teaching is associated with higher hospital costs. In **Carr and P. Feldstein**'s 1967 study (as cited in Flood & Scott, 1987), total costs were found to be higher for hospitals with internship and residency programs. In 1978, **Lave and Lave** (as cited in Flood & Scott, 1987) found that controlling for complexity of facilities, size, occupancy rate, and length of stay, the average cost per case was highest in major teaching hospitals, intermediate in nonmajor teaching hospitals, and lowest in nonteaching hospitals.

Sloan and Steinwald (1980), in their study of 1,228 U.S. non-federal, short-term general hospitals, found that hospitals with a medical school affiliation had higher costs. Costs were defined in two ways: total expenses per admission; and total expenses per adjusted patient day (adjusted for outpatient volume). Data for the study covered the period from 1969 to 1975 and came from the American Hospital Association Annual Surveys. Sloan and Steinwald suggested that the higher cost may be due to case mix differences and/or costs associated with teaching that are reflected in patient care expenses (p. 146).

Sloan and Steinwald (1980) were using data from hospitals across the United States and across a six year timespan. For the cost variable, they did make an adjustment which they

called deflating to take into account geographic and temporal differences. Deflating was based on the U.S. Bureau of Labor Statistics Cost of Living Index. In other words, they recognized the need to adjust the dependent variable for the differences in cost of living. This research is noteworthy because of the size of the sample, the extensiveness of the variables tested, and its use of adjustment methodology.

In 1983, **Sloan, Feldman, and Steinwald** (as cited in Flood & Scott, 1987) compared teaching and nonteaching hospitals for the period 1974 to 1977 and found that costs per adjusted admission were 2.0% higher for hospitals with residency training, 5.2% higher for hospitals with medical school affiliations, and 13.9% higher for hospitals belonging to the Council of Teaching Hospitals.

Flood and Scott (1987) also found a positive relationship between medical education and cost in their study of 17 hospitals. They found a zero-order correlation of .42 (significant at the .05 level) between teaching status and cost. Teaching status was identified as the presence of residents in approved programs and cost was identified as the total annual expenditures of each hospital divided by the number of patients treated during the year. Data from the American Medical Association consolidated list of residencies and 1973 American Hospital Association Annual Survey were used for medical school affiliation and cost respectively. The cost was adjusted by the researchers for regional differences by dividing each hospital's score by the Medicare reimbursement index for the county in which the hospital was located. When examined in multiple regressions, teaching status did not remain significant.

J. R. Hollingsworth and E. J. Hollingsworth (1987) compared hospitals in the public (not-for-profit), voluntary (not-for-profit), and proprietary (for-profit) sectors on a number of variables including participation in medical education. In their analysis of 1979 American Hospital Association Annual Survey data, they found that there were differences (significant at the .001 level) in the percentage of hospitals with residency programs among hospitals in the three ownership sectors. Whereas 1.2% of the proprietary hospitals had residency programs, 9.5% of the public hospitals and 21.5% of the voluntary hospitals did. In addition, they found that expenses per patient admission were less for proprietary hospitals ($1,477) than for public ($1,524) and voluntary ($1,682). Their expense variable was not adjusted and their study did not specifically examine the relationship of teaching status and cost.

Zimmerman et al. (1993) found a positive relationship between medical education and cost in their study of intensive care unit (ICU) patients at teaching and nonteaching hospitals. Using 1988-1990 data from 35 hospitals, their findings suggested that the cost of teaching represented 10.5% of the total cost of an average ICU admission. A teaching ICU was defined as a unit in a university hospital or in a hospital with a major medical school affiliation with a minimum of five accredited residency programs and with residents, medical students, or both rotating through the ICU.

Zimmerman et al. (1993) found that teaching ICUs had a higher case mix than nonteaching hospitals. They found that the patients had more life-threatening comorbidities, a greater severity of illness, and a higher admission risk of death. Furthermore, they found that the teaching hospitals were more complex organizationally, that the ICUs were more specialty oriented, had more physicians involved in patient care, and had more full time ICU

medical directors. They also found that the teaching hospitals had greater resource utilization because of increased invasive monitoring, more laboratory studies, and more active therapies.

Zimmerman et al. (1993) estimated that 25% to 40% of this greater resource utilization represented the cost of teaching and the remainder represented the complex nature of the patients. They noted that it may be possible to reduce the excess intensity and frequency of testing and monitoring, but that the impact of these restrictions on the quality of teaching would have to be carefully observed (p. 1433).

HCIA, Inc. and William M. Mercer, Inc. (1995) have also found a positive relationship between medical education and cost. They conduct an annual study to determine the "Top 100" hospitals in the United States. In their analysis, hospitals are divided into and compared within five categories:

1. Urban hospitals with fewer than 250 beds
2. Rural hospitals with fewer than 250 beds
3. Nonteaching hospitals with 250 or more beds
4. Minor teaching hospitals with 250 or more beds
5. Major teaching hospitals with 400 or more beds

HCIA/Mercer (1995) identify the top hospitals in each of the five categories by analyzing Medicare cost report and discharge data from nearly 4,000 general acute care hospitals and calculating eight indicators. These indicators change slightly from year to year. The 1995 report (using 1994 data) examined: mortality; complications; average length of stay; expenses; profitability; outpatient activity; long term growth in equity; and return on assets. Three of the indicators were new in 1995 (index of outpatient activity, long-term growth in

equity, and return on assets), replacing three others (charge per adjusted discharge, net fixed assets per bed, and long-term debt to total assets). See Table 3 for a description of these indicators.

Table 3
1994 HCIA/Mercer Top Hospitals Indicators

Category	Indicator	Description
Financial Management	Expense Per Adjusted Discharge	Total operating expenses divided by the number of discharges, adjusted for case mix, outpatients, and wages
	Cash-Flow Margin (Profitability)	The sum of net income, depreciation and interest expense divided by the sum of net patient revenues and other income
	Long-term Growth in Equity	The average annual compound growth in equity over past three years
	Return on Assets	The sum of net income, depreciation, and interest expense, divided by total assets
Operations	Average Length of Stay	Adjusted for differences in severity of illness (using Refined Diagnostic Related Group [RDRG] methodology)
	Index of Outpatient Activity	The sum of two rankings: relative proportion of outpatient revenues to total revenues in most recent year, and growth in that proportion since 1992
Clinical Practices	Mortality, Risk-Adjusted	Number of actual deaths divided by the number expected, given the risk of death for each patient
	Complications, Risk-Adjusted	Number of actual complications divided by the number expected, using indexes for six patient groups: major surgery, minor surgery, cardiology, endoscopy, medical patients, and all patients. Pediatrics and obstetrics are excluded.

Each year, the "expense per adjusted discharge" has been one of the eight measures utilized. This is calculated as the total operating expenses of a hospital divided by number of adjusted discharges from the hospital (adjusted for outpatient volume, case mix, and wages). An adjusted discharge is calculated by multiplying the number of acute care discharges from the hospital by an inflation factor to include inpatient acute care, as well as inpatient non-acute care and outpatient discharges. Case mix adjustments account for differences in case mix complexity (using the Medicare case mix index) and wage adjustments account for geographic differences in cost of living (using the HCFA wage index). Expense per adjusted discharge is a measure of the hospital's average cost of delivering care on a per-unit basis. Looking at the "expense per adjusted discharge" for each of the five different hospital categories, the peer group (i.e., all hospitals in that group) values are shown in Table 4.

Table 4
1994 HCIA/Mercer Expense Per Adjusted Discharge

Hospital Category	Peer Group
Rural <250 beds	$3,745
Urban <250 beds	$3,853
Nonteaching 250+ beds	$4,113
Teaching 250+ beds	$4,354
Major teaching 400+ beds	$5,627

With respect to the expense performance measure for each peer group, rural hospitals <250 beds had the lowest expense per discharge, followed by urban <250 beds, followed by nonteaching hospitals 250+ beds, followed by teaching hospitals 250+ beds, followed by

major teaching hospitals 400+ beds. Although the results are clouded somewhat by the fact that the rural <250 beds and urban <250 beds categories include both teaching and nonteaching hospitals, with respect to the larger facilities, the expense for teaching hospitals is greater than that in nonteaching hospitals. Examining the peer group values, the expense at the teaching hospitals and major teaching hospitals is 5.86% and 36.81% (respectively) higher than that at the nonteaching hospitals with 250+ beds.

Ownership. The relationship of hospital ownership to cost has been studied extensively over the past several years. Unlike teaching status where the research findings are fairly consistent, research on ownership has yielded seemingly varying results. The study results often are not able to be compared directly one with another because of the different study populations. For example, one study may not include government owned hospitals while another may include them. One study may include all expenses while another may include only Medicare-allowed expenses (i.e., expenses for which Medicare will reimburse).

Sloan and Steinwald (1980), in their study of 1,228 U.S. non-federal, short-term general hospitals with 1969-75 American Hospital Association Annual Survey data, studied hospital ownership. They found a positive relationship between government (i.e., public not-for-profit) ownership and cost per admission (significant at the .01 level).

Watt et al. (1986) researched the comparative economic performance of investor-owned chain and not-for-profit hospitals. Noting that during the decade from 1975 to 1985 the proportion of hospitals affiliated with investor-owned chains increased by 80%, these researchers investigated whether significant differences existed between the economic

performance of investor-owned chain and not-for-profit hospitals. Their sample consisted of 80 matched pairs of general hospitals that provided short-term acute care services. Hospitals were matched on the basis of location (to control for differences in input-factor costs such as wages), scale of operation, services offered, and average length of stay. 1978 and 1980 data from the American Hospital Association Annual Surveys and data from Medicare cost reports were used. Dollar values from the cost reports were adjusted to a common 12-month fiscal year ending December 31.

Among the indicators studied was cost of providing inpatient services. The total costs for inpatient service (including capital and medical education costs) were not significantly higher in the investor-owned chain hospitals than in the comparable not-for-profit hospitals, regardless of whether the measures were adjusted for case mix differences or were calculated on a per admission or per day basis. Also among the indicators studied was general service (overhead, or indirect patient care) cost. The investor-owned chain hospitals had significantly higher general service costs per adjusted day (adjusted to control for differences in outpatient volumes). In large part this was found to be due to the costs of home-office fees and property taxes. The study did not address general service costs per admission. Nor did the study examine direct and indirect patient care and other costs together for a comprehensive examination of cost. However, the study did recognize the importance of adjusting for outpatient volume, case mix, and cost of living and took each of these into account. Since the study did not group inpatient and general service costs for a comprehensive cost variable, the study's conclusions are somewhat limited. This research will build on the Watt et al. (1986) research by examining total cost. Ownership will be examined and the various adjustments made by Watt et al. (outpatient volume, case mix, and cost of living) will also be made.

In the **J.R. Hollingsworth and E. J. Hollingsworth** study (1987), hospitals in the public, voluntary, and proprietary sectors were compared on a number of variables. In their analysis of 1979 American Hospital Association Annual Survey data, they found that expenses per patient admission were less for proprietary hospitals ($1,477) than for public ($1,524) and voluntary ($1,682). Their expense variable was not adjusted in any way and the study was descriptive in nature.

The **American Hospital Association** (AHA) categorizes community hospitals as: nongovernment not-for-profit; investor-owned (for-profit); and state and local government. 1994 AHA Annual Survey data reported in Hospital Stat. Emerging Trends in Hospitals, 1995/96 show that 60.0% of all U.S. community hospitals were nongovernment not-for-profit, 13.8% were investor-owned, and 26.2% were state and local government. Table 5 displays these data for the South Atlantic region and for the state of Virginia. Interestingly Virginia had a much larger proportion of its community hospitals that are nongovernment not-for-profit (82.3%) than the United States as a whole (60.0%) or the South Atlantic Region (54.2%) and a much smaller proportion of state and local government hospitals.

Table 5
1994 AHA Ownership Composition of Community Hospitals

Type of Ownership	U.S.	South Atlantic Region	Virginia
Nongovernment Not-For-Profit	60.0%	54.2%	82.3%
Investor-Owned (For-Profit)	13.8%	23.1%	12.5%
State and Local Government	26.2%	22.7%	5.2%
All Community Hospitals	100.0% (5,229 hosp.)	100.0% (784 hosp.)	100.0% (96 hosp.)

Utilizing the AHA Hospital Stat, Emerging Trends in Hospitals, 1995/96 data, it is possible to compare the adjusted expenses per admission by ownership category (see Table 6). Hospital Stat, Emerging Trends in Hospitals, 1995/96 contains numerous data items for each hospital, including some calculated variables such as "adjusted expenses per admission". The AHA definition of "adjusted expenses per admission" is "Average expense to the hospital in providing care for one hospital inpatient stay". The term "adjusted expenses" is derived by subtracting expenses incurred for the provision of outpatient care from total expenses. This number, representing the expenses incurred for inpatient care only, is divided by total admissions to derive the average expense per hospital stay. It should be noted that these data are not adjusted for case mix (patient complexity) nor for cost-of-living differences.

Table 6
1994 AHA Adjusted Expenses Per Admission by Ownership Categories

Type of Ownership	U.S.	South Atlantic Region	Virginia
Nongovernment Not-For-Profit	$6,256.72	$5,934.78	$5,100.32
Investor-Owned (For-Profit)	$5,528.91	$5,294.56	$5,889.42
State and Local Government	$6,513.39	$6,215.15	$7,826.21
All Community Hospitals	$6,229.83	$5,889.13	$5,518.24

In the United States, the investor-owned (for-profit) hospitals had the lowest expense per admission, followed by the nongovernment not-for-profit hospitals, and the state and local government hospitals. This pattern held true for hospitals in the South Atlantic Region. However, the pattern did not hold true for Virginia hospitals, where the nongovernment not-

for-profit hospitals had the lowest expense per admission, followed by the investor-owned (for-profit) hospitals, and the state and local government hospitals. It is important to keep in mind that these data are not case mix adjusted for the complexity of patients or cost-of-living differences but are adjusted for outpatient volume.

Woolhandler and Himmelstein (1997) studied the costs of care and administration at U.S. for-profit, private not-for-profit, and public hospitals. Administrative costs for 6,227 nonfederal hospitals and the total costs of inpatient care for 5,201 acute care hospitals were calculated for fiscal year 1994 using information hospitals submitted to Medicare (Medicare cost reports and Medicare Minimum Data Set [Prospective Payment System VI]). Similar fiscal year 1990 data had previously been collected and was used in the analysis.

Using multivariate analysis, the effect of hospital ownership on administrative costs was studied, controlling for hospital type (short-term general care, long-term general care, cancer, psychiatric, rehabilitation, and other such as pediatric), census region, hospital size (number of beds), and the proportion of revenues derived from outpatient services. The effect of hospital ownership on total hospital inpatient costs was examined adjusting inpatient costs for local wage levels, hospitals' reporting periods, and case mix.

Since hospital's fiscal years start on different dates, each hospital's cost figures were adjusted using inflation-adjustment factors supplied by the Health Care Financing Administration (HCFA). Cost figures were adjusted using HCFA's case mix index. Adjustments were made for local variations in labor-related costs by applying HCFA's wage index to 71.246 percent of hospital costs, as prescribed by HCFA's adjustment methods.

Woolhandler and Himmelstein (1997) found that inpatient costs at short-term general hospitals (adjusted for case mix, local wage levels, and the starting date of each hospital's

fiscal year) averaged $7,319 per discharge. For-profit hospitals had higher costs per discharge ($8,115) than private not-for-profit hospitals ($7,490) or public hospitals ($6,507).

They found that adjusted administrative costs at short-term general hospitals averaged $1,778 per discharge: $2,289 per discharge at for-profit hospitals; $1,809 at private not-for-profit hospitals; and $1,432 at public hospitals. Administrative costs accounted for 76.8 percent of the total cost difference per discharge between for-profit and not-for-profit hospitals and for 53.3 percent of this difference between for-profit and public hospitals.

The researchers noted that their hospital cost might understate total overhead. Certain expenses are not included on the Medicare Cost Report Worksheet A and were therefore excluded from the analysis. These included: profits; income taxes; many advertising expenditures; and expenses for some "entrepreneurial" activities. Although inpatient data were adjusted for case mix and local wage rates, Woolhandler and Himmelstein (1997) observed that unmeasured differences in the severity of illness or physicians' practices styles could account for some of the differences found.

The research of Woolhandler and Himmelstein (1997) focused on ownership status and did not pursue the relationship of ownership status with other factors, such as presence of medical education and specialty services. In order to gain a better understanding of these relationships, this research will examine ownership status but will also examine a number of other factors.

Shukla, Pestian, and Clement (1997) compared not-for-profit and for-profit hospitals on several performance indicators, including cost. The objective of the research was to compare the performance of these hospitals ten years after the implementation of the Medicare Prospective Payment System (Diagnostic Related Group [DRG] based) and "in the

midst of a market-based reform with strong cost restructuring incentives" (p. 121). Researchers used 1993 data from the Virginia Health Services Cost Review Council. Dependent variables were the performance indicators, including profits, revenues, costs, efficiency and productivity, and community support provided. Tax status was used as the independent variable. Only for-profit and private not-for-profit hospitals were included in the study; state and local government owned facilities were excluded. The study also included contextual variables in order to control for the effects of size (number of licensed beds), location (Northern Virginia/other, rural/urban), system affiliation (affiliated/not affiliated), and payor mix (percent adjusted patient days for Medicaid, Medicare and other government, and nongovernment). No significant differences were found between the not-for-profit group and the for-profit group on any of the contextual variables. The two groups were compared on the performance indicators (including cost) using analysis of variance to identify the extent of the difference between the two groups. A multivariate regression model was also evaluated for each performance indicator to control for the effects of the contextual variables. Only the total cost per admission results of their study will be discussed here.

Total cost per admission was defined as:

total operating expenses divided by case mix adjusted admissions

Case mix adjusted admissions was defined as:

[inpatient admissions plus (inpatient admission equivalent of outpatient visits)] multiplied by hospital-wide case mix index

Otherwise stated, case mix adjusted admissions was defined as:

[inpatient admissions multiplied by (inpatient gross revenues plus outpatient gross revenues) divided by inpatient gross revenues] multiplied by hospital-wide case mix index

Shukla et al. (1997) found that the total cost per admission was 24.36% higher for for-profit hospitals than not-for-profit hospitals. The total cost per admission at for-profit hospitals was $5,249; the cost at not-for-profit hospitals was $4,221. This was found to be statistically significant (F-value = 17.32, .05<p<=.1). The researchers also examined the cost less taxes and found that the difference was still significant, noting that only about 30 percent of the higher cost for for-profit hospitals can be explained by taxes.

The intent of the Shukla et al. (1997) research was to focus on the differences between for-profit and not-for-profit hospitals. This research will include the tax status variable, but will also address other variables, particularly those related to the hospital's environment, using Zammuto's theoretical framework.

Patient socioeconomic status. A review of the literature has yielded some mention of the socioeconomic status of a hospital's patients as measured by Medicaid patient volume (**Clement, D'Aunno, and Poyzer**, 1993; **Lynch and Ozcan**, 1994). However, these studies have not addressed the relationship of patient socioeconomic status and hospital cost per admission. The public health literature reveals relationships between health status or health services utilization and various socioeconomic factors such as educational level, employment status, and income level (**McKeown**, 1990; **Rice**, 1990; **Jonas**, 1990). There is a need to further examine the relationship between patient socioeconomic status and hospital performance measures such as cost.

Community poverty level. A review of the literature has not revealed research dealing with community poverty level and hospital cost. The poverty level of the community may be reflected in the socioeconomic status of the hospital's patients, if the hospital is open to all

without regard to ability to pay. However, the community's socioeconomic status may not be reflected in the hospital patients' socioeconomic status. There are relationships between the poverty level of a community and the community/family support structure which may impact the hospital cost of care. As an example, a hospital discharge may not take place if there is not a suitable home environment appropriate for the recovery of the patient; this may increase hospital length of stay and hospital costs. This study will attempt to address the need for research in this area.

Managed care participation. Recent health services research has started to examine the influence of managed care on hospital cost. A study completed in 1996 by **KPMG Peat Marwick** indicates that hospitals in heavy managed care areas are more cost effective. The 1996 KPMG Peat Marwick study was based on 1995 proprietary data compiled in KPMG's Guide to Hospital Performance Database. They focused on the impact of managed care on the 50 largest U.S. metropolitan statistical areas (MSAs). The study classified each of the cities as high, medium, or low managed care markets as defined by the presence of HMOs, HMO penetration rates, provider risk-sharing agreements, and the involvement of employers in the management of care delivered to their employees. The study adjusted hospital cost for patient severity and for cost of living. Researchers found that hospital costs in high managed care markets (30+% penetration of managed care) were approximately 11.2% below the national average when adjusted for patient severity and cost of living. Hospital costs for medium managed care markets (15-30% penetration) were found to be 2.3% below the national average. In low managed care areas (below 15% penetration), the costs were found to be 7.9% above the national average. Findings on Virginia MSAs are provided in Table 7.

Table 7
1995 KPMG Peat Marwick Hospital Costs Compared to National Average

Cities	Costs Compared to National Average
Charlottesville	22.21%
Danville	-1.96%
Johnson City-Kingsport-Bristol	9.74%
Lynchburg	12.83%
Norfolk-Virginia Beach-Newport News	6.77%
Richmond-Petersburg	7.75%
Roanoke	12.59%
Northern VA-Washington D.C.	6.21%

The KPMG Peat Marwick study (1996) provides managed care penetration levels for the top 50 MSAs in the country. The Norfolk-Virginia Beach-Newport News MSA is identified in the low managed care penetration group; the Washington DC-MD-VA-WV MSA is considered in the medium managed care penetration group.

As managed care grows, there is interest in identifying the impact on health care costs. This research will attempt to explore the relationship between a hospital's participation in managed care and its cost per admission.

Physical Factors

Factors categorized as physical include: hospital location; hospital size; and services provided by the hospital. A number of researchers have studied these factors using different definitions of location, size, and services.

Location. In the **HCIA/Mercer** study (1995), hospitals with fewer than 250 beds in service were divided into urban and rural categories for analysis, based on the urban/rural designation used by the Health Care Financing Administration. The study demonstrated that the expense per adjusted discharge was higher at the urban hospitals as shown in Table 4. The expense per adjusted discharge for the urban <250 beds was 2.9% higher than that at the rural <250 beds hospitals. It should be noted that the study excluded hospitals with fewer than 25 acute care beds or fewer than 500 total facility admissions. According to the American Hospital Association Hospital Stat, Emerging Trends in Hospitals, 1995/96 (1994 data), 4.5% of the 5229 U.S. community hospitals had fewer than 25 beds.

The **American Hospital Association** Hospital Stat, Emerging Trends in Hospitals,

1995/96 does not provide data on an urban/rural basis per se, but does provide information for metropolitan and nonmetropolitan areas. In July 1994, the U.S. Office of Management and Budget, in cooperation with the Federal Committee on Metropolitan Statistical Areas, designated Metropolitan Statistical Areas (MSAs) as a result of updated information available through the 1990 Census. These MSAs replaced the previously designated Standard Metropolitan Statistical Areas (SMSAs). An MSA is a geographical designation that represents an integrated social and economic unit with a large population nucleus. An area qualifies for recognition as an MSA if there is a city within the area of at least 50,000 population or an urban area of at least 50,000 population with a total metropolitan population of at least 100,000. MSAs are generally aggregations of counties and in addition to the county containing the main city, an MSA also includes additional counties having strong economic and social ties to the central county. Designation as an MSA requires a larger population than an urban area; areas are considered urban if the population is 5,000 or greater.

The 1994 adjusted expenses per admission for community hospitals as calculated by the American Hospital Association are provided in Table 8. This information shows that the expense in metropolitan area hospitals is 47% to 65% higher than that in nonmetropolitan hospitals (U.S. - 65.4% higher; South Atlantic Region - 51.7%; Virginia - 46.5%). The expense data reflect inpatient expenses only (outpatient expenses were not included). The data have not been adjusted for case mix or cost of living.

Table 8
1994 AHA Adjusted Expenses Per Admission
by Metropolitan/Nonmetropolitan Categories

Location	Expense
United States	$6,230
Nonmetropolitan	$4,063
Metropolitan	$6,719
Census Division 3 (South Atlantic)	$5,889
Nonmetropolitan	$4,166
Metropolitan	$6,319
Virginia	$5,518
Nonmetropolitan	$4,062
Metropolitan	$5,952
Charlottesville	$8,513
Danville	$4,848
Johnson City-Kingsport-Bristol	$3,936
Lynchburg	$5,317
Norfolk-Virginia Beach-Newport News	$5,380
Richmond-Petersburg	$6,565
Roanoke	$6,519
Northern VA-Washington D.C.	$5,458

Size. Throughout the various studies relating to cost, it is interesting to note that health services researchers have defined size in different ways. Although generally size is defined as the number of the hospital's licensed or staffed beds, at times size has been defined as the number of hospital staff, the average daily census, or the amount of total hospital expenditures.

Sloan and Steinwald (1980), in their study of 1,228 hospitals, examined the relationship of bed size to cost, using expense per adjusted patient day and cost per admission. Source of their data was the American Hospital Association Annual Surveys for years 1969-1975. Sloan and Steinwald found that the total expense per adjusted patient day showed economies of scale; in other words, the greater the number of beds, the lower the expense per day. Total expense per admission showed the opposite; the greater the number of beds, the greater expense per admission. In other words, there was a positive relationship between bed size and expense per admission. Their analysis helped to show the differences in using patient days or admissions as the denominator in the cost equation.

Flood and Scott (1987), in their study of 17 hospitals, examined the relationship of cost and size. Cost was defined as the total annual hospital expenditures divided by the number of patients treated during the year (1973), as reported in the American Hospital Association Guide. Size was defined as the total number of personnel employed as reported in the AHA Guide. At the bivariate level, the correlation between size and cost was .55 (significant at the .01 level). Multiple regression analysis did not show a significant relationship. It appeared as though size lost its importance in light of the other factors. In evaluating the results of this study it is important to note that the study excluded hospitals with fewer than 3,000 annual discharges. The cost measure was adjusted for cost of living

differences.

J.R. Hollingsworth and E.J. Hollingsworth (1987) described the differences in the number of beds for hospitals in the proprietary (for-profit), public (not-for-profit), and voluntary (not-for-profit) sectors. Focusing on 1979 data, they found that the average bed size of proprietary and public hospitals was 115, while the average bed size of voluntary hospitals was 210. They found that the expense per admission was $1,477 for proprietary hospitals, $1,524 for public hospitals, and $1,682 for voluntary hospitals. Their study did not attempt to relate bed size and cost. Source of their data was the American Hospital Association Annual Survey; the cost variable was not adjusted.

Zimmerman et al. (1993) in their study of intensive care units (ICUs) in teaching and nonteaching hospitals noted that the teaching hospitals in their sample had over twice the average number of licensed hospital beds as the nonteaching hospitals (666 vs. 310). Also, the teaching hospitals had an average of 24,274 hospital admissions vs. 16,452 for the nonteaching hospitals. They found that the average cost per ICU admission was higher in teaching hospitals than nonteaching hospitals.

A 1995 study conducted by **Healthcare Financial Management and MECON** identified organizational and operational factors that may influence performance. The findings were based on 1994 data from a set of over 300 hospitals across the U.S. that participate in the MECON-PEER$_X$ database (proprietary database of MECON health care information firm). This study placed hospitals in one of four quadrants based upon their labor costs and other direct costs. Hospitals with low labor and low other costs were identified as Quadrant

I and those with high labor and high other costs were grouped as Quadrant IV. The average number of licensed beds in Quadrant I was 272; in Quadrant IV it was 560. In other words, the data showed a positive relationship between bed size and cost.

The Healthcare Financial Management/MECON study (1995) used a wage-adjusted cost. The study also used an adjusted discharge (adjusted for case mix and outpatient volume). Although this study showed differences in certain organizational characteristics (such as hospital services) between low cost and high cost hospitals, it did not look at environmental factors.

The **HCIA/Mercer** study (1995) found that hospitals with under 250 beds had a lower expense per discharge than hospitals with 250 beds or over. Further, they found that of hospitals with 250 beds or over, those with 400 beds or more (and with a major teaching program) had the highest costs per discharge (Table 4). HCIA/Mercer used an expense per discharge which was adjusted for case mix, outpatient volume, and cost of living. It is important to note that the study excluded hospitals with fewer than 25 acute care beds or fewer than 500 total facility admissions per year.

American Hospital Association Hospital Stat. Emerging Trends in Hospitals, 1995/96 provides information on the number of hospitals according to bed size. AHA defines bed size as the number of beds set up and staffed for use in the hospital. Table 9 shows the percentage of hospitals within selected bed size categories.

Table 9
1994 AHA Bed Size Composition of Community Hospitals

Hospital Bed Size	U.S.	South Atlantic Region	Virginia
6-24	4.5%	2.2%	2.1%
25-49	17.2%	11.5%	5.2%
50-99	22.1%	18.0%	17.7%
100-199	25.5%	31.0%	36.5%
200-299	14.3%	16.7%	19.8%
300-399	7.2%	8.4%	9.4%
400-499	4.0%	5.2%	4.2%
500 or more	5.2%	7.0%	5.2%
All Community Hospitals	100.0% (5,229 hosp.)	100.0% (784 hosp.)	100.0% (96 hosp.)

American Hospital Association Hospital Stat, Emerging Trends in Hospitals, 1995/96 also provides information on the adjusted expenses per admission according to hospital bed size. As Table 10 indicates , there is generally a positive relationship between bed size and adjusted expenses per admission.

Table 10
1994 AHA Adjusted Expenses Per Admission by Hospital Bed Size

Hospital Bed Size	U.S.	South Atlantic Region	Virginia
6-24	$3,419.05	$3,531.35	$2,460.72
25-49	$3,735.78	$3,818.01	$5,227.91
50-99	$4,438.16	$4,358.35	$4,078.16
100-199	$5,050.08	$4,860.25	$4,596.79
200-299	$5,797.07	$5,268.47	$4,773.69
300-399	$6,545.86	$5,823.70	$5,592.97
400-499	$7,118.13	$6,197.18	$6,430.14
500 or more	$8,511.01	$7,922.31	$7,849.33
All Community Hospitals	$6,229.83	$5,889.13	$5,518.24

As indicated in this review, the literature points to a strong positive relationship between bed size and cost. Previous studies have recognized the interrelationships that exist between bed size and teaching status and other variables. There is a need to explore these relationships further and to identify the impact of various cost adjustment methods.

Services. Health services research has long recognized that hospitals vary tremendously in the services that they offer. Hospitals offer multiple services including patient care, community services, teaching, and research. This section however focuses only upon the differences in patient care services.

Flood and Scott (1987) in their intensive study of 17 hospitals, studied the relationship of cost and the number of services, which they called facilities, using the American Hospital Association Annual Survey terminology. Cost was defined as the total annual hospital expenditures divided by the number of patients treated during the year (1973), as reported in the American Hospital Association Guide. This was adjusted for cost of living differences. Services or facilities was defined as the number of different types of facilities as reported in the Guide. At the bivariate level, the correlation between facilities and cost was .54 (significant at the .01 level). Multiple regression analysis however, did not demonstrate a significant relationship. It should be noted that Flood and Scott did not adjust cost to account for case mix or outpatient volume. This research will make those adjustments.

In the **J.R. Hollingsworth and E.J. Hollingsworth** (1987) study of 1979 data, there were significant differences (at the .001 level) in the technological complexity of hospitals: average number of facilities and services for public hospitals was 9.6, for proprietary hospitals 10.3, and for voluntary hospitals 14.4.

The **Healthcare Financial Management/MECON** study (1995) showed that there were differences in the services provided by low cost hospitals and high cost hospitals. 35.1% of the low cost hospitals offered open heart surgery while 86.9% of the high cost hospitals did. Comparable percentages for low cost and high cost hospitals for other services are: organ transplant, 11.7% and 75.4%; bone marrow transplant, 9.1% and 57.4%; and Level I trauma services, 21.1% and 70.5%. In other words, a smaller percentage of low cost hospitals provided tertiary level services. The cost data were adjusted for case mix, outpatient volume, and cost of living.

In summary, previous research has examined physical factors including location, size, and services. This research will build on these studies by examining these factors in the context of social and biological factors and by exploring the impact of different cost adjustment methods.

Biological Factors

For the purpose of this research, biological factors include patient age, specifically the hospital's proportion of elderly patients, and the community proportion of elderly residents. The literature does not reveal extensive study of the relationship of the age of hospital patients to hospital cost. Generally, there appears to be a lack of literature dealing with biological factors. The one exception is the recognition that the severity of patients differs from hospital to hospital; generally case mix adjustments are made to data to account for these differences.

Patient age. In the study by **Zimmerman et al.** (1993) of teaching and nonteaching

ICUs, patient age was examined. It was found that patients in nonteaching ICUs were older and that much less emphasis was placed on technologically oriented monitoring and therapy; nonteaching ICUs were found to be less costly than teaching ICUs.

The research conducted by Zimmerman et al. (1993) dealt solely with the cost per ICU admission where this research addresses the total cost per admission. Therefore, it is difficult to draw conclusions from Zimmerman et al. to apply to this research. Additional research is needed in the area of the impact of a hospital's elderly population.

Community elderly population. **Sloan and Steinwald** (1980), in their study of 1,228 hospitals across the years 1969 to 1975, found a positive relationship between the percentage of elderly in the hospital's county and the hospital's expense per admission. There is a need, particularly given the demographic trend of the aging U.S. population, for further research on the elderly and cost.

In summary, previous research has studied the relationship of various social, physical, and biological factors to cost. In some research, the cost has been adjusted in some manner to account for hospitals' differences in factors such as patient complexity, outpatient volume, and/or area cost of living. Further background on the concept of adjustment is provided in the following section.

Cost Adjustment Methods

Review of Cost Adjustment Methods in Previous Research

The concept of adjustment of the cost variable is not new. **Greenfield** (1973) developed a hospital output measure called the Quality Adjusted Patient Day, calculated as:

Total Quality Adjusted Patient Days = [Total Inpatient Days + 1 3 Outpatient Visits + 1 4 Emergency Room Visits] x Quality Proxy

The Quality Proxy was defined as the number of facilities and services available within and reported by the hospital to the American Hospital Association. Greenfield's formula was intended to be a "first approximation" of hospital output and productivity to be refined by future investigators.

P. J. Feldstein (1979) included several adjustments in his hospital cost regression equation:

AC = f(B,S,C,Q,V,P,E,D,O) where

AC = the dependent variable, usually average cost per patient day or per admission

f = a functional relationship, connoting the dependence of AC on the variables on the right side of the equation

B = the measure of hospital size, usually measured in terms of number of beds

S = the hospital's service capability, usually measured by some enumeration of facilities and services in the hospital

C = a measure of patient case mix, measured by the proportion of patients in a given number of disease classifications

Q = a measure of quality, inadequately measured to date (if included at all) by some variable such as inputs per patient, e.g. lab tests

V = severity of illness within a patient disease classification, possibly measured (inadequately) by the number of surgical procedures

P = an adjustment for differences between hospitals for wages and other factor price

E = differences in hospital efficiency

D = educational programs, e.g., number of interns and residents, affiliations with a medical school and a nursing school, as well as representing research and other training programs

O = other variables such as physicians' contributions, outpatient visits, and so on

(pp. 183-184)

P. Feldstein's equation was important because it acknowledged the importance of adjusting for factors such as wage differences, case mix, and outpatient visits. These are the three adjustment factors to be used in this dissertation research. P. Feldstein also included severity of illness with a patient disease classification, which now can be measured (using the All Patient Refined Diagnostic Related Group [APR-DRG], Refined Diagnostic Related Group [RDRG], Disease Staging, or other similar method) but has not generally been used for adjustments. He also included quality, a factor whose measurement continues to be elusive. P. Feldstein set forth a framework by which to study costs. However, he did not include environmental factors such as community socioeconomic status and managed care penetration, two additional factors which this research will address.

More recently, in Spring 1997, the **Advisory Board Company**, a private Washington D.C. based research and education firm, published "Richest Sources of Savings: Lessons from America's Lowest-Cost Hospitals". The research demonstrated that there are wide cost per discharge variations across the country and provided information on sources of labor and supply savings. The Note on Research Methodology states, "The single most important metric for determining a hospital's cost-effectiveness is cost per discharge. Yet comparing

cost per discharge across hospitals may be misleading due to regional and case-mix differences". Researchers in this study calculated cost per discharge using an outpatient adjustment factor, a case mix adjustment, and a wage adjustment. This demonstrates the growing acceptance of using an adjusted cost indicator.

The outpatient adjustment factor was calculated as the ratio of gross patient revenue to gross inpatient acute care revenue. The case mix adjustment used was the hospital's Medicare case mix index. The wage adjustment was calculated by dividing 65% of a hospital's expenses by the wage index as computed by HCFA. The research notes state that 65% represents the approximate portion of total hospital expenses associated with labor costs.

Tables 11-13 summarize the findings of the previous research and identify the cost adjustment method used. The first column of each table identifies the specific factor and the direction of the research finding. Not all factors are listed due to lack of previous research. Where researchers have identified different findings, these findings are listed separately in the first column. The second column contains the name and year of the relevant study. The third column notes the type(s) of adjustment, if any, made by the researchers to the cost variable. The fourth column contains the page reference within this research for the study.

Table 11
Summary of Previous Studies' Findings:
The Relationship of Social Factors and Cost Per Admission

Factor/Finding	Study	Adjustment Methodology	Page #
Teaching Status: *Hospitals participating in medical education have higher cost per admission.	Sloan and Steinwald (1980) Flood and Scott (1987) J.R. Hollingsworth and E.J. Hollingsworth (1987) Zimmerman et al. (1993) HCIA/Mercer (1995)	Cost of living Cost of living None None Cost of living, case mix, outpatient volume	41 42 43 43 44
Ownership: *Government owned hospitals have higher cost per admission.	Sloan and Steinwald (1980)	Cost of living	48
*Cost per admission for inpatient service was not significantly higher in the investor-owned hospitals than the comparable not-for-profit hospitals.	Watt et al. (1986)	Cost of living, case mix, outpatient volume	48
*Private not-for-profit have higher cost per admission than public hospitals which have higher cost than for-profit hospitals.	J. R. Hollingsworth and E.J. Hollingsworth (1987)	None	50
*Public hospitals have higher cost per admission than private not-for-profit hospitals which have higher cost than for-profit hospitals in U.S. and South Atlantic Region.	AHA (1995)	Outpatient volume	50
*Public hospitals have higher cost per admission than for-profit hospitals which have higher cost than private not-for-profit hospitals in Virginia.	AHA (1995)	Outpatient volume	50
*For-profit hospitals have higher cost per admission than private not-for-profit which have higher cost than public hospitals.	Woolhandler and Himmelstein (1997)	Cost of living, case mix, outpatient volume, fiscal year start	52
*For-profit hospitals have higher cost per admission than private not-for-profit hospitals in Virginia. (Public hospitals were not included in study.)	Shulka, Pestian, Clement (1997)	Case mix, outpatient volume	53
Managed Care Participation: *Hospitals in low managed care penetration areas have higher cost per admission.	KPMG Peat Marwick (1996)	Cost of living, case mix	56

Table 12
Summary of Previous Studies' Findings:
The Relationship of Physical Factors and Cost Per Admission

Factor/Finding	Study	Adjustment Methodology	Page #
Location:			
*Hospitals located in urban areas have higher cost per admission than	HCIA/Mercer (1995)	Cost of living, case mix, outpatient volume	58
hospitals in rural areas.	AHA (1995)	None	58
Size - Beds:			
*Hospitals with large number of beds have higher cost per admission	Sloan and Steinwald (1980)	Cost of living	61
	Zimmerman et al. (1993)	None	62
than hospitals with small number of beds.	Healthcare Financial Management/ MECON (1995)	Cost of living, case mix, outpatient volume	62
	HCIA/Mercer (1995)	Cost of living, case mix, outpatient volume	63
	AHA (1995)	Outpatient volume	63
*Voluntary hospitals have a larger number of beds than proprietary or public hospitals and have a higher cost per admission.	J.R. Hollingsworth and E.J. Hollingsworth (1987)	None	62
Size - Staff:			
*Hospitals with large number of staff have higher cost per admission than hospitals with small number of staff.	Flood and Scott (1987)	Cost of living	61
Services:			
*Hospitals with large number of services have higher cost per admission than hospitals with small number of services.	Flood and Scott (1987)	Cost of living	67
	Healthcare Financial Management/ MECON (1995)	Cost of living, case mix, outpatient volume	68
*Voluntary hospitals have a larger number of services than proprietary or public hospitals and have a higher cost per admission.	J.R. Hollingsworth and E.J. Hollingsworth (1987)	None	67

Table 13
Summary of Previous Studies' Findings:
The Relationship of Biological Factors and Cost Per Admission

Factor/Finding	Study	Adjustment Methodology	Page #
Patient Age: *Intensive Care Units (ICUs) that have younger patients have higher cost per admission than ICUs that have older patients.	Zimmerman et al. (1993)	None	68
Community Elderly: *Hospitals with a high proportion of elderly in the community have a higher cost per admission than hospitals with a low proportion.	Sloan and Steinwald (1980)	Cost of living	69

Adjustment Methods

Outpatient adjustment. As seen in Tables 11-13 and in the discussion of previous research, the cost per admission variable is often adjusted to account for outpatient volume. This adjustment is calculated by: 1) limiting the costs to inpatient costs only and using inpatient admissions only; or 2) using total (inpatient and outpatient) costs and adjusting the admissions number to represent outpatient volume as well. The second approach is more common as data on inpatient expenses only are often not available. However, information on outpatient revenue and inpatient revenue is generally available and can be used in the methodology to develop an adjusted admission. The second approach also gives a more comprehensive view of the hospital since outpatient care is a significant part of most hospital's services.

Case mix adjustment. Adjustment for case mix is often found in current research in an effort to control for the different complexity of patients found at different hospitals. Since the implementation of Medicare's Prospective Payment System (using Diagnostic Related Groups [DRGs]), the Medicare case mix index is generally used to make the adjustment. Each hospital's patient is assigned a DRG based upon their diagnosis, procedures, age, sex, and discharge disposition (examples of discharge disposition include discharge to another acute care facility, discharge to a nursing home, death). Each DRG is assigned a case weight by Medicare. For example, DRG 103: Heart Transplant has a weight of 15.3358 while DRG 373: Vaginal Delivery without Complicating Diagnoses has a weight of 0.3602. The case weight is published each year in the Federal Register by the Health Care Financing Administration; the examples cited above provide the case weights for Fiscal Year 1997 and are contained in the August 30, 1996 issue of the Federal Register. A case mix index can be calculated for each hospital by multiplying the case weight of each DRG by the number of

patients in that DRG and dividing by the total number of patients.

Use of severity adjusted data has increased in the recent past. There are a number of systems such as APR-DRG (All Patient Refined DRG), RDRG (Refined DRG), and Disease Staging which provide a more detailed description of severity than the DRG categories. Use of this level of severity adjusted information will grow as the data become more widely available and understood.

Cost of living adjustment. In some research an adjustment to the hospital cost per admission is made in order to account for cost of living. Generally, the Medicare wage index for the city or county in which the hospital is located is utilized. This is adjusted and published annually by the Health Care Financing Administration in the Federal Register. This research will utilize the Medicare wage index for the cost of living adjustment by applying the appropriate wage index to 65% of hospital costs, as applied in The Advisory Board research. Although 71.246% was used in the Woolhandler and Himmelstein research, the researchers noted that the 71.246% was being applied only to those costs recognized by Medicare.

Limitations of Previous Research

A number of studies have examined various environmental and organizational factors and their relationships to cost. Although there is a large amount of research dealing with various organizational characteristics such as teaching status, ownership, and size, there is a lack of research dealing with social factors such as the community's poverty level and the patients' socioeconomic status. There is also a lack of research dealing with biological factors such as the community's elderly population and the hospital's proportion of elderly patients. Zammuto's theory of organizational effectiveness would suggest however that these are key factors to consider. Therefore they will be addressed in this research.

As can be noted in Tables 11-13, a number of methods have been used to adjust cost per admission. Some researchers have not made any adjustment while others have made adjustments to take differences in outpatient volume, case mix, cost of living, and other factors into account. There is no one standard adjustment method. There is a need for research to determine the impact of these different adjustment methods.

In summary, this research will strive to address these two limitations of previous research:

1. The impact of additional social and biological factors on hospital cost per admission
2. The impact of adjustment methods on hospital cost per admission

Therefore, using Zammuto's theoretical framework, this research will examine these factors:

Social factors: Teaching status; type of ownership; patient socioeconomic status; community poverty level; managed care participation

Physical factors: Location; size; services offered by the facility

Biological factors: Patient age; community elderly population

This research will study cost per admission that is: 1) adjusted for hospital case mix, hospital outpatient volume, and area cost of living; 2) adjusted for hospital case mix and hospital outpatient volume only; and 3) unadjusted.

CHAPTER III: METHODS

Introduction

Expanding upon the broad research questions identified in Chapter I, this chapter will start with identifying the specific hypotheses that are being tested in this research. The research methods used in this study will then be described through a discussion of the study population, data collection and sources of data, study variables and operational definitions, and statistical tests.

Research Hypotheses

Consistent with Raymond Zammuto's theoretical framework in which social, physical, and biological factors impact organizational performance, the following hypotheses were tested:

A. Social factors will impact hospital performance.

A1. Hospital participation in medical school education will increase cost per admission. Teaching hospitals' cost will exceed nonteaching hospitals' cost.

A2. The ownership status of a hospital will impact the cost per admission. Not-for-profit hospitals' cost will exceed for-profit hospitals' cost.

A3. The socioeconomic status of a hospital's patients will impact the cost per admission. Hospitals that have a higher proportion of Medicaid patients will have a higher cost per admission.

A4. The poverty level of the community in which the hospital is located will impact

the cost per admission. Hospitals located in communities with a higher percentage of individuals below poverty level will have a higher cost per admission.

A5. Hospital participation in managed care will impact the cost per admission. Hospitals with a lower proportion of managed care patients will have a higher cost per admission.

A6. When these social factors are considered together in one model, the social factor with the greatest impact on cost per admission will be participation in medical education.

B. Physical factors will impact hospital performance.

B1. The rural/urban location of a hospital will impact cost per admission. Urban hospitals will have a higher cost per admission than rural hospitals.

B2. The size of a hospital will impact the cost per admission. Hospitals with a larger number of beds will have a higher cost per admission.

B3. The size of a hospital will impact the cost per admission. Hospitals with a larger number of staff will have a higher cost per admission.

B4. The number of services offered by a hospital will impact the cost per admission. Hospitals with a larger number of services will have a higher cost per admission.

B5. The presence of specialty and tertiary services offered by a hospital will impact the cost per admission. Hospitals that provide specialty and tertiary services will have a higher cost per admission.

B5a. Hospitals with neonatal special care services will have a higher cost per admission than hospitals without the services.

B5b. Hospitals with open heart surgery services will have a higher cost per admission than hospitals without the services.

B5c. Hospitals with inpatient medical rehabilitation services will have a higher cost per admission than hospitals without the services.

B5d. Hospitals with inpatient psychiatric services will have a higher cost per admission than hospitals without the services.

B5e. Hospitals with trauma services will have a higher cost per admission than hospitals without the services.

B6. Hospitals with obstetric services will have a higher cost per admission than hospitals without the services.

B7. When these physical factors are considered together in one model, the physical factor with the greatest impact on cost per admission will be the hospital's provision of tertiary and specialty services.

C. Biological factors will impact hospital performance.

C1. The age composition of a hospital's patients will impact the cost per admission. Hospitals with a larger proportion of elderly patients will have a higher cost per admission.

C2. The age composition of a hospital's community will impact the cost per admission. Hospitals located in communities with a large percentage of elderly residents will have a higher cost per admission.

C3. When these biological factors are considered together in one model, the biological factor with the greatest impact on cost per admission will be the age composition of a hospital's patients.

D. Social, physical, and biological factors will interact together and with each other to impact hospital performance.

D1. Presence of specialty and tertiary services will be associated with the presence of medical education.

D2. Percentage of Medicaid patients will be associated with the presence of medical education.

D3. Not-for-profit ownership status will be associated with medical education.

D4. When social, physical, and biological factors are considered together in one model, the presence of medical education, specialty and tertiary services, and not-for-profit ownership status will be associated with high cost per admission.

D5. When social, physical, and biological factors are considered together in one model, the location of a facility in an area with a relatively high level of poverty and a high proportion of elderly population will be associated with a high cost per admission.

E. Adjusting hospital cost per admission for cost of living in addition to adjustments for case mix and outpatient volume will decrease the variation in cost among hospitals.

Study Population

The study population consisted of hospitals in Virginia that provided general acute care services in 1994. By definition this excluded hospitals that are licensed as outpatient hospitals (such as ambulatory surgery centers) and hospitals that exclusively provide psychiatric, medical rehabilitation, children's, eye and ear services, and chronic care services. A listing of the 85 general acute care Virginia hospitals included in this study can be found

in Appendix C. Three general acute care hospitals were excluded from the analysis. The cost per admission for each of these hospitals, when adjusted for case mix, outpatient volume, and area cost of living, were three or more standard deviations higher than the mean. The data were checked for possible errors but appeared to be correct. These outliers had a strong influence on the regression models and were eliminated from the analysis. Further information on these cases is available in Appendix C.

This study population was selected for these reasons:

- With the development of the Virginia statewide inpatient level data base and the changes in the Annual Historical Filing data base, a great deal of information about Virginia hospitals is now available on both a patient and facility level.
- Data are available for all patients, not only Medicare patients.
- Edit checks were conducted by the Virginia Health Services Cost Review Council, Virginia Health Information, Datis (a data processor intermediary), and HCIA (Health Care Investment Analysts, a data processor intermediary) in efforts to ensure accuracy.
- Data are available for all non-Federal hospitals due to mandatory submission requirements.
- Limiting the study population to hospitals from one state provides control of factors that may influence the study results, such as the regulatory environment.

The characteristics of the study population hospitals are portrayed in Tables 14 - 17. Table 14 provides information on the social variables. Slightly over three-fourths of the hospitals in the study population are teaching hospitals. Over 80% of the hospitals are not-for-profit. For the average hospital, almost 14% of the patients are Medicaid. There is a

wide range of values from a low of 2% to a high of 42%. Looking at the community setting, for the average hospital, almost 15% of community residents are below poverty level; this ranges from a low of 3% to a high of 32%.

After a review of the data showing the percentage of hospital's patients with HMOs or PPOs, the managed care variable was dropped from the study. Almost fifty-three percent of the hospitals reported no patients in the HMO or PPO categories. This would indicate that either the hospital had no patients in these categories or that the hospital did not use these categories to report HMO or PPO patients. Therefore the managed care variable is not included in Table 14 and is not included in any of the additional analysis. The need for improved managed care participation information is addressed further in Chapter V.

Physical characteristics of the hospitals are discussed in Table 15. Almost 60% of the hospitals are located in an urban area. The average licensed bed size is 211, ranging from a low of 25 to a high of 677. The average number of full time equivalent staff is 736, ranging from 68 to 3,501. The average hospital offers 37 services with the range spreading from 11 to 71. Almost 60% of all hospitals offer at least one tertiary or specialty service. Specifically, almost 25% offer neonatal special care, about 18% offer open heart surgery, 14% offer inpatient medical rehabilitation, 41% offer inpatient psychiatric services, and 9% offer trauma services. Eighty percent of all hospitals offer obstetric services.

Table 14
Characteristics of Study Hospitals, Social Factor Independent Variables

Variable	Characteristic	Value
Teaching Status	Nonteaching Teaching	76.5% (65 Hospitals) 23.5% (20 Hospitals)
Ownership	Not-for-Profit For-Profit	83.5% (71Hospitals) 16.5% (14 Hospitals)
Patient Socioeconomic Status: % of Hospital Discharges to Medicaid Patients	Mean (and Standard Deviation) Median (and Interquartile Range) Range: Minimum - Maximum	13.7 (8.1) 12.5 (8.1 - 18.5) 2.0 - 42.0
Community Poverty Level: % of Individuals below Poverty Level	Mean (and Standard Deviation) Median (and Interquartile Range) Range: Minimum - Maximum	14.9 (7.0) 15.6 (8.5 - 20.8) 3.1 - 32.2

Table 15
Characteristics of Study Hospitals, Physical Factor Independent Variables

Variable	Characteristic	Value
Location	Urban Rural	58.8% (50 Hospitals) 41.2% (35 Hospitals)
Size: Number of Licensed Beds	Mean (and Standard Deviation) Median (and Interquartile Range) Range: Minimum - Maximum	211 (149.6) 160 (101.0 - 307.5) 25 - 677
Size: Number of Full Time Equivalent Staff	Mean (and Standard Deviation) Median (and Interquartile Range) Range: Minimum - Maximum	736.3 (637.9) 500.0 (301.0 - 1067.4) 68.5 - 3500.9
Hospital Services: Number of Services	Mean (and Standard Deviation) Median (and Interquartile Range) Range: Minimum - Maximum	37.2 (14.5) 38.0 (24.2 - 46.0) 11 - 71
Hospital Services: Pres. of Spec/Tert.Svcs.	No Spec./Tert. Services Offered Spec./Tert. Services Offered	41.2% (35 Hospitals) 58.8% (50 Hospitals)
Hospital Services: Type of Specialty Services Provided	Neonatal Special Care Open Heart Surgery Inpatient Medical Rehabilitation Inpatient Psychiatric Services Trauma Services	23.5% (20 Hospitals) 17.6% (15 Hospitals) 14.1% (12 Hospitals) 41.2% (35 Hospitals) 9.4% (8 Hospitals)
Hospital Services: Pres. of Obstetric Services	Obstetrical Services Offered	80.0% (68 Hospitals)

Table 16 addresses the biological characteristics of the hospitals. For the average hospital, about 37% of the patients are age 65 or older. This ranges from a low of 14% to a high of 74%. Looking at the community setting, for the average hospital, about 14% of its community residents are age 65 or older, ranging from a low of 4% to a high of 26%.

Table 16
Characteristics of Study Hospitals, Biological Factor Independent Variables

Variable	Characteristic	Value
Patient Age: % of Hospital Discharges to Patients Age 65+	Mean (and Standard Deviation) Median (and Interquartile Range) Range: Minimum - Maximum	37.2 (12.1) 35.3 (30.3 - 42.4) 14.3 - 73.5
Community Elderly Population: % of Individuals Age 65+	Mean (and Standard Deviation) Median (and Interquartile Range) Range: Minimum - Maximum	13.6 (4.2) 13.7 (11.2 - 16.6) 3.8 - 26.5

The characteristics of the study hospitals with respect to the three adjustment variables are shown in Table 17. The patient complexity as measured by the case mix index applied to all patients is 1.056. This ranges from a low of .765 to a high of 1.560. The hospital outpatient volume was defined as the gross outpatient revenue divided by the gross inpatient revenue. For the average hospital, the outpatient volume is about 54% of the inpatient volume. This ranges from 18% to 118%. Cost of living was defined as the Health Care Financing Administration (HCFA) hospital wage index. The average hospital has a wage index of .862. This ranges from .773 to 1.0862.

Table 17
Characteristics of Study Hospitals, Adjustment Variables

Variable	Characteristic	Value
Patient Complexity: Hospital Case Mix Index (All Patients)	Mean (and Standard Deviation) Median (and Interquartile Range) Range: Minimum - Maximum	1.056 (.151) 1.020 (.964 -1.137) .765 - 1.560
Hospital Outpatient Volume: Gross Outpatient Revenue/ Gross Inpatient Revenue	Mean (and Standard Deviation) Median (and Interquartile Range) Range: Minimum - Maximum	53.9 (20.4) 54.8 (35.8 - 70.1) 18.5 - 117.7
Cost of Living: HCFA Hospital Wage Index	Mean (and Standard Deviation) Median (and Interquartile Range) Range: Minimum - Maximum	.862 (.111) .835 (.773 - .919) .773 - 1.082

Data Collection and Sources of Data

The data included in this study consisted of secondary data collected by various state and national agencies and organizations. By law, all Virginia hospitals submitted 1994 fiscal year financial, utilization, and other administrative data to the Virginia Health Services Cost Review Council as part of their Annual Historical Filing. These filings were the primary source of data for this study. The filings served as the basis for the Virginia Health Services Cost Review Council 1995 Buyer's Guide to Efficient and Productive Hospitals and Nursing Homes. This information was supplemented by 1994 hospital data from Virginia Health Information, the organization which serves as the repository for the Virginia hospital patient level data base under contract to the State of Virginia. Starting with July 1993 data, all Virginia hospitals have been required to submit patient level inpatient data to this organization. Therefore, for the first time, comprehensive facility based and community based data are available on Virginia hospital inpatients. In addition, to supplement the information available from these two sources and to validate certain pieces of information, 1993 and 1994 data from the Virginia Department of Health Licensure Division were used. Each hospital, as a part of the annual licensing procedure, submits certain information to the state, including an Annual Hospital Survey. In addition, each year the American Hospital Association (AHA) publishes its Guide to the Health Care Field based upon surveys that AHA member hospitals complete. Information from the 1994 and 1995 Guides (which contain 1993 and 1994 data) were used to augment and validate other data sources. Data from the Health Care Financing Administration and the U.S. Bureau of the Census were also used. As each of the individual variables is discussed in the section below, the source(s) of data for that particular variable is addressed.

Human Subjects

All data used in this research are aggregate hospital level data and are considered public information. The identities of specific hospitals have been protected to the greatest extent possible. The purpose of the research is to show relationships that exist in the study population hospitals, not to focus on any specific hospital or hospitals. Therefore, human subjects concerns have been minimized in this research.

Study Variables and Operational Definitions

In the context of Zammuto's constituency theory, several social, physical, and biological characteristics of Virginia's hospitals will be examined. These characteristics are considered as independent variables and include: teaching status; type of ownership; patient socioeconomic status; community poverty level; location; size; services offered by the facility; patient age; and community elderly population.

The dependent variable is cost per admission, given the high degree of interest by constituencies such as business and government. Three different cost values will be examined: 1) cost that is adjusted for hospital patient complexity as measured by case mix, hospital outpatient volume, and area cost of living; 2) cost that is adjusted for hospital patient complexity and hospital outpatient volume only; and 3) unadjusted cost.

These variables will be discussed in this section, identifying the type of variable, type of factor, level of measurement, definition, and source(s). In addition, reliability, validity, and other data issues will be discussed. The variables used for adjustment purposes (outpatient volume, cost of living, and case mix) will be discussed within the context of the dependent variable, cost per admission.

Teaching Status

Type: Independent Variable/ Social Factor/ Nominal

Definition: This variable addresses the hospital's participation in the education of physicians. Hospitals are identified as teaching hospitals or nonteaching hospitals. Major teaching hospitals and minor teaching hospitals have been grouped together for the purpose of this analysis due to the small number of major teaching hospitals in the study population. Major teaching hospitals are those hospitals that are members of the Council of Teaching Hospitals of the Association of American Medical Colleges. Minor teaching hospitals are those that are approved to participate in residency training by the Accreditation Council for Graduate Medical Education. Hospitals not providing education for physicians are considered as nonteaching. As major and minor teaching hospitals have been grouped together, this variable has two potential values.

Source: Virginia Health Services Cost Review Council 1995 Buyer's Guide to Efficient and Productive Hospitals and Nursing Homes, 1994 data

Other: Within the major teaching and minor teaching categories, there is some diversity among the hospitals. Within the state, there are three medical schools. Two of these schools are state owned and own hospitals. The third medical school is owned privately and does not own a hospital but works with a number of area hospitals. An analysis of the cost per admission of the two state owned facilities, when the cost is adjusted for case mix, outpatient volume, and cost of living, showed that the values exceed three standard deviations from the mean. Inclusion of these facilities would have a significant

impact on the regression model. Therefore, they have been excluded from the analysis. Differences also exist among the minor teaching hospitals. Hospitals vary in the number of residency programs in which they participate and the number of residents rotating through the hospital.

Ownership

Type: Independent Variable/ Social Factor/ Nominal

Definition: This variable refers to the ownership of the hospital, i.e., whether the hospital is a for-profit facility or a not-for-profit facility. Therefore, this variable has two potential values.

Source: Virginia Health Services Cost Review Council 1995 Buyer's Guide to Efficient and Productive Hospitals and Nursing Homes, 1994 data

Other: Within the not-for-profit grouping, there are private and public hospitals. The two state-owned hospitals have been excluded from the analysis due to their outlier status. The one remaining public hospital is grouped with other not-for-profit facilities for purposes of this analysis.

Also, it should be noted that within the past few years in Virginia, there have been changes in the ownership status of some hospitals; the ownership status as identified in the 1995 Buyer's Guide is used for this study.

Patient Socioeconomic Status

Type: Independent Variable/ Social Factor/ Ratio

Definition: This variable refers to the extent to which a specific hospital serves patients of relatively low socioeconomic status. For the purpose of this study, patients

with a relatively low socioeconomic status are defined as those with Medicaid coverage. The value used is the actual percentage of the hospital's inpatient admissions that had Medicaid coverage.

Source: Virginia Health Services Cost Review Council Annual Historical Filings for Fiscal Year 1994

Other: The number of Medicaid admissions is a required field in the Annual Historical Filing. To have Medicaid coverage, an individual must meet certain income requirements and must apply. It is possible that some individuals were admitted to a hospital as self-pay and applied for Medicaid coverage during that stay. Those individuals might not have been reported as Medicaid admissions depending on the sophistication of the hospital's record keeping and computer system. This is not considered to be a significant data issue.

Community Poverty Level

Type: Independent Variable/ Social Factor/ Ratio

Definition: This variable refers to the poverty level of the county or independent city in which the hospital is located. The value used is the percentage of persons with an income below poverty level.

Source: U.S. Bureau of the Census; the 1994 County and City Data Book contains 1989 income data

Other: It should be recognized that a hospital's service area and the county or city in which the hospital is located is not synonymous. The intent of this variable is to examine the social characteristics of the individuals in the community being served by the hospital. The community being served may actually

consist of several counties or it may consist of part of a city. For the purpose of this study, the county or city in which the hospital is located is considered to be the community being served. It is also recognized that the data reflect income status in 1989. However, more recent data are not available. It is assumed that the poverty status of one community relative to another has not changed measurably since the most recent Census.

Hospital Location

Type: Independent Variable/ Physical Factor/ Nominal

Definition: This variable refers to the location of the hospital, i.e., whether the hospital is located within an urban area or a rural area. Therefore, this variable has two potential values.

Source: Virginia Health Services Cost Review Council 1995 Buyer's Guide to Efficient and Productive Hospitals and Nursing Homes; per the Guide Glossary, the rural or urban designation is identified in the Federal Register, Vol. 60, No. 170, September 1, 1995, Rules and Regulations.

Other: Although the Health Care Financing Administration classifies hospitals as either urban or rural, it should be recognized that there can be substantial differences among urban hospitals and among rural hospitals.

Hospital Size: Number of Beds

Type: Independent Variable/ Physical Factor/ Ratio

Definition: This variable refers to the size of the hospital in terms of the number of inpatient beds reported by the facility. For the purpose of this study, the

number of licensed beds is used. The value used is the number of licensed beds as included in the Annual Historical Filing to the Virginia Health Services Cost Review Council; the number of neonatal special care bassinets is not included. The bed number also does not include observation beds.

Source: Virginia Health Services Cost Review Council 1995 Buyer's Guide to Efficient and Productive Hospitals and Nursing Homes and Annual Historical Filings

Other: The Annual Historical Filing requests hospitals to identify their number of licensed beds. The State of Virginia Department of Health Division of Licensure annually approves the number of licensed beds. The number used in this research is the number of licensed beds as reported by the Virginia Health Services Cost Review Council. There may be some small differences between the number of beds reported by the Cost Review Council and that used by the Division of Licensure. These differences are not significant and the Cost Review Council data are used in this research.

Hospital Size: Number of Staff

Type: Independent Variable/ Physical Factor/ Ratio

Definition: This variable measures the size of the hospital in terms of the number of full time equivalent staff employed. Full time equivalent staff is determined by the number of hours paid divided by 2080 (2080 hours equals 40 hours per week multiplied by 52 weeks per year).

Source: Virginia Health Services Cost Review Council 1995 Buyer's Guide to Efficient and Productive Hospitals and Nursing Homes and Annual Historical

Filings

Other: This variable includes individuals paid by the hospital, whether the individuals are employees or are contracted. It does not include "home office" FTEs. It should be noted that this variable does not address the hospital's skill mix (such as ratio of registered nurses to licensed practical nurses, etc.).

Hospital Services: Number of Services

Type: Independent Variable/ Physical Factor/ Ratio

Definition: This variable refers to the number of services offered by each hospital. The value used is the actual number of services, based upon the inventory of services reported to the American Hospital Association.

Source: American Hospital Association Guide to the Health Care Field, 1996, 1995 and 1994 issues (1995, 1994 and 1993 data, respectively), Virginia Health Services Cost Review Council Annual Historical Filing, and the Virginia Department of Health Annual Hospital Survey

Other: The primary source of data for this variable is the American Hospital Association 1995 Guide to the Health Care Field. The AHA Guide data are based upon a questionnaire submitted voluntarily each year by member hospitals. The number and definition of services on this questionnaire changes somewhat from year to year; the 1995 Guide identifies 74 potential services. This information has been supplemented by data from the 1994 and 1996 Guides and the Annual Historical Filing and Annual Hospital Survey to ensure completeness and accuracy. Data for one hospital were not available from any source.

Hospital Services: Presence of Specialty or Tertiary Services

Type: Independent Variable/ Physical Factor/ Nominal

Definition: This variable refers to the presence of specialty or tertiary services offered by each hospital. Services included in this variable are: neonatal intensive care; open heart surgery; medical rehabilitation; inpatient psychiatry; and trauma. Hospitals are defined as either not offering any specialty or tertiary services or as offering at least one specialty or tertiary service. Therefore, there are two possible values of this variable.

Source: American Hospital Association Guide to the Health Care Field, 1996, 1995 and 1994 issues (1995, 1994 and 1993 data, respectively), Virginia Health Services Cost Review Council Annual Historical Filing, and the Virginia Department of Health Annual Hospital Survey

Other: The primary source of data for this variable is the American Hospital Association 1995 Guide to the Health Care Field. Comments on the preceding variable (see Hospital Services - Number of Services) apply to this variable as well. Information from the Virginia Health Services Cost Review Council Annual Historical Filing and the Virginia Department of Health Annual Hospital Survey has been used for validation.

Hospital Services: Type of Specialty Services Provided

Type: Independent Variables/ Physical Factor/ Nominal

Definition: This set of variables refers to the availability of specific tertiary or specialty services offered by each hospital. The specific services being measured include: neonatal intensive care; open heart surgery; medical rehabilitation;

inpatient psychiatry; and trauma services. For each of these individual services, a value of yes or no is given.

Source: American Hospital Association Guide Issue, Virginia Department of Health Annual Hospital Survey, Virginia Emergency Medical Services Office

Other: Each of these tertiary/specialty services is regulated and monitored by the Virginia Department of Health under the Certificate of Public Need program or the Emergency Medical Services office. Each year, information on each of these services, with the exception of trauma, is reported to the Department on the Annual Hospital Survey. Medical rehabilitation and psychiatry services refer to nursing units which are considered "distinct parts" by the Health Care Financing Administration; the method by which Medicare reimburses hospitals for patients in these units is different from patients in other units. With respect to neonatal intensive care, the Department of Health Annual Hospital Survey currently identifies whether a hospital offers a neonatal special care unit. Trauma center designation information was provided by the Virginia Emergency Medical Services office.

Hospital Services: Presence of Obstetrical Services

Type: Independent Variable/ Physical Factor/ Nominal

Definition: This variable refers to the availability of obstetrical services in the hospital.

Source: American Hospital Association Guide Issue and Virginia Department of Health Annual Hospital Survey

Other: This service is regulated by the Virginia Department of Health under the Certificate of Public Need program. Each year, information on this service is

reported to the Department on the Annual Hospital Survey.

Patient Age

Type: Independent Variable/ Biological Factor/ Ratio

Definition: This variable refers to the extent to which a specific hospital serves an elderly patient population. The value used is the actual percentage of the hospital's admissions that are from individuals age 65 and older.

Source: Virginia Health Information Patient Level Data Base: July - December 1994

Other: Patient age is reported by each hospital to Virginia Health Information as a part of the mandated patient level data base.

Community Elderly Population

Type: Independent Variable/ Biological Factor/ Ratio

Definition: This variable refers to the age composition of the county or independent city in which the hospital is located. The value used is the percentage of persons age 65 and older.

Source: U.S. Bureau of the Census; 1994 data

Other: It should be recognized that a hospital's service area and the county or city in which the hospital is located is not synonymous. The intent of this variable is to examine the biological characteristics of the individuals in the community being served by the hospital. The community being served may actually consist of several counties or it may consist of part of a city. For the purpose of this study, the county or city in which the hospital is located is considered

to be the community being served.

Cost Per Admission

Type: Dependent Variable/ Ratio

Definition: Cost per admission is defined as the hospital's operating expenses divided by the number of hospital admissions. Operating expenses were reported by each hospital to the Virginia Health Services Cost Review Council according to specific directions as follows: Total operating expense is the sum of labor expenses (salaries, benefits, contract, home office, and other), non-labor expenses (contract, home office, drugs, physician fees, other), capital expenses (depreciation, interest, insurance, other except for taxes), taxes, and bad debt expense. See excerpt from EPICS: Manual for Supervisors & Users of the Efficiency & Productivity Information Collection System in Appendix D. Total admissions were also reported by each hospital.

Source: Virginia Health Services Cost Review Council 1995 Buyer's Guide to Efficient and Productive Hospitals and Nursing Homes and Annual Historical Filings; Health Care Financing Administration Wage Index data

Other: Three different cost values are used in this research: 1) cost that is adjusted for hospital patient complexity as measured by case mix, hospital outpatient volume, and area cost of living; 2) cost that is adjusted for hospital patient complexity (case mix) and hospital outpatient volume only; and 3) unadjusted cost. The unadjusted cost and the cost that is adjusted for hospital patient complexity (case mix) and hospital outpatient volume only have been calculated from the Annual Historical Filings data. The cost adjusted for

patient complexity and outpatient volume have been checked against the values calculated by the Cost Review Council. The cost that is adjusted for patient complexity (case mix), hospital outpatient volume, and cost of living has been calculated from the Annual Historical Filings and the Health Care Financing Administration wage index. These calculations are described in greater detail below.

Adjustment to total admissions for patient complexity and for outpatient volume. The Virginia Health Services Cost Review Council, in its 1995 Buyer's Guides, applied an adjustment to total admissions in order to reflect the differing complexities of patients among hospitals and to reflect the varying outpatient volumes of different hospitals. Their method has been used in this research.

The adjustment can be viewed as a two part process. According to the EPICS manual (see Appendix D), outpatient adjusted admissions is the sum of admissions and equivalent admissions attributed to outpatient services. The number of equivalent admissions attributed to outpatient services is derived by multiplying admissions by the ratio of gross outpatient revenue to gross inpatient revenue.

Outpatient Adjusted Admissions = *Admissions* + *[(Gross Outpatient Revenue/ Gross Inpatient Revenue)* x *Admissions]*

Gross outpatient revenue and gross inpatient revenue are reported by each hospital on the Annual Historical Filing. Gross revenue is defined as total

established full charges for all hospital services including charity care. Although the outpatient volume adjustment is sensitive to pricing differences, this adjustment is the standard approach used by researchers and the hospital industry.

The patient complexity adjustment is made by applying the Medicare case mix formula to all inpatients, computing an index for all patients, and then multiplying it by outpatient adjusted admissions.

Adjusted Admissions = *Outpatient Adjusted Admissions* x *Case Mix Index*

Adjustment for case mix is often found in current research in an effort to control for the different complexity of patients found at different hospitals. Since the implementation of Medicare's Prospective Payment System (using Diagnostic Related Groups [DRGs]), the Medicare case mix index is generally used to make the adjustment. Each hospital's patient is assigned a DRG based upon their diagnosis, procedures, age, sex, and discharge disposition. Each DRG is assigned a case weight by Medicare. For example, DRG 103: Heart Transplant has a weight of 15.3358 while DRG 373: Vaginal Delivery without Complicating Diagnoses has a weight of 0.3602. The case weight is published each year in the Federal Register by the Health Care Financing Administration. (The examples cited above provide the case weights for Fiscal Year 1997 and are contained in the August 30, 1996 issue of the Federal Register.) A case mix index can be calculated for each hospital by multiplying the case weight of each DRG by the number of patients in that DRG, summing the results and dividing the total by the total number of patients. The case mix index used in this research is an index reflecting the

complexity of all patients (not just Medicare) and was calculated and reported by each hospital in their Annual Historical Filing. In other words, the case mix index was self reported and was not calculated by the Cost Review Council.

Adjustment to total operating expenses for cost of living. The hospital wage index has been used to adjust total operating expenses to reflect the cost of living in the community in which the hospital is located. The wage index for each urban or rural labor market area throughout the country is calculated annually by the Health Care Financing Administration (HCFA). HCFA recognizes that hospital labor costs vary from region to region and uses the wage index in the calculation of Medicare reimbursements to hospitals. The calculation of the wage index value is a multiple step process, starting with the hospitals' reporting to HCFA each year the wages paid and the corresponding hours. The values used in this research are those published in the August 30, 1996 issue of the Federal Register which reflect hospital's FY 1993 data. (Table 4A - 4C, pp. 46256 - 46264).

The wage index adjustment has been applied to 65% of the hospital's total operating expenses. This method has been used in The Advisory Board research (1997). The Woolhandler and Himmelstein (1997) research used a multiplier of 71.246%; however, they recognized that this multiplier is appropriate for Medicare recognized expenses which are less than the hospital's total expenses. Therefore, this research uses the 65% multiplier. The formula for adjusted cost, as used in this research, is as follows:

Total adjusted cost = [(.65 x Total Operating Expenses) Wage Index] - (.35 x Total Operating Expenses)

It should be noted that the Virginia Health Services Cost Review Council did not make a cost of living adjustment to total operating expenses because its report, i.e., the Buyer's Guide, had separate tables and rankings for each of the five health planning regions of Virginia. Hospitals in each region were compared to one another but hospitals across the state were not compared.

To summarize the cost calculations used in this research, formulas are provided below:

- Cost that is adjusted for hospital patient complexity as measured by case mix, hospital outpatient volume, and area cost of living (labeled COSTALL) was calculated in the following manner:

  COSTALL = [[(.65 x Total Operating Expenses) Wage Index] - (.35 x Total Operating Expenses)] / [Admissions -[(Gross Outpatient Revenue Gross Inpatient Revenue) x Admissions]] x Case Mix Index

- Cost that is adjusted for hospital patient complexity case mix and hospital outpatient volume only (labeled COSTCMOP) was calculated in this manner:

  COSTCMOP = Total Operating Expenses / [Admissions -[(Gross Outpatient Revenue Gross Inpatient Revenue) x Admissions]] x Case Mix Index

- Unadjusted cost (labeled COSTUNADJ) was calculated as follows:

COSTUNADJ = Total Operating Expenses / Inpatient Admissions

Statistical Tests

To describe the characteristics of the hospitals involved in this study, frequency data were analyzed for the nominal level independent variables. For ratio level independent variables, the means, standard deviations, medians, interquartile rankings, and ranges were identified. Distributions of the variables were examined for normality using the K-S (Lilliefors) test. The data were also reviewed for completeness and for outliers and the original study variables and population were revised as appropriate.

To identify the relationships among the various independent variables and between the independent variables and the dependent variable, bivariate analyses was conducted. When both variables were nominal level data, Chi Square analysis was done. The Yates Continuity Correction or Fisher's Exact Test was used as appropriate. Correlation coefficients were utilized in studying the relationships among ratio level variables. The Pearson's R or Spearman Correlation was used as indicated (Munro & Page, 1993; Norusis, 1996).

T-tests were used to examine differences in mean values of ratio variables between groups (Munro & Page, 1993). Levene's Test for Equality of Variances was used. Throughout the analysis, statistical significance was defined as $p \leq .05$.

Multiple linear regression analysis was used to attempt to explain the relationships between the independent variables and the dependent variable. Multiple linear regression models were developed in which the various independent variables were assigned a weight based on their relationship with the dependent variable. Regression diagnostics were conducted to ensure that the regression assumptions were met.

Tests were carried out using three different versions of the dependent variable, cost per admission:

1) cost adjusted for hospital case mix, outpatient volume, and cost of living (labeled as COSTALL);

2) cost adjusted for hospital case mix and outpatient volume only (labeled as COSTCMOP); and

3) unadjusted cost (labeled COSTUNADJ).

CHAPTER IV: RESULTS

Introduction

Presentation of the data analysis and results will follow the format suggested by Zammuto's theoretical framework. Zammuto identified three categories of factors that impact organizational performance: social; physical; and biological. Following an examination of the dependent variable, cost per admission, the discussion will move into an analysis of the independent variables, following Zammuto's framework. For each of these variables, its relationship with the dependent variable will be explored. In addition, the relationships among the independent variables will be studied. Woven throughout the discussion will be analysis of the impact of the different cost adjustment methods. The hypotheses identified in Chapter III will be tested to determine if the research findings support them.

Cost Per Admission

The dependent variable, cost per admission, has been calculated in three ways: 1) cost adjusted for hospital case mix, outpatient volume, and cost of living (COSTALL); 2) cost adjusted for hospital case mix and cost of living only (COSTCMOP); and 3) unadjusted cost (COSTUNADJ). Measures of central tendency and variability of the dependent variable were examined (see Table 18).

Table 18
Cost Per Admission, Measures of Central Tendency and Variability

Cost	Mean (and Standard Deviation)	Minimum and Maximum	Coefficient of Variation
COSTALL	$4,869 (598)	$3,402-$6,089	12.28
COSTCMOP	$4,408 (738)	$2,857-$6,018	16.75
COSTUNADJ	$7,051 (1,262)	$4,190-$10,636	17.90

COSTALL: Cost per admission adjusted for hospital case mix, hospital outpatient volume, and area cost of living
COSTCMOP: Cost per admission adjusted for hospital case mix and hospital outpatient volume only
COSTUNADJ: Unadjusted cost per admission

The mean unadjusted cost per admission (COSTUNADJ) is $7,051. COSTUNADJ is calculated by dividing total cost (both inpatient and outpatient costs) by the number of inpatient admissions. Therefore it does not take into account the outpatient services that hospitals provide. When cost per admission is adjusted for the outpatient volume and for case mix (COSTCMOP), the mean cost is $4,408. The outpatient and case mix adjustments are made to the denominator of the cost per admission equation. Therefore, the total cost (inpatient and outpatient) is divided by the adjusted admissions and the result is a lower mean cost per admission than the unadjusted calculation. When cost per admission is further adjusted for area cost of living (COSTALL), the mean cost is $4,869. Most hospitals in Virginia are located in areas where the cost of living index is below 1.0; the mean cost of living for study hospitals is .862. Therefore, the effect of the cost of living adjustment on the mean cost per admission for the study hospitals is to increase the cost; i.e., COSTALL is higher than COSTCMOP.

To measure the variability of the dependent variable, the standard deviation was calculated. The standard deviation for COSTALL is $598, less than the standard deviation

for COSTCMOP, $738, or COSTUNADJ, $1,262. In order to test for the significance of the differences of the variances of COSTALL, COSTCMOP, and COSTUNADJ, analysis was conducted using the "Test for Difference between Variance of Two Related Samples" (Bruning & Kintz, 1987, p. 113). This test showed that the variances of the three cost calculations are significantly different from one another. An analysis of the difference between the variances of COSTALL and COSTCMOP yields a t-value of 5.38, indicating that the difference is significant at $p<.001$. Analysis of the difference between the variances of COSTALL and COSTUNADJ yields a t-value of 11.37 and analysis of the difference between the variances of COSTCMOP and COSTUNADJ yields a t-value of 8.83; both also are significant at $p<.001$.

As identified above, the standard deviation for COSTALL is less than that for COSTCMOP which is less than that for COSTUNADJ. An additional comparison of the variability of the three cost values uses the coefficient of variation (Norusis, 1996, p. 78). The coefficient of variation allows for comparison of values of differing magnitudes. The coefficient of variation for COSTALL is 12.28. This is less than the coefficient of variation for COSTCMOP, 16.75, which is less than the coefficient of variation for COSTUNADJ, 17.90. This shows that COSTALL varies less than COSTCMOP which varies less than COSTUNADJ.

It was hypothesized that adjusting hospital cost per admission for cost of living in addition to adjustments for case mix and outpatient volume will decrease the variation in cost among hospitals (Hypothesis E). *This research supports the hypothesis.*

In the following sections, the research hypotheses will be tested using the COSTALL calculation. Bivariate and multivariate analysis findings using the COSTCMOP and COSTUNADJ calculations will also be reported to determine the impact of the different types

of adjustments.

Social Factors

Five variables were initially identified as social factors for the purpose of this research. These were: hospital teaching status; hospital ownership; patient socioeconomic status; community poverty level; and hospital managed care participation. As discussed in Chapter III, due to data limitations, managed care participation could not be included in further analysis. Descriptive statistics for the remaining four variables are found in Table 14.

Bivariate Analysis - Social Independent Variables and the Dependent Variable

The relationships of the remaining four social factor independent variables with the dependent variable were examined. As seen in Table 19, there is a significant difference in the cost per admission between teaching and nonteaching hospitals. Using the COSTALL calculation, the mean cost per admission for teaching and nonteaching hospitals is $5,141 and $4,785, respectively. It was hypothesized that teaching hospitals' cost will exceed nonteaching hospitals' cost (Hypothesis A1). *This research supports the hypothesis.* The difference is also significant for the COSTCMOP calculation. The difference is not significant for the unadjusted cost (COSTUNADJ). With the introduction of the outpatient adjustment, the difference becomes significant; teaching hospitals have a significantly lower outpatient volume than nonteaching hospitals.

When examining hospital ownership, there is not a significant difference between the cost per admission of for-profit and not-for-profit hospitals for the COSTALL calculation. Although the COSTALL cost per admission is higher for the for-profit hospitals than the not-for-profit hospitals, the difference is not significant ($p=.094$; level of significance for this

research is defined as $p \leq .05$). It was hypothesized that not-for-profit hospitals' cost will exceed for-profit hospitals' cost (Hypothesis A2). *This research does not support the hypothesis.* Although not significant for COSTALL, the difference is significant for the COSTCMOP calculation ($p=.043$). The cost of living adjustment appears to reduce the significance of the difference in cost between for-profit and not-for-profit hospitals. The average wage index for for-profit hospitals was .8973; the average for not-for-profit hospitals was .8553. The difference was not significant ($p=.197$). However, the cost of living adjustment would tend to increase the for-profit cost per admission less than the increase in the not-for-profit cost per admission. Therefore, the adjustment serves to reduce the gap between the for-profit cost and the not-for-profit cost. There is no significant difference for the COSTUNADJ calculation. The factor that may be responsible for the significance of the COSTCMOP difference is the outpatient volume adjustment; the for-profit hospitals have a significantly lower outpatient volume than the not-for-profit hospitals.

There is no significant relationship between patient socioeconomic status (the percentage of hospital patients with Medicaid) and the cost per admission for COSTALL. It was hypothesized that hospitals that have a higher proportion of Medicaid patients will have a higher cost per admission (Hypothesis A3). *This research does not support the hypothesis.* The difference is also not significant for the COSTCMOP calculation. However, there is a significant negative relationship between the percentage of hospital patients with Medicaid and the cost per admission for COSTUNADJ. There is a significant negative relationship between percentage of hospital patients with Medicaid and case mix which may account for the difference in findings between the unadjusted and the adjusted versions. The cost per admission when adjusted for case mix would be reduced more for hospitals with high case mix than for hospitals with low case mix (such as those with a high percentage of Medicaid

patients).

There is no significant relationship between community poverty level (the percentage of city or county residents below poverty level) and cost per admission for COSTALL. It was hypothesized that hospitals located in communities with a higher percentage of individuals below poverty level will have a higher cost per admission (Hypothesis A4). *This research does not support the hypothesis.* There is a significant negative relationship between community poverty level and cost per admission for the COSTCMOP and COSTUNADJ calculations. As the cost of living adjustment is made to cost per admission, the significance disappears. This may be explained by the significant negative relationship between community poverty level and area cost of living.

Table 19
Relationships of Social Factor Independent Variables with Dependent Variable

Independent Variable	COSTALL	COSTCMOP	COSTUNADJ
Teaching Status[a,b,1]			
Teaching: Mean & SD	$5,141 (509)	$4,708 (620)	$7,378 (1,084)
Nonteaching: Mean & SD	$4,785 (601)	$4,315 (751)	$6,950 (1,303)
Ownership[b,1]			
For-Profit: Mean & SD	$5,113 (669)	$4,771 (867)	$7,624 (1,736)
Not-for-Profit: Mean & SD	$4,821 (575)	$4,336 (695)	$6,938 (1,128)
Patient Socioeconomic Status: % of Patients with Medicaid[c,2]			
R Squared (and Sign)	.0020 (+)	.0060 (-)	.2183 (-)
Community Poverty Level: % of Community Residents below Poverty Level[b,c,2]			
R Squared (and Sign)	.0207 (-)	.1702 (-)	.1337 (-)

COSTALL: Cost per admission adjusted for hospital case mix, hospital outpatient volume, and area cost of living
COSTCMOP: Cost per admission adjusted for hospital case mix and hospital outpatient volume only
COSTUNADJ: Unadjusted cost per admission

[a] Significant for COSTALL at $p \leq .05$
[b] Significant for COSTCMOP at $p \leq .05$
[c] Significant for COSTUNADJ at $p \leq .05$

[1] T-test for independent samples
[2] Pearson's correlation coefficient

Multivariate Analysis - Social Independent Variables and the Dependent Variable

To identify the social factor with the greatest impact on cost per admission, multiple linear regression models were run using the four variables - teaching status, ownership, patient socioeconomic status (percentage of patients with Medicaid), and community poverty level (percentage of community residents below poverty level).

With COSTALL as the dependent variable, the regression model accounts for 9.7% of the variability of cost per admission. As shown in Table 20, teaching status and ownership are the only variables that impact cost per admission when adjusted for case mix, outpatient volume, and cost of living and it is teaching status that has the greatest impact. It was hypothesized that when social factors are considered together in one model, the social factor with the greatest impact on cost per admission will be participation in medical education (Hypothesis A6). *This research supports the hypothesis.*

Table 20
Multivariate Regression Analysis for Cost Per Admission
Adjusted for Case Mix, Outpatient Volume, and Cost of Living (COSTALL)
Social Factors

Variable	B(SE)	95% CI	Beta	p
Teaching Status	374 (146)	84, 665	.2672	.0123
Ownership	337 (168)	3, 671	.2105	.0478
Patient Socioeconomic Status	1065 (862)	-650, 2780	.1443	.2203
Community Poverty Level	-1630 (995)	-3610, 350	-.1908	.1052

Adjusted R Square = .0973
F = 3.2633
Significant F = .0157

With COSTCMOP as the dependent variable, 24.6% of the cost per admission variability is explained by the model. As shown in Table 21, community poverty level, teaching status, and ownership have a significant impact on cost per admission, when adjusted for case mix and outpatient volume only, with community poverty level having the greatest impact. Community poverty level is significantly negatively related to cost of living. As seen in the COSTALL model, when the dependent variable is adjusted for cost of living, community poverty level is not significant.

Table 21
Multivariate Regression Analysis for Cost Per Admission
Adjusted for Case Mix and Outpatient Volume (COSTCMOP)
Social Factors

Variable	B (SE)	CI	Beta	p
Teaching Status	409 (165)	81, 737	.2362	.0153
Ownership	449 (189)	72, 826	.2270	.0201
Patient Socioeconomic Status	1348 (973)	-589, 3284	.1478	.1699
Community Poverty Level	-4860 (1123)	-7096, -2625	-.4606	.0000

Adjusted R Square = .2461
F = 7.8549
Significant F = .0000

With COSTUNADJ as the dependent variable, the model explains 26.4% of the cost per admission variability. As shown in Table 22, patient socioeconomic status (percentage of patients with Medicaid) is the only variable with a significant impact on cost per admission when unadjusted. Patient socioeconomic status is significantly negatively related to case mix; this may be the reason that patient socioeconomic status loses its significance in the adjusted versions.

Table 22
Multivariate Regression Analysis for Cost Per Admission
Unadjusted (COSTUNADJ)
Social Factors

Variable	B (SE)	CI	Beta	p
Teaching Status	500 (278)	-54, 1054	.1691	.0762
Ownership	573 (320)	-63, 1209	.1695	.0767
Patient Socioeconomic Status	-5799 (1643)	-9068, -2530	-.3722	.0007
Community Poverty Level	-3291 (1896)	-7064, 482	-.1825	.0864

Adjusted R Square = .2645
F = 8.5511
Significant F = .0000

Physical Factors

Six variables have been identified as physical factors for the purpose of this research. These are: hospital location; number of beds; number of staff; total number of services; presence of specialty and tertiary services (defined as one or more of the following services: neonatal intensive care, open heart surgery, medical rehabilitation, inpatient psychiatry, and trauma); and the presence of obstetrics (Note: Obstetrics is not included in the specialty and tertiary list of services). In addition, some analysis has been conducted on specific tertiary and specialty services: neonatal intensive care, open heart surgery, medical rehabilitation, inpatient psychiatry, and trauma. Descriptive statistics for each of these variables is found in Table 15.

Bivariate Analysis - Physical Independent Variables and the Dependent Variable

As seen in Table 23, there is a significant difference in the cost per admission between urban and rural hospitals for the COSTALL calculation. The COSTALL mean cost per admission for urban and rural hospitals was $5,049 and $4,611, respectively. It was hypothesized that urban hospitals will have a higher cost per admission than rural hospitals (Hypothesis B1). *This research supports the hypothesis.* The difference is also significant for the COSTCMOP and COSTUNADJ calculations.

There is a significant positive relationship between hospital size (as defined by number of licensed beds) and the cost per admission for the COSTALL calculation. The R Squared value for COSTALL was .1767. It was hypothesized that hospitals with a larger number of beds have a higher cost per admission (Hypothesis B2). *This research supports the hypothesis.* There is also a significant relationship for the COSTCMOP and COSTUNADJ calculations.

There is also a significant positive relationship between hospital size (as defined by number of full time equivalent staff) and the cost per admission for the COSTALL calculation. The R Squared value for COSTALL is .1424. It was hypothesized that hospitals with a larger number of staff have a higher cost per admission (Hypothesis B3). *This research supports the hypothesis.* There is also a significant relationship for the COSTCMOP and COSTUNADJ calculations.

Table 23 also shows a significant positive relationship between hospital services (as defined by total number of hospital services) and the cost per admission for the COSTALL calculation. The R Squared value for COSTALL is .0782. It was hypothesized that hospitals with a larger number of services have a higher cost per admission (Hypothesis B4). *This research supports the hypothesis.* There is also a significant relationship for the COSTCMOP and COSTUNADJ calculations.

There is a significant difference in the cost per admission of hospitals with specialty and tertiary services and the cost per admission of hospitals without those services for the COSTALL calculation. The COSTALL mean cost per admission for hospitals that did and did not provide specialty and tertiary services is $5,077 and $4,571, respectively. It was hypothesized that hospitals that provide specialty and tertiary services have a higher cost per admission (Hypothesis B5). *This research supports the hypothesis.* There is also a significant relationship for the COSTCMOP and COSTUNADJ calculations.

Specific specialty and tertiary services were examined to determine if their presence had an impact on the cost per admission. There is a significant difference in the cost per admission between hospitals that did or did not provide neonatal special care services for the COSTALL calculation. The COSTALL mean cost per admission for hospitals that did and did not provide neonatal special care services is $5,221 and $4,760, respectively. It was

hypothesized that hospitals with neonatal special care services will have a higher cost per admission than hospitals without the services (Hypothesis B5a). *This research supports the hypothesis.* The difference is also significant for the COSTCMOP and COSTUNADJ calculations.

There is also a significant difference in the cost per admission between hospitals that did or did not provide open heart surgery services for the COSTALL calculation. The COSTALL mean cost per admission for hospitals that did and did not provide open heart surgery services is $5,173 and $4,803, respectively. It was hypothesized that hospitals with open heart surgery services will have a higher cost per admission than hospitals without the services (Hypothesis B5b). *This research supports the hypothesis.* The difference is also significant for the COSTCMOP and COSTUNADJ calculations.

There is a significant difference in the cost per admission between hospitals that did or did not provide inpatient medical rehabilitation services for the COSTALL calculation. The COSTALL mean cost per admission for hospitals that did and did not provide inpatient rehabilitation services is $5,285 and $4,800, respectively. It was hypothesized that hospitals with inpatient medical rehabilitation services will have a higher cost per admission than hospitals without the services (Hypothesis B5c). *This research supports the hypothesis.* The difference is not significant for the COSTCMOP calculation ($p=.063$; level of significance for this research is defined as $p \leq .05$) but is significant for the COSTUNADJ calculation.

There is no significant difference in the cost per admission between hospitals that did or did not provide inpatient psychiatric services for the COSTALL calculation ($p=.101$; level of significance for this research is defined as $p \leq .05$). It was hypothesized that hospitals with inpatient psychiatric services will have a higher cost per admission than hospitals without the services (Hypothesis B5d). *This research does not support the hypothesis.* There is a

significant difference for the COSTCMOP calculation. The COSTUNADJ calculation shows no significant difference. It appears as though the cost per admission difference becomes significant as the outpatient volume adjustment is made; hospitals with inpatient psychiatric services have a significantly lower hospital outpatient volume than hospitals without psychiatric services. Therefore the cost difference widens. However, hospitals with psychiatric services have a higher area cost of living than hospitals without. Therefore it appears as though the cost difference significance disappears as the cost of living adjustment is made.

There is no significant difference in the cost per admission between hospitals that did or did not provide trauma services for the COSTALL calculation. It was hypothesized that hospitals with trauma services will have a higher cost per admission than hospitals without the services (Hypothesis B5e). *This research does not support the hypothesis.* There is also no significant difference for the COSTCMOP calculation but there is a significant difference for the COSTUNADJ calculation. Hospitals with trauma services have a higher case mix than hospitals without. It appears as though this difference may be the reason for the significant difference for COSTUNADJ but not for the adjusted cost versions.

Another service, obstetrics, was examined to determine if its presence had an impact on the cost per admission. There is no significant difference in the cost for hospitals that do or do not provide obstetric services for the COSTALL calculation. It was hypothesized that hospitals with obstetric services will have a higher cost per admission than hospitals without the services (Hypothesis B6). *This research does not support the hypothesis.* There is also no significant difference for the COSTCMOP or COSTUNADJ calculations. For each of the three cost versions, hospitals without obstetric services have a higher cost per admission than hospitals with obstetric services but the differences are not significant. The levels of

significance are: COSTALL, p=.291; COSTCMOP, p=.363; and COSTUNADJ, p=.064. It appears as though the case mix adjustment is responsible for the differences in the levels of significance between the unadjusted cost and the adjusted costs; hospitals without obstetrics have an average case mix of 1.1346 and hospitals with obstetrics have an average case mix of 1.0367. The level of significance of the difference in case mix is p=.073; not significant at the level of significance defined for this research.

Table 23
Relationships of Physical Factor Independent Variables with Dependent Variable

Independent Variable	COSTALL	COSTCMOP	COSTUNADJ
Location[a,b,c,1]			
Urban: Mean & SD	$5,049 (572)	$4,782 (665)	$7,579 (1,163)
Rural: Mean & SD	$4,611 (544)	$3,872 (457)	$6,297 (995)
Number of Beds[a,b,c,2]			
R Squared (and Sign)	.1767 (+)	.2650 (+)	.1456 (+)
Number of Staff[a,b,c,2]			
R Squared (and Sign)	.1424 (+)	.2239 (+)	.1390 (+)
Number of Services[a,b,c,3]			
R Squared (and Sign)	.0782 (+)	.1248 (+)	.1224 (+)
Presence of Specialty/Tert. Svcs.[a,b,c,1]			
No Spec./Tert.Svcs.: Mean & SD	$4,571 (538)	$3,957 (486)	$6,595 (840)
Spec./Tert. Svcs.: Mean & SD	$5,077 (551)	$4,723 (724)	$7,370 (1410)
Neonatal Special Care Services[a,b,c,1]			
Provide NSC: Mean & SD	$5,221 (479)	$5,030 (643)	$7,660 (958)
No NSC: Mean & SD	$4,760 (592)	$4,216 (659)	$6,864 (1,291)
Open Heart Surgery[a,b,c,1]			
Provide OHS: Mean & SD	$5,173 (482)	$4,856 (593)	$7,897 (1,167)
No OHS: Mean & SD	$4,803 (603)	$4,311 (734)	$6,870 (1,214)
Medical Rehabilitation[a,c,1]			
Provide Rehab: Mean & SD	$5,285 (398)	$4,774 (613)	$8,169 (1,688)
No Reh.: Mean & SD	$4,800 (599)	$4,347 (743)	$6,867 (1,086)
Inpatient Psychiatric[b,1]			
Provide Psych: Mean & SD	$4,996 (565)	$4,676 (748)	$7,080 (1,384)
No Psych: Mean & SD	$4,780 (609)	$4,220 (678)	$7,030 (1,183)
Trauma[c,1]			
Provide Trauma: Mean&SD	$5,138 (469)	$4,731 (688)	$8,060 (1,220)
No Trauma: Mean & SD	$4,841 (605)	$4,374 (740)	$6,946 (1,227)
Presence of Obstetrics[1]			
Provide OB: Mean & SD	$4,834 (589)	$4,371 (720)	$6,883 (1,085)
No OB: Mean & SD	$5,006 (631)	$4,554 (815)	$7,724 (1,681)

COSTALL: Cost per admission adjusted for hospital case mix, hospital outpatient volume, and area cost of living
COSTCMOP: Cost per admission adjusted for hospital case mix and hospital outpatient volume only
COSTUNADJ: Unadjusted cost per admission

a Significant for COSTALL at $p \leq .05$
b Significant for COSTCMOP at $p \leq .05$
c Significant for COSTUNADJ at $p \leq .05$

1 T-test for independent samples
2 Spearman correlation coefficient
3 Pearson's correlation coefficient

Multivariate Analysis - Physical Independent Variables and the Dependent Variable

To identify the physical factor with the greatest impact on cost per admission, multiple linear regression models were analyzed. When all six physical variables were used in the modeling, a multicollinear relationship between number of beds and number of staff ($r = .933$) was found. Both the number of beds and the number of staff represented the concept of hospital size. It was decided to use number of beds in the regression model instead of number of staff for several reasons: there is a stronger relationship between number of beds and COSTALL (R Squared = .1767) than between number of staff and COSTALL (R Squared = .1424); only about 65% of hospital cost is labor related; and number of beds impacts not only labor costs, but also facility maintenance and operation costs. The number of hospital services was not used in the regression model due to concerns of lack of independence between that variable and the other variables dealing with hospital services, i.e., presence of tertiary and specialty services and the presence of obstetrics.

With COSTALL as the dependent variable, the regression model accounts for 24.5% of the variability of cost per admission. As seen in Table 24, the presence of specialty and tertiary services, the number of beds, and the presence of obstetrics are significant with number of beds being the variable with the greatest impact on cost per admission when adjusted for case mix, outpatient volume, and cost of living. It was hypothesized that when physical factors are considered together in one model, the physical factor with the greatest impact on cost per admission will be provision of specialty and tertiary services (Hypothesis B7). While the provision of specialty and tertiary services has a strong impact, it does not have the greatest impact. *This research does not support the hypothesis.*

Table 24
Multivariate Regression Analysis for Cost Per Admission
Adjusted for Case Mix, Outpatient Volume, and Cost of Living (COSTALL)
Physical Factors

Variable	B (SE)	CI	Beta	p
Hospital Location	-132 (139)	-408, 144	-.1096	.3428
Presence of Specialty and Tertiary Services	292 (141)	10, 573	.2417	.0423
Number of Beds	1 (.5)	.1, 2.1	.2756	.0266
Presence of Obstetrics	-290 (144)	-577, -3	-.1953	.0478

Adjusted R Square = .2453
F = 7.8248
Significant F = .0000

With COSTCMOP as the dependent variable, the model accounts for 43.8% of the variability. As seen in Table 25, hospital location and presence of specialty and tertiary services are the only variables with a significant impact on cost per admission when adjusted for case mix and outpatient volume only. Hospital location has the greatest impact in this model. Hospital location has a significant relationship with cost of living; urban hospitals have significantly higher costs of living than rural hospitals. The hospital location variable lost significance when the cost per admission was adjusted for cost of living in addition to the case mix and outpatient volume adjustments (COSTALL).

Table 25
Multivariate Regression Analysis for Cost Per Admission
Adjusted for Case Mix and Outpatient Volume (COSTCMOP)
Physical Factors

Variable	B (SE)	CI	Beta	p
Hospital Location	-641 (148)	-936, -347	-.4299	.0000
Presence of Specialty and Tertiary Services	412 (151)	112, 712	.2764	.0077
Number of Beds	.5 (.5)	-.5, 1.5	.1016	.3376
Presence of Obstetrics	-278 (154)	-58, 28	-.1515	.0746

Adjusted R Square = .4376
F = 17.3383
Significant F = .0000

With COSTUNADJ as the dependent variable, the model accounts for 34.3% of the variability of cost per admission. As seen in Table 26, hospital location, number of beds, and presence of obstetrics have a significant impact on cost per admission when unadjusted. Hospital location has the greatest impact in this model as was true with the COSTCMOP model. The significance of hospital location in the COSTUNADJ and COSTCMOP models, but not in the COSTALL model, shows the impact of adjusting for cost of living. Cost of living accounts for a large amount of the variance in cost per admission.

Table 26
Multivariate Regression Analysis for Cost Per Admission
Unadjusted (COSTUNADJ)
Physical Factors

Variable	B (SE)	CI	Beta	p
Hospital Location	-915 (273)	-1458, -371	-.3589	.0012
Presence of Specialty and Tertiary Services	106 (279)	-448, 661	.0417	.7040
Number of Beds	2.1 (1.0)	0.2, 4.0	.2451	.0343
Presence of Obstetrics	-998 (284)	-1564, -432	-.3182	.0007

Adjusted R Square = .3432
F = 11.9732
Significant F = .0000

Biological Factors

Two factors have been identified as biological factors for the purpose of this research: patient age (percentage of hospital patients that are age 65+); and community elderly (percentage of city or county residents that are age 65+). Descriptive statistics for these variables can be found in Table 16.

Bivariate Analysis - Biological Independent Variables and the Dependent Variable

Information on the relationship of these independent variables to the dependent variable can be found in Table 27. There is a significant negative relationship between hospital patient age (percent age 65+) and hospital cost per admission for COSTALL. The R squared value is .1287. It was hypothesized that hospitals with a larger proportion of elderly patients will have a higher cost per admission (Hypothesis C1). *The research does not support the hypothesis.* There is also a significant negative relationship for the COSTCMOP

calculation. There is no significant relationship between patient age and COSTUNADJ. The significance of the relationships of patient age (percent age 65+) and the adjusted cost versions can be explained by the significant positive relationships between patient age (percent age 65+) and case mix and between patient age (percent age 65+) and outpatient volume.

There is not a significant relationship between community elderly (percent age 65+) and hospital cost per admission for COSTALL. It was hypothesized that hospitals located in communities with a large percentage of elderly residents will have a higher cost per admission (Hypothesis C2). *The research does not support the hypothesis.* There is a significant negative relationship between community elderly and COSTCMOP and COSTUNADJ. The lack of significance of the relationship between community elderly and the COSTALL cost per admission may be explained by the significant negative relationship between community elderly and area cost of living.

Table 27
Relationship of Biological Factor Independent Variables to Dependent Variable

Independent Variable	COSTALL	COSTCMOP	COSTUNADJ
Patient Age - % Elderly [a,b,1] R Squared (and Sign)	.1287 (-)	.2252 (-)	.0000 (+)
Community Elderly [b,c,2] R Squared (and Sign)	.0160 (-)	.0935 (-)	.0790 (-)

COSTALL: Cost per admission adjusted for hospital case mix, hospital outpatient volume, and area cost of living
COSTCMOP: Cost per admission adjusted for hospital case mix and hospital outpatient volume only
COSTUNADJ: Unadjusted cost per admission

a Significant for COSTALL at $p \leq .05$
b Significant for COSTCMOP at $p \leq .05$
c Significant for COSTUNADJ at $p \leq .05$

1 Spearman correlation coefficient
2 Pearson's correlation coefficient

Multivariate Analysis - Biological Independent Variables and the Dependent Variable

With COSTALL as the dependent variable, the regression model accounts for 6.4% of the variability of cost per admission. As shown in Table 28, hospital patient age (percent age 65+) is the only significant variable. It was hypothesized that when the biological factors are considered together in one model, the biological factor with the greatest impact on cost per admission will be the age composition of a hospital's patients (percent age 65+) (Hypothesis C3). *This research supports the hypothesis.*

Table 28
Multivariate Regression Analysis for Cost Per Admission
Adjusted for Case Mix, Outpatient Volume, and Cost of Living (COSTALL)
Biological Factors

Variable	B (SE)	CI	Beta	p
Patient Age - % 65+	-1437 (573)	-257, -298	-.2903	.0141
Community Elderly - % 65+	-106 (1646)	-3380, 3168	-.0075	.9487

Adjusted R Square = .0638
F = 3.8638
Significant F = .0249

With COSTCMOP as the dependent variable, 15.5% of the variability is accounted for by the regression model. As seen in Table 29, hospital patient age (percent age 65+) is the only significant variable.

Table 29
Multivariate Regression Analysis for Cost Per Admission
Adjusted for Case Mix and Outpatient Volume (COSTCMOP)
Biological Factors

Variable	B (SE)	CI	Beta	p
Patient Age - % 65+	-1914 (672)	-3252, -577	-.3129	.0056
Community Elderly - % 65+	-3123 (1932)	-6967, 720	-.1778	.1098

Adjusted R Square = .1549
F = 8.6991
Significant F = .0004

With COSTUNADJ as the dependent variable, the model accounts for 12.9% of the variability. As seen in Table 30, hospital patient age (percent age 65+) and community elderly are both significant. Community elderly is the variable with the greatest impact in this model.

Table 30
Multivariate Regression Analysis for Cost Per Admission
Unadjusted (COSTUNADJ)
Biological Factors

Variable	B (SE)	CI	Beta	p
Patient Age - % 65+	3037 (1167)	716, 5359	.2905	.0110
Community Elderly - % 65+	-12014 (3353)	-18684, -5344	-.4000	.0006

Adjusted R Square = .1285
F = 7.1945
Significant F = .0013

Relationships Among Social, Physical, and Biological Factors

There are a number of significant relationships among the social, physical, and biological variables. These are summarized in Table 31; additional information on these relationships is provided following the table.

It was hypothesized that the presence of specialty and tertiary services will be associated with the presence of medical education (Hypothesis D1). Ninety percent of teaching hospitals offer one or more specialty and tertiary services vs. 49% of nonteaching hospitals. The difference is significant. *This research supports the hypothesis.*

It was hypothesized that the percentage of Medicaid patients will be associated with the presence of medical education (Hypothesis D2). The percentage of Medicaid patients at teaching hospitals is 14.2% while the percentage at nonteaching hospitals is 13.6%; the difference is not significant. *This research does not support the hypothesis.*

It was hypothesized that not-for-profit ownership will be associated with medical education (Hypothesis D3). While the percentage of not-for-profit hospitals participating in medical education (25.4%) is higher than that of for-profit hospitals (14.3%), the difference is not significant. *This research does not support the hypothesis.*

Table 31
Relationships Among the Social, Physical, and Biological Independent Variables

	COMM ELDER	HOSP ELDER	OB	TRAUMA	PYSCH	REHAB	HEART	NSCU	SPEC SVCS	SVCS	STAFF	BEDS	LOC	COMM POV	MCAID	OWNER
HOSP ELDER	+															
OB	n.s.	-														
TRAUMA	-	-	n.s.													
PSYCH	n.s.	-	n.s.	n.s.												
REHAB	n.s.	n.s.	n.s.	n.s.	n.s.											
HEART	n.s.	n.s.	n.s.	+	+	+										
NSCU	-	-	+	+	+	n.s.	+									
SPEC SVCS	-	-	n.s.	+	+	+	+	+								
SERVICES	-	-	n.s.	+	+	+	+	+	+							
STAFF	-	-	+	+	+	+	+	+	+	+						
BEDS	n.s.	-	n.s.	+	+	+	+	+	+	+	+					
LOCATION	+	+	n.s.	n.s.	-	n.s.	-	-	-	-	-	-				
POVERTY	+	+	n.s.	n.s.	n.s.	n.s.	n.s.	-	-	-	-	n.s.	+			
MEDICAID	n.s.	-	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	-	n.s.	n.s.	n.s.	+		
OWNER	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	+	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	
TEACH	n.s.	-	n.s.	+	+	+	+	+	+	+	+	+	-	n.s.	n.s.	n.s.

KEY

\+ indicates significant positive relationship

\- indicates significant negative relationship

n.s. indicates relationship is not significant

See Table 32 for description of variable labels and measurement of variables.

Table 32
Description of Variable Labels and Measurement of Variables

Label	Description	Measurement
TEACH	Teaching Status	0 - Nonteaching; 1 - Teaching
OWNER	Type of Ownership	0 - Not-for-profit; 1 - For-profit
MEDICAID	Patient Socioeconomic Status	% of hospital inpatients with Medicaid
POVERTY	Community Poverty Level	% of community residents below poverty level
LOCATION	Hospital Location	0 - Urban; 1 - Rural
BEDS	Number of Beds	Number of licensed beds
STAFF	Number of Staff	Number of full time equivalent hospital staff
SERVICES	Number of Services	Total number of services offered by hospital
SPEC SVCS	Presence of Specialty and Tertiary Services	0 - No specialty/tertiary services 1 - At least 1 spec./tert. service
NSCU	Presence of Neonatal Special Care Unit	0 - No NSCU 1 - NSCU
HEART	Presence of Open Heart Surgery	0- No open heart surgery 1- Open heart surgery
REHAB	Presence of Inpatient Rehabilitation Services	0 - No rehabilitation services 1 - Rehabilitation services
PSYCH	Presence of Inpatient Psychiatric Services	0 - No psychiatric services 1 - Psychiatric services
TRAUMA	Presence of Trauma Services	0 - No trauma services 1 - Trauma services
OB	Presence of Obstetrical Services	0 - No obstetrical services 1 - Obstetrical services
HOSP ELDER	Patient Age - Percent Elderly	% of hospital patients age 65+
COMM ELDER	Community Elderly	% of community residents age 65+

As indicated in Table 31, a number of relationships among the independent variables were found to be significant; level of significance is defined as $p \leq .05$. These are described below; note that only the relationships which are significant are included. Please note that relationships are listed only under one of the variables involved in the relationship, not under both variables.

Teaching Status

As described in Chapter III, the two public major teaching hospitals were excluded from the study population. The study's findings therefore cannot be applied to public major teaching hospitals.

Teaching hospitals are more likely to be located in an urban area than nonteaching hospitals. 85.0% of teaching hospitals are located in urban areas and 50.8% of nonteaching hospitals are. Test: Chi Square Yates' Continuity Correction.

Teaching hospitals have a larger number of licensed beds than nonteaching hospitals. Mean (and standard deviation) for teaching hospitals = 382 (157); for nonteaching hospitals = 158 (100). Test: t-test for independent samples.

Teaching hospitals have a larger number of hospital full time equivalent staff than nonteaching hospitals. Mean (and standard deviation) for teaching hospitals =1407 (823); for nonteaching hospitals = 530 (386). Test: t-test for independent samples.

Teaching hospitals offer a larger number of hospital services than nonteaching hospitals. Mean (and standard deviation) for teaching hospitals = 47 (12); for nonteaching hospitals = 34 (14). Test: t-test for independent samples.

Teaching hospitals have a lower percentage of elderly patients than nonteaching hospitals. Mean (and standard deviation) for teaching hospitals = 31.5 (7.8); for nonteaching hospitals = 39.0 (12.6). Test: t-test for independent samples.

Teaching hospitals are more likely to offer specialty and tertiary services than nonteaching hospitals. 90.0% of teaching hospitals offer specialty/tertiary services and 49.2% of nonteaching hospitals do. Test: Chi Square Yates' Continuity Correction.

Teaching hospitals are more likely to offer neonatal special care services than nonteaching hospitals. 45.0% of teaching hospitals offer NSC services and 16.9% of nonteaching hospitals do. Test: Chi Square Fisher's Exact Test.

Teaching hospitals are more likely to offer open heart surgery services than nonteaching hospitals. 50.0% of teaching hospitals offer OHS services and 7.7% of nonteaching hospitals do. Test: Chi Square Fisher's Exact Test.

Teaching hospitals are more likely to offer inpatient rehabilitation services than nonteaching hospitals. 30.0% of teaching hospitals offer rehab services and 9.2% of nonteaching hospitals do. Test: Chi Square Fisher's Exact Test.

Teaching hospitals are more likely to offer inpatient psychiatric services than nonteaching hospitals. 65.0% of teaching hospitals offer psych services and 33.8% of nonteaching hospitals do. Test: Chi Square Yates' Continuity Correction.

Teaching hospitals are more likely to offer trauma services than nonteaching hospitals. 25.0% of teaching hospitals offer trauma services and 4.5% of nonteaching hospitals do. Test: Chi Square Fisher's Exact Test.

Ownership

For-profit hospitals are more likely to offer specialty and tertiary services than not-for-profit hospitals. 85.7% of for-profit hospitals offer specialty/tertiary services and 53.5% of not-for-profit hospitals do. Test: Chi Square Yates' Continuity Correction.

Patient Socioeconomic Status

There is a positive relationship between percentage of hospital patients with Medicaid

and percentage of the community below poverty level; R Squared = .2062. Test: Pearson's Correlation Coefficient.

There is a negative relationship between percentage of hospital patients with Medicaid and number of hospital services; R Squared = .0466. Test: Pearson's Correlation Coefficient.

There is a negative relationship between percentage of hospital patients with Medicaid and percent of hospital patients that are elderly. R Squared = .1074. Test: Spearman Correlation Coefficient.

Community Poverty Level

Urban hospitals have a lower percentage of community residents below poverty level than rural hospitals. Mean (and standard deviation) for urban hospitals = 12.7 (8.3); for rural hospitals = 15.2 (7.7). Test: t-test for independent samples.

There is a negative relationship between percentage of community residents below poverty level and number of hospital staff. R Squared = .0611. Test: Spearman Correlation Coefficient.

There is a negative relationship between percentage of community residents below poverty level and number of hospital services. R Squared = .0817. Test: Pearson's Correlation Coefficient.

Hospitals with specialty/tertiary services have a lower percentage of community residents below poverty level than hospitals without. Mean (and standard deviation) for hospitals with specialty/tertiary services = 13.6 (7.5); for hospitals without = 16.6 (5.9). Test: t-test for independent samples.

Hospitals with neonatal special care services have a lower percentage of community residents below poverty level than hospitals without. Mean (and standard deviation) for hospitals with NSC = 9.9 (6.3); for hospitals without = 16.4 (6.5). Test: t-test for

independent samples.

There is a positive relationship between percentage of community residents below poverty level and percentage of elderly patients. R Squared = .0485. Test: Spearman Correlation Coefficient.

There is a positive relationship between percentage of community residents below poverty level and percentage of community residents that are elderly. R Squared = .1543. Test: Pearson's Correlation Coefficient.

Location

Urban hospitals have a larger number of licensed beds than rural hospitals. Mean (and standard deviation) for urban hospitals = 274 (155); for rural hospitals = 120 (81). Test: t-test for independent samples.

Urban hospitals have a larger number of hospital full time equivalent staff than rural hospitals. Mean (and standard deviation) for urban hospitals = 974 (693); for rural hospitals = 396 (331). Test: t-test for independent samples.

Urban hospitals offer a larger number of hospital services than rural hospitals. Mean (and standard deviation) for urban hospitals = 42 (13); for rural hospitals = 30 (13). Test: t-test for independent samples.

Urban hospitals are more likely to offer specialty and tertiary services than rural hospitals. 78% of urban hospitals offer specialty/tertiary services and 31.4% of rural hospitals do. Test: Chi Square Yates' Continuity Correction.

Urban hospitals are more likely to offer neonatal special care services than rural hospitals. 38.0% of urban hospitals and 2.9% of rural hospitals offer neonatal special care. Test: Chi Square Yates' Continuity Correction.

Urban hospitals are more likely to offer open heart surgery services than rural

hospitals. 28.0% of urban hospitals and 2.9% of rural hospitals offer open heart surgery. Test: Chi Square Yates' Continuity Correction.

Urban hospitals are more likely to offer psychiatric inpatient services than rural hospitals. 54.0% of urban hospitals and 22.9% of rural hospitals offer psychiatric inpatient care. Test: Chi Square Yates' Continuity Correction.

Urban hospitals have a lower percentage of elderly patients than rural hospitals. Mean (and standard deviation) for urban hospitals = 33.5 (11.9); for rural hospitals = 42.6 (10.3). Test: t-test for independent samples.

Urban hospitals have a lower percentage of community elderly than rural hospitals. Mean (and standard deviation) for urban hospitals = 12.5 (4.3); for rural hospitals = 15.0 (3.7). Test: t-test for independent samples.

Number of Beds

There is a positive relationship between hospital bed size and hospital staff size. R Squared = .8534. Test: Spearman Correlation Coefficient.

There is a positive relationship between hospital bed size and number of hospital services. R Squared = .3904. Test: Spearman Correlation Coefficient.

Hospitals with specialty and tertiary services have a larger number of beds than hospitals without. Mean (and standard deviation) for hospitals with specialty/tertiary services: 278 (155); for hospitals without: 114 (67). Test: t-test for independent samples.

Hospitals with neonatal special care have a larger number of beds than hospitals without. Mean (and standard deviation) for hospitals with NSC: 355 (163); for hospitals without: 166 (114). Test: t-test for independent samples.

Hospitals with open heart surgery services have a larger number of beds than hospitals without. Mean (and standard deviation) for hospitals with OHS: 442 (137); for hospitals

without: 161 (97). Test: t-test for independent samples.

Hospitals with inpatient rehabilitation services have a larger number of beds than hospitals without. Mean (and standard deviation) for hospitals with rehabilitation: 372 (168); for hospitals without: 184 (129). Test: t-test for independent samples.

Hospitals with inpatient psychiatric services have a larger number of beds than hospitals without. Mean (and standard deviation) for hospitals with psychiatric services: 289 (174); for hospitals without: 156 (99). Test: t-test for independent samples.

Hospitals with trauma services have a larger number of beds than hospitals without. Mean (and standard deviation) for hospitals with trauma services: 427 (227); mean for hospitals without: 188 (121). Test: t-test for independent samples.

There is a negative relationship between number of beds and percentage of elderly patients. R Squared = .1436. Test: Spearman Correlation Coefficient.

Number of Staff

There is a positive relationship between hospital staff size and number of hospital services; R Squared = .5014. Test: Spearman Correlation Coefficient.

Hospitals with specialty and tertiary services have a larger number of staff than hospitals without. Mean (and standard deviation) for hospitals with specialty/tertiary services: 1001 (703); for hospitals without: 359 (209). Test: t-test for independent samples.

Hospitals with neonatal special care have a larger number of staff than hospitals without. Mean (and standard deviation) for hospitals with NSC: 1429 (768); for hospitals without: 523 (403). Test: t-test for independent samples.

Hospitals with open heart surgery services have a larger number of staff than hospitals without. Mean (and standard deviation) for hospitals with OHS: 1694 (793); for hospitals without: 531 (355). Test: t-test for independent samples.

Hospitals with inpatient rehabilitation services have a larger number of staff than hospitals without. Mean (and standard deviation) for hospitals with rehabilitation: 1335 (812); for hospitals without: 638 (552). Test: t-test for independent samples.

Hospitals with inpatient psychiatric services have a larger number of staff than hospitals without. Mean (and standard deviation) for hospitals with psychiatric services: 1068 (793); for hospitals without: 504 (357). Test: t-test for independent samples.

Hospitals with trauma services have a larger number of staff than hospitals without. Mean (and standard deviation) for hospitals with trauma services: 1788 (1099); for hospitals without: 627 (458). Test: t-test for independent samples.

Hospitals with obstetric services have a larger number of staff than hospitals without. Mean (and standard deviation) for hospitals with OB: 814 (633); for hospitals without: 425 (573). Test: t-test for independent samples.

There is a negative relationship between number of staff and percentage of elderly patients. R Squared = .2139. Test: Spearman Correlation Coefficient.

There is a negative relationship between number of staff and percentage of community elderly. R Squared = .0455. Test: Spearman Correlation Coefficient.

Number of Services

Hospitals with specialty and tertiary services offer a larger number of services than hospitals without. Mean (and standard deviation) for hospitals with specialty/tertiary services: 42 (12); for hospitals without: 31 (15). Test: t-test for independent samples.

Hospitals with neonatal special care offer a larger number of services than hospitals without. Mean (and standard deviation) for hospitals with NSC: 46 (10); for hospitals without: 34 (14). Test: t-test for independent samples.

Hospitals with open heart surgery services offer a larger number of services than

hospitals without. Mean (and standard deviation) for hospitals with OHS: 49 (11); for hospitals without: 35 (14). Test: t-test for independent samples.

Hospitals with inpatient rehabilitation services offer a larger number of services than hospitals without. Mean (and standard deviation) for hospitals with rehabilitation: 50 (14); for hospitals without: 35 (14). Test: t-test for independent samples.

Hospitals with inpatient psychiatric services offer a larger number of services than hospitals without. Mean (and standard deviation) for hospitals with psychiatric services: 42 (12); for hospitals without: 34 (15). Test: t-test for independent samples.

Hospitals with trauma services offer a larger number of services than hospitals without. Mean (and standard deviation) for hospitals with trauma services: 49 (16); for hospitals without: 36 (14). Test: t-test for independent samples.

There is a negative relationship between number of services and percentage of elderly patients. R Squared = .1265. Test: Spearman Correlation Coefficient.

There is a negative relationship between number of services and percentage of community elderly. R Squared = .0508. Test: Pearson's Correlation Coefficient.

Presence of Specialty and Tertiary Services

Hospitals that offer specialty and specialty services have a lower percentage of elderly patients than hospitals without. Mean (and standard deviation) for hospitals with specialty/tertiary services: 33.5 (11.0); for hospitals without: 42.6 (11.7). Test: t-test for independent samples.

Hospitals that offer specialty and specialty services have a lower percentage of community elderly than hospitals without. Mean (and standard deviation) for hospitals with specialty/tertiary services: 12.8 (4.2); for hospitals without: 14.6 (4.1). Test: t-test for independent samples.

Neonatal Special Care

Hospitals with neonatal special care services are more likely to offer open heart surgery services than hospitals without. 55.0% of hospitals with NSC services offer open heart surgery and 6.1% of hospitals without. Test: Chi Square Fisher's Exact Test.

Hospitals with neonatal special care services are more likely to offer inpatient psychiatric services than hospitals without. 65.0% of hospitals with NSC services offer psych services and 34.8% of hospitals without. Test:Chi Square Yates' Continuity Correction.

Hospitals with neonatal special care services are more likely to offer trauma services than hospitals without. 25.0% of hospitals with NSC services offer trauma services and 4.5% of hospitals without. Test: Chi Square Fisher's Exact Test.

Hospitals that offer neonatal special care services have a lower percentage of elderly patients than hospitals without. Mean (and standard deviation) for hospitals with specialty/tertiary services: 33.5 (11.0); for hospitals without: 42.6 (11.7). Test: t-test for independent samples.

Hospitals that offer neonatal special care services have a lower percentage of community elderly than hospitals without. Mean (and standard deviation) for hospitals with specialty/tertiary services: 12.8 (4.2); for hospitals without: 14.6 (4.1). Test: t-test for independent samples.

Open Heart Surgery

Hospitals with open heart surgery services are more likely to offer inpatient rehabilitation services than hospitals without. 33.3% of hospitals with OHS services offer rehabilitation services and 10.0% of hospitals without. Test: Chi Square Fisher's Exact Test.

Hospitals with open heart surgery services are more likely to offer inpatient psychiatric services than hospitals without. 73.3% of hospitals with OHS services offer psychiatric

services and 34.3% of hospitals without. Test: Chi Square Yates' Continuity Correction.

Hospitals with open heart surgery services are more likely to offer trauma services than hospitals without. 40.0% of hospitals with OHS services offer trauma services and 2.9% of hospitals without. Test: Chi Square Fisher's Exact Test.

Inpatient Psychiatric Services

Hospitals that offer inpatient psychiatric services have a lower percentage of elderly patients than hospitals without. Mean (and standard deviation) for hospitals with psychiatric services: 32.2 (8.6); for hospitals without: 40.8 (13.0). Test: t-test for independent samples.

Trauma Services

Hospitals that offer trauma services have a lower percentage of elderly patients than hospitals without. Mean (and standard deviation) for hospitals with trauma services: 29.3 (7.9); for hospitals without: 38.1 (12.2). Test: t-test for independent samples.

Hospitals that offer trauma services have a lower percentage of community elderly than hospitals without. Mean (and standard deviation) for hospitals with trauma services: 10.2 (3.5); for hospitals without: 13.9 (4.1). Test: t-test for independent samples.

Presence of Obstetrics

Hospitals that offer obstetrics have a lower percentage of elderly patients than hospitals without. Mean (and standard deviation) for hospitals with obstetrics: 34.0 (8.1); for hospitals without: 50.2 (16.4). Test: t-test for independent samples.

Hospital Elderly Patients

There is a positive relationship between percentage of elderly patients and percentage of community elderly. R Squared = .2167. Test: Spearman Correlation Coefficient.

Community Elderly

Significant findings have been identified above under the appropriate variables.

Relationships Between the Independent Variables and the Adjustment Factors and Among the Adjustment Factors

Relationships among the independent variables and the adjustment factors (patient complexity as measured by case mix, outpatient volume, and cost of living) were also examined. In addition, the relationships among the three adjustment factors were studied. Relationships found to be significant were:

Patient Complexity (Case Mix)

Teaching hospitals have a higher hospital patient complexity (case mix) than nonteaching hospitals. Mean (and standard deviation) for teaching hospitals = 1.134 (.169); for nonteaching hospitals = 1.032 (.138). Test: t-test for independent samples.

There is a negative relationship between patient socioeconomic status and hospital patient complexity (case mix). R Squared = .1358. Test: Spearman Correlation Coefficient.

Urban hospitals have a higher hospital patient complexity (case mix) than rural hospitals. Mean (and standard deviation) for urban hospitals = 1.094 (.165); for rural hospitals = 1.003 (.113). Test: t-test for independent samples.

There is a positive relationship between hospital bed size and hospital patient complexity (case mix). R Squared = .2771. Test: Spearman Correlation Coefficient.

There is a positive relationship between hospital staff size and hospital patient complexity (case mix). R Squared = .1881. Test: Spearman Correlation Coefficient.

There is a positive relationship between number of hospital services and hospital patient complexity (case mix). R Squared = .1273. Test: Spearman Correlation Coefficient.

Hospitals with specialty and tertiary services have a higher patient complexity (case mix) than hospitals without. Mean (and standard deviation) for hospitals with the services

= 1.085 (.163); for hospitals without = 1.016 (.125). Test: t-test for independent samples.

Hospitals with open heart surgery services have a higher hospital patient complexity (case mix) than hospitals without. Mean (and standard deviation) for hospitals with OHS = 1.244 (.155); for hospitals without = 1.016 (.117). Test: t-test for independent samples.

Hospitals with inpatient rehabilitation services have a higher hospital patient complexity (case mix) than hospitals without. Mean (and standard deviation) for hospitals with rehabilitation = 1.221; for hospitals without = 1.029. Test: t-test for independent samples.

Hospitals with trauma services have a higher hospital patient complexity (case mix) than hospitals without. Mean (and standard deviation) for hospitals with trauma services = 1.215 (.198); for hospitals without = 1.040 (.137). Test: t-test for independent samples.

There is a positive relationship between hospital patient age (percent age 65+) and hospital patient complexity (case mix). R Squared = .0845. Test: Spearman Correlation Coefficient.

Outpatient Volume

Teaching hospitals have a lower hospital outpatient volume than nonteaching hospitals. Mean (and standard deviation) for teaching hospitals = .399 (.127); for nonteaching hospitals = .583 (.205). Test: t-test for independent samples.

For-profit hospitals have a lower hospital outpatient volume than not-for-profit hospitals. Mean (and standard deviation) for for-profit hospitals = .428 (.182); for not-for-profit hospitals = .562 (.202). Test: t-test for independent samples.

Urban hospitals have a lower outpatient volume than rural hospitals. Mean (and standard deviation) for urban hospitals = .472 (.174); for rural hospitals = .636 (.208). Test:

t-test for independent samples.

There is a negative relationship between hospital bed size and hospital outpatient volume. R Squared = .4115. Test: Spearman Correlation Coefficient.

There is a negative relationship between hospital staff size and hospital outpatient volume. R Squared = .2568. Test: Spearman Correlation Coefficient.

There is a negative relationship between number of hospital services and hospital outpatient volume. R Squared = .1828. Test: Pearson's Correlation Coefficient.

Hospitals with specialty and tertiary services have a lower outpatient volume than hospitals without. Mean (and standard deviation) for hospitals with the services = .453 (.169); for hospitals without = .663 (.188). Test: t-test for independent samples.

Hospitals with neonatal special care services have a lower hospital outpatient volume than hospitals without. Mean (and standard deviation) for hospitals with NSC = .416 (.140); for hospitals without = .578 (.207). Test: t-test for independent samples.

Hospitals with open heart surgery services have a lower hospital outpatient volume than hospitals without. Mean (and standard deviation) for hospitals with OHS = .315 (.082); for hospitals without = .588 (.190). Test: t-test for independent samples.

Hospitals with inpatient rehabilitation services have a lower hospital outpatient volume than hospitals without. Mean (and standard deviation) for hospitals with rehabilitation = .407 (.161); for hospitals without = .561 (.203). Test: t-test for independent samples.

Hospitals with inpatient psychiatric services have a lower hospital outpatient volume than hospitals without. Mean (and standard deviation) for hospitals with psychiatric services = .434 (.161); for hospitals without = .613 (.200). Test: t-test for independent samples.

There is a positive relationship between hospital patient age and hospital outpatient volume. R Squared = .0984. Test: Spearman Correlation Coefficient.

Cost of Living

There is a negative relationship between patient socioeconomic status (percent of patients with Medicaid) and hospital cost of living. R Squared = .0479. Test: Spearman Correlation Coefficient.

There is a negative relationship between community poverty level (percent of residents below poverty level) and hospital cost of living. R Squared = .2582. Test: Spearman Correlation Coefficient.

Urban hospitals have a higher cost of living than rural hospitals. Mean (and standard deviation) for urban hospitals = .925 (.107); mean for rural hospitals = .773 (.000). Test: t-test for independent samples.

There is a positive relationship between hospital bed size and hospital cost of living. R Squared = .2165. Test: Spearman Correlation Coefficient.

There is a positive relationship between hospital staff size and hospital cost of living. R Squared = .2103. Test: Spearman Correlation Coefficient.

There is a positive relationship between number of hospital services and hospital cost of living. R Squared = .1618. Test: Spearman Correlation Coefficient.

Hospitals with specialty and tertiary services have a higher cost of living than hospitals without. Mean (and standard deviation) for hospitals with the services = .898 (.117); for hospitals without = .810 (.078). Test: t-test for independent samples.

Hospitals with neonatal special care services have a higher hospital cost of living than hospitals without. Mean (and standard deviation) for hospitals with NSC = .949 (.120); for hospitals without = .836 (.094). Test: t-test for independent samples.

Hospitals with inpatient psychiatric services have a higher hospital cost of living than hospitals without. Mean (and standard deviation) for hospitals with psychiatric services =

.907 (.123); for hospitals without = .831 (.090). Test: t-test for independent samples.

There is a negative relationship between hospital patient age and hospital cost of living. R Squared = .1733. Test: Spearman Correlation Coefficient.

There is a negative relationship between community elderly and hospital cost of living. R Squared = .1329. Test: Spearman Correlation Coefficient.

Case Mix, Outpatient Volume, and Cost of Living

There is a negative relationship between hospital outpatient volume and hospital patient complexity. R Squared = .1484. Test: Spearman Correlation Coefficient.

There is a negative relationship between hospital outpatient volume and hospital cost of living. R Squared = .1398. Test: Spearman Correlation Coefficient.

All Factors - Social, Physical, and Biological

Multiple linear regression models were developed using social, physical, and biological factors together. The variables that emerged as significant in the social, physical, and biological models for the COSTALL cost calculation were used. These were: teaching status; ownership; number of beds; presence of specialty and tertiary services; presence of obstetrics; and patient age (% 65+).

With COSTALL as the dependent variable, the regression model accounts for 30.9% of the variability of cost per admission. As shown in Table 33, variables emerging as significant are number of beds, presence of obstetrics, and patient age. The presence of obstetrics has the greatest impact in this model. Presence of obstetrics and patient age (65+) have a negative relationship with cost per admission. In other words, hospitals with obstetrics and hospitals with a higher percentage of elderly patients have lower cost per admission. The

number of beds has a positive relationship with cost per admission; hospitals with a larger number of beds have a higher cost per admission.

Table 33
Multivariate Regression Analysis for Cost Per Admission
Adjusted for Case Mix, Outpatient Volume, and Cost of Living (COSTALL)
Social, Physical, and Biological Factors

Variable	B (SE)	CI	Beta	p
Teaching Status	23 (168)	-311, 356	.0162	.8928
Ownership	236 (155)	-73, 545	.1471	.1332
Number of Beds	1.0 (.5)	.1, 2.2	.2989	.0263
Presence of Specialty and Tertiary Services	152 (143)	-133, 437	.1258	.2920
Presence of Obstetrics	-545 (162)	-868, -222	-.3671	.0012
Patient Age - % 65+	-1760 (583)	-2921, -598	-.3554	.0035

Adjusted R Square = .3086
F = 7.2500
Significant F = .0000

It was hypothesized that when social, physical, and biological factors are considered together in one model, the presence of medical education, specialty and tertiary services, and not-for-profit ownership status will be associated with high cost per admission (Hypothesis D4). *This research does not support the hypothesis.*

However, the presence of medical education and specialty/tertiary services is positively related to the number of beds which is included in the model. Also, the presence of medical education and specialty/tertiary services is negatively related to the percentage of elderly patients, which is included in the model. Therefore, the effect of medical education

and specialty/tertiary services appears to be explained by the presence of the other variables included in the model.

With respect to the ownership component in the hypothesis, in the social factors regression model where ownership emerges as significant, the relationship is a positive one. In other words, for-profit hospitals have a higher cost per admission than not-for-profit hospitals; this appears to be related to the finding that for-profit hospitals are more likely to offer specialty and tertiary services. When ownership is included in the model which incorporates social, physical, and biological factors together, it is not significant.

It was hypothesized that when social, physical, and biological factors are considered together in one model, the location of a facility in an area with a relatively high level of poverty and a high proportion of elderly population will be associated with a high cost per admission (Hypothesis D5). *This research does not support this hypothesis.*

Community poverty and community elderly also did not emerge as significant in the COSTALL social or biological models. There is a significant negative relationship between cost of living and community poverty and community elderly. The cost of living adjustment reduces the significance of the community poverty variable and the community elderly variable. In addition, there is a significant positive relationship between community poverty level and the percent of hospital elderly and between community elderly and the percent of hospital elderly; percent of hospital elderly is included in the regression model.

With COSTCMOP as the dependent variable, the regression model accounts for 43.4% of the variability of cost per admission. As shown in Table 34, variables emerging as significant are number of beds, presence of specialty and tertiary services, presence of obstetrics, and patient age. Patient age has the greatest impact in this model.

Table 34
Multivariate Regression Analysis for Cost Per Admission
Adjusted for Case Mix and Outpatient Volume (COSTCMOP)
Social, Physical, and Biological Factors

Variable	B (SE)	CI	Beta	p
Teaching Status	-88 (187)	-461, 286	-.0506	.6419
Ownership	319 (174)	-26, 665	.1614	.0697
Number of Beds	1.4 (.6)	.2, 2.6	.2810	.0211
Presence of Specialty and Tertiary Services	323 (160)	4, 642	.2165	.0471
Presence of Obstetrics	-728 (181)	-1089, -367	-.3969	.0001
Patient Age - % 65+	-2780 (652)	-4079, -1481	-.4544	.0001

Adjusted R Square = .4339
F = 11.7305
Significant F = .0000

In the COSTCMOP model, the presence of specialty and tertiary services emerges as significant where it does not in the COSTALL model. Presence of specialty and tertiary services is positively related to cost of living; hospitals with specialty/tertiary services have a higher cost of living. Therefore, the cost of living adjustment appears to reduce the significance of the specialty/tertiary services variable.

With COSTUNADJ as the dependent variable, the regression model accounts for 27.7% of the variability of cost per admission. As shown in Table 35, variables emerging as significant are number of beds and presence of obstetrics. Number of beds has the greatest impact in this model. Both patient age and the presence of specialty/tertiary services have significant relationships with case mix and outpatient volume. These relationships appear to account for the difference in findings between the COSTUNADJ and COSTCMOP models.

Table 35
Multivariate Regression Analysis for Cost Per Admission
Unadjusted (COSTUNADJ)
Social, Physical, and Biological Factors

Variable	B (SE)	CI	Beta	p
Teaching Status	-310 (362)	-1031, 410	-.1050	.3939
Ownership	397 (335)	-271, 1065	.1174	.2400
Number of Beds	4.0 (1.1)	1.8, 6.3	.4794	.0007
Presence of Specialty and Tertiary Services	365 (309)	-251, 981	.1432	.2415
Presence of Obstetrics	-792 (350)	-1489, -95	-.2526	.0265
Patient Age - % 65+	-1698 (1260)	-811, 4206	.1624	.1818

Adjusted R Square = . 2766
F = 6.3534
Significant F = .0000

Summary

The purpose of this research is to examine the relationships between various environmental and organizational factors and cost, using Zammuto's theoretical framework. Multiple linear regression analysis has been used to identify the significant social variables. Similarly, regression models have been developed to identify the significant physical variables and the significant biological variables. The social, physical, and biological variables found to be significant in each of these individual models have been used to build a model incorporating all factors.

Throughout this chapter, results have been reported using three different versions of the dependent variable, cost per admission: 1) cost adjusted for hospital case mix, outpatient volume, and cost of living (COSTALL); 2) cost adjusted for hospital case mix and outpatient

volume only (COSTCMOP); and 3) unadjusted cost (COSTUNADJ). Hypotheses have been tested using the COSTALL cost per admission, while findings relating to the other two cost calculations have been reported.

Conclusions will be drawn from these findings and recommendations for further research will be identified in Chapter V.

CHAPTER V: CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

Introduction

The primary purpose of this research has been to examine the relationships between various environmental and organizational factors and hospital performance; hospital performance has been defined as cost per admission. Raymond Zammuto's model of organizational performance assessment has been used as the theoretical framework. According to Zammuto, social, physical, and biological factors impact organizational performance. For the purpose of this research, twelve factors, i.e., independent variables, have been studied. Social factors include: hospital teaching status; hospital ownership; patient socioeconomic status (percent of patients with Medicaid); and community poverty level. Physical factors include: hospital location; hospital size - number of beds; hospital size - number of staff; number of services offered; the presence of specialty and tertiary services such as neonatal special care, open heart surgery, inpatient rehabilitation, inpatient psychiatric services, and trauma; and the presence of obstetrics. Biological factors include: patient age (percentage of patients age 65+) and community elderly.

An additional purpose of this research has been to explore the differences in cost adjustment methods, specifically the impact of adjusting for cost of living differences among hospitals. While most cost adjustment methods take case mix and outpatient volume differences into account, not all account for cost of living differences. This research has studied cost per admission with and without the cost of living adjustment.

A number of hypotheses about relationships of various factors with cost per admission were identified and tested. The results are summarized in Table 36 and will be discussed in the context of the theoretical framework and previous research in the following section. Following this discussion, the impact of different cost adjustment methods will be explored. The chapter will conclude with recommendations for further research.

Zammuto's Model of Organizational Effectiveness Assessment

Hospital cost is clearly a complex issue. Many factors come into play in determining hospital cost per admission. Zammuto's model of organizational effectiveness assessment offered a systematic and organized approach to identifying and testing the various factors that impact hospital performance. When this model is used, two limitations should be considered. First, the categorization of a variable as social, physical, or biological is subject to different interpretations. However, it is not the specific category that is important; what is important is that the model can be used to ensure that all different factors are considered. Second, it is difficult to capture some factors in a quantifiable manner. Whereas factors such as physician practice styles, hospital management practices, patient compliance with treatment, and others play a role in determining cost, they are difficult to quantify.

This research has focused on cost per admission since cost has been an issue of concern to hospital constituencies such as government and business. It should be recognized however that the performance of a hospital cannot be adequately measured by any one single indicator. Hospitals provide many services ranging from patient care to community service to education to research. Each of these services has many aspects including quality, consumer satisfaction, accessibility, comprehensiveness, and outcome in addition to cost.

Table 36
Summary of Hypothesis Testing Results

Hypothesis	Bivariate Results	Multivariate Results For ONE Factor	Multivariate Results for ALL Factors
A. Social factors will impact hospital performance.			
A1. Hospital participation in medical school education will increase cost per admission. Teaching hospitals' cost will exceed nonteaching hospitals' cost.	Supported	Supported	Not supported
A2. The ownership status of a hospital will impact the cost per admission. Not-for-profit hospitals' cost will exceed for-profit hospitals' cost.	Not supported	Opposite direction supported	Not supported
A3. The socioeconomic status of a hospital's patients will impact the cost per admission. Hospitals that have a higher proportion of Medicaid patients will have a higher cost per admission.	Not supported	Not supported	Not tested [2]
A4. The poverty level of the community in which the hospital is located will impact the cost per admission. Hospitals located in communities with a higher percentage of individuals below poverty level will have a higher cost per admission.	Not supported	Not supported	Not tested [2]
A5. Hospital participation in managed care will impact the cost per admission. Hospitals with a lower proportion of managed care patients will have a higher cost per admission.	Not tested [1]	Not tested [1]	Not tested [1]
A6. When these social factors are considered together in one model, the social factor with the greatest impact on cost per admission will be participation in medical education.		Supported	

Hypothesis	Bivariate Results	Multivariate Results For ONE Factor	Multivariate Results for ALL Factors
B. Physical factors will impact hospital performance.			
B1. The rural/urban location of a hospital will impact cost per admission. Urban hospitals will have a higher cost per admission than rural hospitals.	Supported	Not supported	Not tested [2]
B2. The size of a hospital will impact the cost per admission. Hospitals with a larger number of beds will have a higher cost per admission.	Supported	Supported	Supported
B3. The size of a hospital will impact the cost per admission. Hospitals with a larger number of staff will have a higher cost per admission.	Supported	Not tested [3]	Not tested [2]
B4. The number of services offered by a hospital will impact the cost per admission. Hospitals with a larger number of services will have a higher cost per admission.	Supported	Not tested [3]	Not tested [2]
B5. The presence of specialty and tertiary services offered by a hospital will impact the cost per admission. Hospitals that provide specialty and tertiary services will have a higher cost per admission.	Supported	Supported	Not supported
B5a. Hospitals with neonatal special care services will have a higher cost per admission than hospitals without the services.	Supported	Not tested [4]	Not tested [2]
B5b. Hospitals with open heart surgery services will have a higher cost per admission than hospitals without the services.	Supported	Not tested [4]	Not tested [2]
B5c. Hospitals with inpatient medical rehabilitation services will have a higher cost per admission than hospitals without the services.	Supported	Not tested [4]	Not tested [2]
B5d. Hospitals with inpatient psychiatric services will have a higher cost per admission than hospitals without the services.	Not supported	Not tested [4]	Not tested [2]
B5e. Hospitals with trauma services will have a higher cost per admission than hospitals without the services.	Not supported	Not tested [4]	Not tested [2]
B6. Hospitals with obstetric services will have a higher cost per admission than hospitals without the services.	Not supported	Opposite direction supported	Opposite direction supported
B7. When these physical factors are considered together in one model, the physical factor with the greatest impact on cost per admission will be the hospital's provision of tertiary and specialty services.		Not supported	

Hypothesis	Bivariate Results	Multivariate Results For ONE Factor	Multivariate Results for ALL Factors
C. Biological factors will impact hospital performance.			
C1. The age composition of a hospital's patients will impact the cost per admission. Hospitals with a larger proportion of elderly patients will have a higher cost per admission.	Opposite direction supported	Opposite direction supported	Opposite direction supported
C2. The age composition of a hospital's community will impact the cost per admission. Hospitals located in communities with a large percentage of elderly residents will have a higher cost per admission.	Not supported	Not supported	Not tested [2]
C3. When these biological factors are considered together in one model, the biological factor with the greatest impact on cost per admission will be the age composition of a hospital's patients.		Supported	
D. Social, physical, and biological factors will interact together and with each other to impact hospital performance.			
D1. Presence of specialty and tertiary services will be associated with the presence of medical education.	Supported		
D2. Percentage of Medicaid patients will be associated with the presence of medical education.	Not supported		
D3. Not-for-profit ownership status will be associated with medical education.	Not supported		
D4. When social, physical, and biological factors are considered together in one model, the presence of medical education, specialty and tertiary services, and not-for-profit ownership status will be associated with high cost per admission.			Not supported
D5. When social, physical, and biological factors are considered together in one model, the location of a facility in an area with a relatively high level of poverty and a high proportion of elderly population will be associated with a high cost per admission.			Not supported
E. Adjusting hospital cost per admission for cost of living in addition to adjustments for case mix and outpatient volume will decrease the variation in cost among hospitals.	Supported (bivariate, multivariate results not applicable)		

NOTE: Hypotheses A - C were tested using the cost per admission adjusted for cost of living, case mix, and outpatient volume.

[1] Managed care hypothesis not tested due to inadequate data.

[2] Variables that were not significant or were not used in the multivariate model for one factor were not used in the multivariate model for all factors.

[3] Hospital staff size and number of services were not used in the multivariate model for physical factors due to multicollinearity and lack of independence concerns respectively.

[4] Specific specialty and tertiary services were not tested at the multivariate level.

While a number of social, physical, and biological factors were studied, this research found that the number of licensed beds had a positive relationship with cost per admission; in other words, hospitals with a larger number of beds tended to have higher cost per admission. The study also found that the presence of obstetric services and the percentage of patients who were elderly had a negative relationship with cost per admission; in other words hospitals with obstetric services tended to have lower cost per admission and hospitals with elderly patients tended to have lower cost per admission. The regression model accounted for only 30.86% of the variance. It is clear that a number of other factors come into play in determining cost per admission. Each of the independent variables included in this research will be discussed briefly below.

Social Factors

Initially, five social factors were identified for this research: hospital teaching status; hospital ownership; patient socioeconomic status; community poverty level; and managed care participation. Data were collected on managed care participation (defined as percentage of patients in HMOs or PPOs). However, the data were not adequate to allow analysis; this is discussed further under Recommendations for Further Research. Therefore, conclusions will be limited to the other four social variables.

Teaching status. The relationship of teaching status to cost has been studied extensively over the past several years. This research generally supported the findings of previous research regarding the impact of teaching status on cost. It should be noted that public major teaching facilities were not included in the study (please see Chapter III and Appendix C for additional information); therefore, the conclusions of this study cannot be

applied to public major teaching hospitals. For the study hospitals, at the bivariate level, there was a significant difference in the cost per admission for teaching and nonteaching hospitals for the COSTALL calculation (cost per admission adjusted for case mix, outpatient volume, and cost of living) as well as for the COSTCMOP calculation (cost per admission adjusted for case mix and outpatient volume only). It was not significant for the COSTUNADJ calculation however (unadjusted cost per admission). Teaching hospitals have a significantly lower outpatient volume than nonteaching hospitals; this appears to account for the difference in findings between the adjusted and the unadjusted costs.

In the multivariate linear regression analysis of the social factors only, teaching status was a significant variable in the COSTALL model; in fact, it was the variable with the greatest impact on cost per admission. Teaching status was also a significant variable in the COSTCMOP model, although community poverty level emerged as the variable with the greatest impact. The fact that community poverty level was significant in the COSTCMOP model but not the COSTALL model shows the impact of adjusting for cost of living. Teaching status was not a significant variable in the COSTUNADJ model looking at social factors only.

When teaching status was considered in a regression model which incorporated social, physical, and biological factors together, it was not a significant variable. Other factors such as the number of beds, the presence of obstetrics, and patient age (percentage of patients age 65+) emerged as significant. The number of beds is positively related to teaching status and patient age is negatively related to teaching status. Therefore it appears that other variables may explain the relationship seen at the bivariate level between teaching status and cost.

A review of previous research identifies other researchers that have found significant relationships between teaching status and cost per admission. These include Sloan and

Steinwald (1980), Flood and Scott (1987), J.R. Hollingsworth and E.J. Hollingsworth (1987), Zimmerman et al. (1993), and HCIA/Mercer (1995). Sloan and Steinwald (1980) used data that were adjusted for cost of living, but not for case mix nor outpatient volume. Their data covered the period from 1969 to 1975; during this time, hospital outpatient volume was extremely small so an adjustment would have had a very minimal impact. They did conclude however that the higher cost of teaching hospitals may be due to case mix differences. As the current research shows, even when the data are adjusted for case mix, the cost differences are significant. Similar to the current research, Flood and Scott (1987) also found a significant relationship between teaching status and cost per admission at the bivariate level, but not at the multivariate level when all factors were considered. Their sample size was also small. J.R. Hollingsworth and E.J. Hollingsworth (1987) found that a smaller percentage of for-profit hospitals were teaching hospitals than not-for-profit hospitals. The current research did not find a significant difference in the percentages. The exclusion of the major teaching hospitals in this research may be a part of the reason. In addition, in recent years, there has been a "blurring of the lines" between for-profit and not-for-profit hospitals as hospitals have changed ownership through acquisitions. The current research generally supports the findings of Zimmerman et al. (1993) who found higher costs in Intensive Care Units in teaching hospitals than in nonteaching hospitals. The current research also supports the findings of HCIA/Mercer (1995) where costs in teaching hospitals were higher than in nonteaching hospitals at the bivariate level. Their study population consisted of nearly 4,000 hospitals across the country, which allowed them to categorize hospitals as major or minor teaching hospitals. The study did not include multivariate analysis.

In the current research, the size of the study population imposed some limitations. As previously stated, the two public major teaching hospitals in the state were excluded from the

study population. The remaining major teaching hospital was grouped with the minor teaching hospitals. A study with a larger sample size which would allow analysis of major teaching hospitals vs. minor teaching hospitals vs. nonteaching hospitals might uncover different findings. Further research is still needed in this area to identify the impact of teaching status. In order to analyze the impact of different levels of medical education (i.e., major teaching hospitals, minor teaching hospitals, and nonteaching hospitals), a larger sample size is essential. This remains an important question as hospital cost remains under the scrutiny of constituents such as business and government. Medical education can be considered as a social good. It is essential that hospitals participate in the education of physicians. The questions of who should pay for medical education (government, business, etc.) and how remain unresolved. While this debate continues, it would appear to be unfair to somehow penalize hospitals that participate in medical education simply because their cost per admission may be higher than nonteaching hospitals.

Ownership. Although the relationship of ownership to cost per admission has been studied extensively over the past several years, there is little consistency in the findings. This is most likely due to differences in the manner in which cost is calculated (for example, including only Medicare-allowed expenses, including or excluding home office costs in the case of a multihospital system, including only inpatient costs or administrative costs instead of total costs, etc.) and differences in the study populations (i.e., including or excluding hospitals of a certain bed size, public/proprietary/voluntary vs. not-for-profit/for-profit, etc.).

This research did not find a significant relationship between ownership and cost per admission at the bivariate level using the COSTALL calculation. There was a significant difference however using the COSTCMOP definition, which adjusts for case mix and

outpatient volume only. While the cost per admission is higher for for-profit hospitals than not-for-profit hospitals using the COSTALL definition ($5,113 vs. $4,821), the level of significance is .094, higher than the .05 level defined as significant for this research. Using the COSTCMOP calculation, the for-profit cost is $4,771 and the not-for-profit cost is $4,336, significant at the .043 level. When a cost of living adjustment is made to the cost variable, the difference between the for-profit and the not-for-profit cost becomes nonsignificant. The difference that other researchers have found may actually be due to cost of living. At the bivariate level, there was no significant difference using the COSTUNADJ calculation. The factor that may be responsible for the significance of the COSTCMOP difference is the outpatient volume adjustment; the for-profit hospitals have a significantly lower outpatient volume than the not-for-profit hospitals.

In the multivariate linear regression model using social factors only, ownership did emerge as a significant variable using the COSTALL calculation. Ownership was also a significant variable using the COSTCMOP calculation but was not significant using the COSTUNADJ calculation.

However, in the multivariate linear regression model using social, physical, and biological factors together, ownership was not significant (p=.1332) for the COSTALL, COSTCMOP, or COSTUNADJ models. Therefore, it appears as though the significance of the ownership is explained by the presence of the variables in the model.

This research generally supports the research conducted by Watt et al. (1986) which found that cost per admission was not significantly higher in for-profit hospitals than in not-for-profit hospitals. Watt et al. (1986) designed their study and made adjustments to the data which incorporated case mix, outpatient volume, and cost of living adjustments. Although not the same methodology as the COSTALL calculation used in this research, the purpose

of the adjustments were the same and the findings were similar. J.R. Hollingsworth and E.J. Hollingsworth (1987) using 1979 unadjusted data found that the cost per admission was less in for-profit hospitals than in not-for-profit hospitals. This research does not support their findings. Similarly, the American Hospital Association (1995) analysis of 1994 data show that for all U.S. hospitals, the cost per admission (when adjusted for outpatient volume) is less for for-profits than for not-for-profits. However, this does not hold true for Virginia hospitals where the 1994 AHA data show that the cost per admission is less for not-for-profit hospitals than for for-profit hospitals. It would be instructive to conduct further research to determine the difference between the U.S. hospital findings and the Virginia hospital findings. The Woolhandler and Himmelstein (1997) study adjusted data to account for case mix, outpatient volume, and cost of living differences and found that for-profit hospitals had a higher cost per discharge. However, the level of significance is not specified. The current research found a significant relationship at $p = .094$, but not at the $p \leq .05$ level specified as significant for this study. This research supports the work of Shulka, Pestian, and Clement (1997) which found a significant difference in the cost per admission between for-profit and not-for-profit using the Virginia Health Services Cost Review Council cost definition (which is equivalent to the COSTCMOP calculation used in this research). Shulka, Pestian, and Clement (1997) found a 24.36% difference in the cost, significant at $.05<p<.1$. This research found only an 8.35% difference between the costs using the COSTCMOP calculation, significant at $p = .043$. This research used 1994 data, whereas the Shulka, Pestian, and Clement (1997) research was based on 1993 data.

It is clear that one's conclusions regarding the relationship of ownership to hospital cost rely heavily on the definition (calculation) of cost and on the level of significance used. The relationship remains an important question as the public debate regarding "for profit

medicine" continues. To better understand the relationship of ownership to cost, additional detailed analysis should be carried out to identify the specific elements of cost such as labor, taxes, home office expenses, etc.

Patient socioeconomic status. Although the literature review identified some prior research dealing with the socioeconomic status of patients, the research did not address the relationship of socioeconomic status of patients with cost per admission. For the purpose of this research, socioeconomic status was defined as individuals with Medicaid coverage. The bivariate analysis did not show a significant relationship for the COSTALL or COSTCMOP calculations. In other words, there was no relationship between percentage of patients with Medicaid and hospital cost per admission. This research did show a significant negative relationship for the COSTUNADJ calculation; i.e. hospitals with a high percentage of Medicaid patients had a lower cost per admission. Similarly, in the multivariate analysis of social factors only, patient socioeconomic status did not emerge as a significant variable for the COSTALL or COSTCMOP calculations. In the regression model for the COSTUNADJ calculation, it was the only significant variable. The significance was lost as the adjustments were made for outpatient volume and case mix. Since patient socioeconomic status did not emerge as significant in the COSTALL social model, it was not used in the model incorporating social, physical, and biological factors together.

There is a still need for further research into patient socioeconomic status as well as other social variables such as patients' education level and occupation to gain a better understanding of how social characteristics of hospitals' patients impact the hospitals' organizational performances. These social variables may impact patient compliance with treatment which in turn can impact hospital performance. The social variables may serve as

a proxy for certain risk factors that may impact patient treatment and recovery. The social variables may indicate the availability or lack of availability of a family or home support network. There are many ways in which the social factors such as patient socioeconomic status may impact hospital performance; these need to be researched further.

Community poverty level. There appears to be little if any previous research relating the poverty level of a community to the organizational performance of a community institution such as a hospital. This study examined community poverty level defined as the percentage of community residents with incomes below poverty level. The bivariate analysis of community poverty level and cost per admission did not show a significant relationship for the COSTALL calculation. However, there was a significant negative relationship for the COSTCMOP and for the COSTUNADJ calculations. As the cost of living adjustment is made to cost per admission, the significance disappears. This may be explained by the significant negative relationship between community poverty level and area cost of living. In the multivariate analysis of social factors only, community poverty level was not a significant variable for the COSTALL calculation. However, it was a significant variable for the COSTCMOP calculation and was the variable with the greatest impact on the model. The variable was not significant in the COSTUNADJ model. As the variable did not emerge as significant in the social factor multivariate model, it was not included in the multivariate linear regression analysis which incorporated social, physical, and biological factors together.

Of particular interest are the significant relationships found with the COSTCMOP calculations, but not the COSTALL calculations. This demonstrates the importance of the poverty level factor as a proxy for cost of living and the need to adjust the dependent variable for cost of living.

The significant negative relationships found between community poverty level and number of services and presence of specialty and tertiary services raise the question of the availability and accessibility of health care services to residents in communities with high poverty levels. Community poverty level, educational level, occupation - these community social factors need to be researched further to identify relationship to hospital performance. Many of the same reasons as given above with respect to patient socioeconomic status apply here.

In summary, additional research is necessary to identify the impact that social factors have on hospital performance. In addition, research should focus on the continuum of care to identify the relationship these factors have with the outcome of the total episode of care, including physician visits and other components of health care.

Physical Factors

Six physical factors were examined in this research: location; number of beds; number of staff; number of hospital services; presence of specialty and tertiary services; and presence of obstetrics.

Location. This research generally supports previous research of location and cost. The current research showed that at the bivariate level, urban hospitals had a significantly higher cost per admission for the COSTALL, COSTCMOP, and COSTUNADJ calculations. In the multivariate analysis of the physical factors only, location did not emerge as a significant variable in the COSTALL model. However, in the COSTCMOP model, location was a significant variable and was the variable with the greatest impact. In the COSTUNADJ

model, location again emerged as a significant variable and as the variable with the greatest impact. Due to lack of significance in the COSTALL physical factors model, location was not considered for the "all factors" model which incorporated social, physical, and biological factors together.

It is important to note that location emerges as a significant variable in the models that are not adjusted for cost of living and does not emerge as a significant variable in the one model that does adjust for cost of living. It appears that the location itself is not important, rather it is the cost of living. This supports the importance of adjusting for cost of living when calculating cost per admission.

This research supports the findings of the HCIA/Mercer (1995) study. After adjusting cost per admission for case mix, outpatient volume, and cost of living, they found a difference in the cost between rural and urban hospitals under 250 beds in size. This research found a significance difference at the bivariate level for COSTALL. The American Hospital Association (1995) study showed a higher cost per admission for metropolitan areas. Their cost was adjusted for outpatient volume but not for case mix nor cost of living. This research did not use an equivalent calculation, but generally supports the AHA findings.

In the past, a hospital has been identified as urban or rural based upon its location. In actuality, the service areas of some hospitals are a mix of urban and rural. With a patient level data base such as that administered by Virginia Health Information, it is possible to identify (by city, county, or ZIP code) the areas from which a hospital draws its patients. Therefore, with more detailed information now available, more refined analyses can be done regarding the urban/rural nature of a hospital's service area.

Number of beds. The size of a hospital, as measured by its number of beds, has been

strongly associated with hospital cost. The current research supports the findings of previous research in this area. At the bivariate level, this research found bed size, identified as the number of licensed beds, to be positively related to hospital cost per admission when: 1) the cost is adjusted for case mix, outpatient volume, and cost of living (COSTALL); 2) the cost is adjusted for case mix and outpatient volume only (COSTCMOP); and 3) the cost is unadjusted (COSTUNADJ).

In the multivariate analysis of physical factors only, the number of beds was a significant variable in the COSTALL regression model and was the variable with the greatest impact on the model. In the COSTCMOP regression model, the number of beds did not emerge as a significant variable, possibly because location emerged as a significant variable in this model. With location and presence of specialty and tertiary services as significant variables in the COSTCMOP model, the number of beds lost its significance. In the COSTUNADJ model, the number of beds reemerged as a significant variable, whereas presence of specialty and tertiary services lost its significance.

In the multivariate linear regression model incorporating social, physical, and biological factors, in the COSTALL model, the number of beds again was a significant variable. The number of beds was also a significant variable in the COSTCMOP model. In the COSTUNADJ model, the number of beds was a significant variable and had the greatest impact on the model.

This research supports that carried out by Sloan and Steinwald (1980) who found a positive relationship between bed size and cost per admission. J.R. Hollingsworth and E. J. Hollingsworth (1987) found that voluntary hospitals had a larger number of beds than proprietary hospitals and had a higher cost per admission. The current research supports their findings regarding the relationship of bed size and cost. However, in the current research

ownership was not related to bed size. The average bed size of the not-for-profit hospitals was 210 beds, very close to the for-profit hospital bed size average of 213. Zimmerman et al. (1993) noted that teaching hospitals had a larger number of beds than nonteaching and had a higher cost per ICU admission. The current research found that teaching hospitals had significantly more beds than nonteaching hospitals and had a higher cost per admission. The current research supports the findings of the Healthcare Financial Management/MECON (1995) study which also found a positive relationship between bed size and cost. That study used a wage adjusted cost and an adjusted discharge (adjusted for case mix and outpatient volume). The American Hospital Association (1995) data also showed a positive relationship between bed size and adjusted expenses per admission (adjusted for outpatient volume, only).

Number of staff. Size of a hospital has been defined by the number of hospital staff in some research. This research defined staff as the number of full time equivalent staff. At the bivariate level, this research found a positive relationship between number of staff and cost per admission for COSTALL, COSTCMOP, and COSTUNADJ. In developing the multiple linear regression model for physical factors only, it was determined that number of beds and number of staff are multicollinear (R Squared = .8534). Total number of beds has a stronger relationship with the dependent variable and was used in the multivariate analysis.

Flood and Scott (1987) used total number of staff to define size. They found a significant bivariate relationship, as did this research. Their multiple regression analysis did not show a significant relationship; other variables emerged as more significant. Since they did not used number of beds to measure size, their multivariate findings cannot be directly compared with this research.

Number of services. Number of services has been used in previous research as a measure of the hospital's size or the hospital's technological complexity. At the bivariate level, the current research found a significant relationship between the number of services offered and hospital cost for COSTALL, COSTCMOP, and COSTUNADJ. Number of services was not used in the multivariate analysis due to possible issues of independence. Flood and Scott (1987) found a significant bivariate relationship but not a significant multivariate relationship. The J.R. Hollingsworth and E.J. Hollingsworth (1987) study found significant differences in the average number of services for public hospitals, proprietary hospitals, and voluntary hospitals. This research did not find a significant difference between not-for-profit and for-profit hospitals, with an average of 37 and 38 services respectively. The Flood and Scott (1987), J.R. Hollingsworth and E.J. Hollingsworth (1987), and the current research used the American Hospital Association survey data to measure the number of services. While this is an important data source, the data are self reported and are unaudited. It is possible that a different measure of hospital service offerings would provide different results.

Presence of specialty and tertiary services. The presence of specialty and tertiary services was defined as offering one or more of the following services: neonatal special care; open heart surgery; inpatient medical rehabilitation; inpatient psychiatric care; and trauma. At the bivariate level, hospitals with specialty and tertiary services had significantly higher costs per admission for the COSTALL, COSTCMOP, and COSTUNADJ calculations. At the multivariate level, in the regression analysis using physical factors only, the presence of specialty and tertiary services emerged as a significant variable in the COSTALL and COSTCMOP models, but not the COSTUNADJ model. For the multivariate linear

regression model incorporating social, physical, and biological factors together, the presence of specialty and tertiary services was a significant variable in the COSTCMOP model, but was not significant for the COSTALL or COSTUNADJ models.

Little research has been conducted looking specifically at specialty and tertiary services and their relationship to hospital cost. One reason may be the relative youth of many of these services. The Healthcare Financial Management/MECON (1995) study did show that there were differences in the services provided by low cost hospitals and high cost hospitals, i.e., high cost hospitals were more likely to offer these services: open heart surgery; organ transplant; bone marrow transplant; and Level I trauma. Their data were also adjusted for case mix, outpatient volume, and cost of living.

Presence of obstetric services. The relationship of obstetric services to cost is one of the more interesting findings of this research. While obstetric services was not related to cost per admission at the bivariate level, it emerged as a significant variable at the multivariate level. In the multivariate analysis of physical factors only, the provision of obstetrics was a significant variable with a negative influence on cost in the COSTALL and COSTUNADJ models. In other words, hospitals providing obstetrical care had lower costs per admission than hospitals not providing obstetrics. In the COSTALL model, the number of beds and the presence of specialty and tertiary services variables both had higher Beta weights than presence of obstetrics. In the COSTUNADJ model, location had a higher Beta weight than presence of obstetrics.

In the multivariate linear regression analysis incorporating social, physical, and biological factors together, presence of obstetrics emerged as a significant variable in the COSTALL, COSTCMOP, and COSTUNADJ models. In fact, for the COSTALL model,

presence of obstetrics had the largest Beta weight.

Compared to other hospital patients, most obstetric patients use relatively few hospital resources. OB patients in general are healthy and stay in the hospital only a short time. They do not require costly surgeries or medications. The case mix adjustment is designed to account for the relative complexity of patients. However, in the COSTALL and COSTCMOP calculations which include a case mix adjustment, hospitals with OB services still appear to have a lower cost per admission than hospitals without OB services. Further research is needed to identify reasons for the relationship between OB and cost and to identify the impact of different adjustment methodologies on this finding.

Biological Factors

Biological factors included in this research were patient age and community elderly.

Patient age. Bivariate analysis found a significant negative relationship between the percentage of a hospital's patients over age 65 and the cost per admission for the COSTALL and COSTCMOP calculations. In the multivariate analysis of biological factors only, patient age emerged as the only significant variable for the COSTALL and COSTCMOP models and as one of the significant variables for the COSTUNADJ model. In the multivariate analysis, patient age continued to have a negative impact on cost.

Patient age also emerged as a significant variable in the regression models which incorporated social, physical, and biological factors together for the COSTALL and COSTCMOP calculations. In the COSTALL model, the Beta weight for patient age was -.3554, second to presence of obstetrics with a Beta weight of -.3671. In the COSTCMOP model, patient age was the variable with the greatest impact, with a Beta weight of -.4544.

Previous research regarding patient age is very limited. Zimmerman et al. (1993) in their study of ICUs found that patients in nonteaching hospital ICUs were older and that the nonteaching ICUs had a lower cost per admission. The current research found that nonteaching hospitals had a significant higher percentage of elderly patients than teaching hospitals and that hospitals with a higher percentage of elderly had a lower cost per admission. Therefore, the current research generally supports that of Zimmerman et al. (1993).

Potential explanations for the significance of the percentage of elderly variable include the following: elderly may tend to be admitted for care for chronic conditions vs. acute conditions and may tend to receive less costly care; elderly may tend to be readmitted for care for chronic conditions so that cost over time may be more expensive but cost per discharge may be less expensive; and hospitals with a large percentage of elderly may tend to have skilled nursing facilities to which they may discharge patients, with the result being a less costly hospital stay.

Community elderly. Community elderly was defined in this research as the percentage of community residents age 65+. The bivariate analysis of community elderly and cost per admission identified a significant negative relationship for the COSTCMOP and COSTUNADJ calculations. In the multivariate analysis of biological factors only, community elderly was a significant variable only in the COSTUNADJ model, again with a negative impact. Since community elderly did not emerge as a significant variable in the COSTALL multivariate analysis of biological factors only, it was not used to develop the regression model incorporating social, physical, and biological factors together.

Sloan and Steinwald (1980) found a positive relationship between percentage of

elderly in the hospital's county and the hospital's expense per admission. Their calculation of expense took cost of living into account. The current research does not support their findings. The current research found a significant positive relationship between community elderly and community poverty level and significant negative relationships between community elderly and number of hospital staff, number of hospital services, and the presence of specialty and tertiary services. All of these elements, i.e., high poverty level, low number of hospital staff and services, and the lack of specialty and tertiary services, are all associated with lower cost per admission, not higher cost per admission. The data for the Sloan and Steinwald (1980) study covered the period from 1969 to 1975. The Medicare Prospective Payment System based on DRGs began in 1983. Under this program, hospitals were reimbursed by Medicare a set payment per discharge for most patients. The change in payment system may be a part of the reason that the findings of the Sloan and Steinwald (1980) and the current research are different.

The aging of the population and the impact of the Medicare program call for additional research in this area to determine the relationships of age with hospital cost.

Impact of Adjustment

A comparison of the findings using the COSTALL and COSTCMOP adjustment methodologies clearly shows the impact of location related variables on cost calculation. Location related variables such as location and poverty level were significant in the COSTCMOP multivariate linear regression models, but were not significant in the COSTALL models, where a cost of living adjustment was done to the dependent variable. To be able to separate out the impact of other variables on cost, this research would indicate that it is desirable to adjust for the location related cost factors by incorporating a cost of living

adjustment in the dependent variable.

The purpose of adjusting the dependent variable, cost per admission, is to take into account factors that are known to impact cost and to adjust cost accordingly so that the cost of one hospital may be appropriately compared with that of another. Adjustment for case mix is well accepted because it is known that hospitals vary in the complexity of their patients and that this has an impact on cost. Similarly, adjustment for outpatient volume is well accepted because it is known that hospital outpatient volumes vary and when total costs are examined, some adjustment is need to the admissions number to take outpatients into account.

Adjustment for cost of living is gaining acceptance and is generally used in national studies. As this research indicates, if cost of living is not adjusted for, variables such as hospital location and community poverty level have a significant impact on cost. Therefore, it is useful to make an adjustment to the dependent variable to take cost of living into account. With such an adjustment, it is possible to distinguish other factors that have an impact.

Recommendations for Further Research

Additional research is needed to address each of the major purposes of this research. Research is necessary to further identify social, physical, and biological factors that relate to hospital cost. Although this research included numerous factors, there are yet a number of factors that were not addressed in this research. For example, it is known that physician practice patterns (such as use of critical care paths, discharge plans, etc.) are important to hospital cost per admission; this would be considered as a social factor. Similarly it is known that hospital management practices and administrative policies (such as programs focusing on performance improvement) are important factors in cost; these could also be considered as social factors. A biological factor deserving greater study is the role of patient severity.

While case mix is an indicator of patient complexity, there are other measurements of patient severity such as Disease Staging and APR-DRG (All Patient Refined Diagnostic Related Groups). Another factor to consider in examining hospital cost per admission is patient behavior and compliance (compliance with treatment regimen, for example).

In addition to factors that were not included, additional research is needed for variables that were included. Better data are needed in order to measure the impact of managed care on cost per admission. More accurate and detailed identification of payor type is needed. To accurately assess the impact of teaching status on cost per admission, a large study population will be needed. In addition, it would be valuable to better understand the impact of ownership on cost per admission and to understand the differences between U.S. and Virginia data in this area. Also, to better understand the impact of location, additional research should be carried out examining the actual service areas of hospitals (using new patient level data bases). Also, it would be valuable to look at the impact on cost per admission of specific specialty and tertiary services; a large study population would be necessary to conduct this study.

In addition to examining hospital cost per admission, an area deserving greater research is examining an episode of care that encompasses but is not limited to a hospitalization. This is particularly important as more health care is provided on an outpatient basis outside of the hospital.

The other major purpose of this research is examination of adjustment methodologies. It was not the intent of this research to identify the merits and disadvantages of various methodologies, but it would be desirable to have further research carried out on different methods to adjust for patient complexity and severity, for outpatient volume, for cost of living, and for other factors. There is a need for greater standardization of methodologies to

facilitate analysis and comparisons.

Finally, there is a need to apply the research that is conducted in order to develop improved performance measurement methods, i.e., methods that serve to promote improvements in the health care system rather than lead to unanticipated negative impacts on the system. The implications of a performance measurement system must be clearly analyzed to ensure that hospital responsibilities such as community service are not impacted negatively in the struggle to achieve low hospital costs.

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APPENDIX A:

VIRGINIA GENERAL ASSEMBLY SENATE BILL 518

An Act to amend and reenact §§ 9-156 through 9-160 and 9-163 of the Code of Virginia, to amend the Code of Virginia by adding sections numbered 9-161.1 and 9-162.1, and to repeal §§ 9-161 and 9-162 of the Code of Virginia, relating to the Virginia Health Services Cost Review Council.

[S 518]

Approved APR 15 1992

Be it enacted by the General Assembly of Virginia:

1. That §§ 9-156 through 9-160 and 9-163 of the Code of Virginia are amended and reenacted and that the Code of Virginia is amended by adding sections numbered 9-161.1 and 9-162.1 as follows:

§ 9-156. Definitions.—As used in this chapter:

"Consumer" means any person (i) whose occupation is other than the administration of health activities or the provision of health services, (ii) who has no fiduciary obligation to a health care institution or other health agency or to any organization, public or private, whose principal activity is an adjunct to the provision of health services, or (iii) who has no material financial interest in the rendering of health services;

"Council" means the Virginia Health Services Cost Review Council;

"Health care institution" means (i) a general hospital, ordinary hospital, outpatient surgical hospital, nursing home or certified nursing facility licensed or certified pursuant to Chapter 5, Article 1 (§ 32.1-123 et seq.) of Title 32.1, (ii) a mental or psychiatric hospital licensed pursuant to Chapter 8 (§ 37.1-179 et seq.) of Title 37.1 and (iii) a hospital operated by the University of Virginia or Virginia Commonwealth University. In no event shall such term be construed to include any physician's office, nursing care facility of a religious body which depends upon prayer alone for healing, independent laboratory or outpatient clinic;

~~"Voluntary cost review organization" means a nonprofit association or other nonprofit entity which has as its function the review of health care institution costs and charges but which does not provide reimbursement to any health care institution or participate in the administration of any review process under Chapter 4, Article 1.1 (§ 32.1-102.1 et seq.) of Title 32.1;~~

"Aggregate cost" means the total financial requirements of an institution which shall be equal to the sum of:

a. The institution's ~~reasonable~~ current operating costs, including ~~reasonable~~ expenses for operation and maintenance of approved services and facilities, ~~reasonable~~ direct and indirect expenses for patient care services, working capital needs and taxes, if any;

b. Financial requirements for allowable capital purposes, including price-level depreciation for depreciable assets and ~~reasonable~~ accumulation of funds for approved capital projects;

c. For investor-owned institutions, after tax return on equity at the percentage equal to two times the average of the rates of interest on special issues of public debt obligations issued to the Federal Hospital Insurance Trust Fund for the months in a provider's reporting period, but not less, after taxes, than the rate, or weighted average of rates, of interest borne by the individual institution's outstanding capital indebtedness. The base to which the rate of return determined shall be applied is the total net assets, adjusted by paragraph b of this definition, without deduction of outstanding capital indebtedness of the individual institution for assets required in providing institutional health care services.

§ 9-157. Council; members; terms; reimbursement; etc.—A. The ~~Virginia Health Services Cost Review Commission is continued and shall hereafter be known as the~~ Virginia Health Services Cost Review Council ~~. The Council~~ shall be composed of ~~fifteen~~ *seventeen* members ~~as follows: thirteen members shall~~ *to* be appointed by the Governor, ~~five~~ *nine* of whom shall be consumers, *five representatives of employers or business groups and four consumers-at-large;* six of whom shall be persons responsible for the administration of nongovernmental health care institutions ; ; one of whom shall be an employee of a prepaid hospital service plan conducted under Chapter 42 of Title 38.2 ; and one of whom shall be an employee of a commercial insurer which underwrites accident and sickness insurance ; ~~one member shall be the Commissioner of Health or his designated representative and one member shall be the Director of the Department of Medical Assistance Services or his designated representative~~ . Two of the consumer members

appointed by the Governor shall be experienced in financial management or accounting. The nongovernmental health care institution members shall consist of three persons responsible for the administration of hospitals and three persons responsible for the administration of nursing homes.

Beginning July 1, 1992, each member of the Council ~~appointed by the Governor~~ shall be appointed for a term of ~~three~~ *four* years except that the ~~three~~ *new* members ~~representing nursing homes~~ initially appointed on July 1, ~~1988~~ *1992* , to increase the Council to ~~fifteen~~ *seventeen* members shall be appointed for terms of ~~from one to~~ *two,* three *or four* years to provide for staggered terms.

B. Appointive members of the Council shall not be eligible to serve as such for more than two consecutive full terms. Two or more years shall be deemed a full term.

C. Members of the Council shall receive fifty dollars per meeting of the Council and committees appointed by the chairman, not to exceed fifty dollars for any one day, for their service on the Council and shall also be reimbursed for necessary and proper expenses that are incurred in the performance of their duties on behalf of the Council.

D. A consumer member shall be elected by the Council to serve as chairman. The Council may elect from among its members a vice chairman. Meetings of the Council shall be held as frequently as its duties require.

E. Nine members shall constitute a quorum.

§ 9-157.1. Executive Director; powers and duties.—A. The Governor shall appoint an Executive Director of the Council, subject to confirmation by the General Assembly. The Executive Director shall hold his position at the pleasure of the Governor.

B. The Executive Director shall have the following powers:

1. To supervise the administration of work of the Council;

2. To prepare, approve, and submit any requests for appropriations and be responsible for all expenditures pursuant to appropriations;

3. To employ such staff as is necessary to carry out the powers and duties of this chapter, within the limits of available appropriations;

4. To do all acts necessary or convenient to carry out the purpose of this chapter and to assist the Council in carrying out its responsibilities and duties;

5. To make and enter into all contracts and agreements necessary or incidental to the performance of its duties and the execution of its powers under this chapter, including, but not limited to, contracts with the United States, other states, and agencies and governmental subdivisions of the Commonwealth. *If the Executive Director contracts with an organization for services as necessary to conduct the technical analyses of health care institution filings under this chapter, he may only do so upon receiving the prior approval of the Council to contract with that organization.*

§ 9-158. Uniform reporting regulations.—A. The Council shall establish by regulation a uniform system of financial reporting by which health care institutions shall report their revenues, expenses, other income, other outlays, assets and liabilities, units of service and related statistics. In determining the effective date for reporting requirements, the Council shall be mindful both of the immediate need for uniform health care institutions' reporting information to effectuate the purposes of this chapter and the administrative and economic difficulties which health care institutions may encounter in complying, but in no event shall such effective date be later than two and one-half years from the date of the formation of the Council. ~~In the case of nursing homes, the effective date shall be no later than July 1, 1990. During the year of July 1, 1989, through June 30, 1990, each nursing home provider shall comply with subdivisions A 1 and A 2 of § 9-159 and assist in developing requirements for reporting such other costs incurred in rendering services as the Council may prescribe.~~

B. In establishing such uniform reporting procedures the Council shall take into consideration:

1. Existing systems of accounting and reporting presently utilized by health care institutions;

2. Differences among health care institutions according to size, age, financial structure, methods of payment for services, and scope, type and method of providing services;

3. Other pertinent distinguishing factors;

4. Data and forms presently used by other state agencies receiving similar information from hospitals and nursing homes, in order to eliminate duplicate reporting of data and reduce the administrative burden of compliance to the minimum; and

5. Methods to minimize the financial impact and administrative burdens on all providers.

C. The Council, where appropriate, shall provide for modification consistent with the

purposes of this chapter, of reporting requirements to reflect correctly these differences among health care institutions and to avoid otherwise unduly burdensome costs in meeting the requirements of the uniform system of financial reporting.

§ 9-159. Filing requirements.—A. Each health care institution shall file annually with the Council after the close of the health care institution's fiscal year:

1. A certified audited balance sheet detailing its assets, liabilities and net worth, unless the institution is part of a publicly held company, in which case the equivalent extracted data for the institution shall be submitted in lieu of certified audited data;

2. A certified audited statement of income and expenses, unless the institution is part of a publicly held company, in which case the equivalent extracted data for the institution shall be submitted in lieu of certified audited data;

3. All reports referenced in § 9-158 and such other reports of the costs incurred in rendering services as the Council may prescribe ~~:~~ ;

4. A current charge schedule, with any subsequent amendments or modifications of that schedule being filed with the Council at least sixty days in advance of their effective dates; and

5. A report of aggregate costs and aggregate charges in a form specified by the Council.

The Council may, by regulation, exempt charge changes which have a minimal impact on revenues from the requirement, pursuant to subdivision 4 above, for filing amendments or modifications of a current charge schedule at least sixty days in advance of their effective dates.

B. ~~The findings, recommendations and justification for such recommendations of the Council shall be open to public inspection, but individual health care institution filings made pursuant to this chapter shall not be subject to the provisions of § 2.1-342. Individual patient and personnel information shall not be disclosed.~~ *No individual health care institution filings relating to an institution's budget shall be open to public inspection. Except as provided in § 9-160 A 5, individual patient and personnel information shall not be disclosed. Other individual health care institution filings shall be open to public inspection once the Council has adopted findings, recommendations and justification for such recommendations regarding that institution.*

C. The Council shall have the right to inspect *during regular business hours upon reasonable notice* any health care institution's audits and records as reasonably necessary to verify ~~reports~~ *the accuracy of any information submitted* .

§ 9-160. Continuing analysis, publication, etc.—A. The Council shall:

1. Undertake financial analysis and studies relating to health care institutions.

2. Publish and disseminate information relating to health care institutions' costs and charges including the publication of changes in charges other than those having a minimal impact prior to any changes taking effect. *The Council may publicly comment on any increase or decrease in charges that it determines to be excessive or inadequate.*

3. Survey all ~~hospitals~~ *health care institutions* that report to the Council or any corporation that controls a ~~hospital~~ *health care institutions* to determine the extent of *related party transactions and* commercial diversification by such ~~hospitals~~ *health care institutions* in the Commonwealth. The survey shall be in a form and manner prescribed by the Council and shall request the *following* information ~~specified in subdivisions a. f, g, h and i below on each hospital or such corporation and, with respect to any tax-exempt hospital or controlling corporation thereof, the information specified in subdivisions a through i below for each affiliate of such hospital or corporation, if any~~ :

a. The name and principal activity;

b. The date of the affiliation;

c. The nature of the affiliation;

d. The method by which each affiliate was acquired or created;

e. The tax status of each affiliate and, if tax-exempt, its Internal Revenue tax exemption code number;

f. The total assets;

g. The total revenues;

h. The net profit after taxes, or if not-for-profit, its excess revenues; ~~and~~

i. The net equity, or if not-for-profit, its fund balance ~~:~~ ; *and*

j. Information regarding related party transactions.

As a part of this survey, each ~~hospital~~ *health care institution* that reports to the Council or any corporation which controls a ~~hospital~~ *health care institution* that reports to the Council shall submit ~~an~~ audited consolidated financial ~~statement~~ *statements and audited consolidating financial schedules* to the Council which ~~includes a balance sheet detailing~~

include its total assets, liabilities , *revenues, expenses,* and net worth ~~and~~ a ~~statement of income and expenses and includes information on all such corporation's affiliates~~ .

The survey shall include the required information for all affiliates in which the health care institution or any corporation which controls a health care institution has a twenty-five percent or greater ownership interest. The Council may, by regulation, exempt certain types of required information and certain classes of affiliates. Information regarding affiliates of organizations that do not have corporate headquarters in Virginia and that do no business in Virginia need not be provided.

The Council shall report the results of this survey by December 1 of each year to the General Assembly. This report shall be open to public inspection. Information filed pursuant to this subdivision shall not be subject to the provisions of § 2.1-342.

4. Provide information concerning costs and charges to the public , *including information about the relationship between aggregate costs and aggregate charges,* in a form which consumers can use to compare costs and services in order to increase competition within the health care industry and contain health care costs.

B. The Council may require the furnishing and review of projected annual revenues and expenses of health care institutions and comment on them.

~~B.~~ *C.* The Council shall prepare and may make public summaries and compilations or other supplementary reports based on the information filed with or made available to the Council.

~~C.~~ *D.* The Council, in carrying out its responsibilities under this ~~section and § 9-161~~ *chapter* , shall be cognizant of other programs which bear upon the operation of health care institutions including programs relating to health planning, licensing and utilization review.

§ 9-161.1. Methodology to review and measure the efficiency and productivity of health care institutions.—By January 1, 1993, the Council shall promulgate regulations establishing a methodology for the review and measurement of the efficiency and productivity of health care institutions. The methodology shall provide for, but not be limited to, comparisons of a health care institution's performance to national and regional data.

The Council may promulgate different methodologies and reporting requirements for the assessment of the various types of health care institutions which report to it.

§ 9-162.1. Chapter and actions thereunder not to be construed as approval of reasonableness.—Nothing in this chapter or the actions taken by the Council pursuant to any of its provisions shall be construed as constituting approval by the Commonwealth or any of its agencies or officers of the reasonableness of any charges made or costs incurred by any health care institution.

§ 9-163. Administration.— *A. The Council shall prescribe a reasonable fee for each affected health care institution to cover the costs of the reasonable expenses of the Council and any reviews undertaken pursuant to this chapter. The fees shall be established and reviewed annually by the Council. The payment of such fees shall be at such time as the Council designates. The Council may assess a late charge on any fees paid after their due date.*

B. The Council ~~(i)~~ shall *(i)* maintain records of its activities; (ii) ~~shall~~ collect and account for all fees prescribed to be paid into the Council and account for and deposit the moneys so collected into a special fund from which the expenses of the Council shall be paid; *and* (iii) ~~shall~~ enforce all regulations promulgated by it ; ~~and (iv) shall contract with any voluntary cost review organization for services necessary to carry out the Council's activities where this will promote economy, efficiency, avoid duplication of effort and make best use of available expertise~~ .

2. That the Council shall submit a preliminary report by December 1, 1993, and a final report by no later than October 1, 1994, to the Commission on Health Care for All Virginians and to the Governor and the General Assembly, regarding the effectiveness of its efficiency and productivity measurements in controlling health care costs. Further, the Council shall, if a determination is made that the measurements are not effective in controlling health care costs, include in the final report a plan to implement a mandatory rate-setting mechanism.

3. That §§ 9-161 and 9-162 of the Code of Virginia are repealed.

APPENDIX B:

VIRGINIA GENERAL ASSEMBLY SENATE JOINT RESOLUTION 118

SENATE JOINT RESOLUTION NO. 118

Requesting the Virginia Health Services Cost Review Council to develop and adopt a methodology which identifies the most efficient providers of high quality health care in the Commonwealth.

Agreed to by the Senate, February 11, 1992
Agreed to by the House of Delegates, February 21, 1992

WHEREAS, the Virginia Health Services Cost Review Council was established in 1978 and has had as part of its responsibilities the authority to initiate reviews or investigations to assure purchasers of health care services that hospitals' aggregate charges are equitable and reasonably related to aggregate costs; and

WHEREAS, in 1978, the Virginia Health Services Cost Review Council adopted the Virginia hospital industry's methodology for review of hospital costs and charges; and

WHEREAS, the Virginia Health Services Cost Review Council has continued to use that same methodology, with some modifications, even though significant changes in health care financing for hospitals have occurred in the last ten years, resulting in reimbursement based largely on prospective payments or individually negotiated discount arrangements; and

WHEREAS, since 1983, the Virginia Health Services Cost Review Council has sought to keep Virginia's rate of increase in health care costs at or below the national rate; and

WHEREAS, health care expenditures comprised 12 percent of the Gross National Product in 1990 and may well exceed 15 percent by the year 2000; and

WHEREAS, nursing homes and certified nursing facilities are included within the statutory definition of health care institutions and therefore come under the Council's review authority; and

WHEREAS, in 1989, the Virginia Health Services Cost Review Council adapted the same previously cited methodology for its review of nursing homes and certified nursing facilities; and

WHEREAS, in January 1991, the Virginia Health Services Cost Review Council voted to review these methodologies; and

WHEREAS, the Secretary of Health and Human Resources retained a consultant to study the Council's methodology; and

WHEREAS, at the December 1991 meeting of the Commission on Health Care for All Virginians, the consultant reported on the following potential improvements in methodology: the development of efficiency and productivity tests and the consideration of improving quality by using a patient-level data base; now, therefore, be it

RESOLVED by the Senate, the House of Delegates concurring, That the Virginia Health Services Cost Review Council consider the recommendations of the consultant retained by the Secretary of Health and Human Resources to study the Council's methodology and to promulgate, by January 1, 1993, changes to the methodology which will improve identification of the most efficient providers of high quality health care within the Commonwealth.

The Virginia Health Services Cost Review Council shall report to the Commission on Health Care for All Virginians by October 15, 1992, on proposed changes to the methodology and present a plan for recognizing and commending the most outstanding health care providers within the Commonwealth, as measured by its methodology.

APPENDIX C:

LISTING OF STUDY HOSPITALS/ OUTLIER HOSPITAL DATA

NAME	CITY
Alexandria Hospital	Alexandria
Alleghany Regional Hospital	Low Moor
Arlington Hospital	Arlington
Augusta Medical Center	Waynesboro
Bath County Community Hospital	Hot Springs
Bedford County Memorial Hospital	Bedford
Buchanan General Hospital	Grundy
Centra Health	Lynchburg
Chesapeake General Hospital	Chesapeake
Chippenham Medical Center	Richmond
Clinch Valley Medical Center	Richlands
Community Hospital of Roanoke Valley	Roanoke
Community Memorial Healthcenter	South Hill
Culpeper Memorial Hospital	Culpeper
Danville Regional Medical Center	Danville
DePaul Medical Center	Norfolk
Dickenson County Medical Center	Clintwood
Fair Oaks Hospital	Fairfax
Fairfax Hospital	Fairfax
Fauquier Hospital	Warrenton
Franklin Memorial Hospital	Rocky Mount
Giles Memorial Hospital	Pearisburg
Greensville Memorial Hospital	Emporia
Halifax Regional Hospital	South Boston
Healthsouth Medical Center	Richmond
Henrico Doctors' Hospital	Richmond
John Randolph Hospital	Hopewell
Johnston Memorial Hospital	Abington
Johnston-Willis Hospital	Richmond
Lee County Community Hospital	Pennington Gap
Lewis-Gale Hospital	Salem
Lonesome Pine Hospital	Big Stone Gap
Loudoun Hospital Center	Leesburg
Louise Obici Memorial Hospital	Suffolk
Martha Jefferson Hospital	Charlottesville
Mary Immaculate Hospital	Newport News
Mary Washington Hospital	Fredericksburg
Maryview Medical Center	Portsmouth
Memorial Hospital of Martinsville & Henry County	Martinsville
Metropolitan Hospital	Richmond
Montgomery Regional Hospital	Blacksburg
Mount Vernon Hospital	Alexandria
Newport News General Hospital	Newport News
Northampton-Accomack Memorial Hospital	Nassawadox
Northern Virginia Doctors' Hospital	Arlington
Norton Community Hospital	Norton
Page Memorial Hospital	Luray
Portsmouth General Hospital	Portsmouth
Potomac Hospital Corporation	Woodbridge
Prince William Hospital	Manassas
Pulaski Community Hospital	Pulaski

NAME	CITY
R.J. Reynolds-Patrick County Memorial Hospital	Stuart
Radford Community Hospital	Radford
Rappahannock General Hospital	Kilmarnock
Reston Hospital Center	Reston
Retreat Hospital	Richmond
Richmond Community Hospital	Richmond
Richmond Memorial Hospital	Richmond
Riverside Regional Medical Center	Newport News
Riverside Tappahannock Hospital	Tappahannock
Riverside Walter Reed Hospital	Gloucester
Roanoke Memorial Hospitals	Roanoke
Rockingham Memorial Hospital	Harrisonburg
Russell County Medical Center	Lebanon
Sentara Bayside Hospital	Virginia Beach
Sentara Hampton General Hospital	Hampton
Sentara Leigh Hospital	Norfolk
Sentara Norfolk General Hospital	Norfolk
Shenandoah Memorial Hospital	Woodstock
Smyth County Community Hospital	Marion
Southampton Memorial Hospital	Franklin
Southside Community Hospital	Farmville
Southside Regional Medical Center	Petersburg
St. Mary's Hospital (Norton)	Norton
St. Mary's Hospital (Richmond)	Richmond
Stonewall Jackson Hospital	Lexington
Stuart Circle Hospital	Richmond
Tazewell Community Hospital	Tazewell
Twin County Regional Hospital	Galax
Virginia Beach General Hospital	Virginia Beach
Warren Memorial Hospital	Front Royal
Williamsburg Community Hospital	Williamsburg
Winchester Medical Center	Winchester
Wise Appalachian Regional Hospital	Wise
Wythe County Community Hospital	Wytheville

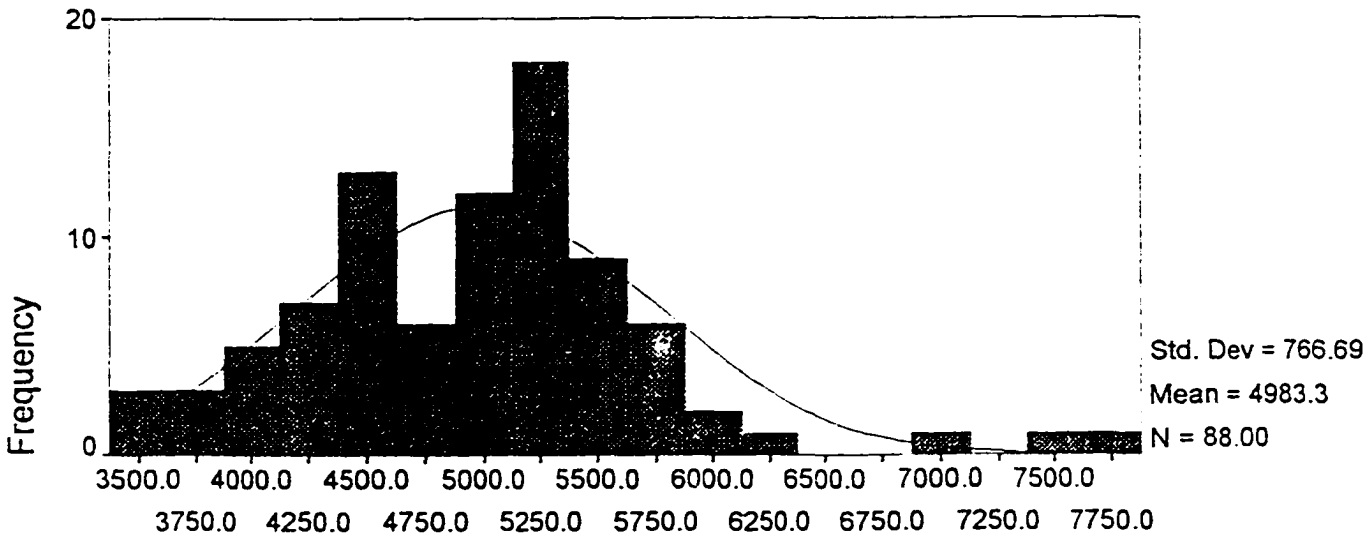
Number of cases read: 85 Number of cases listed: 85

OUTLIER HOSPITAL DATA

Three hospitals were excluded from the study based on their cost per admission (COSTALL) outlier status. See graphs on following pages.

Histogram of Study Hospitals

Prior to Exclusion of Outliers

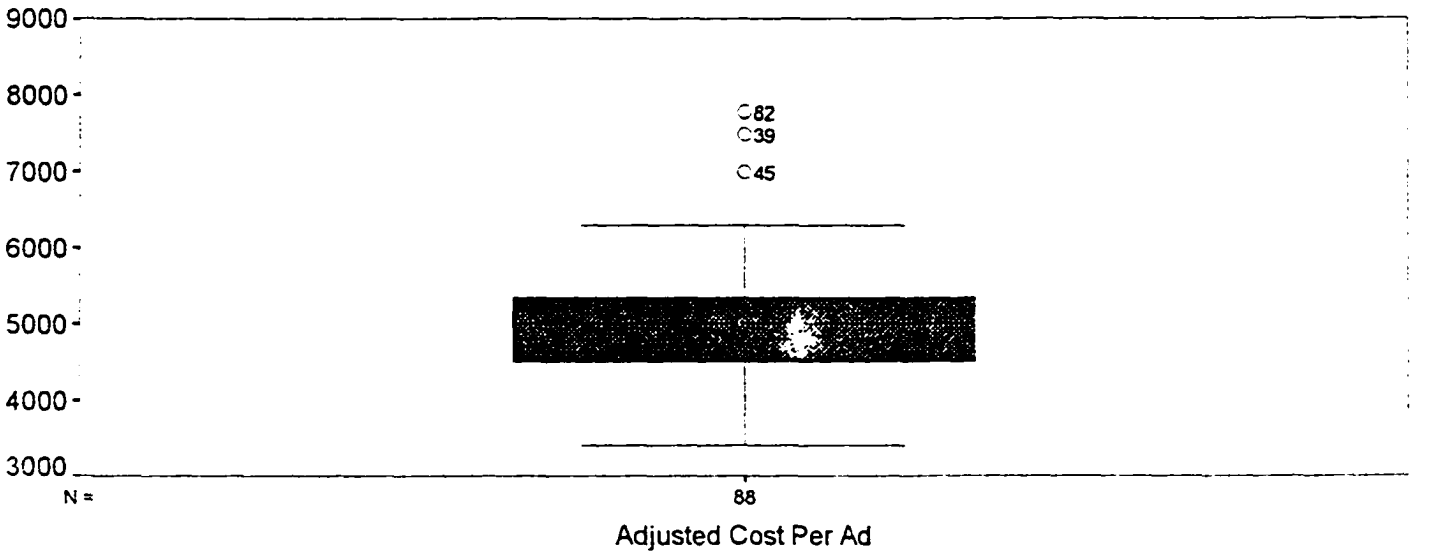


Adjusted Cost Per Admission

Hospitals at and above 3 standards deviations from mean were excluded.

Boxplot of Study Hospitals

Prior to Exclusion of Outliers



Outliers (designated by o) have cost per admission 1.5 to 3 box lengths from the upper edge of the box and were excluded.

APPENDIX D:

EXCERPT FROM EPICS:

MANUAL FOR SUPERVISORS AND USERS OF THE EFFICIENCY AND PRODUCTIVITY INFORMATION COLLECTION SYSTEM

Preface

These reports have been generated from data supplied by each hospital. The data included independently audited financial statements and unaudited case-mix and volume statistics. While tests of reasonableness have been conducted by the Virginia Health Services Cost Review Council and the Williamson Institute for Health Studies, any misreporting of data by a facility in a region may affect its ranking and the rankings of other facilities in the region. The Virginia Health Services Cost Review Council and the Williamson Institute take no responsibility for errors and/or omissions of data that may have affected indicators and/or the Efficiency and Productivity Scores.

The Council has requested each facility to review the information in the report pertinent to it and to provide comment. All comments have been published herein without editing. Some of the comments set out data never provided to the Council or have used this as an opportunity for commercial speech. By publishing these comments, the Council does not intend or imply its endorsement of them and takes no responsibility for their content.

Introduction

The Virginia Health Services Cost Review Council (VHSCRC) was established in 1978 by the Virginia General Assembly to promote the economic delivery of high quality and effective institutional health care services, and to create an assurance that the charges of hospitals are reasonably related to costs. In 1989, legislation was expanded to include nursing homes.

In 1992, the legislature mandated that the Council develop a methodology to measure the efficiency and productivity of health care institutions. The VHSCRC entered into a contract with the Williamson Institute to develop a methodology to evaluate the efficiency and productivity of hospital and nursing home operations. Since 1992, the staff of the VHSCRC and the Williamson Institute have worked together to develop this market-based approach to cost containment. The initial result of the new measurement process is found in this three volume *1994 Annual Report: Volume I Efficiency & Productivity– Performance Profiles of Hospitals; Volume II Efficiency & Productivity–Performance Profiles of Nursing Homes; and Volume III Health Care Industry Trends–Virginia Hospitals and Nursing Homes.*

This methodology, unique to Virginia, promotes competition in the marketplace by ranking facilities according to how efficiently resources are used. The methodology is in its infancy. The VHSCRC will continue collaborating with the health care industry, business, and trade associations to refine the methodology.

The Council's 17 members are appointed by the governor and represent hospitals, nursing homes, insurance companies, business groups and consumers.

Additional information about the reports and other activities of the Council may be obtained by contacting the Public Relations Coordinator, at 805 East Broad Street, 6th Floor, Richmond, Virginia 23219, (804) 786-6371.

Executive Summary

This report is the first annual release of data from the Virginia Health Services Cost Review Council measuring the efficiency and productivity of hospitals in the Commonwealth. The report provides comparisons of hospitals within the major regions of the state. Companion reports provide similar data on nursing homes as well as comparisons of health care institution's performance to national and regional data.

The Virginia Health Services Cost Review Council has identified 26 hospitals representing each major region of the state, as efficient and productive compared to other institutions in their region.

The current methodology uses five major categories of productivity and efficiency indicators to rank acute care hospitals. All of the current indicators are based upon financial and operational data. In future reports, the Virginia Health Services Cost Review Council will include indicators of the quality of care. Such data from hospitals was not available until 1994.

The new reporting methodology is authorized by the Virginia General Assembly and was prepared through the work of the Virginia Health Services Cost Review Council staff, the Williamson Institute, and numerous interested parties representing government, industry, and consumers, including individuals, employers, traditional insurance companies and managed care companies.

Methodology Overview

This report is intended to meet the request of the Virginia General Assembly that the Virginia Health Services Cost Review Council (VHSCRC) develop a new methodology to review costs of health care institutions. The General Assembly's request is contained in Senate Bill (SB) 518, passed in the 1992 session:

> "By January 1, 1993 the Council shall promulgate regulations establishing a methodology for the review and measurement of the efficiency and productivity of health care institutions. The methodology shall provide for, but not be limited to, comparisons of a health care institutions' performance to national and regional data.
>
> The Council may promulgate different methodologies and reporting requirements for the assessment of the various types of health care institutions which report to it."
>
> *§ 9-161.1 of the Code of Virginia (1992)*

To supplement the requirements of SB 518, Senate Joint Resolution (SJR) 118 (1992) also required the VHSCRC to develop a methodology that will improve the identification of the most efficient providers of high quality health care within the Commonwealth.

VHSCRC Process for Developing the Methodology

In response to these requests, the Virginia Health Services Cost Review Council adopted a market-based approach, rather than a regulatory approach. The VHSCRC voted to eliminate its previous process of reviewing and approving increases in hospital charges or budgets using general accounting rules for rates of increase. Instead, under the market approach, the VHSCRC has elected to provide consumers with up-to-date, accurate information on hospital charges, costs, productivity, financial viability and community support activities. In doing so, the Council's underlying assumption is that consumers—broadly defined to include individuals and families, traditional health insurance companies, managed care companies, employers, and other business groups—can improve their purchasing decisions regarding health care. Thus, the role of the government in this approach is to ensure that the market place has efficient access to accurate information about hospitals.

The VHSCRC contracted with the Williamson Institute (WI) of the Department of Health Administration at Virginia Commonwealth University, Richmond, Virginia, to guide the development of the new methodology. The VHSCRC staff led the development of the market-based methodology, with the contribution of the WI and the complete involvement of work groups representing both individual consumers and third-party payers, as well as working groups of industry representatives, at every step of the way. As various strategies to develop the methodology were examined, the WI provided an environment where consumers, members of government, and the representatives of the health care industry could meet and openly discuss the methodological issues. After many approaches to measuring and reporting data on productivity and efficiency had been examined and either rejected or adopted, the VHSCRC approved the current methodology.

The formal adoption of the methodology is contained in the rules and regulations published June 1994 (VR-370-01-001; *Code of Virginia*, Title 9, Chapter 26) and June 1994 (VR-370-01-002; *Code of Virginia*, Title 9, Chapter 26).

Purpose of the Methodology

While the methodology makes certain information on hospitals available to the market, it leaves decisions about how to act on the information to the discretion of the consumers. Thus the methodology is designed to:

- report relevant and comprehensive measures of hospital efficiency;
- allow for benchmarking and comparison of facilities;
- present information in an understandable form;
- make information publicly available in a timely fashion.

The 1994 version of the methodology covers cost and productivity, but it does not report information on the quality of care. Under the direction of the VHSCRC and its staff, the WI is now developing additional indicators that will measure the quality of care.

DESCRIPTION OF THE METHODOLOGY

To assure that information could be easily understood by potential users, an effort was made to select the least complex and most easily understood method of identifying efficient providers of health care. Ratio analysis was chosen. This method uses ratios of resources used and services provided to measure efficiency.

Eighteen Performance Indicators

A comprehensive set of criteria was defined to select indicators in the following five categories: charges, costs, productivity and utilization, financial viability, and community support activities. Across the five categories, 18 specific indicators of hospital performance were adopted. The 18 indicators for acute care hospitals, along with the desired directions of their performance, are summarized in Figure 1. The formula for each of the indicators can be found in the VHSCRC docu-

Figure 1. Indicator Categories: Description and Desired Direction

Category	Description	Desired Direction
Charges	1. Gross Patient Revenue per Adjusted Admission ($)	↓
	2. Net Patient Revenue per Adjusted Admission ($)	↓
Costs	3. Cost per Adjusted Admission ($)	↓
	4. Labor Cost per Adjusted Admission ($)	↓
	5. Non-Labor Cost per Adjusted Admission ($)	↓
	6. Capital Cost per Adjusted Admission ($)	↓
Productivity/ Utilization	7. Full-Time Equivalents per Adjusted Occupied Bed	↓
	8. Paid Hours per Adjusted Admission	↓
	9. Staffed Beds Occupancy (%)	↑
	10. Licensed Beds Occupancy (%)	↑
	11. Special Service Utilization (%)	↑
	12. Case-Mix Adjusted Average Length of Stay	↓
Financial Viability	13. Cash Debt Coverage	↑
	14. Total Margin (%)	↑
	15. Return on Assets (%)	↑
	16. Fixed Asset Financing Ratio	↓
Community Support Activities	17. Community Support Provided (%)	↑
	18. Medicaid Participation (%)	↑

ment entitled *EPICS: Acute Care Hospital Manual for Supervisors and Users of the Efficiency and Productivity Information Collection System*, which is available from the VHSCRC upon request.

Rankings Based on Geographical Regions of the State

To identify efficient hospitals, comparisons were drawn among the performance of hospitals in the same region of the state. Institutions were grouped into geographical regions and ranked in relation to the other institutions within their region. In this way benchmark values, or key values for the indicators used to rank hospitals, were established. Each hospital's reported values for an indicator can be used to measure the hospital's performance against that of other institutions in the same region. The geographical regions for acute care hospitals are shown in Figure 2.

Although data were collected from acute care, ambulatory surgical, children's, psychiatric, rehabilitation, and sub-acute hospitals, only acute care hospitals are ranked. Indicator values are presented for the non-ranked facilities, however, in Section E of this report.

Figure 2. Geographical Regions

Region	Description
I	Northwest Virginia
II	Northern Virginia
III	Southwest Virginia
IV	Central Virginia
V	Eastern Virginia

Quartile Ranking System

To assess overall efficiency, each acute care hospital was ranked and assigned a quartile score on each indicator. Each quartile represents 25 percent of the institutions within the peer group. Each hospital received a score of 1, 2, 3, or 4 for each indicator, depending upon the quartile in which it fell. A quartile score of 1 for an indicator means that an institution ranked in the top quartile (top 25 percent) on that indicator, as noted in Figure 3 on page A-1. On some indicators, such as the Gross Patient Revenue per Adjusted Admission, the desired direction is downward. That is, a lower value yields a first quartile rank. Other indicators, such as Total Margin, require the hospital to have a higher value in order to receive a first quartile rank.

Regional Efficiency and Productivity Score

Quartile scores were summed over all indicators. The sum was then divided by the number of indicators to obtain a hospital's average quartile score. This score is called the Efficiency and Productivity Score (EPS). The top-ranked hospitals were designated by using the EPS to identify the top 25 percent of institutions within each region of the state.

Validity Testing

The methodology has received extensive validity checking to determine if any group was favored by the methodology. Specifically, the methodology was tested to determine if statistically significant differences existed between various groups of facilities. These groups were: rural and urban facilities; small, medium, and large facilities; for-profit and not-for-profit facilities; system-affiliated and non-system-affiliated facilities; and facilities that begin their fiscal years in different calendar years. The results of the testing show that the only statistically significant difference in EPS scores is between rural and urban facilities. This does not necessarily indicate a methodological shortcoming. In fact, it may suggest that a difference between these facilities actually does exist.

Indicators were also tested to determine if enough variation existed to be able to use the quartile approach. Significant variations were found to exist among facilities on each indicator (indicator-variance) and on the overall facility ranking (facility-variance). In addition, the reliability of the data supplied by facilities was extensively tested.

LIMITATIONS & FUTURE ENHANCEMENTS OF THE METHODOLOGY

Despite the extensive validation, caution should be exercised in interpreting the rankings, because as yet they incorporate no indicators for the quality of care. It must also be emphasized that the efficiency measures are relative rather than absolute measures of performance. This means hospitals are ranked only in comparison to other hospitals in that region; hospitals have not been ranked across regions. A final point is that the methodology is in its first year of application. Additional data are now being collected to provide another updated ranking next year, in which comparisons will be possible between years. Users will then be able to determine whether a facility has improved in efficiency and productivity.

More sophisticated measures of efficiency for individual patient stays, drawn from the Virginia patient-level data base approved by the General Assembly in 1993, are yet to be incorporated. The patient-level data base captures, among other data, the use of ancillary services and patient charges. That data could be used to assess both the efficiency and the effectiveness of care provided to a specific group of hospital patients, such as those within a certain Diagnosis Related Group (DRG). The patient-level data also capture discharge status, which could be used to develop risk-adjusted outcome indicators of a hospital's quality of care. If there are significant variations in the risk-adjusted quality indicators, then quartile ranking could be used to compare hospital's quality of care.

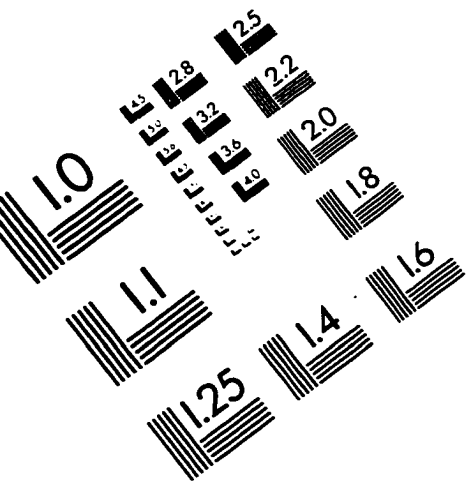
Autobiographical Statement

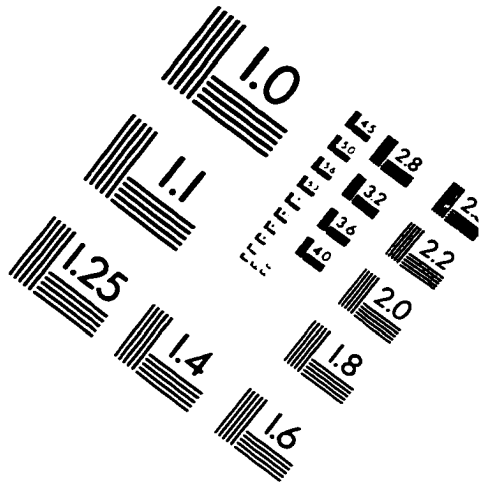
Debra Kay Dierksmeier Anderson received her Master's degree in Public Health in May 1977 from the University of North Carolina in Chapel Hill. In May 1974 she received her Bachelor of Arts degree with Distinction in Sociology and Psychology from the University of Hawaii in Honolulu. Academic honors include induction into the Honor Society of Phi Beta Kappa in May 1974 and the Honor Society of Phi Kappa Phi in April 1991.

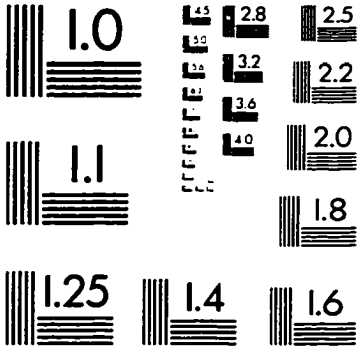
Deb currently serves as the Director of Planning for Tidewater Health Care. She has worked for Tidewater Health Care/Virginia Beach General Hospital and Portsmouth General Hospital since January 1985. Other health positions held previously include: Director of Planning and Community Affairs, Schoitz Medical Center, Waterloo, Iowa; Health Planner and Subarea Director for the Iowa Health Systems Agency, Des Moines, Iowa; Study Associate and Research Assistant positions at the University of North Carolina and University of Hawaii; Intern with the Division of Health Services in North Carolina; and Program Assistant with Kaiser Medical Foundation Hospital in Honolulu.

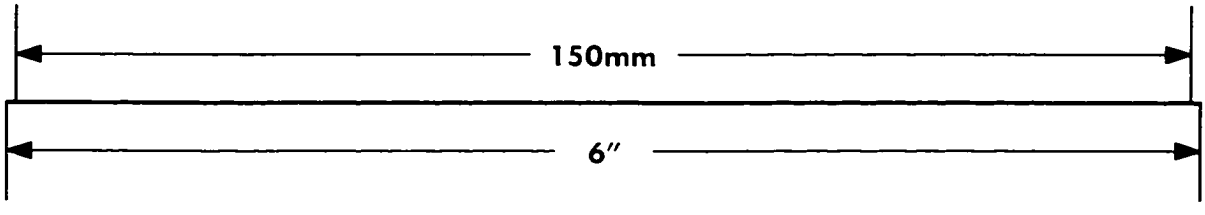
Deb has taught health planning courses at Norfolk State University and has guest lectured at Old Dominion University and the University of Northern Iowa. She is married with two children and resides in Chesapeake, Virginia.

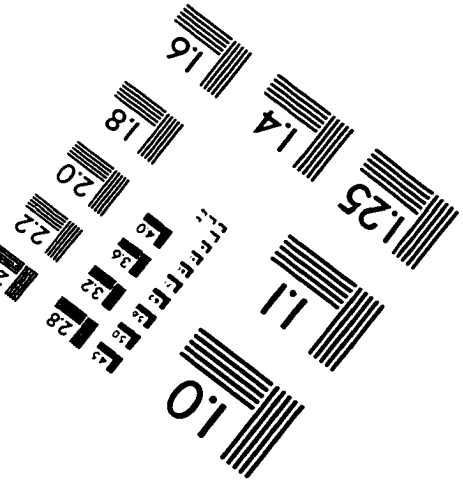
IMAGE EVALUATION TEST TARGET (QA-3)

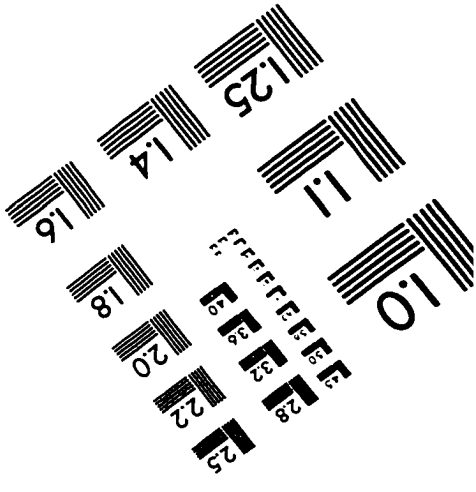












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