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WORKSHOP IN HEALTH ADMINISTRATION STUDIES

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"The Interrelationship Among Quality Indicators, Profitability and Market Share for Hospitals Treating Medicare Beneficiaries"

WORKSHOP PAPER

for

Thursday, January 12, 1989

Rosenwald 405

3:30 to 5:00 p.m.

Hospital Care
Frontiers in Managing Quality

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ABSTRACT

Higher quality of hospital care, in terms of lower mortality rates, costs less than poorer quality. This result has been known for other industries and is now demonstrated for hospitals. Publically available data bases make it possible for hospitals to construct Pareto analyses that will point to their best opportunities for quality improvement of outcomes.

A Brief History

The terms "quality" and "health care" have been linked together for decades. Many of the early advances in both quality control and public health have common origins. For example, in fighting the London cholera epidemics of 1848 and 1853, Dr. John Snow developed concentration diagrams.[1] Florence Nightingale was not only a powerful force in establishing modern hospital practices. Although British, she was also made an honorary member of the American Statistical Association for her work in developing statistical graphical techniques to analyze and control the quality of health care.[2]

In more recent times, there appears to have developed within the medical community a general view that quality can be assessed on three different dimensions: (1) structure (the people, equipment and materials available for care), (2) process (the actions taken by medical practitioners), and (3) outcomes (the health and well-being of the patient).[3] The accreditation of hospitals, as performed by the Joint Commission on Accreditation of Health Care Organizations (or simply Joint Commission) focuses primarily on the existence of adequate structure and process. Peer review procedures have been established by hospitals for the review of individual physician's practices. Similar peer and utilization reviews are required by a variety of governmental programs from Medicare to local health planning authorities.

Most of these quality assessment activities in hospitals are focused on identifying those physicians (or other professionals) who are not practicing according to established standards. For those of us who have watched the growth of quality management in other industries over recent decades, the general quality process in hospitals is a familiar one: extensive inspection to find the cases that are not in conformance with some (possibly arbitrary) standard, followed by considerable loss from the work required to repair the damage.

New methods of payment for hospital services have increased pressure on hospitals to reduce their costs. For example, Medicare payments are now on a diagnosis-related-group (DRG) basis. DRG reimbursement is a fixed fee for each patient with a given condition. Payment for DRG cases is no longer based on the specific individual services provided.

New Initiatives and Opportunities

There are early indications that leaders in the health care industry are now beginning the process of establishing orderly quality improvement and management processes similar to those adopted by leading companies in other industries.[4] It is

especially noteworthy that the President of the Joint Commission on Accreditation of Health Care Organizations, Dr. Dennis O'Leary, has announced an "Agenda for Change." This initiative includes, among other things, increased emphasis on data such as clinical indicators and patient outcomes in the accreditation process.[5]

The Federal Health Care Financing Administration (HCFA) that oversees Medicare has begun to publish data on patient outcomes from individual hospitals for Medicare patients. These data have stirred considerable controversy, but they have also created a useful opportunity. The public availability of these data means that it is possible to look at the variation across hospitals in the outcomes of the care they provide for each of a number of different medical conditions.

Those of us who have become accustomed to seeing the world in terms of the opportunities for quality improvement will immediately see these data as such an opportunity. If, as these data show, there is a 1000% variability among hospitals in the survival rates of coronary artery bypass graft surgery, the manager committed to quality will immediately want to know, "What do the best hospitals do that is different from the others?"

Anyone who has had the experience of working on a quality improvement project team will not be surprised that for bypass surgery too, the desirable quality outcome (successful surgery) is frequently less than half as costly as the failure (death of the patient). With much of the recent emphasis on cost reduction in health care, there has been substantial concern that controlling costs will lead to lower quality care. While we cannot address that issue in detail here, what we will see is that many efforts to improve quality will also reduce costs.

Lexecon Health Service (LHS) is an information provider to hospitals and health care purchasers. It has been researching outcome measures of quality since 1984. In general terms, the LHS research illustrates that cost and quality have the same general relationship in hospitals as they have in other industries; namely, there is a tremendous cost associated with low quality.

PIMS Data and Industry

Before looking at empirical evidence regarding cost and quality in hospital care, we will briefly discuss research results from other industries that interrelate quality, market share, and profit. PIMS is an acronym for Profit Impact of Market Strategies. It is a data base originally developed at General Electric and generalized at Harvard Business School to allow quantitative analyses of various marketing strategies. The data base is now managed by the Strategic Planning Institute. The PIMS data contain self-reported information from strategic business units of hundreds of large corporations. Data include information on product

quality, market share estimates, return on investment, revenue, market growth rate, productivity, and other factors. Quantitative research with the PIMS data by Phillips, et. al. indicates, "Across all businesses quality was shown to influence return-on-investment indirectly via its positive effects on market position."[6] Many had previously assumed that high quality, large market share, and high rates of return were incompatible. These factors are not incompatible but are positively associated.

When one speaks of quality, there are two possible species that may be under discussion.[7] One relates to the features provided to the customer; these features generate satisfaction for the customer and increase the salability or demand for the service or good being provided. For example, a private hospital room is an additional service or feature. The second species of quality relates to the freedom from deficiencies. These deficiencies lead to customer complaints, waste, and the need to do work over again. For example, nosocomial infections (those that originate in the hospital) can be viewed as defects in the care provided.

Buzzell and Gale make a similar point in developing their model from the PIMS data.[8] They distinguish between quality as customer's perception of quality (e.g., what potential patients and physicians think about the quality of a hospital) and quality as conformance (e.g., adhering to appropriate procedures in medical diagnosis and treatment). Figure 1 is an adaptation of a flow-chart from Buzzell and Gale which illustrates how both types of quality drive profitability and growth.[9]

Figure 1

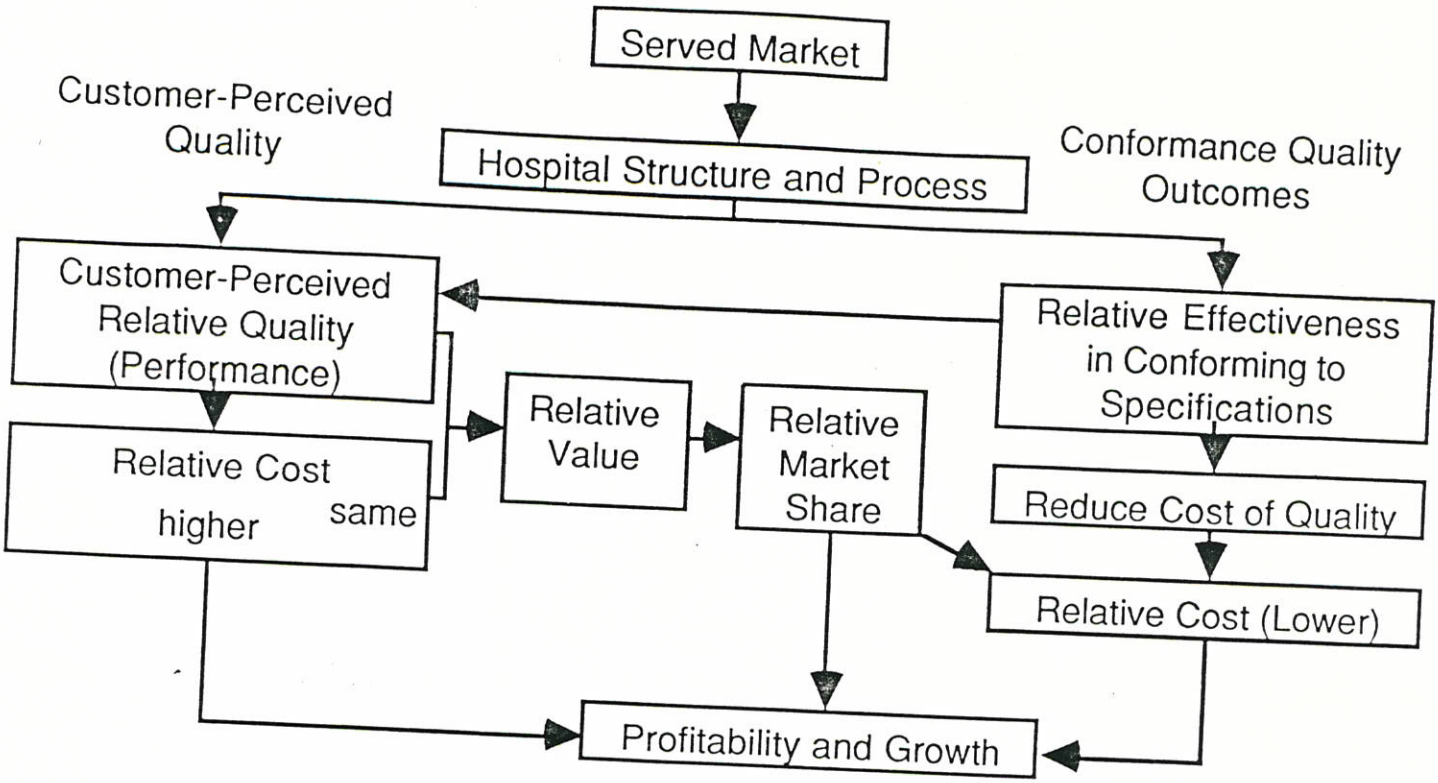
Figure 2 quantifies the findings from Buzzell and Gale on the degree to which quality and market share drive profitability or return on investment.[10] Higher market share means higher profits, holding quality constant. Higher quality means higher profits, when market share is the same.

Fig. 2

Buzzell and Gale conclude, "In the long run, the most important single factor affecting a business unit's performance is the quality of its products and services, relative to those of competitors."[11] Paraphrasing them, the best way for health care providers to survive and profit is to fulfill their mission of providing quality care.

Outcome Data and Hospitals

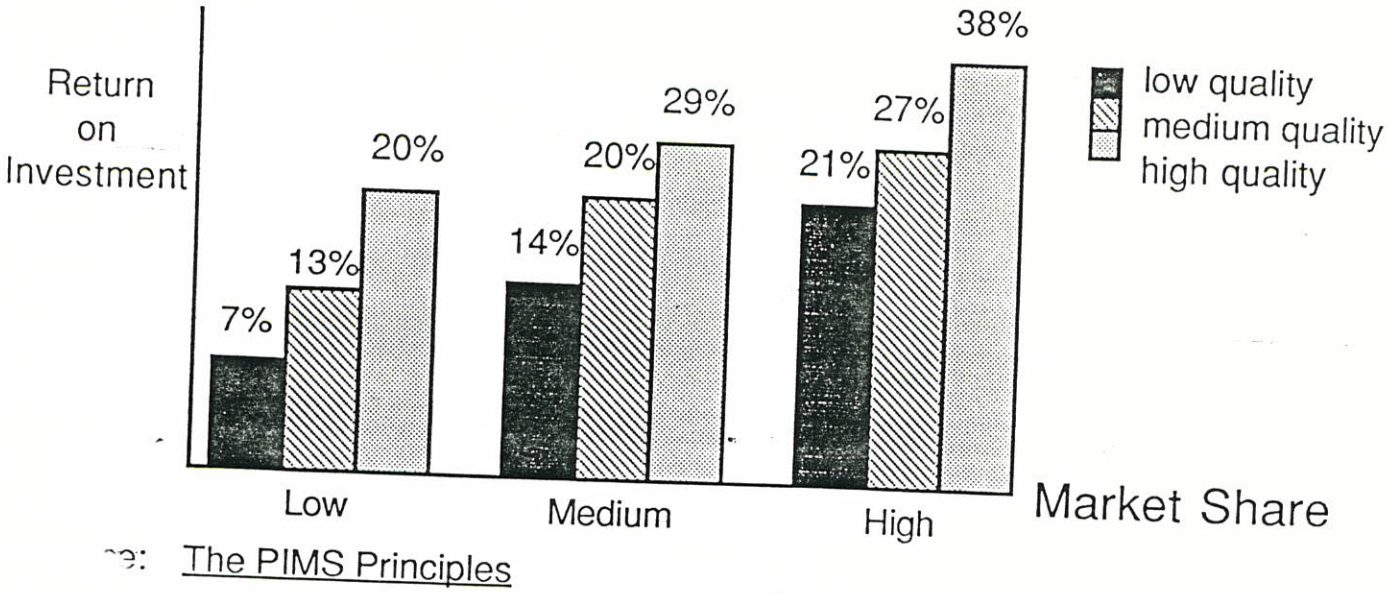
In order to study the interrelationship among quality, market share, cost, and contribution margin for hospitals, LHS has combined several publicly available data bases to form a hospital analog of the PIMS data base. LHS merged together Medicare



Source: Modification of chart from The PIMS Principles

Figure 1

Quality and Share Both Drive Profit



ce: The PIMS Principles

Figure 2

discharge data (10 million hospital visits annually) with hospital-specific financial data. LHS's data base combines market share, quality indicators, contribution margin estimates, and revenue for all U.S. hospitals by product line for the Medicare market segment. In approximately ten states similar data are publicly available for all patients from all hospitals.

LHS's research focuses on outcome measures of quality because the outcome is the most important facet of quality to the patient. Mortality rates are the easiest outcome measure to monitor. Mortality thirty days after admission is used as a measurement point rather than the day of discharge from the hospital. This measure provides an indicator that is less biased by local discharging patterns of physicians or hospitals.[12] After adjustment for patients' risk factors such as age, sex, presence of diabetes or other comorbidities, we would expect similar 30 day post admission mortality rates. In other words, hospitals performing the same surgical procedure on similar patients with the same disease are expected to have comparable mortality rates. This should also be true for acutely ill medical patients, low risk newborns, and many other areas. Medical cancer patients are not appropriate for 30 day post admission analysis since long-term survival must be studied.

LHS modified HCFA's clinical classification scheme from its 1987 Medical Hospital Mortality Information release by analyzing medical from surgical patients separately. HCFA's statistical models were then recalibrated using all hospitalized Medicare beneficiaries to compute the expected mortality rate for each product line in each hospital. Quality for a product line in a hospital is defined here as the difference between the predicted (expected) mortality rate, and the observed mortality rate, expressed in standard deviations. Higher numbers are better quality in the following examples.

For this research, market share is defined as the number of Medicare discharges for the product line of a hospital divided by all Medicare discharges in that product line within the same three digit zip code. (More specific market share measures such as a hospital's share relative to its three largest competitors should be used for hospital-level strategic planning. Consideration of each market's unique condition was impossible for this national research. The results should be more dramatic if the market were more precisely defined.)

All U.S. hospitals have been classified into one of five quality groups for each surgical procedure. The five classes are as follows:

-2 Quality, measured as observed mortality rate, is two or more standard deviations above the predicted rate, adjusted for known risk factors.

-1 Quality, measured as observed mortality rate, is between one and two standard deviations above the predicted rate, adjusted for known risk factors.

0 Quality, measured as observed mortality rate, is within one standard deviation of the predicted rate, adjusted for known risk factors.

+1 Quality, measured as observed mortality rate, is between one and two standard deviations below the predicted rate, adjusted for known risk factors.

+2 Quality, measured as observed mortality rate is two or more standard deviations below the predicted rate, adjusted for known risk factors.

To estimate hospital's profit (or more accurately calle contribution margin) we used the patient level discharge data from HCFA to obtain hospital charges and reimbursement. Charges are the total itemized bills for the patients based on the services provided. Reimbursement is the amount actually paid by Medicare for that patient. Average charges and reimbursement were calculated by hospital by product line. LHS multiplied the average charges from the discharge report by 66 percent to get an estimated average cost per discharge for each hospital's product lines. (For this research we are using the national average cost-to-charge ratio of 66 percent. Hospital specific cost-to-charge ratios are used for individual hospital-level planning.) The difference between a hospital's HCFA reimbursement and its estimated cost is our definition of its contribution margin. The contribution margin does not include the fixed cost reimbursement nor medical education reimbursement received by the hospital from HCFA.

The following graphs illustrate the positive relationship among quality, market share, and contribution margins for certain surgical product lines. The graphics used are called bubble plots and the area of the circle is proportional to the contribution margin of that quality group. Shaded circles represent losses--the larger the shaded circle the greater the loss. Each bubble is centered on the hospital group's quality rating and average market share. Figure 3 contains data on all urban hospitals with 500 or more beds that are not members of the Council of Teaching Hospitals (COTH--hospitals with very close medical school affiliations). The clinical area is surgical urology which is mainly prostatectomies. High relative quality (+1) is associated with a large market share and an average contribution margin of $112 per Medicare discharge while lower quality (0, -1, and -2 quality groups) have progressively larger losses. The -2 quality group loses $500 per Medicare discharge. There are no hospitals in the +2 quality group as mortality rates for surgical urology are very low for all hospitals, so no hospital was two or more standard deviations below

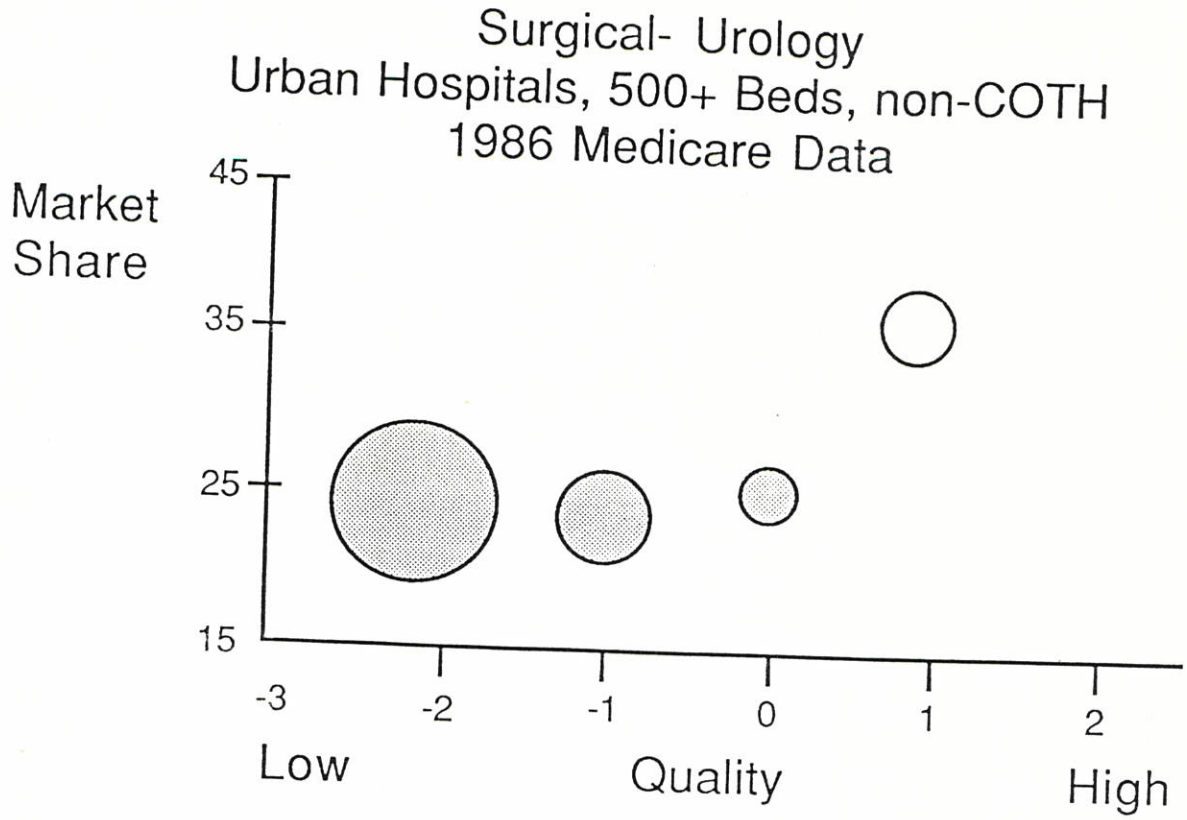

Surgical- Urology
Urban Hospitals, 500+ Beds, non-COTH
1986 Medicare Data
Market Share
45
35
25
15
-3
-2
-1
0
1
2
Low
Quality
High

Figure 3

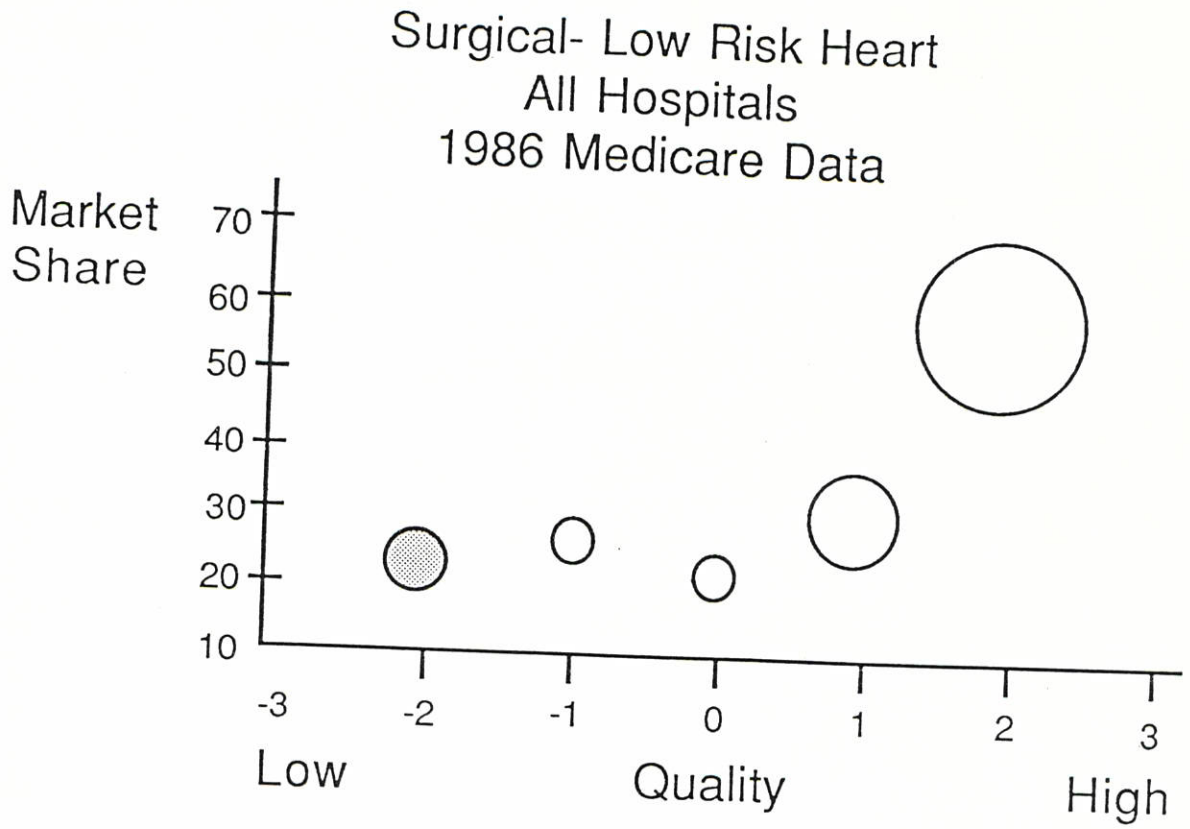

Surgical- Low Risk Heart
All Hospitals
1986 Medicare Data
Market Share
70
60
50
40
30
20
10
-3
-2
-1
0
1
2
3
Low
Quality
High

Figure 4

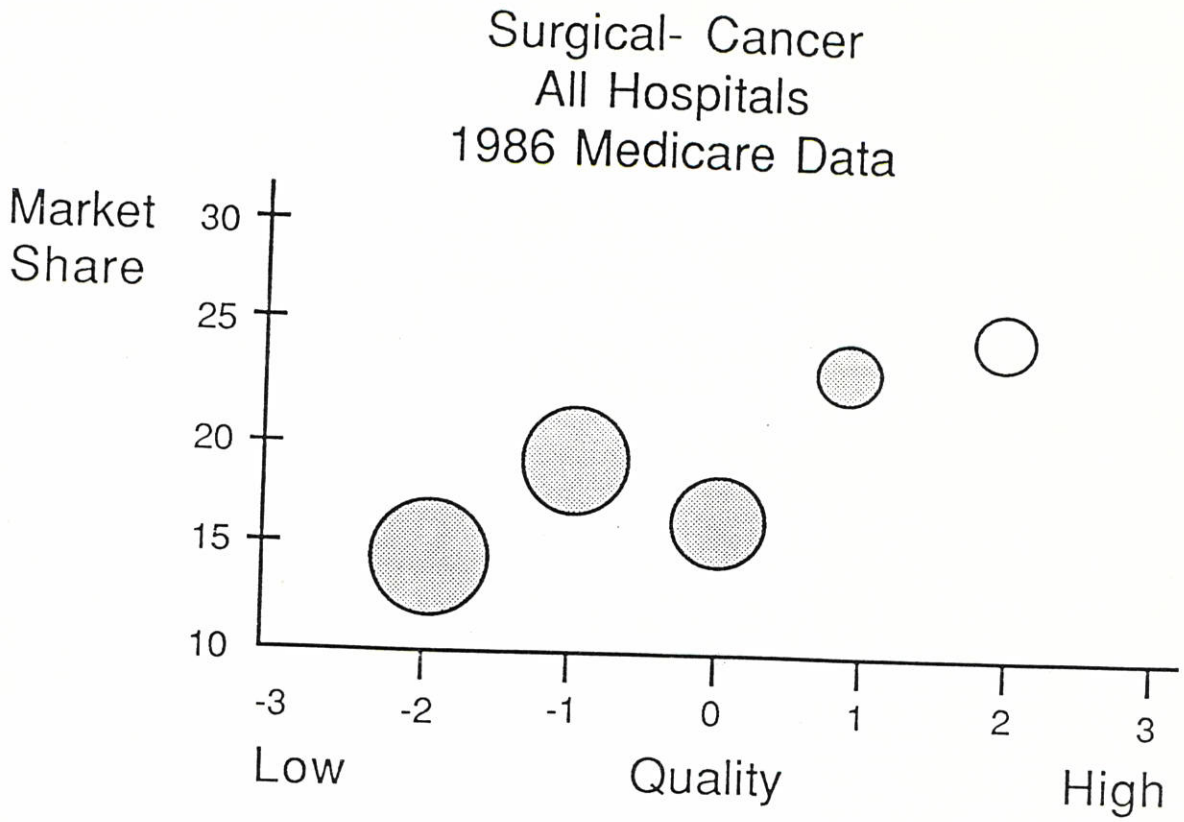

Surgical- Cancer
All Hospitals
1986 Medicare Data
Market
Share
30
25
20
15
10
-3
-2
-1
0
1
2
3
Low
Quality
High

Figure 5

the predicted rate.[13]

Figure 3

Figure 4 contains data from all U.S. hospitals performing low-risk open heart surgery which is mainly coronary artery bypass graft surgery. The highest quality hospitals are far more profitable than lower quality hospitals. The +2 quality group had a $3,359 contribution margin per Medicare discharge while the -2 quality group lost $435 per Medicare discharge. Similar patterns are seen for various size and teaching status groupings of hospitals.

Figure 4

Figure 5 contains data for surgical cancer from all U.S. hospitals. The only group profiting in Graph 4 is the highest (+2) quality group which had a $276 contribution margin per Medicare discharge. The other hospital groups suffer larger and larger losses as quality declines. The -2 quality group lost $1,100 per Medicare discharge.

Figure 5

Iatrogenic (i.e., doctor induced) complications, nursing errors, adverse drug reactions, and other preventable problems are also outcome measures. High rates of surgical complications or nursing errors are indicators of poor quality and are undesirable, primarily because of their effects on the patients, but also because they dramatically increase cost and increase the likelihood of substantial malpractice claims. Complications are tricky to analyze using discharge data because there is a large variation in medical record coding. Teaching hospitals have interns, residents, staff physicians, or attending physicians all writing on the patient's medical record. They also tend to have sophisticated, computerized medical record and billing systems that help to provide a greater awareness and ease of reporting of complications. Therefore, hospitals with similar teaching status should be used for cross-sectional analyses of complications. Analysis of complications supplement mortality rate analysis and can be used to target medical record reviews as well as to help explain aberrant mortality rates. Rates of incorrect medications, transfusion reactions, and other errors should be monitored and trends analyzed. These events are examples of failures in critical control variables. When there is failure, the likelihood of the patient's death has increased substantially.

Figure 6 illustrates the average charges for coronary artery bypass graft surgery for the six large teaching hospitals in Boston. Charges for patients discharged alive, without a reported complication were about $23,000. Charges for patients with a complication were about $33,000 or 43 percent higher. Charges for

patients that died are around $56,000 or 143 percent higher than live discharges without complications.

Figure 6

Complications, errors, and death are expensive events because the patient requires more intensive and extensive care. Capitation payments or DRG reimbursement will result in large losses if a hospital has unusually high rates of adverse outcomes.

Figure 7 demonstrates a similar but slightly less pronounced pattern for patients' lengths of stay using the same underlying data as Figure 6. Virtually every surgical area that LHS has researched gives similar findings. The patterns are less clear for medical patients.

Figure 7

Rates of readmission to a hospital within thirty days is another outcome measure. One can monitor and analyze readmissions due to surgical complications and premature discharge. Overall readmission rates within 30 days should be analyzed as an outcome indicator because HCFA has instructed the peer review organizations to begin to monitor those rates. The reason for readmission is complex to analyze from existing discharge data, so hospitals should analyze and understand their own data to minimize the likelihood of misinterpretation by outside organizations or purchasers, as well as to identify opportunities for quality improvement.

Uses of Hospital-Specific Data

Hospital-specific comparative data can and should be used by hospitals for strategic analyses and statistical targeting of detailed quality reviews. In an increasingly competitive environment, hospitals must take a critical look at the relative position of their product lines. Many institutions must decide between eliminating or investing in unprofitable product lines. Profitable product lines must be protected against competitors. The choice between restructuring (i.e., eliminating) a product line and building on that line can only be made rationally by considering comparative information in the context of the hospital's resources and mission.

Figure 8 profiles a renowned urban teaching hospital's surgical product lines. (We are using HCFA data for this illustration, but individual hospitals will naturally want to use additional internal data they have.) Quality scores range from a low of approximately -0.5 for minor gastrointestinal diseases to a high of over +2.5 for surgical cancer. (Quality scores in Figures 8 and 9 are based on the actual standard deviation rather than the five ranges used in the previously described research.)

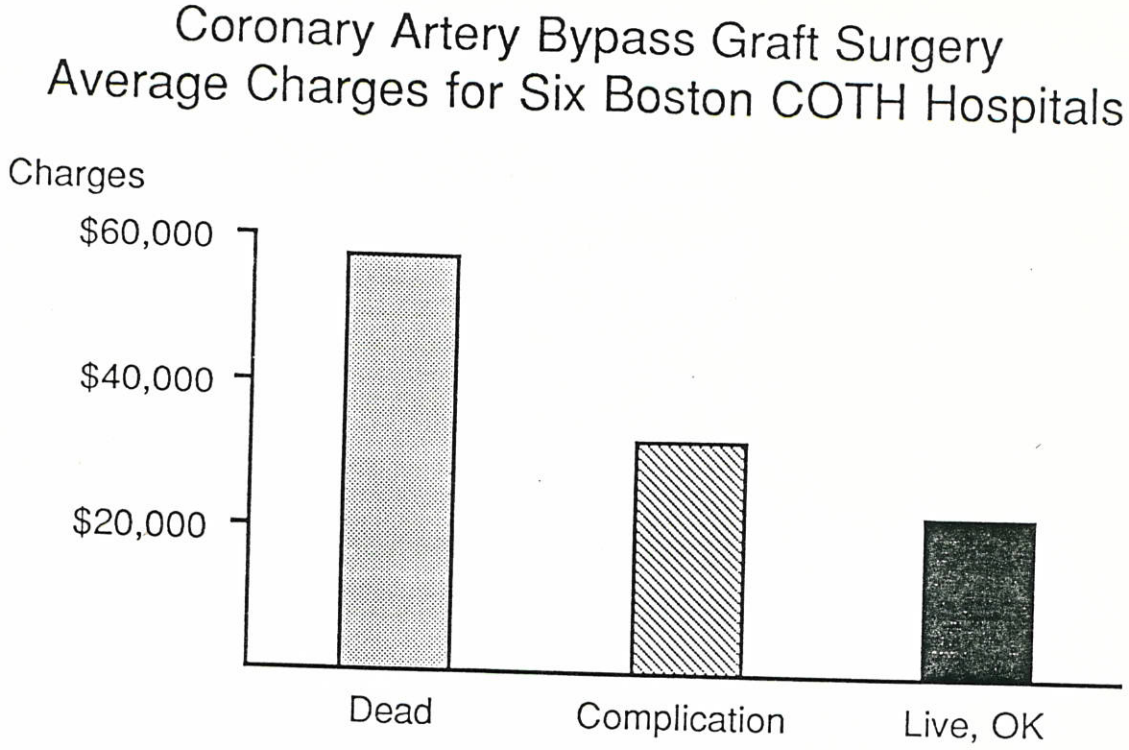

Coronary Artery Bypass Graft Surgery
Average Charges for Six Boston COTH Hospitals
Charges
$60,000
$40,000
$20,000
Dead
Complication
Live, OK

Figure 6

Coronary Artery Bypass Graft Surgery
Average Length of Stay for Six Boston COTH Hospitals

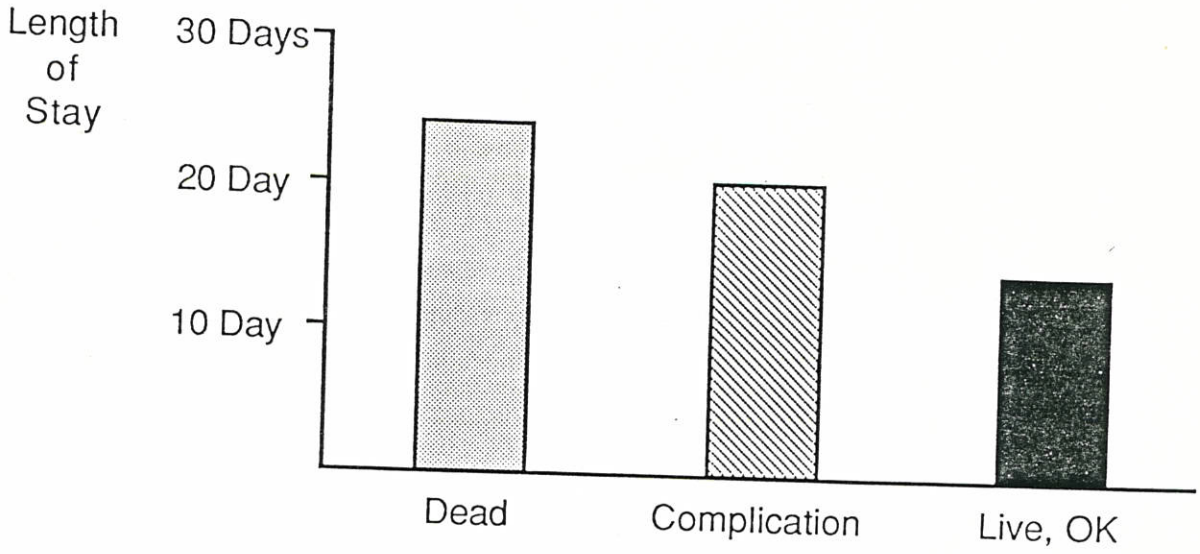


Figure 7

It is unusual for all product lines to exhibit this skew towards high quality. Market share ranges from 3% for trauma to a high of 56% for low risk open heart surgery. The contribution margin varies from a loss of $5,000 per discharge for renal surgery to a contribution margin of $5,100 per discharge for low risk open heart surgery. The following are hypothetical examples of specific product line recommendations that might arise from a strategic analysis:

1. Low risk open heart surgery must be defended as it is extremely profitable in a fairly mature market. However, serious competition is unlikely due to the enormous market share, high outcome quality, and positive image enjoyed by this prominent hospital.

2. Surgical cancer should be promoted. The quality is extremely high and it is profitable in a clinical area in which most hospitals lose money. Most patients undergo 'elective' rather than 'emergency' surgery for cancer. Therefore, growing the market geographically along with this hospital's share could reap large returns and secure an extremely strong competitive position for this hospital.

3. Minor and major gastrointestinal surgical product lines should undergo a detailed quality review to determine the cause of the relatively low quality ratings. Quality should be improved, if possible, and then the GI lines should be promoted.

4. Renal surgery has a $5,000 loss per patient but a large market share and a reasonable quality rating. The hospital should conduct a more intensive review of potential causes for these large losses. Perhaps kidney transplants and other expensive unprofitable renal procedures lie outside the scope of its mission. If not, the hospital might be forced to subsidize renal surgery with profits from other product lines.

5. Surgical trauma has high quality but a small market share. The hospital might be forced to live with the small market share due to geography.

Figure 8

Table 1 illustrates how these data for the same hospital as Figure 8 might be used in a modified Pareto analysis to target the areas for quality improvement.[14] Six major classes of surgery lost money in 1986, as calculated using the research methods outlined above. Nearly two-thirds of those losses come from two types of procedures--renal and orthopedic.

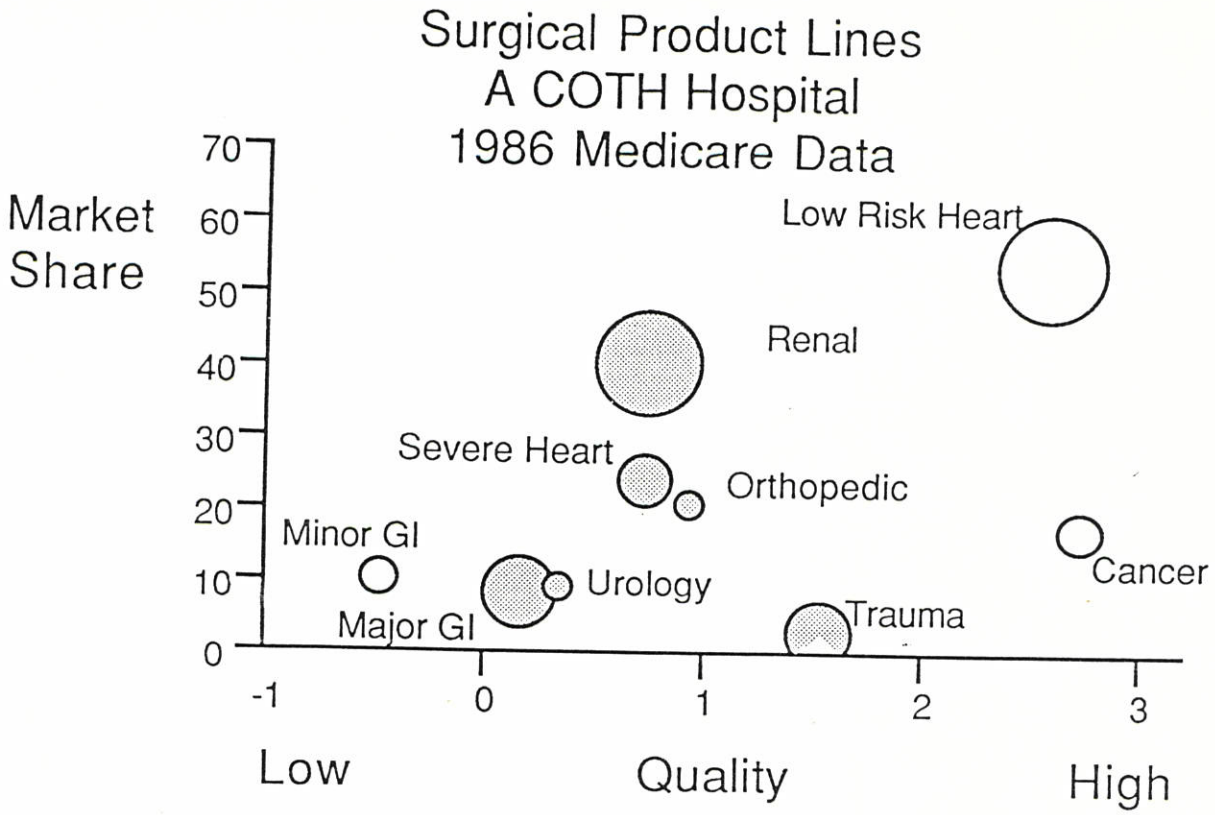

Surgical Product Lines
A COTH Hospital
1986 Medicare Data
Market Share
70
60
50
40
30
20
10
0
Low Risk Heart
Renal
Severe Heart
Orthopedic
Minor GI
Urology
Cancer
Major GI
Trauma
-1
0
1
2
3
Low
Quality
High

Figure 8

Table 1

While neither of these procedures has below-average quality, both of them are only in the average range, with quality indexes of 0.69 and 0.91, respectively. This suggests that investigation of ways to improve the outcomes of these classes of surgery might be successful since others must be achieving significantly better results. Improved outcomes are also likely to have a beneficial effect on the bottom line.

Not all money-losers necessarily have lower quality outcomes--e.g. trauma in this hospital. But a Pareto distribution of financial loses by surgical area compared with the quality index for each area does appear to be a useful tool for targeting some first areas for investigation.

In addition to comparisons among its own product lines, a hospital must compare its performance to its competitors' performance in each product line. Figure 9 illustrates the performance of five university-based hospitals in low risk open heart surgery. All are located in the same metropolitan area (SMSA). There is a huge disparity between the highest and lowest quality scores (over 6 standard deviations between hospital 5 and hospital 1) as well as a large difference in market share (under 5% to almost 50%). As promotion of quality emerges as an important marketing factor, hospitals 3, 4, and 5 must increase quality and then promote themselves to compete effectively with hospitals 1 and 2. Hospital 2 is very profitable when compared to hospital 1 (i.e., $4,600 per discharge versus $1,300 per discharge). Nevertheless, hospital 2 is in a vulnerable position due to its inferior quality relative to hospital 1. Hospital 2 should work to improve its quality before it is overtaken by hospital 1.

Figure 9

A detailed quality review should begin with an analysis of outcome rates for specific surgical procedures over time. The review must be designed carefully, It will need to meet both the technical quality management and the medical staff requirements. The active participation of the medical staff is vital for both the technical adequacy and the medical usefulness of the review. Mortality, complication, and error rates should be charted over time to determine whether the process is under control. If outcomes are not in control, then causes of special variations should be researched. Examples of special variations include individual physicians' behavior, unusual patients (e.g., a new influx of extremely ill patients from a new referral arrangement with another hospital that was not accounted for in the risk adjustment), or implementation of new procedures.

Comparisons of mortality and complication rates among hospitals will help determine what outcome rates are readily achievable with

Surgical Procedure	Percent of financial loss	Cumulative loss	Quality Index
Renal	37.85%	37.85%	0.69
Orthopedic	28.00%	65.85%	0.91
Urology	10.49%	76.34%	0.47
Major GI	10.17%	86.51%	0.26
Trauma	6.80%	93.32%	1.41
High risk heart	6.68%	100.00%	0.69

Table 1. Surgical procedures losing money for a COTH hospital

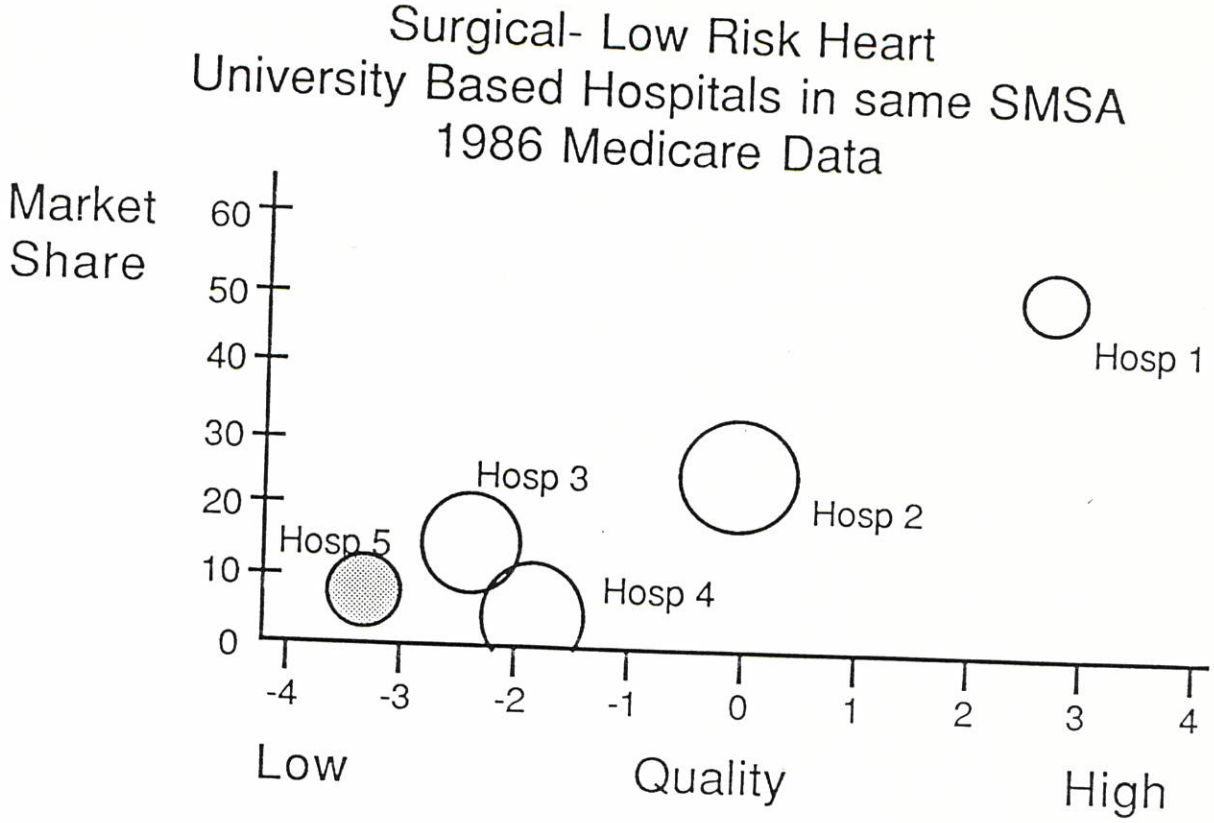

Surgical- Low Risk Heart
University Based Hospitals in same SMSA
1986 Medicare Data
Market Share
60
50
40
30
20
10
0
Hosp 1
Hosp 2
Hosp 3
Hosp 4
Hosp 5
-4
-3
-2
-1
0
1
2
3
4
Low
Quality
High

Figure 9

current technology. Both hospital administrators and physicians need to be involved to change the system effectively. Improving quality is a lot like curing disease. First one needs to diagnose the causes of poor quality. Specific types of complications can be identified using the discharge data. High rates of post-operative wound infections would imply a need for a detailed review of antibiotic prophylaxis. However, high rates of hemorrhages complicating the procedure would call for a comprehensive review of the surgical technique. Once the prime causes of poor quality are identified, it becomes much easier to remedy the problem. Leaping to the remedy without proper diagnosis, however, can be very harmful. In addition, remedies need to be focused on systemic changes, not simply recimination for errors.

Research Conclusions

The principal finding from all of the LHS research is that high quality outcomes are associated with lower cost care. Not only are high quality outcomes a potential marketing tool for hospitals, but the savings from avoiding complications and death will drop to a hospital's bottom line when the hospital is reimbursed by a capitation or DRG system.

To date, the academic literature has found few relationships between outcomes and structure or process as currently understood.[15] However, physicians and nurses can benefit by focusing directly on the desired end result--the outcome--to help them identify those factors which are the most important for the process. Hospitals have access to other hospital's data. The best performers can be readily identified using statistical methods. These methods can identify non-competitive hospitals (e.g., in a different geographic location) that are likely candidates for a poor-performance hospital to learn from. While this could be considered anti-competitiveness in some industries, it is laudable in health care. We cannot stress too heavily that the improvement process must be conducted in a constructive manner rather than as a punitive tool.

Developing elaborate clinical protocols for doctors and nurses without good scientific knowledge of the critical control variables will do little more than prevent a few malpractice cases by enforcing current but somewhat arbitrary standards. We are uncertain of the historical reasons for the attention spent principally on process and structure to the neglect of the scientific study of the relation between process and outcomes.

A greater understanding of efficacy of care is necessary. Research must parallel the studies described in this article, which address the quality of execution of the treatment. Large scale data bases are invaluable as starting points for understanding efficacy of care as well as the quality of execution of the care rendered. If somebody discusses a cost-to-quality trade-off in hospital care, he or she is talking about the cost of structural

or procedural quality--not outcome quality. The empirical research results we have reported here now provide strong quantitative evidence that high quality outcomes are typically less expensive than poor quality outcomes whenever other factors are constant.

For hospitals that are establishing comprehensive quality improvement processes, publicly available HCFA data can be used to perform classical Pareto analysis to identify their most critical problems. They can also help the hospitals consider the market effects of quality and suggest hypotheses to examine in the search for remedies to their quality problems. For employers who see health care as one of their most expensive and least controllable suppliers, these data may suggest appropriate cooperative strategies with the suppliers. And for all of us who share a common concern for quality health care, these data may be an important first step in an exciting and productive diagnostic journey.

The high quality of the American health care system has been heralded world-wide. By enhancing quality we can maintain our leadership position and satisfy the demands of patients and payors alike. New forms of competition or regulation have increased the urgency for improvement. However, systematic continuous quality improvements and planning programs take years to develop and implement. Substantial leadership based on sound quality management strategies is needed if we are to rise to the challenge.

Notes

1. Horace Freeland Judson, The Search for Solutions, Holt, Rinehart, and Winston, 1980, pp. 42-45.

2. I. Bernard Cohen, "Florence Nightingale," Scientific American, Vol 250, No.3, pp. 128-37 (March 1984).

3. Avedis Donabedian, Explorations in Quality Assessment and Monitoring, Volume I: The Definition of Quality and Approaches to its Assessment, Health Administration Press, Ann Arbor, 1980.

4. For example, on 27-29 September 1987, the National Demonstration Project on Industrial Quality Control and Health Care Quality brought together CEO's from 21 major health providers and a like number of quality professionals from other industries to inaugurate pilot projects on broader quality applications in health care. The results of these projects were reported in a summative conference 23-24 June 1988.

5. Dennis O'Leary, "Future Trends in Evaluating Quality of Care," Administrative Radiology, January 1988, pp. 13-17.

6. Lynn W. Phillips, Dae R. Chang, and Robert D. Buzzell, "Product Quality, Cost Position, and Business Performance: A Test of Some Key Hypotheses," Journal of Marketing Volume 47, Spring 1983, p. 41.

7. See for example, J. M. Juran, Juran on Planning for Quality, Free Press, 1988, pp 4-5.

8. Robert D. Buzzell and Bradley T. Gale, The PIMS Principles, Free Press, 1987, pp. 80-82.

9. Ibid. p. 106.

10. Ibid. p. 109.

11. Ibid. p. 7.

12. To the extent that these different discharge patterns affect the quality of care, they will and should affect the results reported here. The choice of the 30-day post-admission measure

comes closest to measuring mortality at the same point in the treatment process.

13. While the mortality rates used in this research have been adjusted for a number of known risk factors, they have not been adjusted for variations in severity of illness at admission. There is no universally accepted method for severity measurement, and research in that area is following a number of different routes. In any case, the HCFA data cannot be adjusted for severity, and the HCFA data base is the only publically available set large enough to perform this type of analysis. It is by no means clear what, if any, affect severity adjustments might make, but the sheer number of cases used in this research make it unlikely that the principal findings would be altered in any significant way.

14. Named after the Italian economist Vilfredo Pareto, who noted that the vast majority of income was concentrated with a distinct minority of persons. This type of analysis is an important initial step in selecting quality improvement projects, as well as in determining the most important causes of quality problems. It helps focus scarce problem-solving resources on the most significant matters.

15. One of the more notable exceptions found in the academic literature is a strong positive relationship between the volume of difficult surgical procedures and positive outcomes. See Harold S. Luft, "The Relation Between Surgical Volume and Mortality: An Exploration of Causal Factors and Alternative Models," Medical Care, September 1980, Volume XVIII, No. 9, pp. 940-949. or Ann Barry Flood, W. Richard Scott, and Wayne Evy, "Does Practice Make Perfect? Parts I and II," Medical Care, February 1984, Vol. 22, No. 2, pp. 98-125.

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BINNS

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BUSINESS EXPERIENCE

10/84 - present — **Lexecon Health Service, Inc.**, Chicago, Illinois

President -- Responsibilities include all facets of managing a start-up company plus product development.

10/83 - 9/84 — Non-compete contract after take-over of Phoenix-Hecht--Developed business plan for Lexecon Health Service.

6/83 - 10/83 — **Phoenix-Hecht Inc.**, Chicago, Illinois.

Vice President -- Responsibilities for this small, privately held, cash management consulting data base company included product enhancements, new product development, mass marketing, and planning.

9/78 - 6/83 — **Needham, Harper and Steers Advertising,** Chicago, Illinois.

Associate Director of Marketing Decision Systems (1/83 - 6/83) -- Internal responsibilities included developing sales and profit forecasts plus new products. Client responsibilities included quantitative marketing, sales and profit forecasting, plus aiding new product development and introduction.

Research Supervisor (2/81 - 1/82)
Research Associate (9/78 - 2/81)

EDUCATION

1979 — **University of Michigan,** Ann Arbor, Michigan.
Ph.D. Psychology (Mathematical area) Decision theory and quantitative methods.

1976 — **University of Michigan,** Ann Arbor, Michigan.
M.A. Mathematics
M.A. Psychology

1973 — **Kenyon College,** Gambier, Ohio.
B.A. Mathematics and Psychology

PERSONAL BACKGROUND

Marital Status: Married, no children
Birthdate: July 6, 1951
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