MANAGEMENT OF INFORMATION TECHNOLOGY AND QUALITY PERFORMANCE IN HEALTH CARE FACILITIES

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MANAGEMENT OF INFORMATION TECHNOLOGY AND QUALITY PERFORMANCE IN HEALTH CARE FACILITIES

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The objective of the research was to investigate the moderating effect of IT infrastructure on the relationship between management of health care information and quality performance in health care departments. Variables measured included manager perceptions of quality, management of health care information (MOHCI), and IT infrastructure. In addition, customer perceptions of quality performance were also investigated.

Ninety-one managers and 104 customers from a convenience sample of ten health care facilities in Pennsylvania participated in the survey. Health care departments were the units of analysis investigated. Among the participating health care facilities two major teaching institutions with open heart and trauma units, a kidney dialysis center, a provider of hospice education and information, and six community and primary health care providers. The size of the institutions range from 50 beds to more than 600 beds. Good variation in terms of size, types, and nature of tasks resulted from this convenience sample. One or more functional departments was investigated at all ten institutions. These departments included pharmacy, respiratory, laboratory, nursing, emergency, medical records, surgery, pulmonary, pediatrics, nuclear medicine and X-ray services. These eleven departments typically exist at all facilities.

This research focused on the determinants of departmental quality. This study conceptualized and developed measures for quality, MOHCI, and IT infrastructure variables. A significant relationship was found between the management of health care information and quality performance. IT infrastructure was proposed to have a moderating effect on quality performance. However, this study found IT infrastructure to have a direct effect upon quality performance. Significant differences were found between customer and manager perceptions of quality.

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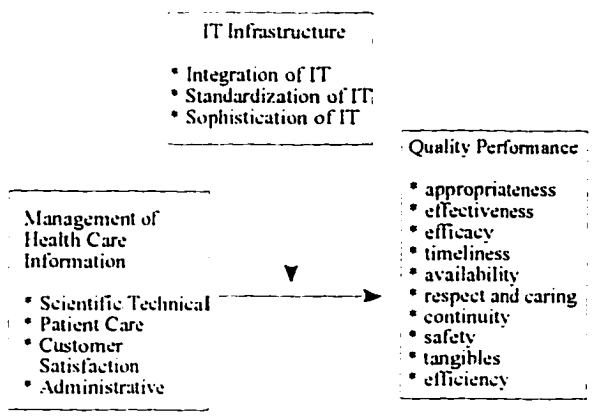
Chapter One

Introduction

This chapter develops the significance of this study. It begins with a statement of the problem, and the contributions of the research. A reconciliation of the topic to the present literature is then made. Emphasis was placed on defining health care quality by integrating the marketing view with the Joint Commission on Accreditation of Hospitals (JCAH), and Total Quality Management (TQM) views (Parasuraman, Zeithaml, and Berry, 1985; JCAH, 1995; Baldrige Award Criteria, 1995; Berry, Parasuraman, and Zeithaml, 1994; Dean and Evans, 1994).

The research model consists of three constructs- IT infrastructure, management of health care information, and quality performance- and is summarized in Figure 1.

Figure 1: Research Model



Management of health care information is the first construct which is presented. Scientific/Technical, patient-care, customer satisfaction, and administrative information are identified as the four major dimensions of management of health care information.

Information Technology (IT) infrastructure is the second construct of the research model. Integration, standardization, and sophistication of IT hardware, software, databases, and networks are the three dimensions of this construct. Finally, the quality performance construct is comprised of appropriateness of services, availability of services, continuity of services, effectiveness of services, efficacy of procedures, efficiency of services, respect and caring for customers, timeliness of services, service tangibles and safety of customers.

Significance of the Study and Problem Statement

There has been little systematic theory which has evolved for the management of health care quality performance using industrial engineering techniques. "The clinical professionals have generally looked with suspicion upon the technically sophisticated tools for operational improvement" (Sahney, 1993). This statement portrays the status of quality performance, management of health care information, and IT infrastructure by clinical professionals in health care facilities. This study addressed this problem by answering the following research questions:

R1: What is the relationship between management of health care information and quality performance in health care departments?

R2: How does IT infrastructure moderate the relationship between management of health care information and quality performance in health care departments?

Total Quality Management (TQM) in the health care field has made basic industrial engineering techniques available to hospitals and their employees. Furthermore, concern over costs has made the application of quality performance measures more acceptable

within the health-care industry. Several instruments have been developed to measure quality in the manufacturing sector (Flynn, Schroeder, and Sakakibara, 1994; Saraph, Benson, and Schroeder, 1989). However, only conceptual attempts have been made to define these constructs in health care. This research has developed an instrument to measure the connection between information management, IT infrastructure, and quality performance in health care departments.

Research Methods

This research examines how quality performance varies due to differences in management of health care information, and IT infrastructure. The unit of analysis in this study is the health care facility department. Among the participating health care facilities are several major teaching institutions with open heart and trauma units, a kidney dialysis center, a provider of hospice educational and informational support, and seven community and primary health care providers. The size of the institutions range from 50 beds to more than 600 beds.

There were 92 manager and 105 customer data points from eleven health care facilities. Good variation in terms of size, types, and nature of tasks resulted from this convenience sample.

Functional departments were investigated at all ten institutions. These departments included pharmacy, respiratory, laboratory, nursing, emergency, medical records, surgery, pulmonary, pediatrics, nuclear medicine, and X-ray services. These eleven departments are basic to the functioning of any hospital, and typically existed at all facilities.

The data were screened for normality and linearity by employing univariate analysis. Factor analysis was used to eliminate redundant items, and to test for unidimensionality (Kim and Muellar, 1978). Cronbach's alpha was used to test the reliability of survey items. Multicollinearity was tested using correlation analysis. Sharma et al.'s (1981) four step typology was employed in order to determine if IT infrastructure moderates the relationship between management of health care information and quality performance.

Contributions

This research makes several contributions. It develops a measure for quality performance. More broadly, this study explores the importance of IT capabilities, especially IT infrastructure in achieving quality. The study looks also at information management (IM) and quality from an integrated viewpoint by synthesizing the Marketing, JCAH, and TQM literature.

In addition, this research developed and validated an instrument to measure management of health care information and IT infrastructure. This research focuses on departmental quality. Only initial work on this unit of analysis has been examined in the literature.

Similarly, up to this point, the relationships between information management (IM), IT, and quality have only been partially explored in the literature. Finally, this research advocates actionable guidelines for practitioners which have evolved from this investigation. The results of this study have lead to better conceptualization of quality, management of information (MOI), and IT infrastructure research and evaluation.

Limitations

There are several limitations of this research. First, the study's focus is at the departmental level, and may not be reconcilable with findings which use the organization as a unit of analysis. Second, the constructs are exploratory in nature and may require further refinements. Third, the research is limited to a convenience sample and is not generalizable to all populations. Finally, the survey assumes that variance is captured by using a questionnaire format. Case studies may be necessary to add richness (Eisenhardt, 1989; Jick, 1979; Kaplan and Duchon, 1988; Lee, 1989; Miles, 1979; Platt, 1992; Strauss, 1987; Van Maanen, 1979: Yin, 1994).

Chapter Two

Literature Review

Quality Performance

Standards in the practice of public health are reflected in the American Public Health Association's *Model Standards* (1985; 1991). These have traditionally emphasized health outcomes, flexibility to allow communities to establish and quantify their own objectives. They also have the role of government as a residual guarantor responsible for assuring that prevention services are provided through community agencies. In addition the *Assessment Protocol for Excellence in Public Health (APEX-PH) (1990)* provides a methodology for assessing departmental operations relative to meeting standards. Model Standards and APEX-PH provide health care facilities with a validated and standardized method to access and meet health care needs. Traditionally, quality assurance methods have been necessary but not sufficient to meet the challenges now facing the health care industry. TQM offers a means for improving existing health care processes and to enhance health care facilities' performance within a changing environment.

The health sector has embraced the TQM philosophy, pro formally, if not in practice. Continuous quality improvement (CQI) has been endorsed by the Joint Commission on Accreditation of Hospital Organizations (JCAHO). These practices are supposed to be implemented at the departmental level of the health care facility. However, effective implementation has not been forthcoming. Rather, health care departments maintain a craft guild mentality in which the scientific management practices of Frederick Taylor are

given priority over the TQM approach (McLauglin, 1994). The evolution of industrial engineering, in health care facility departments, from scientific management to TQM is still in the early stages. The health care functional areas still need to adopt a TQM approach using the simultaneous engineering of IT, and the management of information (Swanson, McComb, Smith, and McCubbery: 1991).

Much of the present thinking about health care quality performance draws from the TQM literature. For example, in 1988, the Healthcare Forum and Witt Associates Incorporated first recognized continuous improvement in health care organizations (The Healthcare Forum, 1991). Six major categories comprise the judging criteria: leadership and strategic planning, quality assurance, human resource utilization, quality results, and patient and community needs assessment.

Quality performance in health care has also been influenced by the Baldrige Award. The Baldrige Award criteria for 1995 describes what an organization must do in order to be "excellent". Excellence is driven by leadership, information and analysis, strategic quality planning, human resource development and management, systematic management of process quality, quality and operational results, and customer satisfaction (The Baldrige Award criteria, 1995). Quality performance in health care has been influenced by the Shingo Prize. The Shingo Prize for Excellence in American Manufacturing is granted by Utah State University, and was named for Shigeo Shingo (Application Guidelines, 1994-95). It was first given in 1988, and consists of the following criteria: total quality and productivity management, culture and infrastructure, manufacturing strategy, processes,

and system integration, measured quality and productivity, measured customer satisfaction, and summary of achievements.

The Union of Japanese Scientists and Engineers have inaugurated the Deming Prize in Japan. The Deming Prize has influenced health care quality performance (Deming, 1982, 1986). The Deming Prize criteria (1994) are vague, and have had less of an impact than the Baldrige Award. Since 1992, the European Quality Award has been presented annually by the European Foundation for Quality Management in Eindhoven, the Netherlands. This award differs from the Baldrige in that the European Quality Award measures a company's success in achieving its planned financial targets. The European Quality Foundation Award (1995) not only gives awards to organizations, but also to academic theses, articles, and television broadcasts.

The next section focuses on quality performance in health care as it has been conceptualized by key works reported in the literature.

Quality Performance and Health Care

Kano, Seraku, Takahashi, and Tsuji (1984) describe three different measures of quality:

* one-dimensional quality
* attractive or unexpected quality; and
* must-be or expected quality.

Waiting time or reduced cycle time is a one-dimensional quality measure which can be readily perceived. When a staff person stops work to assist a lost visitor, this is an

example of unexpected quality. An example of must-be or expected quality is the avoidance of a hospital-acquired infection. Patients expect, at the minimum, they will not acquire an infection while in the hospital (Gaucher and Coffey, 1993).

O'Leary (1994) presents a more elaborate framework to access quality performance. He suggests that quality performance in health care departments can be measured using nine dimensions. These metrics include:

* **appropriateness** or the degree to which service is relevant to the patient's clinical needs,
* **continuity** or the degree to which service is coordinated with other functional areas,
* **effectiveness** or the degree to which service is provided in the correct manner,
* **efficacy** or the degree to which a service accomplishes the desired outcome by applying the correct technology,
* **efficiency** or the ratio of results of services to the resources used,
* **timeliness** or the degree to which the service is provided at the time it is most beneficial/necessary,
* **availability** or the degree to which the appropriate service is present to meet patient needs,
* **respect and caring** or the degree to which those providing the service do so with respect for individual differences,
* **safety** or the degree to which environmental risk is reduced.

Appropriateness can be illustrated by the number of unnecessary coronary angiography procedures which are attempted in the catheter lab. If 50% of patients who undergo this

procedure suffer cardiac death, myocardial infarction, or unstable angina, then the procedure is not appropriate in 50% of cases. If 50% of the attempted coronary angioplasties do not dilate the lesion then the procedure is not effective in 50% of cases. If four phone calls are necessary to arrange transportation of the patient to the catheter lab and eight are made then efficient coordination of ancillary activities across functional departments is not achieved, and the procedure had only 50% of the continuity that it should. If ten laboratory tests are necessary for establishing essential base lines for angioplasty, and twenty are ordered, the efficacy of the procedure is only 50%. On the other hand, if the hemoglobin and hematocrit must be done twice rather than once then the procedure is not efficient. If the angioplasty procedure is not available, then the availability is zero. Respect and caring are also important for quality performance. Angioplasty may be offered at several competing areas and the administration may not wish to place the service in a department which has little or no sensitivity for patient feelings. Safety has many connotations. One threat to safety would be that of a department offering angioplasty and no one having the credentials for this service. Finally, if a suspected heart attack patient arrives at the emergency room and is not given thrombolytic therapy immediately, the patient will die and there will be no need for angioplasty. There would be little timeliness of this procedure.

Comparison of the Joint Commission on Accreditation of Hospitals and Service Quality

The service quality literature has paid attention to quality performance assessment. Given that health care is part of the service industry, it is important to examine relevant

work done in this area. This should inform us in our conceptualization of health care quality. For example, Fiegenbaum, Ishikawa, Taguchi, Crosby, Kearns, Mazda, Taylor, Deming, and Juran have made significant contributions to TQM (Gabor, 1990; Ishikawa, 1985; Juran, 1988: Deming, 1986). More recently, Dean and Bowen (1994) believe that some insights of total quality should be incorporated into management theory. Waldman (1994) sees the individual as affecting TQM. Garvin (1987) reports that Motorola launched a five-year quality improvement program called Six Sigma, which strives for 99.9999998 percent correct operation. This concept of zero defects has also been adopted in part by the service sector. Service businesses may strive for "zero defections" in satisfying every customer.

> "Customer defections have a surprisingly powerful impact on the bottom line. They can have more to do with a service company's profits than scale, market share, unit costs, and many other factors usually associated with competitive advantage. As a customer's relationship with the company lengthens, profits rise. And not just a little. Companies can boost profits by almost 100% by retaining just 5% more of their customers" (Reichheld and Sasser, 1990).

The work of Parasuraman et al. (1985; 1988), Zeithaml (1990), Berry and Parasuraman (1993), Berry et al. (1991; 1994) focuses on conceptualizing quality performance in the service industry. They draw on eleven dimensions of service quality:

* **reliability** or the consistency of performance and dependability,
* **responsiveness** or the willingness of employees to provide service in a timely manner,
* **competence** or possession of the required skills and the knowledge to perform the service,
* **access** or approachability and ease of contact,
* **courtesy** or politeness, respect, consideration, and friendliness of contact personnel,
* **communication** or keeping customers informed, and listening to them,
* **credibility** or trustworthiness, believability and honesty,
* **security** or the freedom from danger, risk, or doubt,
* **understanding/knowing the customer**, or making the effort to understand the customer's needs,
* **empathy** or caring about the customer,
* and **facilities and personnel tangibles** or the physical evidence of the service.

A comparison between Parasuraman, Zeithaml, and Berry's (1985; 1988; 1990; 1991; 1993; 1994) service quality measures, those proposed by O'Leary (1994), and JCAHO (1995) guidelines for quality reveal many similarities. For example, all three talk about coordination, courtesy, respect, efficiency, and effectiveness. O'Leary, the JCAHO, and Parasuraman et al. embody many quality dimensions suggested by the major quality awards (JCAHO, 1995; Baldrige Award Criteria, 1995; Parasuraman, Zeithaml, and Berry, 1985; 1987, 1990, 1991, 1993, 1994; Shingo Prize, 1995).

The dimensions of quality performance are identified by integrating the TQM and quality management literature. These dimensions are shown in Figure 2.

Figure 2: Quality Performance Dimension

Appropriateness of services
Continuity of services and tasks
Efficiency of tasks
Timeliness of services
Respect and caring for customers
Safety of customers
Effectiveness of services
Availability of services
Efficacy in technique application
Facility and personnel tangibles

Proposed Quality Dimensions

In this study, health care quality is visualized as a multidimensional construct composed of ten dimensions:

* **appropriateness** of services
* **effectiveness** of services
* **efficacy** of services and tasks
* **efficiency** of tasks
* **timeliness** of services
* **availability** of services
* **respect and caring** for customers
* **continuity** of services
* **safety** of customers
* **tangibles** of facilities and personnel

The survey items in this research are patterned after the SERVQUAL instrument developed by Zeithaml et al. (1990) and validated by Pitt et al. (1995). Each quality

performance item is grounded in a validated instrument. Every attribute in this study has been rigorously examined and validated. For example, appropriateness was accepted into our instrument because it corresponds to Parasuraman et al's (1985, 1988, 1994) credibility attribute in which the customer's best interests are at heart. This attribute was reinforced with a definition provided directly from O'Leary (1994). Availability embodies both the marketing concept of customer access to convenient hours and location. The JCAHO's (1995) concept of continuity corresponds with the explanation and assurance associated with communication in Parasuraman et al's 1985 work.

In a similar manner, Berry et al's concept of reliability in which service is seen as being dependable and accurate is closely associated with the JCAHO (1995) concept of effectiveness i.e. providing correct service. O'Leary (1994) sees efficacy as the accomplishment of what is desired. This maps to Parasuraman et al's conceptualization of competence as being composed of knowledge and skill. Berry et al. construes assurance as courtesy and empathy. This fits the mental map of the JCAHO (1995) when they describe treating the patient with sensitivity, respect and caring. Both the marketing and medical literature recognize safety as freedom from risk in the environment. Likewise, both streams of literature define prompt service or timeliness as delivery of the service when it is the most beneficial or necessary.

The attribute tangibles which Berry et al. (1994) and Parasuraman et al. (1995) refer to as physical facilities and appearances was included in the instrument even though there was no close match with the JCAHO (1995) or O'Leary (1994). Several attributes, such as fairness, were deemed as closely corresponding to attributes already accepted in the

instrument and so were not included. Items not drawn from the SERVQUAL instrument were derived directly from the definitions provided by O'Leary (1994).

Quality performance was assessed using respondent answers to each of the following:

SD	D	N	A	SA	NA
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Does Not Apply

1.	The department has up-to-date technology.	SD	D	N	A	SA	NA
2.	Departmental physical facilities are visually appealing.	SD	D	N	A	SA	NA
3.	Departmental employees are well dressed and neat in appearance.	SD	D	N	A	SA	NA
4.	The appearance of the physical facilities of the department are in keeping with the kind of services provided.	SD	D	N	A	SA	NA
5.	When the department promises to do something by a certain time, it does so.	SD	D	N	A	SA	NA
6.	When customers have a problem, the department shows a sincere interest in solving it.	SD	D	N	A	SA	NA
7.	The department is dependable.	SD	D	N	A	SA	NA
8.	The department provides its services at the times it promises to do so.	SD	D	N	A	SA	NA
9.	The department insists on error-free records.	SD	D	N	A	SA	NA
10.	The department tells customers exactly when services will be performed.	SD	D	N	A	SA	NA
11.	Departmental employees give prompt service to users.	SD	D	N	A	SA	NA

12. Departmental employees are always willing to help others.	SD	D	N	A	SA	NA
13. Departmental employees are never too busy to respond to customer's requests.	SD	D	N	A	SA	NA
14. The behavior of departmental employees instills confidence in customers.	SD	D	N	A	SA	NA
15. Customers will feel safe in their transactions with departmental employees.	SD	D	N	A	SA	NA
16. Departmental employees are consistently courteous with others.	SD	D	N	A	SA	NA
17. Departmental employees have the knowledge to do their job well.	SD	D	N	A	SA	NA
18. The department gives customers individual attention.	SD	D	N	A	SA	NA
19. The department has operating hours convenient to all its customers.	SD	D	N	A	SA	NA
20. The department's employees give customers personal attention.	SD	D	N	A	SA	NA
21. The department has the user's best interests at heart.	SD	D	N	A	SA	NA
22. The department's employees understand the specific needs of its customers.	SD	D	N	A	SA	NA
23. The department provides appropriate and relevant services to its customers.	SD	D	N	A	SA	NA
24. Customers are satisfied with the range of services available in the department.	SD	D	N	A	SA	NA
25. The department coordinates its services with other departments.	SD	D	N	A	SA	NA
26. The department coordinates its services over time with respect to each customer.	SD	D	N	A	SA	NA
27. The department provides a safe environment for its customers .	SD	D	N	A	SA	NA
28. The department utilizes the correct technology and procedures given the current state of knowledge.	SD	D	N	A	SA	NA

29. The tasks/procedures utilized by the department leads to the desired/ projected outcomes.	SD	D	N	A	SA	NA
30. The department obtains maximum benefit for its customers with the least expenditure of resources.	SD	D	N	A	SA	NA

Management of Health Care Information

Introduction

Management of information plays a supportive role in quality performance. This role is a common thread throughout the TQM literature. Information and analysis is a core component of the Malcolm Baldrige Award (Garvin, 1987; Hart and Bogan, 1992; George, 1992; Haavind et al, 1992), the Shingo Prize for Excellence in Manufacturing (1994), and the Accreditation Manual for the JCAHO (1995). Davenport (1994) points out that management of information plays a supportive role in making processes more efficient and effective.

The health care sector is an information-laden industry (Pegels, 1995). However, today's health care information requirements differ from those of the past, in terms of both the internal and external reporting needs of health care departments (DesHarnais, Marshall, and Dulski, 1994). Today, physicians, quality managers, TQM teams, marketing staff, financial managers, regulators, insurance plans, accreditation agencies, purchasers, coalitions, and other customers generate greater demands for Scientific/Technical, patient-care, customer satisfaction, and administrative information. We will investigate each of these information types in the following sections.

Types of Health Care Information Management

Scientific/Technical Information

Scientific/Technical information is important for maintaining the department's knowledge base. Knowledge about cutting edge techniques and procedures in the medical literature are essential to delivering quality health care. Scientific/Technical information provides the knowledge base for identifying, organizing, retrieving, analyzing, delivering, and reporting clinical and managerial journal literature, reference information, and research data for use in designing, managing, and improving patient-specific and departmental processes (JCAHO, 1995). This Scientific/Technical information may come from either the general environment or the health care environment (Duncan, Ginter, and Swayne, 1995). For example, laser technology was developed for uses outside the health care industry. Today, there is a continuing environmental slip in which uses for laser technology are being applied within both the health care and general environments (Terry, 1977).

Information flows are created through normal operations of individuals, departments, and organizations in both the general environment and the health care environment. However, some Scientific/Technical information may have more significance than others. For example, competitive advantage may be gained by learning about new diagnostic technologies such as magnetic resonance imaging (MRI). Departments within the health care facility must be able to access new information in order to respond properly to

changes in the health care environment (Longest, 1990; Pegels and Rogers, 1988; Peters, 1988).

Patient-care Information

Specific data and information on patients is essential for maintaining accurate medical records of the patient's medical history and physical examinations. In addition patient-specific data and information are critical to tracking all diagnostic and therapeutic procedures and tests. Maintaining accurate information about patient-care results and discharges is also imperative to delivering quality health care (Bergman, 1993; Gabrieli, 1993).

Communication within and across health care departments is particularly important for managing patient-care information. Coordination of patient-care information within departments helps guarantee quality health care delivery. However, linkages between departments requires both sophisticated information technology and the strategic management of information.

Management of information and information technology have played a large part in changing health care delivery. Medical informatics is the term used to describe the management of information that supports the delivery of patient-care (Greenes and Shortliffe, 1990). For example, some states have legal requirements that hospital departments provide patient-care information on admissions, discharges, and lengths of stay to the public. In addition, state and federal governments specify the length of time that records must be stored (Workgroup for Electronic Data Interchange, 1992).

The sheer quantity of patient-care information which is generated and stored can be overwhelming to a health care department. Health care departments are faced with maintaining records that document the patient's ailment, the physician's diagnosis, and the recommended course of treatment. Insurance companies, federal and state government, and individuals use this information for reimbursement and tax purposes. In addition, this information may be used in malpractice cases, outcome measures, and research studies (Duncan, Ginter, and Swayne, 1995).

Customer Satisfaction Information

Customer satisfaction information may be gathered on external customers such as patients and their family and friends. In addition, customer satisfaction information is necessary for internal customers as well. Internal customers include physicians and employees. Surveys designed to gather information on patient satisfaction should take into account sociodemographic characteristics, physical and psychological status, attitudes and expectations concerning medical care, the outcome of treatment, and the health care setting (McLaughlin and Kaluzny, 1994). Cleary and McNeil (1991) point out that any of these factors may have a positive or negative influence on satisfaction.

Schweikhardt et al. (1993) argue that the patient's family and friends may be more difficult to satisfy than the patient. However, satisfaction of this customer group is rarely evaluated. Family and friends are valuable sources of information and can be very influential in perceptions of quality performance (McLaughlin and Kaluzny, 1994).

Physician satisfaction information is essential to any quality improvement effort. The Quality Improvement Strategy (QIS) has been used to gather information on physician satisfaction with hospital services. The QIS method links quality performance with physician satisfaction (Beach and Burns, 1993).

Information on employee satisfaction is important for understanding the overall health care work process. Employee satisfaction information provides a horizontal view of quality performance. As Batalden and Nelson (1991) point out, "By viewing health work from the customer's perspective, it becomes possible to understand better the nature and size of quality gaps that might exist when departments try to work together to meet patient needs."

Customer satisfaction information is necessary to understand results and trends which are based on the customer's behavior and beliefs. Information on customer satisfaction is important in determining customer preferences and expectations about how to effectively deliver departmental health care services. Collection, use and storage of customer satisfaction information is integral to instituting a listening and learning attitude by each department. Customer satisfaction information can be used to improve departmental quality performance by both formal and informal measures (Sherer, 1993; Navarro, 1993). For example, information about patient complaints can be used to provide better service, and to institute new services when appropriate. Information should be accurate, accessible, timely, complete, secure. and bias free so that patient complaints can be easily resolved. Customer satisfaction information may be used to better identify individual patient needs, and to determine if there are any differences in the department's approach to

different customer segments (Aaker, 1984). Comparison of departmental customer satisfaction with other functional areas is also an important management of health care information function.

Administrative Information

Administrative information is essential for formulating and implementing effective policies both at the organizational and departmental level. For example, administrative information is necessary to determine the degree of risk involved in financing expansion of services. Strategic and operational strategies both require administrative information before they can be implemented (Duncan, Ginter, Swayne, 1995).

Traditionally, the CEO has been responsible for strategic management and the role of IT in this process (Benjamin, Dickson, and Rockart, 1985; Lederer and Mendelow, 1989; Raghunathan, and Raghunathan, 1989). "Most senior executives are now well aware of the critical role information technology (IT) plays in enhancing organizational competitiveness in the 1990s" (Applegate and Elam, 1992).

More recently, department managers and employees have become more involved with the use of IT in managing administrative information. Parsons (1983) argues that IT can be a competitive weapon that can change an industry's structure, alter key competitive forces, and affect a company's choice of strategy. Zmud (1984) believes that in order to meet the challenges of these new roles of IT, changes must occur in how IT activities are organized. Blanton, Watson, and Moody (1992) suggest that organizations adopt a contingency approach to organizing IT activities into responsible IT groups by exploring

the relationships between certain characteristics of the organizational structure and the effectiveness of support provided by IT groups. Therefore, department managers and employees today have become more responsible for scanning and influencing the environment, managing key constituencies, and developing adaptive strategies (Zuckerman, 1989; Harper, 1992).

Administrative information is required for strategy implementation. It is a key tool used by middle management to provide leadership and commitment to the departmental mission and vision. Administrative information is especially important in keeping the quality objective before all employees (Kalunzy, 1989). Quality performance has become an important commitment for employees at all department levels. Middle managers are in the best position to use administrative information to encourage and reinforce this commitment. Administrative information is also a key ingredient in reengineering the organization. Managers must make the organizational vision meaningful to health care professionals by utilizing administrative information to appeal to the social and economic motives important for the operational success of departments and individuals (Duncan, Ginter, Swayne, 1995).

Information must be collected, interpreted, and stored in order to effectively manage the functional area. The standardized definition, accuracy, analysis, quality, and reporting of information needs to be aggregated to support managerial decisions and operations, and to improve performance activities (JCAHO, 1995). Administrative information must be collected, interpreted, and stored in order to effectively schedule departmental processes, pinpoint departmental errors, archive departmental performance, and continuously

improve financial services. In addition, administrative information is necessary for improving services by tracking customer needs, scheduling efficient methods of delivery, and coordinating financial data across departments. Through accessible, accurate, timely, complete, secure, unbiased, and high quality administrative information, financial processes can be maintained and improved in order to achieve increased performance (Folger, 1989; Anderson, 1985).

Management of Information and Health Care

Management of information is a group of processes and activities which focuses on meeting the functional department's information needs. The goal of information management is to collect, manage, use, and store information which will improve departmental Scientific/Technical, patient care, customer satisfaction, and administrative processes. Managed information processes may be affected by the IT infrastructure, however, it is important to first understand and define management of information as a theoretical construct. The JCAHO (1995) provides a useful basis for conceptualizing information management in a health care unit.

JCAHO Objectives

The JCAHO (1995) has set forth a set of standards to "describe a vision of effective and continuously improving information management in health care organizations". The objectives related to achieving this vision are "more timely and easy access to complete information throughout the organization; improved data accuracy; demonstrated balance

of proper levels of security versus ease of access; use of aggregate data, along with external knowledge bases and comparative data, to pursue opportunities for improvement; redesign of important information-related processes to improve efficiency; and greater collaboration and information sharing to enhance patient care (JCAHO, 1995).

Proposed Management of Health Care Information Attributes

In this study, we have drawn on the JCAHO objectives for continuously improving information management. These provide a useful base, but do not reflect an adequate list of attributes. Therefore, we have expanded on these items to fill this gap at least partially.

The management of Scientific/Technical, patient-care, customer satisfaction, and administrative information is composed of several attributes. These attributes are now discussed.

Accessibility is an important attribute in the management of health care information (JCAHO, 1995; Baldrige Award Criteria, 1995; Parker and Case, 1993). Often, health care data that reside in secondary storage are composed of records- patient records, records of procedures and tests, records of scheduled operations, and so on. After Scientific/Technical, patient-care, customer satisfaction, and administrative records are processed, they need to be accessed, either sequentially or directly.

Accurate information is defined as the degree to which data are free of errors or mistakes. (JCAHO, 1995; Baldrige Award Criteria, 1995; Stair, 1992). In some cases, inaccurate health care information occurs at the collection point. There have been numerous problems with inaccurate data stored in hospital information systems. Wrong

limbs have been surgically removed as a result of faulty information. People have been denied access to health care because of inaccurate data. In some cases, inaccurate information can threaten the life of patients.

Most health care departments develop **standardized definitions** and policies for end-users and health care workers (Stair, 1992). There must be agreements on information formats and procedures. Scientific/Technical, patient-care, customer satisfaction, and administrative information cannot maintain integrity unless these standards and policies are maintained.

Timeliness is an important attribute in the management of health care information (JCAHO, 1995; Baldrige Award Criteria, 1995, Stair, 1992). Timely patient-care information requires a just-in-time basis. Knowing last weeks patient test results is not as important as knowing what the results are today. Timing is also crucial for customer satisfaction and administrative applications, including inventory control, trends and forecasting, and cash-flow projections. In medical emergencies, fast processing of documents or reports can literally affect human life.

Complete information contains all the important facts (Stair, 1992; Parker and Case, 1993). A patient chart, for example, that does not include all important tests and procedures performed is not complete. Complete information is also important for administrative purposes. If hospital administrators file an investment report that does not include all important costs it is not complete.

Security is the protection of information from intentional or unintentional destruction, modification, or disclosure (JCAHO, 1995; Date, 1990; McFadden and Hoffer, 1995).

Data administrators of Scientific/Technical, patient-care, customer satisfaction, and administrative information at the departmental level are responsible for accessing, updating, and protecting data. If proper controls are not applied, the database is vulnerable to security breaches because a large user community is sharing a common resource.

Analysis of data is an important component of both the JCAHO (1995) and the Baldrige Award Criteria (1995). Scientific/Technical, patient-care, customer satisfaction, and administrative information must be analyzed to find out how quality, customers, operational performance and relevant financial data can be integrated to support departmental review, action, and planning.

Information can be sorted, classified, and presented as neatly formatted reports (Parker and Case, 1993). **Reporting** of Scientific/Technical, patient-care, customer satisfaction, and administrative data in a pleasing and easily understood format is essential for the management of health care information.

The **quality** of Scientific/Technical, patient-care, customer satisfaction, and administrative information should be consistently high (JCAHO, 1995; Baldrige Award Criteria, 1995). Physician reports, for instance, that are cluttered with unnecessary information or relevant data that is not in a sequential format could lead to mistakes and life threatening errors.

A comprehensive list of attributes has been constructed based on the literature. The attributes accessibility, accuracy, standardized definition, timeliness, completeness, security, analysis, reporting, and quality have their origins in the JCAHO (1995), Baldrige

Award (1995), Shingo Award Criteria (1995), Deming Prize (1994), European Quality Award (1995) and textbooks (Parker and Case, 1993; Stair; 1992). Accessibility was included in our instrument because items could be directly adapted from the JCAHO and Baldrige Award. The same is true for the attributes of accuracy, timeliness, analysis and quality. Standardized definitions, completeness, security, and reporting were included in the instrument because of the identification of their importance in the literature (Stair, 1992; Parker and Case, 1993; McFadden and Hoffer, 1995). Figure 3 shows the dimensions of management of health care information. Definitions of these attributes are summarized in Table 1.

Table 1: Attributes of Information

Attribute	Definition
Accessibility	In health care, a performance dimension addressing the degree to which an individual or a defined population can approach, enter, and make use of needed health services or information.
Accuracy	The degree to which data are free of errors or mistakes.
Standardized Definition	Agreements on information formats and procedures.
Timeliness	In health care, a performance dimension addressing the degree to which a care/intervention or information is provided to a customer at the most beneficial or necessary time.
Completeness	The degree to which desired data exist and are available for use.
Security	Freedom from danger, injury or risk in information use.
Analysis	The process of interpreting data and drawing valid conclusions leading to a decision or judgement.
Reporting	Descriptive of an event, occurrence, incident, or result.
Quality	Degree of excellence or fitness for use of information.

Figure 3: Management of Health Care Information

Scientific/Technical

Patient-Care

Customer Satisfaction

Administrative

Management of health care information is conceptualized using respondent answers to each of the following:

1	2	3	4	5	NA
Very Low	Low	Acceptable	High	Very High	Does Not Apply

Attribute	Type of Information			
	Scientific/ Technical Information	Patient-care Information	Customer Satisfaction Information	Administrative Information
Accessibility of				
Accuracy of				
Standardized definition of				
Timeliness of				
Completeness of				
Security of				
Analysis of				
Reporting of				
Quality of				

Information Technology Infrastructure

Introduction

Traditionally, IT infrastructures closely paralleled the health care organization's rigid functional hierarchy. Hardware, software, databases, and networks were rarely integrated, standardized, or sophisticated. As a result of these fragmented, and unstandardized systems, information flows were uncoordinated, unreliable, and disjointed (Anderson, Aydin, and Jay, 1994). Today, IT infrastructures are increasingly challenged in terms of responsiveness to Scientific/Technical, patient-care, customer satisfaction, and administrative information needs. To achieve requisite responsiveness, the information technology infrastructure is evolving in its ability to connect professionals to one another, and in the delivery of timely information within and between functional departments (Nolan and Crosan, 1995).

Health care IT infrastructures enable health care professionals in functional departments to perform their work. Various health care teams draw upon the IT infrastructure in order to gather, coordinate, and deliver Scientific/Technical, patient-care, customer satisfaction, and administrative information. IT infrastructure can be defined by the standardization and integration of its constituent components.

Components of the Health Care IT Infrastructure

The IT infrastructure of health care information systems is composed of four base technologies including hardware, software, databases, and networks. This is a highly

technical area that is evolving rapidly (Glaser, 1994). Let us look at each of these components individually.

Hardware ranges from centralized mainframe computers to decentralized microcomputers (Scott Morton, 1991). A hardware trend is toward moving processing power out of the central site. This trend is picking up speed because today's desktop and portable workstations have more memory, and are faster than mainframes of the 1980s. There is also a strong trend toward cooperative processing. As a result of computers working together in networks, processing power has been distributed away from the mainframe, and toward a client-server environment (Sprague and McNurlin, 1993).

Software applications are used to support care-related operational processes and to improve the effectiveness and efficiency of these processes (Glasser, 1994).

However, the relative costs of software compared with hardware applications have increased dramatically. "Over the last few decades, software has become more important and expensive as a function of total systems costs" (Stair, 1992). Software costs were a small percentage of total costs in the 1950s. Now, software can be seventy five percent or more of the total cost of a present day health care department's computer system. There are several reasons for this trend of greatly increased expenditures in software. One reason is that there have been reduced hardware costs as a result of advances in hardware technology. A second reason for increased software costs is that the applications are becoming increasingly more complex and therefore require more time and money to develop (Rodger, Pendharkar, and Bhatt; 1995). Finally, the salaries of software developers has increased because there is a greater demand for these individuals' skills.

Software costs are expected to comprise an even greater portion of the cost of the overall computer system in the future (Brandt, 1991).

Telecommunications networks range from private to public, narrow band to broadband. Scott Morton (1991) observes that the driving force behind the emergence and evolution of networks is the need to support and access databases. While networks have experienced considerable change, the future promises even more drastic changes (Sprague and McNurlin, 1993). Today, local area networks (LAN's) connected to wide area networks (WANs) are leading to increased computer connectivity among information workers. This network infrastructure growth will hasten the transformation from a mainframe environment to a workstation centered, distributed computing one. In the future, wireless communication technologies such as spread spectrum and diffuse infrared will receive broader acceptance and allow people to do their jobs anytime or anyplace (Grimm, 1995).

Databases are composed of stored information or classes of data which may be centrally located or distributed in various departments and locations. Databases have evolved from file management systems to database management systems (Sprague and McNurlin, 1993). Today, the trend is toward distributed data, and the focus has changed from data resources to information resources, both internal and external to health care departments. Data management is concerned mainly with internal facts organized in data records. Information resources also include data from external sources.

Integration of Components

Keen (1991) defines integration as "making the separate components of a technology base or business service work together and share resources". Health care information systems and comparative databases draw on data generated by diverse providers and other health professionals. These data and the applications that access the data must be integrated if a composite picture of the Scientific/Technical, patient-care, customer satisfaction, and administrative information is to be achieved (Glaser, 1994). Connectivity is another way of saying that the hardware, software, databases, and networks are integrated.

The technological infrastructure of organizations is becoming increasingly complex (Henderson, 1990). More and more, information technology is being used to improve coordination of activities both within and across organizations (Cash and Konsynski, 1985; Henderson and Venkatraman, 1989; Keen, 1986; Rockart and Scott Morton, 1984). Rockart and Short (1989) argue that internal integration across value-added functions is a key to interorganizational information systems implementation. For example, computers and video networks are providing long-distance health care through medical connectivity. This is a rich and sophisticated media. Doctors can interact with each other and ancillary medical personnel not only through E-mail text, but also via video and audio means. A difficult patient case in a rural area can be given expert specialist attention simply by using "distance" medicine. Not only can patient records, text, and documents be transmitted instantaneously via electronic means- but live video, X-rays, and other diagnostic parameters can be discussed in an interactive manner with live discussions weaving a web

of competency never before witnessed in medical history. This high bandwidth connectivity can enable real-time interaction in a health care context.

One of the most innovative, integrated, and recent developments in the management of health care information is the concept of shared care. This philosophy takes the idea of distributed computing and information technology to new heights. "After a primary hospital stay, necessary with severe illness, an alternative to further hospitalization will be shared care. Shared care comprises the continued and coordinated and integrated activities of different people from different institutions applying different methods in different time frames, all in a combined effort to aid patients medically, psychologically and socially in the most beneficial ways (Ellsasser, Nkobi, and Kohler; 1995).

Standardization of Components

Standardization is defined as agreements on formats, procedures, and interfaces that permit users of hardware, software, databases, and networks to deploy products and systems independent of one another with the assurance that they will be compatible with any other product or system that adheres to the same standards (Keen, 1991; Stair, 1992; Tan, 1995). Health care departments can expect to see increasing degrees of connectivity given the widespread nature of networks and the standardization of connections. Steadily, health care organizations are moving toward the point where anyone, anywhere can connect to anyone else in order to provide shared care (Bloom, 1995). Venkatraman and Zaheer (1990) discuss the concept of connectivity enabled by electronic data interchange (EDI). Today, the concept of connectivity has taken on a broader meaning, especially in

the context of medical connectivity. The medium is much richer today in terms of interactivity, temporal constraints, and bandwidth. Furthermore, in order for hospitals to realize shared care at an interorganizational level, they must first standardize the connections of IT between departments.

Sophistication of Components

Technological sophistication refers to the recentness or currentness of the technology. In the early 1980s, the term "computers" was used to describe information processing. Today, "information technology (IT) has become the generally accepted umbrella term for a rapidly expanding range of sophisticated equipment, applications, services, and basic technologies" (Keen, 1991).

Advanced IT potential provides major changes in health service. Virtual surgery may become a reality. Surgeons may be able to congregate in health care facilities located in metropolitan areas and perform surgery anywhere in the world using ultra high bandwidth techniques. With advances in robotics and electronics, this surgery will be even more precise than present human capabilities allow. Diagnostics will not be tied to only one or two opinions, but a whole team of specialists can examine the patient through nanotechnological advances. Sophisticated virtual reality computers will allow surgeons, and other medical personnel to practice their techniques not on live patients, but virtual patients which cannot die or feel pain from human mistakes.

Nanotechnology, or remaking the world molecule by molecule, is an emerging science on the cutting edge of IT sophistication (Regis, 1995). As Eide, Pentecost, and

Henderson-James (1992) point out, miniaturization is a major scientific field which will affect health care. Already the Japanese are working on developing a sophisticated technology which will tour the body and report back information. A working motor has been created by scientists from Cal Tec, which is only 100 microns in size, has been combined with a spot of light created by Bell Labs, which is only two millionths of an inch wide. Through miniaturization and distance medicine, future diagnosis of any area of the body can be done at any location in the world that has ultra high bandwidth connectivity capabilities. Sophisticated IT will enable team decisions to be made in the best interests of the patient, and ultra high bandwidth connectivity will be the media which will make distance medicine an "actual" reality.

Integration, Standardization, and Sophistication of Information Systems

Systems integration, standardization, and sophistication, are additional ingredients necessary for coordinating the data repositories of Scientific/Technical, patient-care, customer satisfaction, and administrative information systems (Duncan, Ginter, and Swayne, 1995). As the number and kind of health care workers using computers as a part of their daily activities increases, it is becoming evident that an integrated, standardized, and sophisticated IT infrastructure is essential for maintaining and improving quality performance (Luttman, Siren, and Laffel, 1994).

IT infrastructure is an important differentiating factor between high and low quality performance in health care departments (Collins, 1994). Hardware, software, networks, and databases are the major components of information technology which gather, store,

and disseminate information about quality (Goverman, 1994; Glasser, 1994). The integration, standardization, and sophistication of these components significantly improve the capabilities of organizational information systems (Scott-Morton, 1991; Keen, 1991; Schyve and Kamowski, 1994).

Conclusions

IT infrastructure moderates the effect of management of health care information on the quality performance in a health care department. This follows from the concept that management of information, information technology infrastructure and quality performance go hand in hand (Markus and Robey, 1983, 1988; Wetherbe and Whitehead, 1977, Raymond, 1990). However, in order for health care departments to meet the demands of the future, a radically different approach to information management is proposed.

DeLone and McLean (1992) argue that the success of IS "has been an elusive one to define." One dimension of IS success which DeLone and McLean (1992) postulate is organizational impact. For example, Danzier (1977) proposed using productivity gains as a measure of IS impact on the organization. Clemons and Kimbrough (1986) investigated impacts of IS success not only on firm performance, but also on industry structure. Bakos (1987) reviewed the literature on the impacts of IT on firm and industry-level performance. Johnston and Vitale (1988) investigated firm performance by measuring the effects of interorganizational systems on reduction of overhead, increases in customer switching costs, barriers to new firm entry, and product differentiation.

Many reasons exist for IT success and the sharing of information to develop quality care and to improve quality performance throughout a health care facility. Prevailing systems are driven by financial data, however, future systems must also consider clinical data (Hopkins, 1992). In an era where the focus is on the quality of health care services, it is difficult to believe that health care workers such as "professional nursing has not been able to effectively apply information technology in order to document nursing outcomes" (Krueger, 1992). The basis for quality health care will be effective information systems. Krueger (1992) further believes that, "The design and implementation of quality driven information systems is not an impossibility. However, it takes significant commitment, a major shift in thinking, adequate resources and specialized knowledge."

Integration, standardization, and sophistication of all four IT infrastructure components are necessary for the effective and efficient operation of the Scientific/Technical, patient-care, customer satisfaction, and administrative information systems of health care departments. Currently, many information systems at the functional level are not designed in accordance with the TQM philosophy. Often departmental information systems cannot be integrated and standardized with other functional areas, and the results of this lack of sophistication are less than satisfactory (Luttman, Siren, and Laffel, 1994). New systems which do not meet user demands are under utilized or not used at all. In addition, the management of health care suffers because Scientific/Technical, patient-care, customer satisfaction, and administrative information systems cannot be effectively employed to improve departmental quality performance (Taylor, Gustafson, Hawkins, Pingree, McTavish, Wise, and Carter, 1994).

To improve quality performance, the IT infrastructure must be able to support integrated, standardized, and sophisticated hardware, software, databases, and networks (Goverman, 1994). Development of the IT infrastructure involves integration, standardization, and sophistication of technical analyzers, diagnostic equipment, LANs, WANs, order entry capabilities, external communication reports, physician specific practice profiles, workstations, emergency backup units, and external and internal databases (Glasser, 1994). The standardization, integration and sophistication of distributed IT hardware and client server architecture along with the various types of man-machine interfaces and processing modes are also important.

The health care industry is very information intensive (Pegels, 1995). Scientific/Technical, patient-care, customer satisfaction, and administrative data are required for decision making at all levels of the health care facility. Management of health care information and management of the organization are, in essence, very closely related. In order to be successful, a health care organization must be able to use health data from both the internal and external environment (Mingione, 1986).

Management of health care information is a concept which views Scientific/Technical, patient-care, customer satisfaction, and administrative information as major resources. The management of health care information has lagged behind other industries in automating Scientific/Technical, patient-care, customer satisfaction, and administrative information (Shannon, 1948). Scientific/Technical, patient-care, customer satisfaction, and administrative information which is not effectively and efficiently used severely limits health care manager's ability to handle decision making responsibilities. For example,

Lindberb et al. (1993) points out the importance of the use of knowledge-based information by physicians for clinical problem solving. "MEDLINE is a bibliographic database containing more than 7 million citations, most with abstracts, from over 3,500 biomedical journals and covering the period 1966 to the present. "The authors found that the information obtained from MEDLINE had an impact on clinical problem solving, choosing the appropriate diagnostic tests, and making the diagnosis. The authors also indicate that MEDLINE was used for diverse needs. "There were even reported instances in which the information obtained via a MEDLINE search was critical to saving a patient's life." There are many examples of inefficient use of information including: collecting information that is not needed, storing information after it is needed, disseminating more information than is necessary, inadequate means of collecting, analyzing, retrieving, and storing information, and difficulty in giving users access to relevant information (Central Computer and Telecommunications Agency, 1990).

Technological sophistication refers to the latest, most up-to-date technology being used by the organization. Benjamin and Scott Morton (1988) and Weill and Olson (1989) define the level of integration as the extent to which various IT components are linked together in a strategic and economic manner.

Standardization of IT refers to the extent to which the hardware, software, databases, and networks are compatible with each other. Barnett, Jenders, and Chueh (1993) state that a "major impediment to the development of a computer-based clinical record system has been the lack of agreement in standards both for the clinical terminology to be used and for the computer technology." In order for computer-based record systems to be

effective, they must replace the paper record completely. The authors feel that this adaptation will require the "modification of longstanding traditions of medical record keeping." There is a collaboration between the Health Level Seven and the American Society for Testing and Materials (ASTM) to implement a standard for the protocol to be used in the communication of laboratory data in an electronic format. The lack of standards makes it difficult to properly measure treatment cost-effectiveness, and learn how patient outcomes are affected by clinical decisions.

In order to provide a bridge between the vision of an integrated, standardized, and sophisticated vision of the IT infrastructure and the development of a systems architecture to support that vision, a set of policies and standards are necessary to ensure connectivity and compatibility in the IT infrastructure (Tan, 1995). For example international standards such as IBM's systems network architecture (SNA) and the open systems interconnection (OSI) reference model can be used to link the health care departments to the outside world. Standards for hardware acquisition, software adoption, and database and network implementation are also integral parts of developing the overall architecture (Dunbar, 1990; Wu, et al. 1993).

Tan (1995) believes that an open systems architecture offers a solution for organizations that are sometimes locked into the technologies of the past. An open systems architecture provides flexibility to take advantage of both existing systems and new technologies. While an open systems solution may be difficult to obtain, it is a viable alternative to retaining systems that are poorly integrated, difficult to maintain, costly, and hard to change (Zerrenner, 1990).

Teng and Grover (1992) suggest that data integration is desirable and leads to increased organizational performance. Goodhue, Wybo, and Kirsch (1992) state that many organizations cannot make coordinated organization-wide responses to business problems because of data integration problems. For example, Torchia (1994) argues that data can be used to improve quality. The author suggests that health care employers are finding that there are many advantages to being equipped with specific data on the performance of their health care plans. Cost control and better health care for their employees are among the benefits which were realized from analyzing claims and utilizing data.

There have been many attempts by researchers to increase data integration. For example, Brandt (1993) argues that "integration of existing databases is critical to the development of the nationwide computer-based patient record required for health care in the 21st century. Corum (1994) gives an example of how system integration allowed one hospital to perform the same procedure with the same results as another hospital for 75% less cost. Batini, Levzerini, and Navathe (1986) developed theoretical schemas for disparate databases. Chen (1976) used entity relationships to conceptualize data integration. Martin (1986) suggests the use of information engineering for data integration.

Lederer and Sethi (1991) point out the failure of many integration efforts. One reason for this failure may be due to lack of user involvement and failure to secure top management support. Iguanzo and Pol (1993) stress the importance of data that staff and management can access and apply to both strategic planning and day-to-day issues.

Roberts (1994) stresses that information-management professionals should be involved in the development of a health care facility's information-management plan. Teng and Grover (1992) also point out that there may be a lack of integration between corporate and IS planning. However, Goodhue et al. (1992) believe that data integration is contingent upon organizational context. These authors believe that data integration depends on three factors: degree of difficulty required to design and implement integrated data systems, degree of interdependence of subunits, and the need for flexible action by subunits.

Spath (1993) describes how quality management activities are "dependent upon valid and reliable data about health care processes and patient outcomes. " Information-management professionals can use continuous quality improvement techniques to meet the challenge of providing Scientific/Technical, patient-care, customer satisfaction, and administrative information. Health information departments can begin to design appropriate integrated, standardized, and sophisticated systems that support quality management activities. However, health care departments must be able to identify their primary customers and understand those customers' needs and expectations.

IT Infrastructure Dimensions

A comprehensive list of attributes for IT infrastructure was constructed based on the literature. Each IT infrastructure attribute proposed in this research is grounded in theory or adopted from a validated instrument. The attributes integration, standardization, and sophistication are theoretically addressed (Keen, 1991; Scott Morton, 1991; Sprague and

McNurlin, 1993). In addition, the JCAHO (1995) expressly states the existence of four distinct types of information and information systems. Several items in our instrument were directly adopted from the JCAHO on Scientific/Technical, patient-care, customer satisfaction, and administrative information systems. IT infrastructure dimensions are shown in Figure 4. The IT infrastructure construct was operationalized using respondent answers to each of the following items:

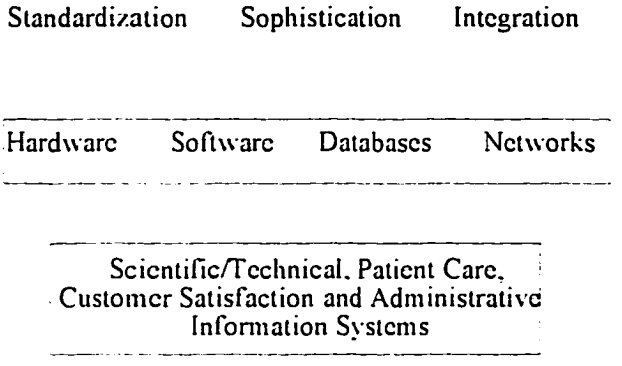
1	2	3	4	5	NA
Very Low	Low	Acceptable	High	Very High	Does Not Apply

Integration of:	Scientific/Technical information system	Patient-care information system	Customer satisfaction information system	Administrative information system
Information technology				
Standardization of:	Scientific/Technical information system	Patient-care information system	Customer satisfaction information system	Administrative information system
Information technology				

1	2	3	4	5	NA
Manual	Very Old Technology	Old Technology	Current Technology	Leading Edge Technology	Does Not Apply

Sophistication of:	Scientific/Technical information system	Patient-care information system	Customer satisfaction information system	Administrative information system
Information technology				

Figure 4: IT Infrastructure



Research Model

The research model examines the relationship between management of health care information and quality performance in health care departments. IT infrastructure is proposed as a moderating variable. Two research questions arise from this model:

R1: What is the relationship between management of health care information and quality performance in health care departments?

R2: How does IT infrastructure moderate the relationship between management of health care information and quality performance in health care departments?

The research questions lead to the following propositions:

Proposition 1: Better overall management of health care information should be directly related to increased quality performance at the departmental level of health care facilities.

Proposition 2: The integration of IT infrastructure should moderate the effect of management of health care information and quality performance at the departmental level of health care facilities.

Proposition 3: The standardization of IT infrastructure should moderate the effect of management of health care information and quality performance at the departmental level of health care facilities.

Proposition 4: The sophistication of IT infrastructure should moderate the effect of management of health care information and quality performance at the departmental level of health care facilities.

Chapter Three

Research Design

Survey research methods were used to examine how quality performance varies due to differences in management of health care information and IT infrastructure in health care facility departments. "Survey research studies large and small populations (or universes) by selecting and studying samples chosen from the populations to discover the relative incidence, distribution, and interrelations of sociological and psychological variables" (Kerlinger, 1986).

Huber (1982) suggests that if you are going to use one person in the organization, then you should use the most informed person who will give the best overall assessment. This should be the most focused person in the department. This research endeavored to follow Huber's suggestion.

Some archival data had been collected on the initial site visits to two health care facilities. These sites were helpful in determining the probability of success of the research. The material which was gathered consisted of several documents which referred to JCAHO and CAP requirements for IT and quality issues as well as training manuals for quality education for employees (College of American Pathologists, 1994; Crosby, 1988; JCAHO Accreditation Manual, 1995). Other archival data such as documents generated during the development, implementation, and day to day operations of the hospital information system may be proprietary information which the health care facilities may not want to share. In a similar vein, lapses in quality performance indicators, and citations by accrediting agencies may not be available to the general public.

Survey Sample

The unit of analysis in this study is the functional department of health care facilities. Among the participating health care facilities were several teaching institutions with open heart and trauma units, a kidney dialysis center, a provider of hospice educational and informational support, and seven community and primary health care providers. The size of the institutions range from 50 beds to more than 600 beds.

There were 92 manager and 105 customer surveys gathered from eleven health care facilities. Good variation in terms of size, types, and nature of tasks resulted from this convenience sample. The functional departments were investigated at all 11 institutions. These departments included pharmacy, respiratory, laboratory, nursing, emergency, billing, pulmonary, pediatrics, surgery, nuclear medicine, and X-ray services. These eleven departments are basic to the functioning of any hospital, and typically existed at all facilities which were surveyed.

Variable Measurement

Hospital and Departmental Demographics

Measurement methods and the operalization related to the variables are investigated in this section. Two broad demographics were collected: hospital and department. The hospital demographics which were collected gave important insights into size, profit status, type of hospital, geographical location, membership in a HMO or PPO, number of

physicians with practicing rights, and annual operating budget. Hospital and departmental demographics were collected using a multiple choice and fill-in-the-blank format. Departmental demographics were helpful in informing our research on the department name, title of the respondent, number of employees working in the department, type of employees, annual operating budget, and number of patients the department serves daily. The primary constructs, information technology infrastructure (IT), management of health care information, and quality performance variables were also examined.

Hospital demographics were based on respondent answers to each of the following:

Hospital Demographics

1. How many beds does your hospital have?

_A. Less than 100 _B. 100-200 _C. 201-300 _D. 301-400 _E. 401-500 _F. 501-700 _G. More than 700

2. Is your hospital?

_A. For Profit _B. Not for Profit

3. What type of hospital are you (check all that apply)?

_A. Teaching _B. Research Center _C. Primary Care _D. Trauma Center _E. Community

4. What is the geographical setting of your hospital?

_A. Rural _B. Urban

5. What city and state is your hospital located in? _____

6. Is your hospital a member of a planned provider organization (PPO)?

_A. Yes _B. No

7. Is your hospital a member of a health management organization (HMO)?

_A. Yes _B. No

8. How many hospitals are in your PPO?

_A. 1 _B. 2-5 _C.5-10 _D.10-15 _E. More than 15 (Specify):_____

9. How many hospitals are in your HMO?

_A. 1 _B. 2-5 _C.5-10 _D.10-15 _E. More than 15 (Specify):_____

10. How many physicians have practicing rights at your hospital?

_A. Less than 50 _B. 50-100 _C. 101-200 _D. 201-300 _E. More than 300 (Specify):_____

11. What is your approximate annual operating budget?_____

Department Demographics

12. What is the name of your department? _____

13. What is your title?_____

14. How many employees work in your department? _____

15. How many employees in your department are:

A. Administrative?_____ B. Health Care Professionals?_____ C. Technical Support?_____

16. What is your approximate annual operating budget?_____

17. How many patients does your department serve daily?

_A. Less than 50 _B 50-100 C. 101-200 _D. 201-300 _E. More than 300

Information Technology Infrastructure

Hardware, software, networks, and databases are the important information technology components for gathering, storing, processing, and disseminating information. Furthermore, the literature states that IT has significant impacts on the capabilities of the organizational information systems. Keen (1991) defines integration as making the separate components of a technology base or business service work together and share resources. Standardization is defined as agreements on formats, procedures, and interfaces that permit users of hardware, software, databases, and networks to deploy products and systems independent of one another with the assurance that they will be compatible with any other product or system that adheres to the same standards (Keen, 1991). Technological sophistication refers to the recentness or currentness of the technology.

The IT infrastructure questions utilized a response matrix format which has been used by a number of researchers. The response matrix format employed two different scales. One scale ranged from "very low" to "very high" and was used to measure the attributes of the standardization and integration of the IT infrastructure. Another scale was used to measure the level of sophistication of information technology. This scale ranged from "manual" to "leading edge technology".

In our study, IT infrastructure was measured by asking health care department respondents to answer to what extent IT (hardware, software, networks, and databases) are standardized and integrated for Scientific/Technical, patient-care customer satisfaction, and administrative information. Sophistication of IT (hardware, software, networks, and

databases) for Scientific/Technical, patient-care, customer satisfaction, and administrative information were also used as an IT infrastructure metric.

Standardization

The IT infrastructure standardization questions are also presented in the response matrix format. This format utilizes a scale ranging from "very low" to "very high". IT (hardware, software, networks, and databases) standardization were captured using a mean at the aggregate level for each type of information. Cumulation across all four means was used to capture overall standardization of IT.

Integration

The IT infrastructure integration questions used the response matrix format. This format utilizes a scale ranging from "very low" to "very high". IT integration was captured using a mean at the aggregate level for Scientific/Technical, patient-care, customer satisfaction, and administrative information. Cumulation across all four means was used to capture overall integration of IT.

Sophistication

Finally, technologies used can be broken down into key constituent components/processes. A five-point Likert scale was used to measure the level of sophistication of information technology. This scale ranged from "manual" to "leading edge technology". The level of sophistication of information technology was captured

using a mean at the aggregate level for Scientific/Technical, patient-care, customer satisfaction and administrative information. Cumulation across all four means was used to capture overall sophistication of IT.

Management of Health Care Information

Hospital departments usually deal with Scientific/Technical, patient-care, customer satisfaction, and administrative information. These four types of information have been adopted from the JCAHO (1995). The management of Scientific/Technical, patient-care, customer satisfaction, and administrative information is composed of several attributes. Definitions of these attributes are shown in Table 2. Each of these attributes needs to be managed, including accessibility (JCAHO, 1995; Baldrige Award Criteria, 1995; Parker and Case, 1993), accuracy (JCAHO, 1995; Baldrige Award Criteria, 1995; Date, 1990; McFadden and Hoffer, 1994), standardized definition (Date, 1990; McFadden and Hoffer, 1994), timeliness (Baldrige Award Criteria, 1995; Stair, 1992), completeness (Stair, 1992; Parker and Case, 1993), security (Date, 1990; McFadden and Hoffer, 1995), analysis (JCAHO, 1995; Baldrige Award Criteria, 1995), reporting (Parker and Case, 1993), and quality (JCAHO, 1995; Baldrige Award Criteria, 1995). The management of health care information questions utilized a response matrix format. We utilized a scale ranging from "very low" to "very high" to measure the attributes of the management of health care information.

Quality Performance

The service quality literature has paid attention to quality performance assessment. For example, Fiegenbaum, Ishikawa, Taguchi, Crosby, Kearns, Mazda, Taylor, Deming, and Juran have made significant contributions to TQM (Gabor, 1990; Ishikawa, 1985; Juran, 1988: Deming, 1986). More recently, Dean and Bowen (1994) believe that some insights of total quality should be incorporated into management theory. Waldman (1994) sees the individual as affecting TQM. Garvin, (1987) reports that Motorola launched a five-year quality improvement program called Six Sigma, which strives for 99.9999998 percent correct operation. This concept of zero defects has also been adopted in part by the service sector. Service businesses may strive for "zero defections" in satisfying every customer (Reichheld and Sasser, 1990).

Respondents were asked to respond to performance questions using appropriateness, effectiveness, efficacy, efficiency, timeliness, availability, respect and caring, continuity, tangibles and safety. (JCAHO, 1995; Baldrige Award Criteria, 1995, Parasuraman, Zeithaml, and Berry, 1985, 1987, 1990, 1991, 1993, 1994; Shingo Prize, 1995).

A customer is one who receives a product or service from a department. In addition to patients, the customer may be an organization, department or individual. For example, other hospitals, hospital departments, employees or doctors may be customers. Quality performance metrics were in the form of Likert questions ranging from "strongly disagree" to "strongly agree".

Survey Sample and Design

The target sample was drawn from a convenience sample of local health care facilities in the Johnstown area. In order to increase the rate of valid responses, health care facilities with which the researchers have personal contacts were selectively solicited. Health care organizations were included in the sample if their departments address quality performance measures.

The target sample was asked to fill out a questionnaire about the four major constructs of the study. These constructs are management of health care information, IT infrastructure and quality performance. Management of health care information has been defined to be composed of Scientific/Technical, patient-care, customer satisfaction, and administrative information dimensions. Exploratory factor analysis was used to investigate which of the nine attributes would be included in each dimension. In a similar fashion, quality performance has been defined as being composed of ten dimensions.

IT Infrastructure has been conceptualized as being cumulatively additive, and composed of standardization, sophistication, and integration dimensions. These dimensions can be broken down into the subdimension of IT (hardware, software, databases, and networks). In turn, the subdimensions are conceptualized to be composed of Scientific/Technical, patient-care, customer satisfaction, and administrative information.

Analytical Approach

A content validity and literature review was conducted in conjunction with managers of several different health care departments. This study was done in order to determine

the face validity and content validity of the instrument. These managers were not included as participants in the final survey. However, their comments were used to help to refine the instrument.

The collected data were analyzed using multiple regression. The sample was relatively large compared to the number of independent variables, and the number of degrees of freedom were not restrictive when trying to reach a level of prediction (Hair, Anderson, Tatham, and Black, 1992).

The data were screened for normality and linearity by employing univariate analysis. Factor analysis was used to add richness to the study, to eliminate redundant items, and to examine unidimensionality (Kervin, 1992). Cronbach's alpha was used to test the internal consistency of survey items. Multicollinearity was tested using correlation analysis (Churchill, 1979; Nunnally, 1978; Kurvin, 1992; Sethi and King, 1991).

Moderation Effect

The research model hypothesizes that IT infrastructure (Z1) is a moderator variable on the management of health care information (X) and quality performance (Y). This moderation effect can be analyzed using Sharma et al.'s (1981) four step typology, as shown in Figure 5.

Figure 5: Typology of Specification Variables

	Related to Criterion and or Predictor Variable	Not Related to Criterion and Predictor Variable
No Interaction With Predictor Variable	1 Intervening Exogenous Antecedent Suppressor Predictor	2 Homologizer Moderator
Interaction With Predictor Variable	3 "Quasi" Moderator	4 "Pure" Moderator

Adapted from Sharma et at. (1985)

The first step was to use the moderated regression procedure (MRP) to determine whether a significant interaction occured between the predictor variable (X) and the moderator variable (Z). The second step was to determine the relationship between the moderator variable and the criterion variable. The third step was to determine if (Z) was related to the predictor or criterion variable. If there was a relationship, then (Z) was a quasi moderator variable. If not, then (Z) was a pure moderator variable.

The third step is to determine if (Z) is related to the predictor or criterion variable. (If (Z) was related, it is an exogenous, intervening, antecendent, suppressor or predictor variable). We proceeded to step four if (Z) was not related to either the criterion or predictor variables. The fourth step was to use median or other types of splits to subgroup the total sample using the hypothesized moderator variable. We did a test of significance for differences in predictive validity across subgroups. If no significant

differences were found, then (Z) was not a moderator. (Z) is a homologizer operating through the term if significant differences were found.

Chapter Four

Results

In this chapter, data preprocessing, descriptive statistics, hypothesis testing and comparison of manager and customer perceptions are presented. This study collected data from hospitals as well as customers. Hospital data were collected from managers at two different levels. Different methodologies were employed in the collection of manager and customer data.

Sample

Type of Sample

Two groups of constituents, managers and customers, were selected for participation in the study. The first step in the sampling process was to receive acceptance of the research project from the Human Subjects Committee at Southern Illinois University at Carbondale. This approval was received on November 27, 1995. The second step was to identify managers from 10 health care facilities who would agree to fill out questionnaires. The managers were personally contacted and asked if they would be willing to take the time to fill out the surveys. Contact was made in person, by telephone, or through written communication. Managers included key administrative directors as well as supervisors from the major functional levels of radiology, medical laboratory, pharmacy, nursing, respiratory, billing, surgery, nuclear medicine, emergency room, and pediatrics.

It was deemed feasible to collect customer surveys from these same functional areas. A mall intercept approach was adopted in which customers were asked to fill out the

survey in waiting areas and other high traffic locations associated with the departments. One strength of this method was that the customers could have the survey shown and explained. However, inherent in this technique are the distractions associated with respondents who may be in a hurry or not in the proper frame of mind. There is also more of a chance for interviewer bias and nonprobability sampling problems.

Unit of Analysis

The functional department is the unit of analysis in the study. These departments provide the fundamental services in most health care organizations. The departments selected are listed in Table 2.

Hospital, Department, Manager and Customer Descriptions

Hospital and departmental demographics are a rich source of information for describing the research sample. The number of total respondents, a description of the hospitals, a description of departments, and a description of responding managers and customers are summarized in Tables 2 through 8.

Table 2: Total Number of Departments and Respondents

Department	Managers		Customers	
	Departments	**Respondents**	**Departments**	**Respondents**
Radiology	6	7	10	10
Medical Laboratory	9	10	10	10
Pharmacy	8	9	10	10
Nursing	8	14	10	10
Respiratory	6	6	10	10
Billing/Medical Records	8	12	10	10
Surgery	5	8	10	10
Nuclear Medicine	5	5	10	10
Emergency Room	6	8	10	10
Pediatrics	5	5	10	10
Administration	4	5	2	2
Physical Therapy	2	2	2	2
Total	72	91	104	104

Table 3: Description of Hospitals

Hospital	CVMH	Gettysburg	Somerset	Lee	Windber	Lancaster	Mercy	Spangler	Allegheny General	Meyersdale
Beds	450 beds	150 beds	150 beds	250 beds	100 beds	600 beds	300 beds	75 beds	600 beds	50 beds
Profit status	NFP	NFP	NFP	NFP	NFP	NFP	NFP	NFP	NFP	NFP
Type	Teaching	Community	Community	Community	Community	Teaching	Trauma	Community	Teaching	Community
Location	urban	rural	rural	urban	rural	urban	urban	rural	urban	rural
City	Johnstown	Gettysburg	Somerset	Johnstown	Windber	Lancaster	Johnstown	Spangler	Pittsburgh	Myersdale
HMO/PPO	PPO	PPO	Neither	Neither	Neither	HMO	PPO	PPO	Both	Neither
Participating Providers	4 providers	3 providers	1 provider	1 provider	1 providers	7 providers	2 providers	12 providers	12 providers	1 provider
Practicing physicians	250	75	75	150	50	600	100	50	200	50
Operating budget	130 million	24 million	40 million	50 million	20 million	150 million	15 million	12.5 million	150 million	5 million
Occupancy Rate	0.8	0.7	0.7	0.6	0.5	0.8	80%	40%	0.8	30%

In the study, 20 managers, 17 supervisors, 10 administrators, 4 doctors, and 40 directors responded.

Table 4: Title and Frequency of Respondents

Title	Frequency
Manager	20
Supervisor	17
Administrator	10
Doctor	4
Director	40

Table 5: Number and Frequency of Employees

Number of Employees	Frequency
Less than 5	20
5-10	17
11-15	18
16-20	6
21-25	5
More than 25	25

The type of employee was reported as 8 administrative, 3 health care professionals, 3 technical/support, 11 administrative and technical/support, 12 health care professionals and technical/support, 8 administrative and health care professionals and 47 of all three types.

Table 6: Type of Employee

Type of Employee	Frequency	Percent
Administrative	8	6.5
Health Care Professional	3	3.3
Technical/Support	3	3.3
Administrative and Technical/Support	11	12
Health Care Professionals and Technical/Support	12	13
Administrative and Health Care Professionals	8	8.7
All Three Types	47	51.1

Operating budgets ranged from less than 100,000 dollars to more than 10 million dollars.

Table 7: Operating Budget

Operating Budget	Frequency	Percent
Less than 100,000	12	13.0
100,001-500,000	20	21.7
500,001-999,999	6	6.5
1-5.9 Million	22	23.9
6-10 Million	2	2.2
More than 10 Million	2	2.2
Did not Respond	27	30.4

Number of patients served ranged from less than 50 to more than 300.

Table 8: Patients Served

Number of Patients Served	Frequency	Percentage
Less than 50	35	38.5
51-100	18	19.7
101-200	10	10.9
201-300	7	7.6
More than 300	5	5.5
Did not Respond	16	17.6

Data Collection

Instrument Pretesting and Validity Review

Instrument pretesting and validity review was undertaker as a trial run on a small scale before the final instrument was deployed (Kervin, 1992). The instrument was tested for content validity at both the manager and customer levels. The initial response to the instrument was generally positive, and the feasibility of the research seemed reasonable. Health care facility departments were asked to participate if they had instituted quality initiatives. Respondents covered the entire range of IT infrastructure. Sophistication ranged from "very old technology" to "leading edge technology". Standardization and integration of IT infrastructure ranged from "very low" to "very high". Each health care

facility was asked to complete a survey for at least one department. Most of the hospitals provided results from at least 5 department questionnaires.

Initially the instrument was purported to have face validity because the author had over fifteen years of experience working in the health care field, at five separate health care facilities. Face validity was also checked through the expertise of several professors and medical doctors. The instrument was refined through the efforts of a Pharmacist, and a Doctor of Pharmacy at two different health care facilities. These individuals did not respond on the finalized survey in order to eliminate any bias which may have been inherent in the refinement process.

One of the pilot test study respondents worked at a 400 bed teaching hospital in western Pennsylvania. Another at a 100 bed health care facility in central Pennsylvania. From this pilot study several points were clarified and refined. First, the department as the unit of analysis was judged as appropriate for the study. Second, the review indicated that the questionnaire was too long. Therefore, the IT infrastructure properties of sophistication, integration, and standardization were reduced from thirty items to twelve. Third, the instructions given in several sections of the survey were ambiguous, and imprecise. Suggestions from the pilot respondents were incorporated into the introductory text of each of the major sections of the instrument. Finally, individual items were modified based on suggestions from the respondents. Items were added and deleted in order to add clarity and reduce redundancy. The response format of the instrument was iteratively adapted to ensure respondent readability and ease of use. In effect, much effort was expended to insure that the instrument was "user friendly".

After numerous refinements of the instrument, a second questionnaire for managers was tested with respondents from a 200 bed facility in the Johnstown area of Pennsylvania. In this test, a Laboratory Director and a Director of Nursing were asked to fill out the survey and comment on the accuracy, reliability, and validity of the instrument. Results were very positive and no further adjustments were made to the instrument.

In a similar manner, a separate instrument was tested for measuring perceptions of quality in health care departments. Customers, who had received services from one of the key functional departments, at 5 different health care facilities were asked to fill out the survey and give comments on the clarity, readability and content of the instrument. In general, these customers were satisfied with the survey instrument. However, several refinements were deemed necessary, especially in the wording of the instructions. Comments received from the department patients were more generally directed toward shortcomings in departmental service rather than in the content of the questionnaire itself.

A refined customer survey was tested on five different customers from 5 different health care facilities in 5 separate departments. Customers were generally positive about the wording and meaning of the 30 items on the instrument, therefore, the customer questionnaire was adopted without further refinement.

Administration of the Instrument

The next step in the data collection process was to actually administer the instrument in order to gather the data from the subset of units of the population (McClave and Benson, 1991). In order to facilitate the data gathering process, surveys were hand

delivered to a key contact manager on each of the 10 participating sites. Questionnaires were then distributed, completed and collected with the help of managers. Upon completion, the surveys were personally gathered, identified, and categorized from the 10 participating facilities.

Customer data was collected by the author, from each of the same 10 health care facilities that responded for the managers (Conemaugh, Mercy, Lee, Windber, Somerset, Myersdale, Spangler, Lancaster, Allegheny General, and Gettysburg). Designated functional areas (radiology, lab, pharmacy, nursing, respiratory, billing, surgery, nuclear medicine, emergency room, and pediatrics) participated in the customer survey.

Response Rate and Bias Issues

In all, 91 managers and 104 customers responded to the survey. It should be noted that not all of the participating hospitals had all 10 departments available. Furthermore, it was not possible to get a one to one correlation between department managers and customers at each facility. For example, 9 out of 10 medical laboratory departments responded to the survey. However, for the physical therapy department, only two departments responded. Several top managers showed an interest in filling out the questionnaires. Therefore, in 5 cases, top management filled out the surveys. Since top management data and additional departments were rich sources of information, it was helpful to incorporate these responses. Collection occurred on several separate occasions in order to reduce the risk of biased responses.

A caveat may be appropriate at this point. An effort was made to ensure that at least one manager responded from each department. While it is true that multiple managers from several departments responded to the survey, no more than two managers from any one department responded. In general, customers could be persuaded to fill out the survey much easier than managers due to a mall intercept approach. However, this technique does have weaknesses. It lends itself to interviewer bias and nonprobability sampling.

Data Processing

Missing Values

Missing values have potential implications for restricting sample size in such multivariate analyses as factor analysis and multiple regression. It was decided to replace missing values by means of the respective variables This strategy ensured that the sampling sizes were adequate for some of the multivariate analyses.

Initially, a period was placed in cells that did not have a data value. The period represented a system-missing or user-missing value (SPSS for Windows, 1993). For example, this could be a manager who did not wish to reveal the integration of his or her IT infrastructure. Since data can be missing for a variety of reasons (i.e. "does not apply" was marked), it is important to flag these values as missing. Missing values were then substituted for by inserting the mean score for the observation so that all observations could be used to compute the descriptive statistics.

It should be noted that this treatment of missing values does not affect the means, but reduces the variances of the variables used in the analyses. However, it does exaggerate the sample size and therefore the level of statistical significance of the test (Tabachnick and Fidell, 1989).

Outliers

Parametric measures generally identify patterns within the entire set of observations. Conversely, outliers look at individual observations with the purpose of finding data points which are outside the general set and which tend to influence the regression analysis (Hair et al, 1992). In this research, outliers were not a problem because the scales were defined as being between 1 and 5 with 6 being "does not apply" and treated as a missing value.

Test of Normality

Initial tests of normality were performed using descriptive statistics and frequencies on each questionnaire item in order to check the distribution. All data seemed to conform to a normal distribution . Minimum and maximum ranges as well as means and variances were examined to check normality assumptions.

Descriptive Statistics, Unidimensionality and Reliability of Variables

Reliability of Total Quality Performance for Managers

Reliability is useful in assuring the researcher that a set of latent construct indicators are consistent with their measurements. If the constructs are highly reliable, then the indicators are measuring the same latent construct (Hair et al., 1992). Overall construct reliability or composite reliability for manager total quality performance was 0.89. Cronbach's alpha was used to measure the instrument reliability (McClave and Benson, 1991). Reliabilities above 0.60 were adequate since this research is exploratory (Nunnally, 1978) . Reliability of total quality performance (TQP) for managers is 0.89 (Table 9). Reliability of TQP for customers is 0.91 in (Table 10).

Table 9: Reliability of Total Quality Performance for Managers

Manager Total Quality Performance		
Cronbach Alpha = 0.89		
Factor	**Mean**	**Standard Deviation**
Appropriateness	4.2	0.5
Continuity	4.2	0.6
Efficiency	4.1	0.6
Timeliness.	4.2	0.6
Respect and Caring	4.2	0.5
Safety	4.3	0.5
Effectiveness	4.4	0.6
Availability	4.1	0.7
Efficacy	4.3	0.5
Facility Tangibles	3.7	0.7

Table 10: Reliability of TQP for Customers

Customer Total Quality Performance		
Cronbach Alpha = 0.91		
Factor	**Mean**	**Standard Deviation**
Appropriateness	3.9	0.6
Factory Tangibles	4.0	0.7
Continuity	4.0	0.7
Efficiency	3.7	0..7
Timeliness	3.4	0.9
Respect and Caring	3.6	0..7
Safety	4.0	0.6
Effectiveness	3.8	0.8
Availability	4.0	0..8
Efficacy	4.1	0.6

Unidimensionality and Factor Analysis

The unidimensionality of the different constructs were validated utilizing exploratory factor analysis. Principal components analysis, with Varimax rotation, was used. Factor analysis was run separately on manager and customer data.

Table 11 shows the results of factor analysis of items constituting the ten manager quality performance variables. In a similar manner, Table 13 shows results of factor analysis of items of each of the ten customer quality performance variables. In both cases, all items in each variable generally loaded on a single factor.

The ten manager quality performance variables and customer quality performance variables were factor analyzed separately. Two factors were retained in each case. The manager factor loadings can be seen in Table 12, and the customer loadings in Table 13.

Table 11: Manager Unidimensionality Factor Loadings

Items	Factor Loading	Eigenvalue	Percent of Variation	Variable
1. The department has up to date technology.	0.63	2.07	51.6	Facility Tangibles
2. Departmental physical facilities are visually appealing.	0.89			
3. Departmental employees are well dressed and neat in appearance.	0.29			
4. The appearance of the physical facilities of the department are in keeping with the kind of services provided.	0.89			
5. When the department promises to do something by a certain time, it does so.	0.83	2.1	69.9	Timeliness
6. The department provides its services at the times it promises to do so.	0.86			
7. Departmental employees give prompt services to users.	0.82			
8. When the customers have a problem the department shows a sincere interest in solving it.	0.66	5.14	57.1	Respect and Caring
9. Departmental employees are consistently courteous with others.	0.81			
10. Departmental employees are never too busy to respond to customer's requests.	0.67			
11. Departmental employees are always willing to help others.	0.75			
12. The behavior of departmental employees instills confidence in customers.	0.79			
13. The department gives customers individual attention	0.85			
14. The department's employees give customers personal attention.	0.82			
15. The department has the user's best interests at heart	0.75			
16. The department's employees understand the specific needs of its customers.	0.67			
17. The department is dependable.	0.85	1.44	72.2	Effectiveness
18. The department insists on error-free records.	0.85			

19. The department tells customers exactly when services will be performed.	0.80	1.27	63.3	Availability
20. The department has operating hours convenient to all its customers.	0.80			
21. Customers feel safe in their transactions with departmental employees	0.81	1.33	66.3	Safety
22. The department provides a safe environment for its customers.	0.81			
23. Departmental employees have the knowledge to do their job well.	0.82	1.36	67.8	Efficacy
24. The department utilizes the correct technology and procedures given the current state of knowledge.	0.82			
25. The department provides appropriate and relevant services to its customers.	0.83	1.37	68.4	Appropriateness
26. Customers are satisfied with the range of services available in the department	0.83			
27. The department coordinates its services with other departments.	0.84	1.42	70.9	Continuity
28. The department coordinates its services over time with respect to each customer	0.84			
29. The tasks procedures utilized by the department leads to the desired projected outcomes.	0.85	1.45	72.2	Efficiency
30. The department obtains maximum benefit for its customers with the least expenditure of resources.	0.85			

Table 12: Manager Factor Loadings

Factor 1: Eigenvalue = 5.29 Factor 2: Eigenvalue = 1.09		
Variable	**Factor 1**	**Factor 2**
Appropriateness	.37	.71
Facility Tangibles	-.02	.68
Continuity	.26	.80
Efficiency	.39	.66
Timeliness	.82	.13
Respect and Caring	.72	.45
Safety	.51	.65
Effectiveness	.82	.13
Availability	.71	.28
Efficacy	.57	.55

Table 13: Customer Unidimensionality Factor Loadings

Items	Factor Loading	Eigenvalue	Percent of Variation	Variable
1. The department has up to date technology.	0.70	2.18	54.6	Facility Tangibles
2. Departmental physical facilities are visually appealing.	0.85			
3. Departmental employees are well dressed and neat in appearance.	0.50			
4. The appearance of the physical facilities of the department are in keeping with the kind of services provided.	0.86			
5. When the department promises to do something by a certain time, it does so.	0.88	2.36	78.8	Timeliness
6. The department provides its services at the times it promises to do so.	0.89			
7. Departmental employees give prompt services to users.	0.89			
8. When the customers have a problem the department shows a sincere interest in solving it.	0.78	5.79	64.4	Respect and Caring
9. Departmental employees are consistently courteous with others.	0.82			
10. Departmental employees are never too busy to respond to customer's requests.	0.74			
11. Departmental employees are always willing to help others.	0.85			
12. The behavior of departmental employees instills confidence in customers.	0.85			
13. The department gives customers individual attention	0.79			
14. The department's employees give customers personal attention.	0.84			
15. The department has the user's best interests at heart	0.82			
16. The department's employees understand the specific needs of its customers.	0.73			
17. The department is dependable.	0.85	1.43	71.5	Effectiveness
18. The department insists on error-free records.	0.85			

19. The department tells customers exactly when services will be performed.	0.81	1.31	65.6	Availability
20. The department has operating hours convenient to all its customers.	0.81			
21. Customers feel safe in their transactions with departmental employees	0.87	1.5	75	Safety
22. The department provides a safe environment for its customers.	0.87			
23. Departmental employees have the knowledge to do their job well.	0.83	1.39	69.7	Efficacy
24. The department utilizes the correct technology and procedures given the current state of knowledge.	0.83			
25. The department provides appropriate and relevant services to its customers.	0.87	1.52	76	Appropriateness
26. Customers are satisfied with the range of services available in the department	0.87			
27. The department coordinates its services with other departments.	0.88	1.56	77.8	Continuity
28. The department coordinates its services over time with respect to each customer	0.88			
29. The tasks/procedures utilized by the department leads to the desired/projected outcomes.	0.86	1.47	73.4	Efficiency
30. The department obtains maximum benefit for its customers with the least expenditure of resources.	0.86			

Table 14: Customer Factor Loadings

Factor 1: Eigenvalue = 5.64 Factor 2: Eigenvalue = 1.04		
Factor	**Factor 1**	**Factor 2**
Appropriateness	.79	.15
Facility Tangibles	.43	.77
Continuity	.70	.20
Efficiency	.80	-.06
Timeliness	.72	-.41
Respect and Caring	.87	-.24
Safety	.83	.01
Effectiveness	.79	-.27
Availability	.73	-.04
Efficacy	.78	.26

Management of Health Care Information

Management of health care information (MOHCI) is composed of management of Scientific/Technical, patient-care, customer satisfaction, and administrative information. Factor analysis of the items constituting the four constructs indicates that each is unidimensional (Tables 15-18). Further factor analysis of the four constructs indicates that they also load on a single factor and are unidimensional (Table 19). The means and standard deviations for the four constructs are reported in Table 20. The reliability of the MOHCI scale as measured by the four constructs is 0.87.

Table 15: Factor Loadings for Scientific/Technical Information

Management of Scientific/Technical Health Care Information	
Eigenvalue = 6.7 Variation Explained = 74.1	
Item	**Factor Loading**
Accessibility	.88
Accuracy	.88
Standardized Definition	.84
Timeliness	.84
Completeness	.91
Security	.72
Analysis	.87
Reporting	.90
Quality	.90

Table 16: Factor Loadings for Patient-Care Information

Management of Patient-Care Information	
Eigenvalue = 5.7 Variation Explained = 63.6	
Item	**Factor Loading**
Accessibility	.64
Accuracy	.79
Standardized Definition	.80
Timeliness	.83
Completeness	.85
Security	.69
Analysis	.82
Reporting	.84
Quality	.89

Table 17: Factor Loadings for Customer Satisfaction Information

Management of Customer Satisfaction Health Care Information	
Eigenvalue = 5.9 Variation Explained = 65.8	
Item	**Factor Loading**
Accessibility	.75
Accuracy	.81
Standardized Definition	.84
Timeliness	.83
Completeness	.84
Security	.69
Analysis	.87
Reporting	.84
Quality	.83

Table 18: Factor Loadings for Administrative Information

Management of Administrative Health Care Information	
Eigenvalue = 6.6 Variation Explained = 72.8	
Item	**Factor Loading**
Accessibility	.80
Accuracy	.86
Standardized Definition	.85
Timeliness	.88
Completeness	.91
Security	.74
Analysis	.87
Reporting	.86
Quality	.91

Table 19: Factor Loadings for Management of Information

Eigenvalue = 2.9 Percent of Variation = 72.1	
Item	**Factor**
Scientific/Technical	.80
Patient-Care	.89
Customer Satisfaction	.82
Administrative	.88

Table 20: Management of Health Care Information Reliability

Cronbach's Alpha = .87		
Factor	**Mean**	**Standard Deviation**
Scientific/Technical	3.4	0.8
Patient-Care	3.6	0.7
Customer Satisfaction	3.2	0.7
Administrative	3.3	0.7

IT Infrastructure

Factor analysis was run on the four items in each of the three variables in the IT infrastructure construct to test for unidimensionality. For integration, standardization, and sophistication of IT respectively, all four items loaded on one factor (Tables 21-23). Factor analysis of these three variables in turn indicated that IT infrastructure is a unidimensional construct (Table 24). The mean and standard deviation of the three variables and the overall reliability of the IT infrastructure measure is given in Table 25.

Table 21: Factor Loadings for Integration of IT

Integration of IT	
Eigenvalue = 2.9 Variance Explained = 72.2	
Item	**Factor Loading**
Integration of Scientific/Technical information systems	0.85
Integration of customer satisfaction information systems	0.84
Integration of patient-care information systems	0.89
Integration of administrative information systems	0.83

Table 22: Factor Loadings for Standardization of IT

Standardization of IT	
Eigenvalue = 2.9 Variance Explained = 71.9	
Item	**Factor Loading**
Standardization of Scientific/Technical information systems	0.84
Standardization of customer satisfaction information systems	0.84
Standardization of patient-care information systems	0.89
Standardization of administrative information systems	0.82

Table 23: Factor Loadings for Sophistication of IT

Sophistication of IT	
Eigenvalue = 2.3 Variance Explained = 57.4	
Item	**Factor Loading**
Standardization of Scientific/Technical information systems	0.74
Standardization of customer satisfaction information systems	0.78
Standardization of patient-care information systems	0.76
Standardization of administrative information systems	0.75

Table 24: Factor Loadings for IT Infrastructure

Eigenvalue = 2.3 Percent of Variation = 77.6	
Item	**Loading**
Integration	.94
Standardization	.93
Sophistication	.76

Table 25: IT Infrastructure Reliability

IT Infrastructure		
Cronbach Alpha = 0.85		
Item	**Mean**	**Standard Deviation**
Integration	2.7	0.8
Standardization	2.7	0.8
Sophistication	3.0	0.8

Testing of Direct Relationship Hypotheses

Hypothesis 1: Better overall management of health care information should be directly related to increased quality performance at the departmental level of health care facilities.

A significant relationship was found between overall management of health care information and increased quality performance at the departmental level of health care facilities. The R-square, F Value, and Pr>F can be seen in Table 26.

Table 26

Dependent Variable is Quality Performance				
Management of Health Care Information	**R-Square**	**F Value**	**Pr>F**	**Significance**
Overall	0.22	25.05	0.0001	Significant

Testing of Interaction Hypotheses

Hypothesis (2): The integration of IT infrastructure should moderate the effect of management of health care information and quality performance at the departmental level of health care facilities.

Hypothesis (3): The sophistication of IT infrastructure should moderate the effect of management of health care information and quality performance at the departmental level of health care facilities.

Hypothesis (4): The standardization of IT infrastructure should moderate the effect of management of health care information and quality performance at the departmental level of health care facilities.

In order to determine if the IT infrastructure variables are indeed true moderators requires the following steps according to Sharma et al's typology (1981). First, it must be determined if there is an interaction between the predictor variable and the proposed moderator variable. A moderated regression analysis was run to determine this interaction. It was found that management of health care information had no interaction with integration of IT infrastructure ($p=0.18$), sophistication of IT ($p=0.26$) and standardization of IT infrastructure ($p=0.16$). Since no significant interaction was found between management of health care information and all three IT infrastructure variables (integration and standardization and sophistication), we proceeded to step three of the

typology. The third step is to determine if the moderator variable is related to the predictor or criterion variable. There was a significant relationship between quality performance and integration of IT infrastructure (p=0.007) and between management of health care information and integration of IT infrastructure (p=0.0001). In a similar manner, there was a significant relationship between quality performance and standardization of IT infrastructure (p=0.002) and between management of health care information and standardization (p=0.0001). Finally, while there was not a significant relationship between quality performance and sophistication of IT infrastructure (p=0.61), there was a significant relationship between management of health care information and sophistication (p=0.0001). Therefore, integration, standardization, and sophistication fall into the first cell of Sharma et al.'s typology and are all considered to be either intervening, exogenous, antecedent, suppressor, or predictor variables. In effect this tells us that IT infrastructure does not act as a moderator through interaction effects. Rather IT infrastructure exerts a direct effect on quality performance. These results can be seen in Table 27.

Table 27: Testing for Moderator Variables

IT Infrastructure Factor Interaction for Integration	**Significance**	**Pr>F**	**Type of Variable**
Integration and MOHCI interaction	No	0.18	Intervening Exogenous Antecedent Suppressor Predictor
Quality performance and integration	Yes	0.007	
MOHCI and integration	Yes	0.0001	
IT Infrastructure Factor Interaction for Standardization	**Significance**	**Pr>F**	**Type of Variable**
Standardization and MOHCI interaction	No	0.16	Intervening Exogenous Antecedent Suppressor Predictor
Quality performance and Standardization	Yes	0.002	
MOHCI and standardization	Yes	0.0001	
IT Infrastructure Factor Interaction for Sophistication	**Significance**	**Pr>F**	**Type of Variable**
Sophistication and MOHCI interaction	No	0.26	Intervening Exogenous Antecedent Suppressor Predictor
Quality performance and sophistication	No	0.61	
MOHCI and sophistication	Yes	0.0001	

Comparison of Customers and Managers

Customer and manager perceptions of quality were compared using a 2 Tail T-test of Significance. Results of these comparisons can be seen in Table 28.

Table 28: Descriptive Statistics for Managers and Customers

Item	Customer Mean	Manager Mean	Significance
The department has the user's best interests at heart.	3.7	4.3	0.0001
Department employees give customers personal attention.	3.8	4.3	0.0001
The department gives customers individual attention.	3.9	4.3	0.001
Department employees are consistently courteous with others.	3.7	4.1	0.0001
The department obtains maximum benefit for its customers with the least expenditure of resources.	3.4	4.0	0.0001
When the department promises to do something by a certain time it does so.	3.3	4.1	0.0001
The department provides its services at the times it promises to do so.	3.4	4.3	0.0001
Departmental employees give prompt service to users.	3.5	4.2	0.0001
The behavior of departmental employees instills confidence in customers	3.6	4.2	0.0001
Departmental employees have the knowledge to do their job well.	4.1	4.4	0.002
The department's employees understand the specific needs of its customers.	3.9	4.3	0.0001
Departmental employees are never too busy to respond to customer's requests	3.3	3.8	0.001
The appearance of the physical facilities of the department are in keeping with the kind of services provided.	4.0	3.5	0.002
Employees are always willing to help others.	3.7	4.2	0.0001
Departmental employees are well dressed and neat in appearance	4.1	4.2	0.16
The department insists on error-free records.	3.6	4.3	0.0001

Departmental physical facilities are visually appealing.	3.8	3.2	0.0001
The department is dependable.	3.9	4.6	0.0001
The department utilizes the correct technology and procedures given the current state of knowledge.	4.2	4.3	0.21
The department tells customers exactly when services will be performed.	3.7	4.2	0.002
Customers feel safe in their transactions with departmental employees.	3.9	4.2	0.003
The department has up to date technology.	4.0	3.8	0.05
When the customers have a problem the department shows a sincere interest in solving it	3.7	4.5	0.0001
The department has operating hours convenient to all its customers.	4.1	4.0	0.61
The department provides a safe environment for its customers.	4.2	4.4	0.03
The tasks/procedures utilized by the department leads to the desired/projected outcomes.	4.0	4.2	0.02
The department coordinates its services over time with respect to each customer.	3.8	4.2	0.001
The department coordinates its services with other departments.	3.9	4.2	0.002
Customers are satisfied with the range of services available in the department.	3.9	4.0	0.24
The department provides appropriate and relevant services to its customers.	4.0	4.3	0.003

Univariate and Multivariate Tests of Significance for Customers and Managers

The results of the univariate tests of significance suggest that, in general, the differences between customer and manager means are statistically significant. Significant differences were found for appropriateness (0.02), continuity (0.0001), efficiency (0.0001), timeliness (0.0001), respect and caring (0.0001), safety (0.002), effectiveness (0.0001), efficacy (0.009), and facility tangibles (0.002). There was no significant difference between customer and manager means for availability (0.12). Univariate significance as well as customer and manager means for each quality performance factor can be seen in Table 29.

A stepdown analysis was used to determine if group mean differences between customers and managers were statistically significant. Individual F tests were computed for each dependent variable after eliminating the effects of the other dependent variable preceding it in the analysis. There are significant differences across groups. In addition, Pillais criterion have significance level (0.001) well below the redescribed 0.05 level. Hotellings and Wilks F values at 12.9 with 10 and 184 degrees of freedom well exceed their critical F values set at alpha = 0.05. In a similar fashion, Roys greatest characteristic root is 0.41, and also exceeds the critical gcr value set at 0.05. Therefore, it is indicated that there are indeed unique differences between the perceptions of managers and customers toward quality. Multivariate tests of significance for customers and managers can be seen in Table 30.

Table 29: Customer and Manager Means

Factor	Customer Mean	Manager Mean	Univariate Significance
Appropriateness	3.9	4.2	0.02
Continuity	3.9	4.2	0.0001
Efficiency	3.7	4.1	0.0001
Timeliness	3.4	4.2	0.0001
Respect and Caring	3.7	4.2	0.0001
Safety	4.1	4.3	0.002
Effectiveness	3.8	4.4	0.0001
Availability	3.9	4.1	0.12
Efficacy	4.1	4.3	0.009
Facility Tangibles	4.0	3.7	0.002
Total Quality Performance	3.8	4.2	0.0001

Table 30: Multivariate Tests of Significance

Test Name	Value	Approximate F	Degrees of Freedom Between Groups	Degrees of Freedom Within Groups	Significance of F Statistic
Pillais	0.41	12.9	10	184	.0001
Hotellings	0.70	12.9	10	184	.0001
Wilks	0.59	12.9	10	184	.0001
Roys	0.41				

Chapter Five

Objectives

Modern theories of quality performance have provided the health care industry with a conceptual framework (Deming, 1986; Juran, 1989; Parasuraman et al., 1985, 1988; JCAHO, 1995; Zeithaml et al., 1990, 1993; Berry et al., 1991, 1993, 1994; Pitt et al., 1995). This conceptual framework can be used to link the Donabedian trilogy of structure, process, and outcome of care into a cohesive system for evaluating quality of health care performance at the departmental level (Donabedian, 1988). Opportunities for improving quality performance are typically stimulated by an examination of the structure or process of care which affect outcomes (Donabedian, 1988). The disadvantages of attempts to improve quality performance driven by management of information focused on only one of these three elements are legion (Sanazaro, 1991; Cohen, 1991). For example, medical records reviews may have a false-positive rate as high as 95% if they are based on generic screening criteria (Sanazaro, 1991). In addition, their usefulness as a primary source of data for quality performance assessment and improvement has been questioned (Donabedian, 1988). Even checklist self-reporting by health care providers may be unsatisfactory if the reporting is inconsistent (Cohen, 1991). Furthermore, completing the check-list may be of a low priority because it is not related to patient care.

The main objective of this research was to investigate the moderating effect of IT infrastructure on the relationship between management of health care information and quality performance in health care departments. This objective illustrates the importance of combining the process of systematic management of health care information, with a

higher level of provider involvement in IT infrastructure- in order to improve quality performance outcomes at the departmental level. Furthermore, an objective of the research was to test theory. Because this study has demonstrated the direct (rather than moderating) effect of IT infrastructure on improved quality performance, we have reinforced the importance of structure in the Donabedian trilogy. In order to meet the research objectives, data was gathered from both managers and customers in the major functional areas of 11 health care facilities. The moderation effect was tested using Sharma et al's (1981) typology.

Discussion

The private sector has revolutionized health care and it continues do so. HMOs, insurance companies, physicians, pharmaceutical companies, and hospitals are in a furious struggle to determine which of these health care customers interests come out on top. Unfortunately, patient interests have been relegated to the bottom of the list. Managed care has seen rapid growth during this period, and has led to dramatic restructuring of health care delivery.

Early health maintenance organizations focused on cost containment via preventative care, standardized medical practices, and elimination of unnecessary procedures and tests. More recently, HMOs seem more interested in managing costs than in maintaining health. This new perspective leaves a lot of doubt as to whether physicians put the interests of the patient first.

Because of these changes in health care, it has become more and more evident that doctors are going to spend less time with their patients. As such, it will be the informed patient who gets the most benefit from a physician consultation. Better management of information and information technology such as videos, the Internet, and television, can be used to empower and inform patients by providing them with the vocabulary and information needed to take charge of their own health. Only by working together with their physician can patients take charge of their own health.

Health care, demographics and information technology changes are occurring simultaneously. As the baby boomers begin to enter their 50s, they are placing increased demands on the health care system. These consumers have an insatiable thirst for information, and may be the impetus for a partnership of informed physicians and patients. Information technology and the management of information will be instrumental in finding the right mix of physician autonomy and patient rights.

This research addresses the issues of quality, management of information and information technology. An important significant relationship was found between overall management of information and increased quality performance at the departmental level of health care facilities. This relationship suggests that reporting of problems in the structure, process, or outcome of health care provides a safety net of information which helps to assure that important quality performance problems are not overlooked. Since management of information is important for maintaining the department's knowledge base, it is not unusual to find that managers perceive that knowledge about cutting edge techniques and procedures in the medical literature are essential to delivering quality

health care. Management of information provides the knowledge base for identifying, organizing, retrieving, analyzing, delivering, and reporting clinical and managerial journal literature, reference information, and research data for use in designing, managing, and improving patient-specific and departmental processes (JCAHO, 1995). Departments within the health care facility must be able to access new information in order to respond properly to changes in the health care environment (Longest, 1990; Pegels and Rogers, 1988; Peters, 1988).

Furthermore, the significant relationship found between management of information and increased quality performance at the departmental level of health care facilities has other implications. Specific data and information on patients is essential for maintaining accurate medical records of the patient's medical history and physical examinations. In addition, patient specific data and information are critical to tracking all diagnostic and therapeutic procedures and tests. Maintaining accurate information about patient-care results and discharges is also imperative to delivering quality health care (Bergman, 1993; Gabrieli, 1993). Managers use the term medical informatics to describe the management of information that supports the delivery of patient-care (Greenes and Shortliffe, 1990). Therefore it seems fitting to find that managers would perceive the implied relationship between management of health care information and quality performance. These results lend support to the established thinking and builds upon theory.

The significant relationship found between management of health care information also has implications from a customer satisfaction information standpoint. Management of customer satisfaction information is used to increase quality performance at the

departmental level of health care facilities. Schweikhardt et al. (1993) argues that the patient's family and friends may be more difficult to satisfy than the patients. Further, McLaughlin and Kaluzy, (1994) argue that family and friends are valuable sources of information and can be very influential in perceptions of quality performance. Customer satisfaction information may be gathered on external customers such as the patient and their family and friends. In addition, customer satisfaction information is necessary for internal customers as well. Therefore it is not surprising that managers perceive better management of information as being vital to increased quality performance.

Finally, the significant relationship found between better management of health care information and increased quality performance is important from an administrative view point. Administrative information is essential for formulating and implementing effective policies at the departmental level. Both strategic and operational strategies require administrative information before they can be implemented (Duncan, Ginter, and Swayne, 1995). Parsons (1983) argues that IT can be a competitive weapon that can change an industry's structure, alter competitive forces, and affect a company's choice of strategy. Further, the standardized definition, accuracy, analysis, quality, and reporting of information needs to be aggregated to support managerial decisions and operations, and to improve performance activities (JCAHO, 1995). Therefore, it seems fitting that managers would perceive the management of administrative health care information as being instrumental in improved quality performance. Folger (1989) and Anderson (1985) both point out that it is accessible, accurate, timely, complete, secure, unbiased, and high

quality administrative information which aids in maintaining and improving financial performance.

In conclusion, a significant relationship was found between overall management of health care information and improved quality performance at the departmental level in health care facilities. Considering that management of information is a group of processes and activities which focuses on meeting the functional department's informational needs, it is not surprising to find that managers perceive management of information to be critical to improving quality performance. This is in keeping with the JCAHO (1995) standards to "describe a vision of effective and continuously improving information management in health care organizations."

The final sample size which was investigated was 91 managers and 104 customers from 10 health care facilities. This sample provided a suitable number of supervisor, manager and customer participants to compare and contrast responses. The sample was a fairly representative one because the profile of health care facilities included small, medium, and large organizations. In addition, managers from different levels of the facilities were surveyed. This was basically a convenience or judgmental sample because it is not possible or feasible to collect data from several thousand institutions in a cross sectional study. This is an opportunity for future research using longitudinal methods.

Some specific demographic frequencies may be helpful in describing the sample. Managers from the radiology departments of 6 hospitals responded. Hospital managers from 10 medical laboratory, 8 from pharmacy, 8 from nursing, 6 from respiratory, 8 from billing/medical records, 5 from surgery, 5 from nuclear medicine, 6 from the emergency

room, 5 from pediatrics, 4 from administration, and 2 from physical therapy also responded. However, there were some duplication of department respondents from managers. Radiology had 7 respondents, medical laboratory 10, pharmacy 9, nursing 14, respiratory 6, billing/medical records 12, surgery 8, nuclear medicine 5, the emergency room 8, pediatrics 5, administration 5, and physical therapy 2. Altogether, 91 managers, from 10 hospitals and 12 departments, collectively responded.

Ten customers responded from radiology, medical laboratory, pharmacy, nursing, respiratory, billing/medical records, surgery, nuclear medicine, pediatrics, and the emergency room. Two customers responded from physical therapy departments. There were no duplications of customer responses in the departments. In total, 104 customers responded to the survey.

The titles of department respondents included 20 managers, 18 supervisors, 10 administrators, 4 doctors, and 39 directors. Twenty departments reported less than 5 employees, 17 reported 5 to 10 employees, 18 reported 11 to 15 employees, 6 reported 16 to 20 employees, 5 reported 21 to 25 employees and 25 departments reported more than 25 employees.

The departments surveyed reported 8 administrative type of employees, 3 health care professionals, 3 technical/support, 11 administrative and technical/support, 12 health care professionals and technical/support, 8 administrative and health care professionals. Forty seven departments reported all three types of employees.

Twelve departments reported operating budgets of less than 100,000 dollars. Twenty reported a budget between 100,000 and 500,000 dollars. Six departments reported

budgets between 500,000 and 1,000,000 dollars. Twenty two reported operating budgets between 1 and 6 million dollars. Two departments had operating budgets between 6 and 10 million. Finally, one department had an operating budget of more than 10 million dollars.

Thirty five departments reported that they served less than 50 patients daily. Eighteen departments serve between 50 and 100 patients. Ten departments serve between 100 and 200 patients. Seven departments reported that they serve between 200 and 300 patients daily. Finally, 5 departments reported that they serve more than 300 patients on a daily basis.

Hospitals ranged in size from 50 beds to more than 600. Both for profit and not for profit facilities participated in the survey. Hospitals ranged from teaching types to community, primary, and trauma in both a rural and urban setting, mostly from western and central Pennsylvania. Hospitals surveyed included both preferred provider organizations as well as health management organizations. Some hospitals surveyed were neither a PPO nor a HMO. Participating providers ranged from 1 provider to more than 12. Practicing physicians ranged from 50 to over 600. Operating budgets covered a range from 5 million to more than 150 million dollars. Finally, occupancy rates at the various facilities ranged from 30% to over 80%.

The preceding demographics show good variation in terms of departmental and hospital size, types, and nature of tasks resulted from this convenience sample. The r-square value between management of information and quality performance is 0.23. Therefore, this research would be of value to any hospital administrator, whether from a

large or small facility, for two reasons. First, health care payers including the federal government and managed care organizations want individual physicians and physician groups to meet certain quality performance standards (Vitez and Macario, 1996). Second, hospital administrators are obsessed with technology (Fogelsonger, 1995). This study shows a direct relationship between overall management of health care information and quality performance, as well as a direct relationship between the individual components of MOHCI (Scientific/Technical, patient care, administrative, and customer satisfaction) and quality performance. In a similar manner, the IT infrastructure variables of integration and standardization showed significant direct relationships to quality performance and were not shown to have interaction effects. This research would therefore also have value to other stakeholders of the organization such as public policy administrators, insurance companies, funding agencies, suppliers, and government agencies such as Medicare by demonstrating the Donabedian importance of process, structure, and outcomes in improving quality performance.

The quantitative scales used in this research were measures which ultimately gave evidence to the properties which contribute to quality. Some of these measures are indeed outcomes such as the items which measure timeliness and dependability. However, some of these items are viewed by the patient as means to an end. Others can be ends by themselves. For example, from a MIS perspective, error free records are an end in itself. However, the patient is interested in taking this concept one step further such that the error free records allow for care which does not lead to any fatal mistakes such as drug overdoses or prescription of the wrong medications.

By having the quality performance portion of the questionnaire filled out by both customers and managers, it is possible to compare the means (descriptive statistics) between these two groups utilizing MANOVA and a two tail t-test in order to look for significant differences. For example, comparison of means between customers and managers lead to several conclusions. In general, managers tended to rate quality performance higher than customers in almost all cases. Notable exceptions were in the fact that the customers found the physical facilities more appealing than the managers. (Perhaps the managers were tired of looking at the same surroundings day after day). Also the customers had a higher mean than the managers in perceiving that the department had up to date technology. (It may look new to the customers, but the managers know that it is not state of the art). Also, there was a significant difference (at the .05 level) between manager and customer means for almost all the items with the notable exception that both groups agreed that employees were well dressed and neat, ($p=0.16$), the department uses the correct technology ($p=0.21$), the department has convenient operating hours ($p=0.61$), and that customers are satisfied with the range of services ($p=0.24$).

At the aggregate level, it again was evident that managers scored higher means than customers. (This may be due to some social desirability effects in which the managers are fearful of retaliation if the results of the survey are not kept anonymous). A notable exception was facility tangibles where the means were higher for the customers than the managers. Only the availability factor showed a nonsignificant relationship ($p=0.12$) at the 0.05 significance level. Finally, total quality performance showed the managers with a

higher mean (4.17) than customers (3.8). There was a significant difference in means (p=0.0001).

Although tests for unidimensionality showed similar results for both customers and managers, factor analysis also illustrated some different perceptions. For example, the manager rotated factor matrix of the original ten variables loaded on two factors. Appropriateness, facility tangibles, continuity, efficiency, and safety loaded on one factor. Timeliness, respect and caring, effectiveness and availability loaded on another factor. Initially, these factor loadings do not seem to make logical sense. However, an important objective of this research was to test the unidimensionality and stability of the factor structure of the dependent variable-quality performance. In addressing the unidimensionality issue, a unidimensional factor emerged for each variable for both customer and manager quality performance constructs. At the factor level, initially, it appears that there is some instability in the factor structure. However, after closer study of the factor structures, we can conclude that the factor structures are not as different as they appear on the surface. For example, if a cut off of 0.3 is used, all ten items will load on the customer's first factor and eight of the ten items excluding facility tangibles and continuity will load on the managers' first factor. In a similar manner, the loadings on the customers' first factor have the same two items with the lowest loadings. Therefore, with some qualifications, all 10 factors can be used as part of the quality measure. In other words, the instability is not evidenced by the 0.3 cut off. Therefore, this can be used as a basis to suggest that the structures are similar, or at least suggest that there is evidence to suggest similarity. Unrotated structures suggest the same findings.

On the other hand, the factor loading of all thirty manager items suggest four factors which may be described as patient concerns, departmental operations, departmental safety, and facility tangibles. Obviously, this is a window of opportunity for future research. In a similar manner, using the original ten variables, the rotated factor matrix for customers also loaded on two factors. Appropriateness, continuity, efficiency, timeliness, respect and caring, safety, effectiveness, availability, and efficacy all loaded on one factor. Facility tangibles, was the only variable which loaded on factor two (.77). Facility tangibles also loaded on the first factor (.43). Loading all thirty customer items produced six factors which could be described as patient concerns, departmental operations, departmental timeliness, facility appearance, departmental coordination, and departmental dependability. Another window of opportunity exists for exploring these theory building factors. More importantly, factor analysis has been utilized in this study to illustrate the difference in perceptions between customers and managers regarding quality performance. Clearly, there is a difference in perceptions between managers and customers which is illustrated in the difference in factor loadings between these two groups.

In this research, we are laying the foundations for theory. Building and testing theory may not necessarily be a sequential process. Rather it is iterative with no hard and fast rules. For example, there are overlaps between IT infrastructure, MOHCI and quality performance. Only through an iterative process can theory be tested and built on the relationships between these constructs.

Theoretical Implications

The work of Parasuraman et al. (1985; 1988), Zeithaml (1990), Berry and Parasuraman (1993), and Berry et al. (1991; 1994) focuses on conceptualizing quality performance in the service industry. Their research conceptualized from eleven dimensions of service quality including reliability, responsiveness, competence, access, courtesy, communication, credibility, security, understanding/knowing the customer, empathy, and facilities and personnel tangibles. O'Leary (1994) in conjunction with the JCAHO suggested that quality performance in health care departments can be measured using nine dimensions. These include appropriateness, continuity, effectiveness, efficacy, efficiency, timeliness, availability, respect and caring, and safety.

This research reinforces the unidimensionality of the quality performance, management of information, and IT infrastructure constructs. The research also showed a significant relationship between quality performance and management of health care information.

Furthermore, this research has reinforced the Donabedian theory of the importance of all three pillars of improving quality performance, i.e. structure, process, and outcomes. While modern theories of quality performance have provided the health care industry with the necessary conceptual framework, they are not sufficient. (Deming, 1986; Juran, 1989). This conceptual framework must be linked to the Donabedian trilogy of structure, process, and outcome of care in order to form a cohesive system for evaluating quality of health care performance at the departmental level (Donabedian, 1988). Opportunities for improving quality performance are typically stimulated by an examination of the structure or process of care which affect outcomes (Donabedian, 1988). The disadvantages of

attempts to improve quality performance driven by management of information focused on only one of these three elements are numerous (Sanazaro, 1991; Cohen; 1991). For example, medical records reviews may have a false-positive rate as high as 95% if they are based on generic screening criteria (Sanazaro, 1991). Furthermore, their usefulness as a primary source of data for quality performance assessment and improvement has been questioned (Donabedian, 1988). Even checklist self-reporting by health care providers may be unsatisfactory if the reporting is inconsistent (Cohen, 1991). Completing the check-list may be of a low priority because it is not related to patient care.

A major theoretical implication in this research was illustrating the importance of combining the process of systematic management of health care information, with a higher level of provider involvement in IT infrastructure, in order to improve quality performance outcomes at the departmental level. Because this study has demonstrated the direct (rather than moderating) effect of IT infrastructure on improved quality performance, we have reinforced the importance of structure in the Donabedian trilogy.

Methodological and Practical Implications

This research adapted Sharma et al's (1981) typology to the information technology literature. In addition, this is a unique integration of the framework with management of information, IT infrastructure, and quality performance. The utilization of this methodology has several implications for practitioners. First, it provides health care managers involved in measuring quality performance with a broad view of activities for a wide variety of health care facilities of varying sizes. However, no matter what the size of

the organization, it is clear that quality is an enterprisewide venture. Despite changes in performance measurement systems, the successful competitor initiates and institutes information systems and management of information which coordinates actions across health care departments, and deploys resources across the organization.

Gone are the days when all information needed by a health care facility is kept in one computer. Information today is spread throughout the hospital in many health care facility departments. Often this information is encapsulated in incompatible systems and often with uncoordinated definitions of formats and terms. Distributed computer systems have become the lifeblood of modern health care facilities, small, medium, or large. It is essential that the different parts of the organization, which have different data systems find ways to work together in order to improve quality performance.

Second, this research provides some guidelines for health care managers for facilitating infusion of quality performance measures. Embracing the principles of quality into the health care facility is a broad aim. It is one which needs to be broken into manageable pieces in order to be implemented. The change in behavior and structure needed for improving quality performance is enhanced and enabled by a number of systems in the infrastructure. However, as this research suggests, the information infrastructure itself is not a moderator between management of information and quality, and the systems themselves do not confer quality.

Third, the study provides descriptive data on the nature of improving quality performance in the context of information management and IT infrastructure. For example, communication and information are the ubiquitous technical elements which are

transforming health care into the next quality revolution. They are central, fundamental, and critical to improving quality in health care departments. This information is not only computer text, but also multimedia pictures and voice data as well. In fact, the information technology in health care facilities is so advanced that the technical ability exists to provide a database of photographs of customers, employees, and products by simply clicking a mouse to get the information needed.

Finally, this research sheds light on three fundamental questions about quality performance measurement and methodology; whether it is reliable in accurately and completely identifying quality indicators; whether it is valid in identifying quality problems which merit further review; and in whether it measures what it is supposed to measure.

Reliability infers stability and the ability of the measure to have good test/retest reliability. In other words, the findings must be the same with different raters or data collectors. Quality indicators are valid if they identify better or worse outcomes in identical patients. Content validity of quality refers to the extent to which the quality indicator reflects the issue of concern. Criterion validity is composed of two subsets; predictive validity or the strength with which the clinical indicator forecasts future performance and concurrent validity or the strength of the relationship between the quality indicator and another measure of the same event.

Practically, one of the biggest reasons for studying quality in hospital departments is to learn how to improve health care through outcomes management. This movement is based on Deming's theoretical work relating to "total quality management" (1986). This process is based on identifying a clinical area which needs potential improvement. Since

this decision may be based on recommendations from governmental agencies, health care providers, physicians, society, and other stakeholders, its capacity for practical implications are limitless. Quality does not exist in a vacuum. The vision of quality gives context and perspective to continuous quality improvement. Quality improvement cannot be seen as a one time effort in which some new stable state is achieved. Rather, quality needs to be perceived as a continuous, never ending improvement which initiates change in the structure of the organization and change in the realignment of its people. Continuous quality improvement is the responsibility of everyone in the organization.

Limitations

There were several shortcomings in this research. These limitations were could be found in both the methodology and in the research model. First, external validity suffers in the model because the results may only be valid for health care facilities. Due to the nature of the instrument, other industries would find the questionnaire of little value in examining quality performance. Second, the data collected were very subjective, and inherent biases were evident in manager's responses. Third, there is a very strong need for more objective data with cross validation between both departments and health care facilities. Gathering of qualitative data, using open ended questions, would also be useful in that this subjective information could be used to triangulate results and give a more complete picture. Fourth, the model is very simplistic and assumes that the multiple regression analysis can fully explain the impact of management of information on quality performance. A more complex model would be more useful in explaining other factors

besides MOHCI and IT infrastructure which are contingent on improving quality performance. Fifth, this research was cross sectional in nature. This static approach had limitations in both the collection and analysis of data. A longitudinal approach would provide a more dynamic view of the interaction between management of health care information and quality performance. Sixth, there may be a gap between the intentions of the research as represented by the survey instrument and the cognitive map of the respondents. Although the instrument was pilot tested, there still may be a hiatus between manager responses and the underlying intent of the questions. Seventh, potential users of the manager quality performance questionnaire should be cautious because the reliability of several of the factors are low. Although at the construct level Cronbach's alpha was rather high for both managers (0.8878) and customers (0.9049). Eighth, as previously discussed, the study suffers from sampling problems, missing data, and imputing issues. Ninth, multicollinearity may be a consideration in interpreting the regression results. Finally, researchers should be wary of the closely aligned concepts which are used in the instrument. For example, it would seem that integration and standardization are perceived as not being semantically distinct. Managers also appear to perceive many of the quality performance items as cross cutting.

Future Directions

Future directions in researching the relationship between management of health care information and quality performance would include: 1.) Gathering more data to support or reject the model. 2.) Gathering of more qualitative data would help to triangulate results.

Different potential variables which impact quality performance may be identified and examined for further supporting and building on present theory. 3.) Future research may also expand the dimensionality of the IT infrastructure moderating variables. Several items could be added to the instrument to expand on integration, standardization, and sophistication of the IT infrastructure. 4.) It may be beneficial to collect data from other countries and compare the results of this study to the management of information and quality performance in Asian and European countries. 5.) As with most questionnaire based research, respondents are not required to express a preference in service characteristics. Since health care facilities are often required to choose between scarce resources, a methodology such as the Q-method (Brown, et al., 1993; Stephenson, 1953) or constant sum scale (Zeithaml, et al., 1990) would be useful in determining relative preferences. 6.) As suggested by Pitt et al., (1995) the customer relationship can be broken down into four major phases; requirements, acquisitions, stewardship, and retirement. Therefore, service quality performance of health care facility departments may be examined by investigating the customer service life cycle phase. 7.) Finally, investigation of the relative importance of quality performance determinants of expected service and their measurement would shed understanding on what influences customer wants and needs in health care facility departments (Zeithaml et al., 1993). 8.) Descriptive statistics were used to measure the difference between means of customers and managers at the aggregate level. In the future, descriptive statistics could be utilized to compare differences in means between customers and managers perceptions of quality performance at each individual organization, and in each of the individual departments. This could be

accomplished on a spread sheet and noting if there is a significant difference between customer and manager means at each organization and in each department. 9.) Differences in health care facility size could be investigated using descriptive statistics to determine if quality performance in greater in larger or smaller hospitals. Finally, statistical analysis of the four manager factors and six customer factors which resulted from the exploratory factor analysis of all thirty items are windows of opportunity for future research.

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SIUC HSC FORM A

REQUEST FOR APPROVAL OF RESEARCH ACTIVITIES INVOLVING HUMAN SUBJECTS

This approval is valid for one (1) year from the approval date. Researchers must request a renewal to continue the research after that date. This approval form must be included in all Master's theses/research papers and Doctoral dissertations involving human subjects to be submitted to the Graduate School.

PROJECT TITLE: MANAGEMENT OF INFORMATION TECHNOLOGY AND QUALITY PERFORMANCE IN HEALTH CARE DEPARTMENTS

CERTIFICATION STATEMENT:

In making this application, I(we) certify that I(we) have read and understand the University's policies and procedures governing research activities involving human subjects, and that I(we) shall comply with the letter and spirit of those policies. I(we) further acknowledge my(our) obligation to (1) accept responsibility for the research described, including work by students under my(our) direction, (2) obtain written approval from the Human Subjects Committee of any changes from the originally approved protocol **BEFORE** making those changes, (3) retain signed informed consent forms, in a secure location separate from the data, for at least **three** years after the completion of the research, and (4) report immediately all adverse effects of the study on the subjects to the Chairperson of the Human Subjects Committee, Carbondale, Illinois, (618) 453-4543, and to the Director of the Office of Research Development and Administration, Southern Illinois University at Carbondale, (618) 453-4531.

JAMES A ROTHER — 11-4-95

RESEARCHER(S) or PROJECT DIRECTORS — DATE

Please print or type out name below signature

ARKALGUD RAMAPRASAD — 11/10/95

RESEARCHER'S ADVISOR (required for all student projects) — DATE

Please print or type out name below signature

The request submitted by the above researcher(s) was approved by the SIUC Human Subjects Committee

Robert C. Rathe — 11/27/95

CHAIRPERSON, SOUTHERN ILLINOIS UNIVERSITY HUMAN SUBJECTS COMMITTEE — DATE

VITA

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Refereed Conferences:

Parag C. Pendharkar and James A. Rodger, "A Generalized Multiple Period Mathematical Model to Solve Company-Dealer-Market Production Scheduling and Inventory Problems in a Production Industry." Midwest Decision Sciences Institute Conference, Cleveland, Ohio - April 1994.

James A. Rodger and Thomas Falcone, "The Impact of Female Human Capital on Information Technology in Organizations." International Academy of Business Disciplines Conference, Pittsburgh, Pennsylvania - April 1994.

James A. Rodger and Parag C. Pendharkar, "The Impact of Extent of Use, Staff Scheduling, and Adoption of Formal Quality Control Mechanisms on End-User Perceptions of Information Technology in the Health Care Industry." National Decision.

Sciences Institute Conference, Honolulu, Hawaii - November 1994 (Funded by a grant from the SIU Center for Rural Health, and the Pontikes Center for MOI). Ganesh Bhatt and James A. Rodger, "Information Requirement Determination: An Interpretive Approach." MBAA Conference, Chicago, Illinois 1995.

Ganesh Bhatt and James A. Rodger, "The Role of Information Technology in TQM Policies." MBAA Conference, Chicago, Illinois 1995.

Ganesh Bhatt and James A. Rodger, "Decision Support Systems in Policy Decisions." Western DSI Conference, San Francisco, California 1995.

Ganesh Bhatt and James A. Rodger, "Management Control: How Can It Guide You?" Western DSI Conference, San Francisco, California 1995.

David Paper and James A. Rodger, "Quality Systems Implementation in Organizations: An Interview-Based Study." Midwest DSI, Saint Louis, April 1995.

David Paper and James A. Rodger, "Implementing Quality Information Systems." AIS, Pittsburgh, August 1995.

James A. Rodger, Parag C. Pendharkar, and Ganesh Bhatt. "Diffusion Theory and the Adoption of Software Innovations: A Critique of the Literature." National DSI Conference, Boston, Mass. November 1995.

James A. Rodger, Parag C. Pendharkar, and Ganesh Bhatt."Strategic Management Systems Evolution: Lamarckian Individual Consciousness or Darwinian Population Ecology?" National DSI Conference, Boston, Mass. November 1995.

Ganesh Bhatt, James A. Rodger, Parag C. Pendharkar."Information Requirement Determination: An Organization Approach." National DSI Conference, Boston, Mass. November 1995.

Ganesh Bhatt, James A. Rodger, Parag C. Pendharkar."A New Paradigm for Total Quality Management." National DSI Conference, Boston, Mass. November 1995.

Ganesh Bhatt, James A. Rodger, Parag C. Pendharkar. "Decision Support Systems in Learning Organizations." National DSI Conference, Boston, Mass. November 1995.

Refereed Journal Publications:

James A. Rodger, Parag C. Pendharkar, and Ganesh Bhatt. "Diffusion Theory and the Adoption of Software Innovations: Common Errors and Future Issues." Under Revision from **Journal of High Technology Management Research.** May 1996.

James A. Rodger, David J. Paper, and Parag C. Pendharkar, "End-User Perceptions of Information Technology and Quality in the Health Care." **Journal of High Technology Management Research.** September 1996.

David Paper and James A. Rodger, "Implementing Quality Information Systems," **Journal of High Technology Management Research.** March 1997.