

# Computer-Based Quality Assurance System

Young Moon Chae, Ph.D.

*The purpose of this study is to demonstrate the usefulness of the computer-based quality assurance (QA) system for achieving a quality-cost trade-off and to demonstrate the validity of the Medical Illness Severity Grouping System (MEDISGRPS) for hospital quality assurance. MEDISGRPS stratifies hospital admissions into severity groups according to key clinical findings, a series of laboratory, pathology, radiology, and physical exam results that indicate an abnormal situation. All 16,428 patients admitted to a large teaching hospital during a nine month period were included in the study. The statistical validity of MEDISGRPS is demonstrated by the direct positive correlation between admission severity and in-hospital mortality and 10th day morbidity rates, as well as between admission severity and total charges, ancillary charges, and length of stay. Empirical examples show how the computer-based QA system provides the information base to establish effectiveness, efficiency, and appropriateness standards, and to identify situations where these standards are not met. The system accurately describes medical practice pattern variations and provides the basis for hospitals to define standards and perform quality assurance.*

---

**Key Words:** Quality assurance, Severity score, Clinical computer system.

The growing complexity of medical care as well as the rapidity with which new knowledge from clinical research is increasing the effectiveness of prevention, diagnosis, and therapy, makes it increasingly important to assure that patients are receiving care of high quality. A number of issues are related to assuring high quality medical care today. One important issue is the quality-cost trade-off. Can costs be contained while quality is maintained? With the improvement in medical technology, there is the potential for overutilization and abuse of the new diagnostic and therapeutic modalities. The current benefit structure of health insurance in Korea, to a degree, rewards such inefficiency.

The purpose of this paper is to demonstrate the usefulness of the computer-based quality assurance system for achieving a quality-cost trade-off and to demonstrate the validity of a severity grouping system, called MEDISGRPS. With an increasing emphasis on high quality and efficient care, such a system will become an essential for hospital survival.

## QUALITY ASSURANCE AND QUALITY CONTROL

In simplest terms, quality assurance (QA) means that the quality of medical care rendered in a hospital meets acceptable standards and that a patient's safety and interests take highest priority at all times (Williams and Donnelly, 1982). Although there is nothing new in this concept, quality assurance per se has been little more than an assumption in Korean hospitals. In order to follow the principle of QA, there should be a formal program and commitment from hospitals.

While the terms "quality control" and "quality assurance" are often used interchangeably, quality assurance is a broader and more positive concept than quality control. That is, quality assurance focuses on improving quality of care whereas quality control refers to "the regulatory process through which we measure quality performance, compare it with standards, and act on the difference" (Juran, 1974).

In particular, hospital performance should be measured against effectiveness, efficiency, and appropriateness standards. Effectiveness is the ability to achieve the desired result — restored health status.

Efficiency is the ability to achieve the desired result with a minimum of resource (cost). Appropriateness is the suitability of the service given the patient's health needs.

Despite the common myth, cost containment is not the same as efficiency. Cost cutting may simply reduce effectiveness. For example, a hospital without a CT scanner may be less costly, but that hospital will be less effective. A hospital must be effective to be efficient. If the desired results are not produced, then the hospital is not efficient no matter how minimal the resources.

## THE COMPUTER-BASED QA SYSTEM

As depicted in Figure 1, the computer-based QA system collects data on all hospital admissions, determines frequencies of admission by chief complaint and other classification methods, and then produces effectiveness, efficiency, and appropriateness reports. A computer-based QA system provides the empirical basis for establishing standards and identifying situations where these standards are not met. Standards of care and severity scores are two essential elements to the system.

### 1) Standards of Care

The Joint Commission on Accreditation of Hospitals (JCAH) has made a major contribution with the introduction of its "Principles and Standards for Quality Assurance," something that is now a must for hospitals wishing to meet accreditation requirements in the United States (Rosenberg, 1975). A similar project was initiated by the Korean Hospital Association in 1980, and now about 170 hospitals are expected to be reviewed by the association in 1985 (Ha, 1985).

In addition to JCAH criteria, there are PSRO (Professional Standard Review Organization) criteria which deal with timing, frequency, and quantity of diagnostic or therapeutic services. However, these criteria are not well accepted by physicians in Korea or in the United States because they are viewed as eliminating flexibility and freedom in medical practice.

QA standards were developed at St. Vincent Hospital (SVH) by empirically describing the medical practice patterns of individual physicians and deciding on the preferred pattern. The physicians outside the preferred pattern were reviewed in detail to identify and address specific problems. The key committees at SVH set standards by consensus. This approach involved examining the variations among individual physician practice patterns, rather than simply taking the average of all practitioners. The average could

reflect a point somewhere between what might be termed good and bad practice patterns, and this is not what the standard should reflect. Instead, standards should promote good practice patterns.

### 2) Severity Scores

Morbidity and mortality rates measure effectiveness in hospitals. However, without an admission severity measure, effectiveness has no context. Hospitals that do not measure admission severity cannot interpret morbidity and mortality rates, nor can they compare effectiveness with other hospitals. Only after effectiveness is known can the quantity and cost of resources used (efficiency) be compared. Furthermore, severity scores are useful in refining measures of prognosis and therapeutic planning.

A brief review of other patient classification methods highlight MEDISGRPS strengths. The diagnosis related group (DRG) system developed by Fetter and his colleagues (1980) has gained widespread support as a basis for both utilization review and as a hospital reimbursement system. The DRG approach requires information on the entire hospital stay, and does not directly address the problem of individual patients with the same diagnosis often varying in severity of illness. Connella and others (1984) expanded the concept of clinical staging of cancer patients to clinical staging of all hospital patients, and have classified discharge diagnoses into more meaningful clinical groups than the DRG system. Staging methods address the severity issue, but are still based on discharge diagnosis and require information on the entire stay, and allocate patients over four levels (often Stage I is uncomplicated and Stage IV death) so that the instrument limits cases to 2 or 3 categories.

Horn and her colleagues (1983) have developed the Severity of Illness Index for hospital patient classification that directly addresses the severity issue, although it is still diagnosis-based. The Severity of Illness Index combines six characteristics: Stage of principal diagnosis, interactions, complications, dependency, procedures, and response to therapy. These methods employ a subjective approach for the chart reviewer to combine subscale scores for a final severity score. More importantly, both methods require information on the entire stay and are influenced by the medical practice pattern followed. Muller (1983) is succinct in her criticism of the Severity of Illness Index. She argues that a patient with a high severity rating may not have been severely ill at admission but rather the high severity rating may have been caused by poor quality in care.

**Table 1. Most common key clinical findings and their assigned severity group**

ABDOMINAL PAIN/FLANK PAIN			
Severity Group 1	Severity Group 2	Severity Group 3	Severity Group 4
	CYSTOSCOPY	PROCEDURES	PHYSICAL EXAM
	Urinary Tract Stone	Endotracheal Intubation	Coma
			PROCEDUREWS Transfusions 12
	PATHOLOGY		
	Acute Appendicitis		
LABORATORY	LABORATORY	LABORATORY	LABORATORY
Glucose 150-299 mg/dl	WBC 18 ( $c \times 10$ ) mm	Amylase 39 9 IU/L	ph 7.1
Albumin 2.5-3.5 gm/dl	Urinary Tract –		
Alkaline Phosphatase	Positive Culture	BUN 51-70 mg/dl –	
125 U/L			
WBC 13-18 ( $c \times 10$ )/mm	Hematocrit 20.1-29.9%	Peritoneal Fluid –	
Hematocrit 30-34.9%		positive Culture	
Calcium 7.0mg/dl		ph 7.1-7.3	
Potassium 5-6 or			
2.5-3.5 m Eg/L			
Sodium 120-128 mEg/L			
X-RAY	X-RAY	X-RAY	X-RAY
Gallstones	Acute Cholecystitis		Biliary Tract
	Small Bowel Obstruction		Obstruction
	Abdomen Mass		
Acute and severe findings	Acute and severe findings	Critical findings	findings
Low potential for	Medium potential for	High potential for	Presence of
organ failure	organ failure	organ failure	organ failure

**Table 2. Mortality and Morbidity rates by admission severity group for patients with abdominal pain/flank pain chief complaint Saint Vincent Hospital – October 1982 – June 1983**

In-hospital	0	1	2	3	4	Total
Mortality Rate	0.7	1.0	2.0	10.0	33.3	3.4*
(per 100 admissions)	(1/145 <sup>a</sup> )	(5/506)	(13/441)	(13/140)	(4/12)	(37/1244)
Morbidity Rate	2.1	10.5	14.3	33.1	62.2	13.5*
(per 100 admissions)	(3/143 <sup>b</sup> )	(52/495)	(61/426)	(41/124)	(5/8)	(162/1196)

\* Chi Square:  $p < .01$ 

a. # deaths/# admissions excluding transfers

b. # patients in severity Group 2 or higher on 10th hospital day/# admissions excluding deaths and transfers

MEDISGRPS collects key clinical findings (KCFs) on admission and during hospitalization in order to measure initial severity and changes over time. These are objective findings – laboratory, pathology, radiology, and physical exam findings – that indicate an abnormal situation. Each finding is assigned to a

severity group. Severity Group 0 is for patients that have none of the MEDISGRPS key clinical findings. Severity Group 1 indicates minimal findings where there is a low potential for organ failure. Severity Group 2 indicates either acute findings connoting a short time course with an unclear potential for organ

failure, or severe findings that involve a high potential for organ failure but when such failure is probably not imminent. Severity Group 3 indicates both severe and acute findings meaning that there is a high potential for organ failure and a short time course is indicated. Severity Group 4 is for critical findings that indicate the presence of organ failure. Patients are assigned to the group of their highest finding. Table 1 presents examples of key clinical findings and their assigned severity group.

## VALIDATION OF MEDISGRPS

All 16,428 patients admitted to Saint Vincent Hospital (a teaching hospital with 578 beds in Worcester, Massachusetts) between October 1, 1982, and June 30, 1983, form the sample for the present study. The admission severity grouping is done after the third day in the hospital because it takes that long for the clinical information to be recorded in the medical record. The chief complaint or reason for admission is used to categorize patients.

### 1) Analysis of Variance (ANOVA)

The following examples demonstrate that MEDISGRPS severity measures are closely related to both effectiveness and efficiency outcomes.

The effectiveness measures used were in-hospital mortality and morbidity rates. Morbidity is defined in this study as the presence and severity level of disease as indicated by one or more key clinical findings. Admission morbidity and severity were measured and compared to tenth day morbidity and severity, in

order to determine if desired results were achieved (effectiveness). The tenth day of the hospital stay was chosen because by this time most patients had improved to the point where they had minimal (Group 1) or no (Group 0) findings. Thus, tenth day morbidity is defined as one or more Group 2, 3, or 4 key clinical findings on the tenth hospital day. These KCFs may occur after day 3 and before day 10.

The results of an analysis of the most common medical and surgical chief admission complaints demonstrate a direct positive relationship between admission severity and mortality and tenth day morbidity rates. For example, Table 2 presents the mortality and morbidity rates for abdominal pain, the most frequent medical admission chief complaint. The Chi-Square test indicates statistical significance ( $p < .01$ ).

To examine efficiency, MEDISGRPS severity measures are linked to total charges, ancillary charges, and length of stay. The results for common medical/surgical complaints indicate a direct positive relationship between admission severity and these efficiency measures. Continuing the abdominal pain example, Table 3 shows that this relationship is statistically significant ( $F = 86.7$ ;  $p < .01$ ). Furthermore, the t-test results indicate that the differences in mean total charges of adjacent severity groups are statistically significant ( $p < .01$ ).

### 2) Discriminant Analysis

Discriminant analysis is a statistical technique which allows the researcher to study the differences between two or more groups with respect to several variables simultaneously. In this paper, discriminant

Table 3. Mean total charges by MEDISGRPS severity groups for abdominal/flank pain admission complaint (deaths and transfers excluded)

Saint Vincent Hospital - 10/1/82 - 6/30/83

Severity Group	N	Mean Total Charge	t-test	Coefficient of Variation (CV)
0	144	1,153	p<.01	1.09 <sup>a</sup>
1	501	2,824		
2	428	4,171	<.01	
3	126	8,460	p<.01	
4	8	29,031	<	
Total	1,207	3,907		1.49

ANOVA:  $F = 86.7$ ;  $p < .01$ ;  $R^2 = 0.224$

<sup>a</sup> Weighted average coefficient of variation (CV)

**Table 4. The results of discriminant analysis on total charge groups for abdominal pain chief admission complaint (Variables used are severity score and age)**

		No. of cases	Predicted groups		
			1	2	3
Actual Groups	1	271	205 (75.6%)	35	31
	2	229	90	83 (36.2%)	56
	3	197	47	30	120 (60.9%)
Total		697	342	148	207

Overall "hit" rate = 58.5%

(Group 1 = under \$2,000 2 = \$2,000-\$4,000, 3 = over \$4,000)

analysis is used to validate the discriminatory power of MEDISGRPS in classifying patients into three total charge groups as well as two morbidity groups.

**(1) Total Charge Groups:** From a financial management perspective, it is important to have the capability to predict their resource consumption or total charges. While it may be difficult to predict resource consumption exactly, the ability to predict several total charge groups can still be very helpful to hospital financial managers.

In order to see how well MEDISGRPS explains or predicts total charges, all patients are divided into three total charge groups: under \$2,000, between \$2,000 and \$4,000, and over \$4,000. In addition to MEDISGRPS, age is also used as an independent variable for classifying patients. One way to assess the discriminatory power of independent variables is by comparing the percent correctly classified by pure chance (without the use of any variables) with the correct classification (or "hit") rate derived from discriminant analysis. By chance, about 33 percent correct classifications would be obtained from each of the three charge groups.

Table 4 shows the results of discriminant analysis for the chief complaint, abdominal pain. When the severity score was used alone, the overall "hit" rate was 51.1%, which is significantly better than the correct rate of 33% by chance. When age was added to the analysis, the overall "hit" rate went up to 58.5%, and individual group "hit" rates become 75.6%, 36.2%, and 60.9%.

Sometime hospitals may want to identify the high charge group as a cost control measure. In such a situation, severity score and age can predict

the high charge group better than pure chance. Of 207 patients predicted as being in the high charge group (group 3), 120 were correct (58%) using two variables, whereas only 197 out of 697 were correct (28%) by chance. These results show that severity score along with age is effective in classifying (or predicting) the three total charge groups.

**(2) Morbidity:** Morbidity measures effectiveness in hospitals. Since patients who are potentially morbid are expected to exhibit complications during their hospital stay, these patients need to be closely monitored based on their admission severity measure. In order to use severity score as a useful quality assurance tool for monitoring effectiveness in hospitals, it is important to show that severity score is strongly related to morbidity (which will not be determined until the tenth day) and can indeed be classified into morbid and non-morbid groups. With only two groups, discriminant analysis amounts to multiple regression analysis with the dependent variable taking the values of 1 and 0. However, when the size of the two groups vary greatly as in our case, the size of each (prior odds) can completely dominate the results. Here it is difficult to determine how well the independent variables discriminate.

As seen in Table 5, prior odds (or correct classification rate by chance) for morbid and non-morbid groups are 8.5% and 91.5%, respectively. The classification table shows the sensitivity rate (actual=1 when predicted=1), the specificity rate (actual=0 when predicted=0), and two misclassification (or error) rates derived from discriminant analysis. When the severity score was used alone, the overall "hit" rate was not better than the prior odds because the non-morbid

Table 5. The results of discriminant analysis on morbidity groups for abdominal pain chief admission complaint

		No. of cases	Predicted Groups	
			0	1
Actual Group	0	635 (91.5%)	633	2
	1	62 (8.5%)	55	7
			688	9

Overall "hit" rate = 91.9%

(Group 0 = non-morbid 1 = morbid)

group completely dominated the results and the prior odds were already high (91.5%). However, when age was added to the analysis, the overall "hit" rate went up slightly to 91.8%. As Morrison (1969) suggests, when one group is much larger than the other, there is often more interest in the smaller group. Of 9 patients predicted as being in the morbid group, 7 were correct. While a slight improvement in overall "hit" rate may not be impressive, this 78% correct rate for

the morbid group, compared with 8.5% correct rate by chance, is a fairly impressive result. Therefore, MEDISGRPS and age are effective in discriminating (and predicting) morbidity groups.

## USING THE COMPUTER-BASED QA SYSTEM

### 1) Effectiveness Analysis

Top priority should be given to discovering why some patients do not meet expected results expressed in terms of mortality and tenth day morbidity. This is crucial not only from the perspective of improving health outcomes, but also because of the large cost savings that can be achieved by finding ways to avoid complications. To illustrate this latter point, Table 6 shows the average total charges for abdominal pain patients separated into morbid and non-morbid subgroups for each admission severity group. The morbid patients have average total charges that are three to four times those of the non-morbid patients. Also, note that the combination of tenth day morbidity status and admission severity explains 43.6% of the variation in charges (ANOVA  $R^2 = 0.436$ ).

There are two complementary approaches to identifying effectiveness problems — individual case

Table 6. Mean total charges by MEDISGRPS severity groups and morbidity status for abdominal/flank pain admission complaint (deaths and transfers excluded)

Hospital #30027 — October 1982 — June 1983

Admission Severity Group	Morbidity <sup>a</sup>	N	Mean Total Charges	t-Test
0	No	141	1,410	p=0.52
	Yes	3	6,367	
1	No	448	2,223	p<.01
	Yes	53	7,908	
2	No	366	3,014	p<.01
	Yes	62	10,998	
3	No	85	5,708	p<.01
	Yes	41	14,165	
4	No	3	10,310	p<.01
	Yes	5	40,264	
Total		1,207	3,907	

ANOVA:  $F = 102.9$ ;  $p < .01$ ;  $R^2 = 0.436$

<sup>a</sup> In Severity Group 2 or higher on the 10th hospital day.

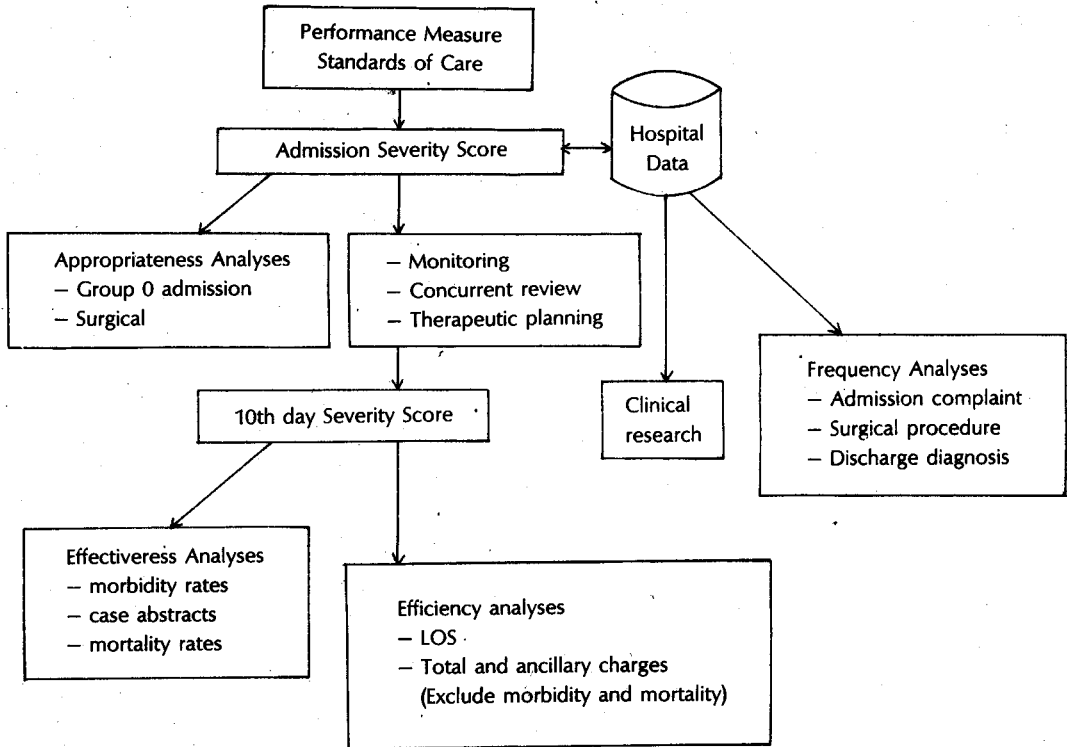


Fig. 1. Computer-based quality assurance system

analysis and comparisons of physician-specific mortality and tenth day morbidity rates. The focus of this study has been on case-by-case analysis because the sample size is too small at this time to permit meaningful studies of physician rates.

All deaths and cases of tenth day morbidity are reviewed. The MEDISGRPS software produces patient abstracts showing the KCFs responsible for both the admission severity group and the tenth day morbidity, as well as the chief admission complaint, discharge diagnosis, DRG, charge data, and other relevant data. Figure 2 presents a sample patient abstract.

These abstracts provide the information necessary to review morbid patients without returning to the medical record, thus keeping the review costs down. By relying on the abstract, the review process does not expose the name of the attending physician which might bias the reviewers decisions. In these reviews, the focus is on patterns of findings that may indicate medical practice problems. Such problems may reveal diagnostic ineffectiveness whereby necessary tests were not done, and/or therapeutic ineffectiveness

whereby proper treatment protocols were not followed.

## 2) Efficiency Analysis

Efficiency analyses should focus on the patients not exhibiting tenth day morbidity. Each physician's practice pattern should be examined in terms of such resource use parameters as total charges, ancillary charges, use of specific ancillary tests or procedures, and length of stay (total or broken down into preoperative and postoperative LOS). MEDISGRPS provides the information to describe practice patterns for each severity group within each chief complaint.

The first type of efficiency analysis looks at physician-specific average total hospital charges within each severity group. For example, Figure 3 shows physician-specific mean total charges for uncomplicated cholecystectomy patients classified at admission into Severity Group 1. Since the focus is on efficiency, this analysis excludes those patients who demonstrate tenth day morbidity. These average hospital charges range from physician A — \$3,954 to

Review Number 1	
Billing Number: _____	Medical Record Number: _____ Sex 1 Age 67
Admission Date: 06-06-83	Discharge Date: 06-24-83
Attending Doctor: _____	Review _____ Date: 06-09-83
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p><u>Complaint Codes</u></p> <p>786.50 Chest Pain</p> <p><u>Diagnosis Codes</u></p> <p>414.9 Chronic Ischemic Heart Disease</p> <p>782.0 Disturbance of Skin Sensation</p> </div> <div style="width: 45%;"> <p>428.0 Congestive Heart Failure</p> <p>438.0 Late Effects of Cerebrovascular Disease</p> <p>410.9 Myocardial Infarction NOS</p> </div> </div>	
Severity Group 1	Hospital Service 22      DRG 124
Ancillary Charges = \$4,754	Total Charges = \$10,785      Disp 5
<u>Physical Exam Findings</u> <p>* Rales or Gallops</p>	
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>Glucose 147</p> <p><u>Electrocardiogram</u></p> <p>* Ischemia</p> </div> <div style="width: 45%;"> <p><u>Laboratory</u>      <u>Findings</u></p> </div> </div>	

Fig. 2. Sample MEDISGRPS patient abstract

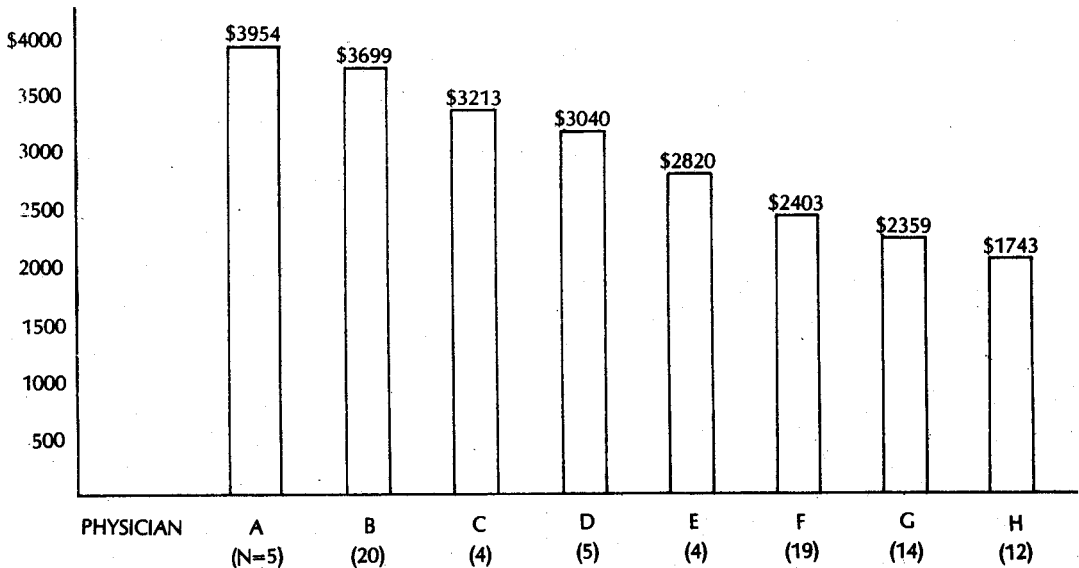


Fig. 3. Mean total charges for severity group 1 cholecystectomy patients by physician Saint Vincent Hospital, Worcester, MA, October 1982 - June 1984

MEAN (ALL PATIENTS): \$3,215  
 MEAN (HMO PATIENTS): \$2,272  
 MEAN (NON-HMO PATIENTS): \$3,645



**Table 7. Proportion of chest pain chief complaint patients with no key clinical findings (severity group 0)  
Saint Vincent Hospital: October 1982 – June 1983**

	Number of Severity Group 0 Outpatients/Total Patients	Percentage
TOTAL (ALL PHYSICIANS)	58/1058	5.5%
PHYSICIAN:	4/7	57.1%
B	8/48	16.7%
C	4/24	16.7%
D	3/38	7.9%
E	3/44	6.8%
F	2/29	6.9%
G	4/60	6.7%
H	2/47	4.3%
I	1/23	4.3%
J	1/25	4.0%
K	1/29	3.4%
L	0/55	0%
M	0/24	0%
N	0/24	0%

**Table 8. Surgical Indications Monitoring: Saint Vincent Hospital – October 1982 – June 1983**

Procedure	Total Cases	No Clinical Findings	Minimal Clinical Findings	Major Clinical Findings
Endarterectomy	15	1(6.6%)	2	12
Abdominal Hysterectomy	29	3(10.3%)	6	20
Appendectomy	36	3(8.3%)	—	33
Cholecystectomy	85	2(2.3%)	37	46

physician H – \$1,743. Note that the physicians with the lowest average are members of a closed panel HMO (Health Maintenance Organization) where the physicians share financial risk.

### 3) Appropriateness Analyses

The purpose of appropriateness studies is to assure that those patients receiving certain services have a demonstrated need for them. One type of study examines the occurrence of admissions for which there are no KCFs (Severity Group). For example, Table 7 presents the results for abdominal pain patients. While 12.0% of all abdominal pain admissions were in Group 0, this percentage varied greatly among attending physicians. The three highest rates are 24.2%, 23.8%, and 21.1% while the lowest are 4.5%, 4.0%, and 0%. When setting standards for this type of study, it is important to realize that both high and low percentages may indicate problems. Physicians with high percentages may have a tendency to hospitalize patients that could be treated out of the hospital. On the other

hand, physicians with low percentages could be waiting too long to admit certain patients.

Surgical indications studies are another type of appropriateness analysis. Such studies determine if there are KCFs that justify the surgical procedure. To illustrate, Table 8 shows data on four procedures: endarterectomy; abdominal hysterectomy, appendectomy and cholecystectomy. For each procedure, the percentage of patients with no KCFs is shown. This type of analysis provides the basis for setting standards, and then comparing individual surgeons and hospitals to these standards.

Diagnosis validation studies are similar in that they compare KCFs to the recorded diagnosis, and permit judgment about whether the clinical evidence supports a particular diagnosis.

## SUMMARY AND CONCLUSIONS

Health care costs can be controlled without decreasing the quality of care given the right incentives for effectiveness and efficiency. These incentives must reward the conservative medical practitioner who delivers services that have a positive impact on health status without over-utilizing expensive resources. Whether these incentives are created by competition or regulation is an important matter for health policy debate.

As health policy changes to reward doing less rather than doing more, the environment will be conducive for hospitals to implement quality assurance systems. Such systems require the ability to see not only that the desired results are achieved in terms of restored health status, but also that this is done at minimum cost. To address both effectiveness and efficiency, MEDISGRPS of the system groups patients by their admission severity, and then measures whether they have complications or morbidity by the tenth hospital day. All morbid patients are reviewed to determine if aberrant patterns of medical practice can be identified. For the non-morbid patients, analysis focuses on the relative efficiency of individual practitioners.

The results of the application of the computer-based QA system at SVH demonstrate both the statistical validity of the measures and the usefulness of the information for quality assurance. An important empirical finding was that the efficiency of individual physicians varied greatly even when morbidity and admission severity were taken into account. Because MEDISGRPS is able to describe these variations, it provides the basis for hospitals to define accepted or preferred medical practice standards. While such standards can be used with positive or negative incentives to change physician behavior, another potential impact is on medical education programs.

Most physicians develop their medical practice patterns in university teaching hospitals as part of their formal medical education (both graduate and undergraduate). It is a reasonable assumption that univer-

sity hospital patients on the average are more severely ill than community hospital patients. Many physicians extend their teaching hospital practice patterns to their community hospital practices upon completing their formal training. The results may be an elaborate style of medical practice that fuels hospital cost inflation while being of questionable benefit in terms of increased effectiveness. The QA system provides the basis for empirical studies of the appropriateness of given medical protocols for patients at each severity level. Physicians can therefore learn to adjust their diagnostic and treatment protocol according to the patient's severity. One important task for us in the future is to adapt such a system to Korean hospitals and to successfully implement it.

## REFERENCES

- Fetter RB, Shin Y, Freeman JL, Averill RF, Thompson JD: *Case mix definition by diagnosis - related groups. Med Care 18 (suppl 2): 1-39, 1980*
- Gonnella JS, Hornbrook MC and Louis DZ: *Staging of disease, JAMA 5:637-644, Feb 1984*
- Graham NO: *Quality assurance in hospitals; Strategies for assessment and implementation. Aspen Publication 199-218, 1982*
- Ha HO: *A direction for accreditation of hospitals in Korea. J of the Korean Hospital Asso 29-41, April 1985*
- Horn SD, Sharkey PD, Betram DA: *Measuring severity of illness; homogeneous case mix groups. Med Care 21:14, 1983*
- Juran JM: *Basic concepts in quality control handbook - 3rd ed, edited by JM Juran, FM Gryna and RS Bingham New York, McGraw-Hill Book Company 1-10, 1974*
- Morrison DG: *"On the Interpretation of Discriminant Analysis" Journal of Marketing Research 6: 156-63, May 1969*
- Muller C: *Paying hospitals; How does a severity measure help? Am J Public Health 73:14, 1983*
- Rosenberg EW: *What kind of criteria? Medical Care 13:966-975, 1975*
- Williams KJ and Donnelly PR: *Quality assurance. Medical care quality and the public trust, pluribus Press, 186-200, 1982*