

Managing customer relationships through E-business decision support applications: a case of hospital–physician collaboration

Rajiv Kohli ^{a,b,*}, Frank Piontek ^a, Tim Ellington ^c, Tom VanOsdol ^d,
Marylou Shepard ^d, Gary Brazel ^d

^a College of Business and Economics, Lehigh University, 621 Taylor Street, Bethlehem, PA 18015, USA

^b Department of Management, University of Notre Dame, Notre Dame, IN 46556, USA

^c TEC Associates, 8340 Galley Court, Indianapolis, IN 46236, USA

^d Saint John's Health System, 2015 Jackson Street, Anderson, IN 46016, USA

Abstract

Customer Relationship Management (CRM) is a valuable concept for hospitals to establish long-term physician relationships. Given predetermined reimbursement amounts, clinical interventions by physicians can significantly impact hospital profitability and quality. Therefore, disseminating quality and cost information to physicians can build lasting relationships, while insuring financial stability.

This paper presents a CRM approach adopted by a hospital through a web-based Physician Profiling System (PPS). We discuss physician involvement in PPS development and present a high-level cost-benefit analysis. Post-deployment results indicate that PPS strengthened relationship with physicians, improved efficiency of clinical operations, while simultaneously improving patient satisfaction. © 2001 Elsevier Science B.V. All rights reserved.

Keywords: Physician profiling; Customer relationship management; Decision Support System; Electronic commerce; E-business; Health care

1. Introduction

As competition and the cost of acquiring new customers continue to increase, the need to build and maintain customer relationships has become a fundamental priority for businesses. Customer Relationship Management (CRM) is critical not just in traditional buyer–seller relationships, but also in

nontraditional customer–supplier relationships. For instance, the relationship of hospitals with physicians, insurance companies, and patients' employers is unique and does not fit the traditional customer–supplier model. Although patients are the end-customers of hospitals, the physicians who admit their patients to the hospitals are also valuable co-customers [38]. Therefore, it is important for hospitals to build strong and long-term relationships with physicians just as they do with patients and insurance companies.

The purpose of this paper is to present a CRM approach in which a healthcare organization de-

* Corresponding author. College of Business and Economics, Lehigh University, 621 Taylor Street, Bethlehem, PA 18015, USA.

E-mail address: rkchli@lehigh.edu (R. Kohli).

signed and developed an Intranet-based system, called Physician Profiling System (PPS), to build relationships with one vital customer constituency—the physicians who practice medicine at the hospital. The paper presents empirical evidence of stronger relationships between the organization and physicians, in addition to financial and quality improvements, resulting from the CRM initiative. The outline of this paper is as follows. In Section 2, we briefly review the CRM literature followed by the CRM perspective in healthcare. Section 3 reviews physicians' decision-making process and the requirements it places on hospital CRM. Section 4 presents the case study of the development and deployment of a web-based information system to support CRM in a hospital and the ensuing outcomes. We also present empirical data to demonstrate the impact of the CRM application on physician retention, hospital quality and performance. Finally, we present conclusions, limitations and areas for further research in Section 5.

2. Review of literature

This section briefly reviews the CRM literature and also examines approaches to strengthen physician relationships, while pursuing quality and performance improvement goals.

2.1. Customer relationship management

CRM is a process through which a seller or service provider manages customer expectations to ensure a long-term relationship and ongoing alignment with dynamic customer needs. The need for CRM arose from the increasing cost of acquiring a customer. It is cheaper for companies to retain existing customers than to acquire new customers [3]. CRM has its roots in 'relationship marketing'—defined as an "overt attempt of exchange partners to build a long-term association, characterized by purposeful cooperation and mutual dependence on the development of social as well as structural bonds [30]". In relationship marketing, a company uses a combination of marketing, communication and service approaches to identify individual customers, creates a relationship between the company and the

customer that stretches over many transactions, and manages the relationship to the benefit of both the customers and the company [35]. Thus, the objective of CRM is to create loyal customers so that the relationship flourishes over a long period of time.

CRM is becoming a priority because information technology (IT), particularly, the Internet, is making it easier for customers to find alternate providers for products and services. However, when appropriately utilized, IT can help retain customers by building and managing the relationship [34]. From a planning viewpoint, building loyalty at any cost may not be the right strategy. Customer loyalty is comprised of *hard-core loyalty*—when customers exclusively and repeatedly purchase one brand, and *reinforcing loyalty*—when the customers may switch brands among product alternatives [35]. The cost of turning customers into hard-core loyalists has to be viewed through the reality that some customers will continue to try different services. Therefore, one-to-one marketing in CRM may be most successful approach when the organizations concentrate on obtaining and maintaining market share, as opposed to capturing the entire market, perhaps emphasizing IT as an enabler [34].

CRM is best initiated through establishing customer relationship teams to execute the plan of an organization. The CRM team should consist of individuals with:

- (a) technical skills to train the customer in the technical aspects of the product or service;
- (b) knowledge with legal matters, such as setting up contracts and terms of cooperation;
- (c) management expertise to plan, coordinate, and control financial, delivery, and logistics activities in the relationship; and
- (d) boundary-spanning competence, such as the organization's relationship with third parties, that can be useful in promoting the relationship with the customers [13].

2.2. CRM approach in healthcare

As cost control becomes a business imperative, CRM is beginning to take hold in healthcare resulting in a realignment of the hospitals' relationship

with physicians [27]. Although patients are hospitals' key customers, the physicians' influence on the hospital revenue stream promotes them as the primary co-customer. This is evident from findings that physicians are responsible for an estimated 80% to 90% of the hospital resource-allocation decisions [7], and that patients rely upon physicians to determine their choice of healthcare facilities [3]. Yet, there is no evidence that physicians are loyal to a hospital in which they practice. Physicians are similar to 'independent contractors', who utilize the hospital facilities to practice their profession. Although hospitals also employ physicians, nearly all physicians still practice independent of hospitals. Given this significant influence of admitting physician decisions, hospitals are continually interested in higher satisfaction among physicians by building and managing a long-term relationship [22]. Thus, it is imperative that hospitals develop a strategy to attract and retain physicians and other independent licensed practitioners.

Given that the customer determines the 'value' of service [4], it is prudent for hospitals to build upon their core competencies, such as clinical outcomes, disease and practice management information. Physicians must be provided with data to assess their patients' conditions and their own performance in treating their patients. Taking advantage of electronic linkages, hospitals can provide this feedback by offering their customers and business partners information faster over Intranets and Extranets [29]. When provided with such information, it is important for physicians to recognize the quality and financial impact of their clinical practice. This is because hospitals are generally reimbursed a predetermined amount for claims filed with the insurance providers. Increasingly, these insurers select physicians and hospitals based upon quality and cost benchmarks. Benchmarks or norms are derived from the combined profiles of physician peers, regional and national benchmarks after controlling for age, severity of illness, and morbidity [14]. Such evaluations of physician and hospital performance information are commonly referred to as 'profiling'.

Hospitals can establish a constructive relationship with physicians by proactively disseminating physician profiles. Historically, physicians have received data indicators generally in a punitive and adverse

setting, such as insurers who exclude a physician for high cost or low quality [5]. Recently, patients are also able to access hospital and physician quality information from clinical web sites on the Internet. Therefore, several advantages accrue to both hospitals and physicians to monitor and share the quality and financial outcomes of the clinical practices. First, the physicians benefit from such profiling data by understanding the data and the process of creating profiles and, consequently, have some control over publicly available cost and quality information. Second, by understanding their profiles, physicians are enabled to proactively negotiate and be a part of managed care plans, employer groups and insurance plans and perhaps most importantly, physicians can appreciate their role in reducing variation and costs, thus making available additional resources for equipment and staff. Finally, having control over the cost and quality of outcomes, physicians can increase their marketability and differentiation from other providers.

Findings from past studies suggest that physician profiles lead to improvement in emergency room costs [32] provide useful information to assist physician performance evaluations [15], and lead to considerable improvements among physicians who did not initially meet the benchmark [7]. Although detailed patient level costs and quality information are available in some operational information systems [21], some suggest that physician profiling may have only a marginal impact on quality and cost and may not be worth the expenditure [2]. Also, there are preliminary indications that the absence of severity adjustment for various types of patients in profiles may have undesired effects, such as when physicians might discharge patients from their practice in order to improve their cost and quality outcomes [16]. Subsequently, some have cautioned that use of physician profiling should be combined with organizational and process change initiatives [7,30], while others contend that evaluating physician practice patterns using profiles over-time and for a well-defined population is the most efficient vehicle for achieving cost and quality goals [1].

In summary, the review of literature indicates that CRM in healthcare is an important cost-effective approach to maintain long-term customer relationships. CRM can be delivered through physician pro-

files that are likely to help physicians improve their performance as well as play a role in improving hospital quality and profitability.

An examination of the decision-making process will identify how a physician profiling system can lead to performance improvements. Perhaps more importantly, an understanding of the physician decision-making process can assist in adding value to the physician customers and in building lasting relationships.

3. Hospital CRM requirements

This section will review the decision-making process of physicians and discusses requirements for creating an enterprise-based CRM for physician relationship management. Through understanding the CRM requirements, it will also identify areas of improvement. In addition, this section will assess the requirements for developing a physician profiling system in a hospital.

3.1. Healthcare decision-making process

Healthcare management involves administrative and clinical decisions. While administrative decision making leads to a list of work and environmental requirements, physicians' clinical decision making leads to diagnostic, prescriptive and treatment processes [8]. Physicians apply approved and standard procedures while being cognizant of the diagnostic discretionary ranges that exist between patients and their diseases created by aggregating the individual clinical patterns and deriving performance indicators for the enterprise [2].

How can CRM initiative create standardized indicators to support physicians' decision making? The literature on physician decision making suggests that physicians utilize data-driven or vigilant approaches to compare their performance with the norms. Data-driven approaches evaluate existing data to identify sources of variation and include epidemiological approach [23], or peer-reviewed and statistical process control methods [12,20]. Data-driven approaches also combine patient interviews, medical record abstracts, and administrative data stored in computerized databases [18]. Administrative data is relatively acces-

sible and has been demonstrated as cost-effective data in enhancing clinical practices [36,37]. Vigilant problem solving, similar to the widely accepted March and Simon problem-solving model [28], is defined as a demanding mental search directed toward minimizing the uncertainty associated with defining a critical problem-solving approach and toward generating a superior strategy for managing the resolution of that problem [19]. Although the vigilant problem-solving model is most appropriate in case-by-case decision making, augmenting such decision making through automated support can enhance the problem-solving outcomes especially because resource constraints set the stage for improved clinical decision making by encouraging physicians to search for a more refined approach to patient care [26].

3.2. Identifying areas for improvement

We propose using administrative data to develop a physician profiling system that will assess resource constraints through comparisons of performance with established benchmarks. Such information will lead to a refinement of physician vigilant decision-making processes and increase the potential for higher quality decision making [26]. Historical patterns of data can be utilized to provide benchmarking outcomes using a multiple successive sieve approach [21]. In this approach, desired patterns of quality and cost outcomes are identified from the literature or other accepted clinical practices. Procedures and treatments provided by the physicians are mapped to resources consumed. By comparing the physician profile of resources consumed with benchmarked cases, the sieve assists in identifying variations in practice. In addition, administrative data can be normalized for high resource-consuming diseases or the severity of patients for equitable comparison of cost and quality variations from benchmarking data [18,25]. 'Better Practice Patterns' are then constructed using either within hospital variations, between hospital benchmarks, and/or external benchmarks. These analyses are then presented to physicians and managers in the form of physician profiles.

The collaboration with the physician customers begins with presenting individual output derived from the aforementioned sieve approach. The explanation

accompanying the data includes (i) the method through which the practice pattern or analytical output was derived, (ii) an explanation of indicators from the data, (iii) clinical relevance of the pattern in the data, and (iv) the suggestion for enhancements needed in clinical operations. Once these actionable items for improving clinical operations have been determined and the critical success factors for the action plans outlined, hospitals monitor the impact of the recommended change and the resulting reduction in variation from established norms. Such monitoring involves applying the successive sieve to new data to examine changes since the dissemination of analysis from the physician profiles.

3.3. Involving physician customers

The involvement of the physician customers in improving operations through establishing norms is critical for success if any changes in operations are to be evidenced. Indeed, their endorsement is highly preferred before any major initiative is implemented. In fact, physician involvement in the management of quality and financial outcomes can show positive result [17]. A program implemented in Maine and replicated in three other US states involved physicians to analyze variation data and examine physician decision-making process. The study concluded that physicians are willing to change their practices if they are brought into a culturally appropriate improvement program where the privacy of their data is protected [6].

Although the electronic revolution in business has been well underway, healthcare has been slow to adapt to information technologies for several reasons—limited competition, resistance from professionals and a lack of ‘pain’ to force a change. However, with the healthcare business changing to a free-market one, it is embracing electronic business (E-business) as a tool to facilitate communications, cost cutting and competitiveness. Examples are seen in recommendations to utilize E-commerce for improved decision making [10], creating electronic medical records, developing remote diagnostics and setting-up Intranets to share information among key stakeholders [31].

In summary, the literature indicates that physician profiles can support critical physician decision mak-

ing through quality and cost benchmarking. A well-designed physician profiling system developed in collaboration with physicians can establish long-term relationships and also improve hospital cost outcomes. With the insights gained from the CRM framework, physician decision-making requirements, and the use of technology in information dissemination, we examine the implementation of a CRM in healthcare through a case study of hospital implementation of a physician profiling system.

4. Physician Profiling System (PPS)—a web-based CRM system

This section provides a case study of a web-based CRM system deployed in a healthcare organization. This case study will present the steps in developing and deploying the PPS, followed by empirical results of the PPS deployment on the quality, financial outcomes and physician retention of the institution.

Research site. Founded in 1894, Saint John’s Health System (SJHS) employs 1500 people and has approximately 200 physicians who practice in its facilities. SJHS includes a 400-bed hospital, a mental health and addiction treatment facility, an Ambulatory Services Center and a Cancer Center among other healthcare facilities. Along with five other nationwide health systems, SJHS is a member of Holy Cross Health System Corporation (HCHSC). Each member of HCHSC subscribes to the corporate Decision Support and Data Warehouse (DSDW). The DSDW, located at HCHSC, has historically been a competitive tool for all its members. Each member organization (MO), linked to HCHSC via a corporate wide-area network (WAN), sends patient and financial information daily into the DSDW (Fig. 1). The DSDW processes the data and places them into relevant parts of the database files. The DSDW contains 6 years of historical data, including item-level charges and costs that can be drilled to the day-of-stay level of a patient. The individual service items are usually rolled up into specific categories reflecting the major hospital clinical departments, such as surgery, laboratory, pharmacy or supplies.

In the following sections, we list steps in the process of designing, developing and delivering an Intranet-based Physician Profiling System (PPS). We

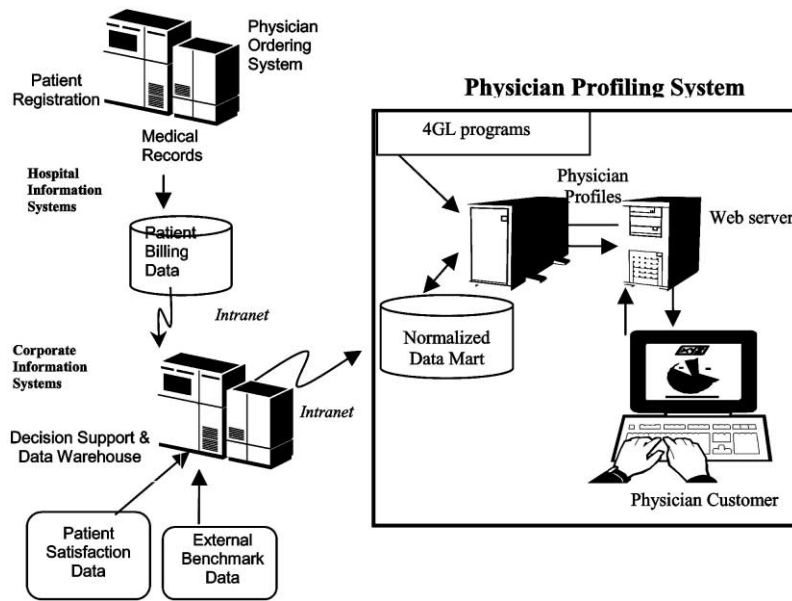


Fig. 1. The Physician Profiling System (PPS) architecture.

present screens from the PPS to illustrate the data provided to the physician customers, and a description of how they utilize data in changing practice patterns. Finally, in Section 4.6, we present a high-level assessment of PPS costs and benefits.

4.1. Step 1: Initial development and customer involvement

The initial concept for the PPS at SJHS grew from a broad-based performance/utilization analysis performed through a collaboration of quality department leaders, one of the coauthors and an independent physician consultant. The analysis identified numerous areas of opportunities for variation reduction and standardization of practice based upon identifiable best practices. Recognizing that physicians will not accept the analysis findings unless they were provided with individualized and comparative performance profiles, we sought senior management approval and undertook the development of a web-based application to facilitate physician profiling using DSDW data.

Although prior to the development of the PPS, the quality department staff and physicians regularly met and shared quality information in committee and

departmental meetings, little additional data analysis or performance improvement interaction ensued. Such discussion was generally ad hoc and centered on case-by-case necessity. To insure physician participation and ownership, we secured approval from a multispecialty physician steering committee (PSC) to work with the performance improvement team (PIT) to undertake the development of the PPS. The PSC consists of well-respected physicians representing numerous specialties. The PIT includes trained quality improvement professionals, managers with clinical and financial background, and benchmarking experts. The PSC took the responsibility to interpret and disseminate the outputs of the PPS to the physician customers. Thus, as suggested in the above-cited literature, our CRM team consisted of individuals with technical, managerial and boundary-spanning skills to execute the CRM plan [13].

4.2. Step 2: Physician Profiling System (PPS) architecture

Based upon suggestions from past research, we commenced the implementation of a web-based PPS to support the physician decision making and build a lasting relationship with them as co-customers of

SJHS [22,24,27,29]. In this section, we describe the PPS architecture.

Developed in a fourth-generation language (4GL), the PPS also serves as a development environment rich in data analysis capabilities. Fig. 1 provides an overview of the PPS. The data for PPS originates in the transaction-level Hospital Information Systems (HIS), such as registration, medical records and order-entry systems. The combined patient level data are transferred daily to DSDW that processes and populates applications, such as item-level costs, expected reimbursement and clinical data. The DSDW also incorporates patient satisfaction data, and national benchmarks for cost and quality. The DSDW is available on-line to authorized decision makers in all hospitals of the organization. In addition, to facilitate CRM with physicians, the DSDW provides a subset of data in a data mart for use in the PPS. The data are selected based upon a criteria (described below) jointly developed by the physicians and hospital administrators.

The PPS data are made available through a web-enabled client-server system. Web-enabled applications are a cost-effective means of delivering timely, relevant and personalized data to customers [9]. The web-based application allows remote access to physician profiles. In addition, web enablement provides scalability for adding more hospitals to the PPS.

4.3. Step 3: Rules, description and diagrammatic representation of profile models

The literature suggests that a determinant of physician profiling systems success is the adjustments for resource demands of patients. The data-mart consists of patient summaries, and corresponding reference files aggregating Diagnosis Related Groups (DRG) into Major Diagnostic Categories (MDC). An MDC generally corresponds to a treatment of a major part of the human body, such as cardiology, pulmonary and neurology, and is similar to product lines in a manufacturing organization. Other reference files include national resource consumption weights assigned to the DRG, relative weights after adjusting for the severity of patients and a listing of physician specialty for comparison with peers in the same specialty. The physician

involvement during the development lead to numerous rules for excluding outliers or cases that may cause a mismatch in benchmarking. Physician involvement during the development is critical to their buy-in and subsequent use of PPS information. Examples of cases excluded from the profiles are deaths, transfers and psychiatric patients not representative of physician practice.

Similarly, readmissions within 30 days and cases with a mean LOS or charge of (+) or (−) 2.5 standard deviations are considered outliers and excluded from benchmarking. A verification program in PPS checks all cases for valid values against the reference files. Table 1 lists the rules, description and purpose of PPS exceptions.

In Fig. 2, we provide an overview of creating the normative standards (norms). The severity-adjusted DRG national benchmark weights for patient revenue, costs and LOS are adjusted by calculating the mean for each specialty group and DRG. Next, the weights are calculated by DRG, and values are used for hospital wide norms. Now that the revenue and LOS have been adjusted, the identified readmits are combined. Each case is then broken out into a level. Each patient case falls into the overall summary level, DRG level, and MDC level.

Revenue and LOS for each physician is normalized by accounting for the differences among their patients through benchmarks, such as All Payor Severity DRG (APS-DRG), National LOS Weights (NLOSW) and APS-DRG National Charge Weights (NCW). The calculations for the norms are as follows:

$$\bar{R}_{pj} = \text{LOS} / [\text{NLOSW} / (\sum \text{NLOSW} / \# \text{ of cases in peer group})], \quad (1)$$

$$\bar{L}_{pj} = \text{Total Revenue} / (\text{NCW} / \sum \text{NCW} / \# \text{ of cases in peer group}), \quad (2)$$

where R_{pj} is the normalized mean of revenue for physician p individual cases for period j ; L_{pj} is the ALOS for physician p for period j .

The normalized average for the revenue category is calculated as:

$$\bar{R}_{irj} = \sum R_{pirj} / N_{ij}, \quad (3)$$

$$\bar{L}_{irj} = \sum L_{pirj} / N_{ij}, \quad (4)$$

Table 1

A list of data exceptions in the Physician Profiling System

Exception rule	Description	Purpose
Exclude DRGs 424 through 438	Exclude Psychiatric patients	Unusually high length-of-stay, not representative of general population
Exclude discharge status = 20 or 40	Exclude patients who died in the hospital	Deceased patients can have unusual resource consumption
Exclude discharge status = 2	Transfers to another acute care facility	Transferred patients' actual total length-of-stay cannot be tracked
Combine cases if discharge date – discharge date = 15 days	Combine patients readmitted within 15 days for the same illness	To account for patient not treated completely during the first stay
Exclude DRG 370–375 and DRG 385–391; Group into a new specialty group	Remove mothers and newborns from the general mix and place them as a separate specialty for comparison	Newborns can vary in the length-of-stay and resources consumed over which physicians have little control
Exclude cases with + or – 2.5 standard deviation	Exclude cases that are outliers	Large variation is due to miscoding or a special circumstance

where R_{prij} is the normalized revenue in revenue category r for physician p in specialty i for the period j , and N_{ij} is the number of cases in specialty i for period j .

4.4. Step 4: Navigating the Physician Profiling System

We describe high-level navigation below and PPS sample screens available to the physicians. As a

physician logs on to the Intranet, a security authentication and approval occurs in the web server. Following authentication, a data set containing all of the levels for each physician is accessed by the PPS to build a list of available DRG, MDC, and summary levels for that physician. The physician profiles server processes the requested choices and creates the graphics in the web server. The graphics are displayed through the physician's web browser as shown in screen prints in Figs. 3 and 4.

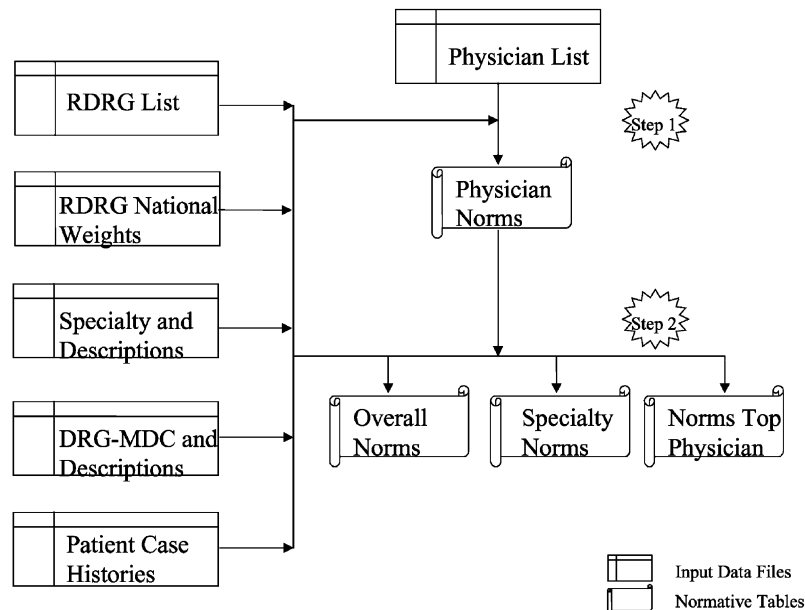


Fig. 2. Input files utilized to create normative tables in PPS.

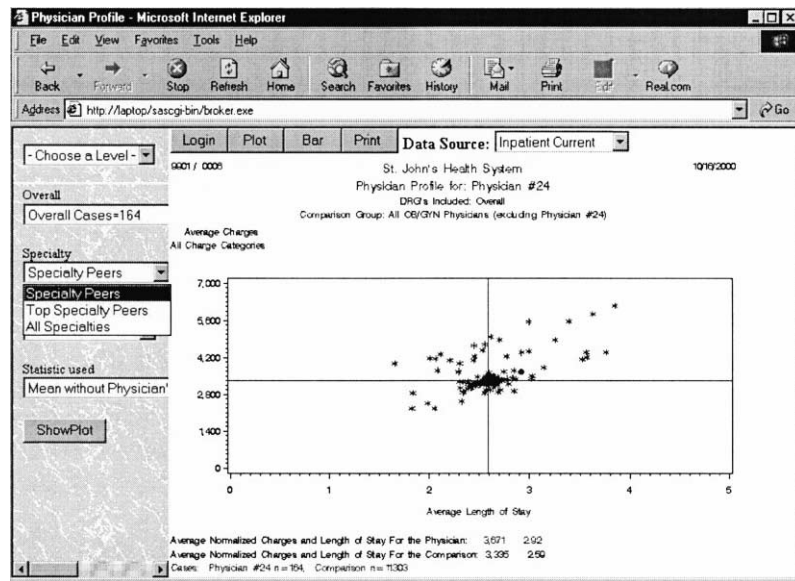


Fig. 3. A PPS screen showing the average (mean) LOS and charges of other physicians (indicated by an *) in the same specialty as compared to the physician with ID 24 (indicated by a rectangular dot †).

4.5. Process improvement through application of PPS data

In a general presentation to all physicians, the PIT disseminates the objectives and a summary of PPS

results followed by profiles customized for each physician. The PPS allows SJHS to manage its resources for the varying levels of disease severity and accordingly change physician practice patterns. By reviewing the baseline profile and comparing it to

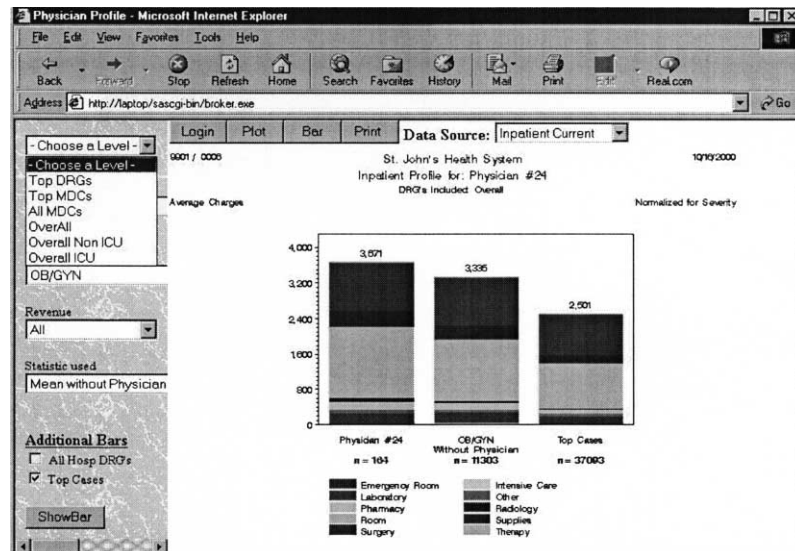


Fig. 4. A PPS screen showing the average (mean) charges by department of one physician (ID 24) as compared to other physicians in the same specialty and top 20% physicians.

one's peers, practice pattern change occurs in a number of ways. Often, physicians with outlier data seek more specific departmental information to determine causes of variation. They may ask the questions—Am I ordering too many CAT scans? Am I using different types of antibiotics? Can other orthopedic devices be used more effectively? Sometimes, mere investigation into the variation leads to desired outcomes. Our experience has shown that on occasion after receiving their profiles, physicians consult their peers to discuss ways to narrow differences between their practice profiles and benchmarks. Physicians have also requested conferences with quality analysts to discuss the variations in greater detail. Generally, this requires case-level data from the DSDW to identify the extent and cause of such variation. A small number of physicians have criticized the variation tracking process, yet have reluctantly accepted the PPS data to counteract publicly available data to regulators, administrators, insurers and the public via Internet web sites.

Nevertheless, most physicians value the PPS-delivered risk adjustment, transfer rates, mortality rates and patient satisfaction scores as comprehensive and usable. They realize that such detailed data are available only through the hospital. Moreover, the hospi-

tal has an interest in partnering with physicians to improve quality and cost outcomes. Due to the involvement of physician peers in the PSC, they seem to trust the PPS outcomes. In addition, the “how can we satisfy the physician customer” attitude of PIT has helped diminish initial skepticism of profile data. Regular input from physician customers on PPS goals and utility was solicited and implemented. SJHS' deliberate choice of physicians as customers to forge a relationship that stretches over many transactions and managing such relationship to the benefit of both parties is defined by Stone et al. [33] as fundamental to the CRM approach.

4.6. Empirical results from costs and benefits from PPS

We present the efficiency and quality gains from the changes in physician practice since the implementation of PPS. In the first 12-month period, the hospital financial indicators show a mean decrease of US\$172 in total charges per case, i.e. increased efficiency, with an aggregate decrease of US\$474,119 for the hospital. Given that hospitals are generally reimbursed a predetermined amount for services, a

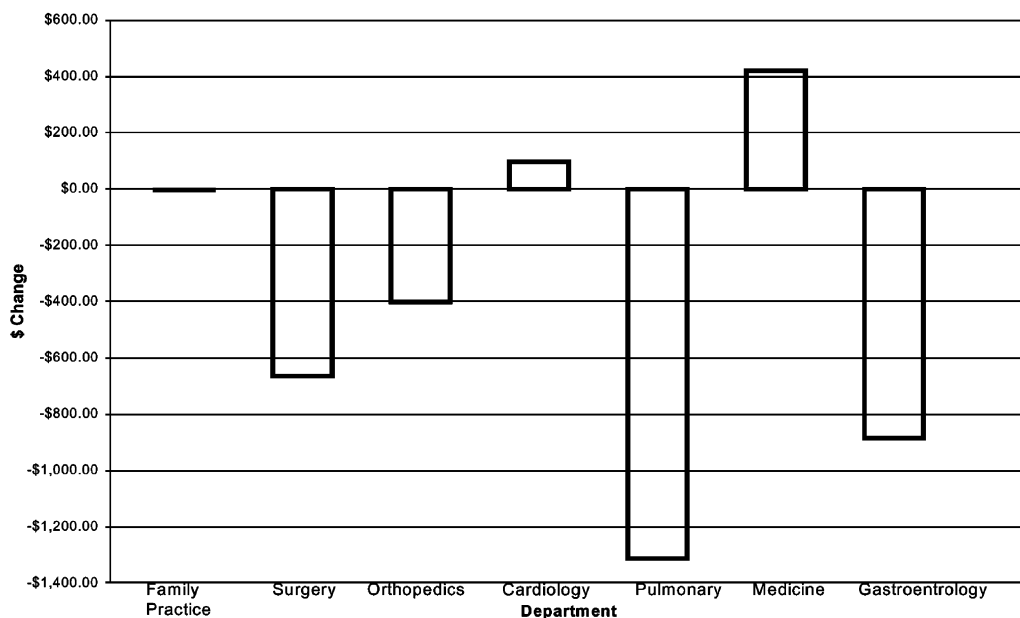


Fig. 5. A bar chart indicating the change in mean US\$ per case by department during the first year.

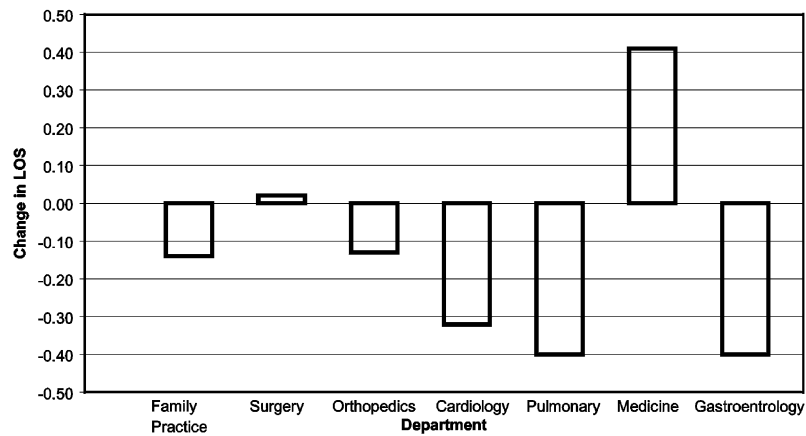


Fig. 6. A bar chart indicating the change in mean LOS days per case by department during the first year.

decrease in charges represents a more efficient operation.

In Fig. 5, we present per case decrease in charges by department for the first 12-month period of PPS. As indicated, most departments show a decrease in per case charges, while the Cardiology and Medicine departments show future efficiency opportunities. The reduction in charges is also paralleled by a mean decrease of 0.06 days in length-of-stay (LOS) per case, with an aggregate decrease of 176 total acute inpatient hospital days. Fig. 6 indicates the decrease in patient days by department in the first 12-month period of PPS. Additionally, data from the 18-month PPS deployment indicates a mean saving of US\$405

in total charges per case, with an aggregate saving of US\$1.42 million in hospital charges. The LOS for the same period indicated a mean decrease of 0.24 day/case, with an aggregate decrease of 835 total inpatient days.

The development and implementation costs of the PPS in this 18-month period sum to US\$163,000. We present a high-level cost–benefit analysis of the PPS in Table 2. We do not, however, include the costs of DSDW development and maintenance because the DSDW has been available for analysis and use well before the PPS development. The high-level cost–benefit analysis indicates that the payback period for the PPS is a little over two months.

Table 2

A high-level assessment of costs, benefits and payback period of investment in PPS

Costs		Benefits	
Description	Costs (US\$)	Savings in decreased charges	Total savings (US\$)
Software development	105,000	US\$405/admission	1,420,000
Hardware	11,000	Total admissions = 3506	
Software	6,000		
Data extraction and management	9,600	Surplus	
Intranet overhead	5,000	Benefits–Costs	
Managerial support	12,000	US\$1,420,000–US\$163,600	1,256,400
Physician support	15,000		
Miscellaneous expenses	5,000		
Total	163,600		
Payback Period			
Period (months)	18	Costs/(Benefits/Period)	2.07 (months)

However, the intangible benefits from establishing the CRM process and retaining physician customers has been invaluable. In addition, the involvement of physicians in the decision-making process had lead to better working conditions. This is demonstrated by the consistently improving customer satisfaction noted during the PPS implementation. Comparison of results as measured during the period of PPS implementation indicate that Saint John's Health System has continued to experience improvements both in charges and LOS. Further analysis of our performance before and after the PPS implementation emphasizes the practice impact of the information disseminated to the physicians. The period following our presentation to the physicians and availability of data in PPS coincide with the period of observed improvement.

While we are not discounting that other factors, such as organizational commitment to reduce variation and budget constraints contributed to improvements, we believe that PPS was the channel that provided information to physicians leading to recognition of improvement opportunities that eventually lead to a change in operations.

We observed that following the dissemination of physician profiles, several quality improvement projects in areas such as neurology, orthopedics, nutrition and effectiveness of pharmaceuticals lead to improvements in financial and clinical outcomes. By contrast, pre-PPS quality improvement projects had demonstrated limited success. A key distinction between the period before and after the PPS is the involvement of the physicians as customers in the development and deployment of PPS. In addition, the PPS has facilitated an on-going dialog among physicians and between the physicians and hospital administrators. For instance, a team consisting of neurology physicians, nurses, physical therapy, occupational therapy case management and discharge planners developed a standardized order set which focused on optimizing patient care. This was followed by on-going interdisciplinary case conferences to review treatment plans for patients who are not progressing as anticipated. Follow-up questions and interpretation of PPS results indicate that changes in organizational functions complemented the CRM approach. For instance, during the first period of PPS, the quality department staff spent an estimated 5% of

their support time in responding to physicians' queries. In the fourth period of the PPS, the support activity is estimated at 30%, suggesting physician engagement in profile analysis possibly leading to stronger customer relationship.

We also observe that physician loyalty, demonstrated by the average number of admissions, increased during the three periods of PPS deployment. Table 3 lists the number of physicians, who regularly admit patients to SJHS, followed by the total number of admissions to the hospital by the physicians. The last column indicates the average admissions per physician. As is evident from the data in Table 3, the number of physician customers declined in each consecutive period, while the number of admissions increased, i.e. fewer physicians were admitting more patients.

Although we do not control for other factors that might have lead to an increase in the admissions, the data in the column "Mean Admissions/Physician" can be interpreted as increase in physician loyalty to SJHS. This supports Yim and Kannan's [35] suggestion that reinforcing loyalty is a reality and organizations should concentrate on maintaining market share as opposed to the entire market. In addition to the quantitative performance indicators, such as charges and length-of-stay information, SJHS routinely provides physicians with benchmarking data for patient satisfaction surveys, transfer and mortality rates, standardized mortality ratios (observed to expected mortality) and other risk-adjusted predictive clinical outcomes measures. One key indicator of the quality of service is the patient satisfaction survey. Although, SJHS has historically enjoyed exceptional patient satisfaction, we were concerned whether the improvements in efficiency through CRM were having an adverse impact on patients' perception of care. Our examination of the patient satisfaction

Table 3
Number of physicians and the admission to the hospital

Period	Active physicians	Total admissions	Mean admissions/physician
1	138	8939	64.78
2	129	8894	68.95
3	126	9233	73.28
4	123	9313	75.71

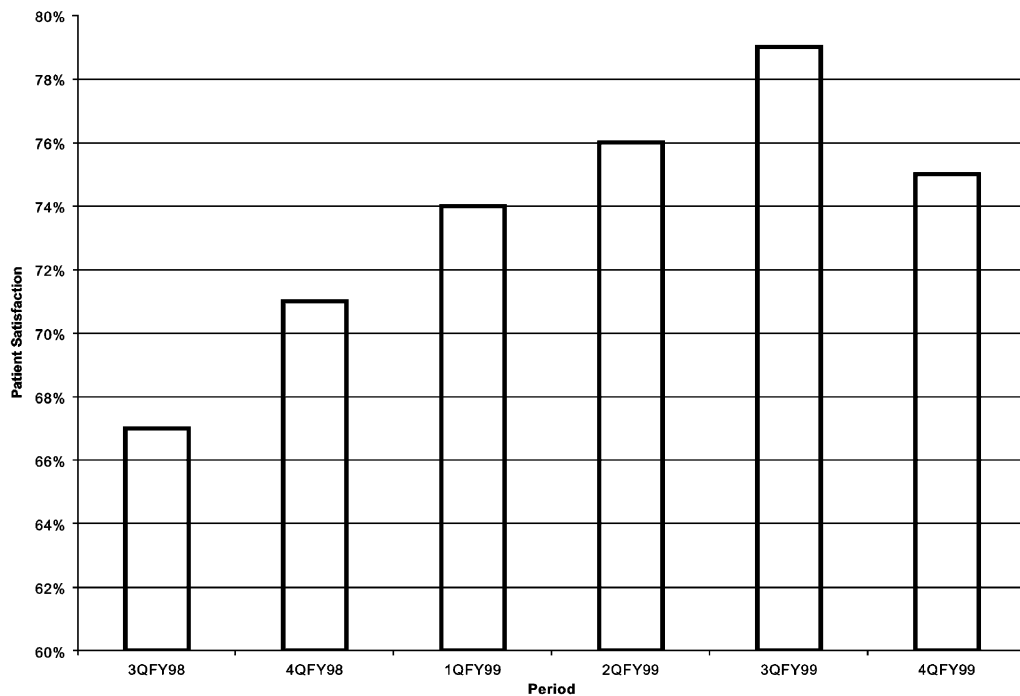


Fig. 7. A chart showing patient satisfaction scores * following PPS implementation * SJHS measures satisfaction as percentage of patients ranking 9 or 10 on a 10-point Likert scale.

One of the objectives of PPS has been used to reduce variation and thus improve performance. In a recent setting, we examined the profiles of a surgeon physician, whose practice is generally viewed as a demonstrated local best practice. While the physician's overall profile was reflected in the lower-left quadrant of the scatter plot, the principal procedure drill-down analysis indicated an opportunity for reduction of surgical supply costs. Subsequent DSDW charge-item detail analysis of the procedure revealed variation in the use of two specific dissection and cauterization devices.

Following the PPS-driven identification of this charge-item specific supply variation, the physician met with the specialty colleagues and the Vice-President of Physician Integration to discuss their rationale for these identified practice differences. The outcome of these discussions resulted in a change in the physician's use of dissection and cauterization devices, as well as a positive shift in the comparative profiling for this procedure for all physicians in that specialty.

In retrospect, it is not surprising that this physician, who was already identified as an efficient and quality-oriented practitioner responded to his PPS profile in this manner. The collective experience of the physicians and hospital administrators, such as in this case, is another manifestation of the predisposition and propensity for the "best" physicians to continually strive for excellence when provided with reliable and useful PPS data.

Fig. 8. A vignette demonstrating an improvement opportunity following PPS data analysis.

results, shown in Fig. 7, for the period of PPS implementation beginning fourth quarter of 1998 (4QFY98) show that SJHS patients' satisfaction has, in fact, increased. This is encouraging given that overall satisfaction at the national level is generally stagnant or declining [11]. Thus, the improved efficiency has not come at the cost of patient satisfaction. In spite of this, we believe that patient satisfaction should be periodically monitored and shared with physicians in order to sustain or improve patient satisfaction (Fig. 8).

5. Implications, limitations and future research

The research and case study presented in this paper has several implications. We demonstrate that by following the CRM tenets, hospitals can augment their relationships with their key customers—physicians. Treating physicians as customers can lead to better working relationships and reduced turnover. Further, our findings demonstrate that electronic means of delivering physician profiles provide an opportunity to facilitate and manage physician–hospital relationship. Sharing information with physicians can lead to improvements in quality as well as financial performance of healthcare organizations.

This case demonstrates the vital role of business strategy and process redesign supported by information systems deployment to affect organizational change. Although researchers have frequently made this point, it has not always been followed in practice. Our case study demonstrates that success of creating profiles was achieved through a well-defined strategy to improve performance and to involve physician customers both in planning and implementation. Further, we find that trust between the customer and the supplier appears to be critical in the implementation of a CRM. Trust between physicians and the hospital was a prerequisite that lead to changes in clinical practices on the hospital floors. Even well-designed information systems fail to demonstrate the 'conversion effectiveness' because of the lack of system use or the inability of the users to make changes where they matter.

In our case study, the hospital's organizational strategy to sustain customer relationships with physicians appears to be driven by the pressures of a

changing marketplace in which profitability is decreasing and scrutiny on quality is increasing. In such a scenario, where hospitals and physicians both felt the 'pain', it increased the likelihood of success of a well-designed CRM strategy. Although further research is required, we believe that such marketplace challenges are not unique to healthcare. Proactive organizations, such as SJHS, can draw their customers' attention to such market challenges in building lasting relationships, prior to the onset of adverse business conditions.

Notwithstanding the above implications and contributions, there are limitations of our study. First, the PPS benefits were captured following the implementation of Intranet-based CRM initiative. Given that the physician performance data were available in the DSDW prior to the CRM initiative, it was not possible for us to isolate the impact of the PPS. Second, due to the introductory nature of PPS, we did not examine the savings from PPS physicians on a case-by-case basis. Further, measurement constructs and variables for PPS effectiveness are still evolving. Such analysis will be possible after physicians directly use PPS and usage data linked with performance are available.

We provide practitioners and researchers with an example of managing nontraditional customers, thus demonstrating wider applicability of CRM. We invite researchers to examine other business arrangements that can benefit from CRM principles. Such areas may be business-to-business situations, such as business organizations and legal counsels, third-party suppliers and end-customers. Similarly, electronic commerce is redefining the customer–supplier roles. In addition, CRM principles can also be applied in managing relationships with electronic intermediaries and members of the product or service value chain. Future research can examine changes in resource consumption before and after the CRM implementation and its link with the intensity of usage. In addition, organizational impacts, such as power imbalances and shift due to published 'report cards' in PPS, can also be examined.

Glossary of Terms

DRG Diagnosis Related Group. One of 500 + categories used to classify patient diagnosis. Originally designed for billing purposes,

now also used for clinical quality and financial outcomes¹

- LOS** Length-of-Stay. Duration of stay of patients in the hospital—generally measured in days.
- MDC** Major Diagnostic Category. DRG rolled up into major categories. Generally corresponding to a major human body organ, e.g. heart, kidneys, brain.
- Morbidity** The incidence of disease, the rate of sickness as in a specified community or group¹
- Mortality** The proportion of deaths to population.¹ Expected mortality is a mathematically calculated risk of death for a given DRG.
- PPS** Physician Profiling System. A web-enabled system reported in this paper developed to provide an overview of physician performance vis-à-vis physician peers and external benchmarks.
- APS-DRG** All Payor Severity DRG is an adjustment for severity of all patients. The adjustment is based upon a model using historical data from all payors.
- Risk-adjustment** Accounted for the possibility of loss, injury, disease, or death.¹ A normalization process accounting for potential risk based upon severity and morbidity. Generally performed in reviewing resource consumption in treatments.
- Severity** The advanced nature of a patient's disease condition.
- Specialty** Category or discipline of specialization, such as cardiology, family practice, and neurology

Acknowledgements

The authors thank Diane E. Brown, Amy J. Dilow, Hank Groot, Don Irmiger and Jeffery Mathison, MD, for their support of the Physician Profiling System project.

¹ Based upon definition in Merriam-Webster's Medical Dictionary, 1995 edition.

References

- [1] I. Ahwah, M. Karpel, Using profiling for cost and quality management in the emergency department, *Healthcare Financial Management* 51 (7) (1997) 48, 50–53.
- [2] O.W. Anderson, M.C. Shields, Quality measurement and control in physician decision making: state of the art, *Health Services Research* 17 (2) (1982) 125–155.
- [3] J.F. Benanti, The physician as customer, *Health Progress* 69 (3) (1988) 62–65.
- [4] R.N. Beveridge, Creating value-focused healthcare delivery systems: Part III. Core competencies, *Journal of Oncology Management* 6 (6) (1997) 16–23.
- [5] R.W. Brooks, Using an intranet for physician desk top data consolidation, *Topics in Healthcare Information Management* 20 (2) (1999) 41–51.
- [6] A.C. Conway, R.B. Keller, D.E. Wennberg, Partnering with physicians to achieve quality improvement, *Joint Commission Journal of Quality Improvement* 21 (11) (1995) 619–626.
- [7] J.H. Evans III, Y. Hwang, N. Nagarajan, Physicians' response to length-of-stay profiling, *Medical Care* 33 (11) (1995) 1106–1119.
- [8] G. Forgionne, R. Kohli, HMSS: a management support system for concurrent hospital decision-making, *Decision Support Systems* 16 (3) (1996) 209–229.
- [9] G.A. Forgionne, A. Gangopadhyay, J.A. Klein, R. Eckhardt, A decision technology system for health care electronic commerce, *Topics in Health Information Management* 20 (1) (1999) 31–41.
- [10] G.A. Forgionne, A. Gangopadhyay, J.A. Klein, R. Eckhardt, Electronic commerce as an enabler of efficient health-care decision-making, *Electronic Markets* 9 (1/2) (1999) 1–5.
- [11] C. Fornell, M.D. Johnson, E.W. Anderson, J. Cha, B.E. Bryant, The American customer satisfaction index: nature, purpose, and findings, *Journal of Marketing* 60 (1996) 7–18, October.
- [12] R. Hand, F. Piontek, L. Klemka-Walden, D. Inczauskis, Use of statistical control charts to assess outcomes of medical care: pneumonia in Medicare patients, *American Journal of Medical Sciences* 307 (5) (1994) 329–334.
- [13] G. Helfert, K. Vith, Relationship marketing teams—improving the utilization of customer relationship potentials through a high team design quality, *Industrial Marketing Management* 28 (5) (1999) 553–564.
- [14] M.S. Hendryx, D.S. Wakefield, J.F. Murray, T. Uden-Holman, C.M. Helms, R.L. Ludke, Using comparative clinical and economic outcome information to profile physician performance, *Health Services Management Research* 8 (4) (1995) 213–220.
- [15] M.S. Hendryx, D.S. Wakefield, J.F. Murray, T. Uden-Holman, C.M. Helms, R.L. Ludke, Using comparative clinical and economic outcome information to profile physician performance, *Health Services Management Resources* 8 (4) (1995) 213–220.
- [16] T.P. Hofer, R.A. Hayward, S. Greenfield, E.H. Wagner, S.H. Kaplan, W.G. Manning, The unreliability of individual

- physician “report cards” for assessing the costs and quality of care of a chronic disease [see comments], *Journal of American Medical Association* 281 (22) (1999) 2098–2105.
- [17] F.W. Hosler, P.A. Nadle, Physician–hospital partnerships: incentive alignment through shared governance within a performance improvement structure, *Joint Commission Journal of Quality Improvement* 26 (2) (2000) 59–73.
- [18] L.I. Iezzoni, The risks of risk adjustment, *Journal of American Medical Association* 278 (19) (1997) 1600–1607.
- [19] I.L. Janis, *Crucial Decisions: Leadership in Policymaking and Crisis Management*, Free Press; Collier MacMillan, New York, 1989.
- [20] M.G. Kahn, T.C. Bailey, S.A. Steib, V.J. Fraser, W.C. Dunagan, Statistical process control methods for expert system performance monitoring, *Journal of American Medical Information Association* 3 (4) (1996) 258–269.
- [21] R. Kohli, J.K. Tan, F.A. Piontek, D.E. Ziege, H. Groot, Integrating cost information with health management support system: an enhanced methodology to assess health care quality drivers, *Topics in Health Information Management* 20 (1) (1999) 80–95.
- [22] P. Kotler, The role and development of marketing in today’s health care institution [interview], *Health Care Strategic Management* 3 (1) (1985) 21–24.
- [23] H. Krakauer, R.C. Bailey, Epidemiologic oversight of the medical care provided to Medicare beneficiaries, *Statistics in Medicine* 10 (4) (1991) 521–540.
- [24] S.E. Krentz, T.R. Miller, Physician resource profiling enhances utilization management, *Healthcare Financial Management* 52 (10) (1998) 45–47.
- [25] R.S. Leary, M.E. Johantgen, D. Farley, M.T. Forthman, L.D. Wooster, All-payer severity-adjusted diagnosis-related groups: a uniform method to severity-adjust discharge data, *Topics in Health Information Management* 17 (3) (1997) 60–71.
- [26] M.A. Lescoe-Long, M.J. Long, R.L. Amidon, J.J. Kronenfeld, D.C. Glick, The relationship between resource constraints and physician problem solving. Implications for improving the process of care, *Medical Care* 34 (9) (1996) 931–953.
- [27] R.S. MacStravic, Hospital–physician relations: a marketing approach, *Health Care Management Review* 11 (3) (1986) 69–79.
- [28] J.G. March, H.A. Simon, *Organizations*, Wiley, New York, 1958.
- [29] W. Mougayar, *Opening Digital Markets*, McGraw-Hill, New York, 1998.
- [30] M.F. Pulde, Physician-centered management guidelines, *Physician Executive* 25 (1) (1999) 40–44.
- [31] W. Raghupathi, J. Tan, Strategic uses of information technology in health care: a state-of-the-art survey, *Topics in Health Information Management* 20 (1) (1999) 1–15.
- [32] E.A. Ramoska, Information sharing can reduce laboratory use by emergency physicians, *American Journal of Emergency Medicine* 16 (1) (1998) 34–36.
- [33] M. Stone, N. Woodcock, M. Wilson, Managing the change from marketing planning to customer relationship management, *Long Range Planning* 29 (5) (1996) 675–683.
- [34] J.D. Wells, W.L. Fuerst, J. Choobineh, Managing information technology (IT) for one-to-one customer interaction, *Information and Management* 35 (1) (1999) 53–62.
- [35] C.K. Yim, P.K. Kannan, Consumer behavioral loyalty: a segmentation model and analysis, *Journal of Business Research* 44 (2) (1999) 75–92.
- [36] E.J. Zarling, F.A. Piontek, R. Kohli, The utility of hospital administrative data for generating a screening program to predict adverse outcomes, *American Journal of Medical Quality* 14 (6) (1999) 242–247.
- [37] E.J. Zarling, F.A. Piontek, R. Kohli, J. Carrier, The cost and efficiency of hospital care provided by primary care physicians and medical subspecialists, *American Journal of Medical Quality* 14 (5) (1999) 197–201.
- [38] A.M. Zuckerman, Hospital and medical staff strategic planning: developing an integrated approach, *Physician Executive* 20 (8) (1994) 15–17.



Rajiv Kohli is an assistant professor in the College of Business and Economics at Lehigh University. He was recently an internal Consultant and Project Leader—Decision Support Services at the corporate office of Trinity Health in South Bend. Dr. Kohli received his PhD from the University of Maryland, Baltimore County. He has taught at the University of Notre Dame, University of Maryland College Park, and University of Maryland University College where he was awarded the Teaching Recognition Award. Dr. Kohli has worked or consulted with MCI Telecommunications, Westinghouse Electronics, and Rohbe Corporation in addition to several healthcare organizations. Dr. Kohli’s research is published in *Journal of Management Information Systems*, *Decision Support Systems*, and *Information and Management* among other journals. Dr. Kohli’s research interests include Organizational Impacts of Information Systems, Process Innovation, and Enhanced Decision-Support Systems.



Frank Piontek is a healthcare informatist for the Trinity Health Information Services Decision Support Group located in South Bend, IN. He has an MA and over 25 years of healthcare experience; including consulting work with state hospital and cost-containment councils. He has coauthored several medical publications and presented dozens of papers to medical conferences. He has also received a National Science Foundation grant for supercomputer applications in data repository formations and related medical outcome drilldown analytics.



Tim Ellington is a Systems Manager with TEC Associates in Indianapolis, IN. TEC Associates specializes in information delivery including data warehousing, reporting and analysis, decision support and web deployment. TEC Associates is a SAS Quality Partner with an established relationship with SAS Institute in providing SAS consulting services. Timothy Ellington has 15 years of experience in the Health Care Industry.

He has built systems for health care insurers, provider networks and health care providers. He has worked on a variety of projects including application development, claims processing systems, decision support systems, data warehousing, data analysis, system administration/support and Internet/Web development. He has experience on many system platforms including mainframe, VAX/VMS, UNIX, and PC/Microsoft Windows. As well as development experience with SAS, he also has experience in SQL, Visual Basic, CLIST, REXX, COBOL, DB2, Informix, Paradox, Microsoft Access, SQL Server, JavaScript, CGI, and HTML. He earned his Bachelor's degree in Computer Technology from Purdue University in 1986.



Thomas J. VanOsdol, MS, MA, SLP, RHIT, CPHQ, is the Director of Case Management, Continuous Quality Improvement, and Health Information Management at Saint John's Health System. Tom's responsibilities include oversight of organizationwide performance improvement, utilization management, and management, integrity and security of patient health information. He has been directly involved in all planning, development, implementation

and ongoing improvement aspects of the Physician Profiling initiative at Saint John's, with an emphasis on the integration and utilization of the profiles data to drive the organization's dynamic performance improvement priorities and outcomes.



Marylou Shepard, BS Accounting, is the Continuous Quality Improvement and Mecon Productivity Analyst at Saint John's Health System. She is responsible for the ongoing development and testing of the Physician Profile tool along with charge level data derivation and variance specific root cause analysis. Marylou is also responsible for coordinating the Mecon Productivity initiative throughout the organization working closely with the Budgeting and Regulatory Readiness areas.



Gary Brazel, MD, is Vice President of Physician Integration at St. John's Health System in Anderson, Indiana. He received his MD from Indiana University in 1987 and completed his family practice residency at St. Francis Hospital in Beech Grove, IN in 1990. He has actively participated in clinical CQI initiatives promoting notable practices and strives to remove unnecessary variation from the patient care process.