Clinical and financial evaluation of patients within a diagnosis related group

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CLINICAL AND FINANCIAL EVALUATION OF PATIENTS
WITHIN A DIAGNOSIS RELATED GROUP

A Thesis
Presented to
The Faculty of the Graduate School
University of the Pacific

In Partial Fulfillment
of the Requirements for the Degree
Master of Science

by
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November 12, 1984
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Dated November 12, 1984.
Dedication

I dedicate this thesis to

my wife, Aisha, my son, Mohamed,

and my parents,

who have been a constant source of love and encouragement, and to

God who provided the strength to endure.

1984
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INTRODUCTION

National expenditures for hospital care have increased significantly since the mid-1960s, rising from $13.9 billion in 1965 to about $99.6 billion in 1980, a gain of nearly 617 percent. These increases have led to a widespread concern regarding the high rate of increase in hospital costs (1-6). Because of the magnitude of the problem, officials of state health care programs now have incentives to reduce the rate of cost increase (2). The problem is more worrisome to the federal government since inpatient expenditures for elderly patients in the Medicare program rose from $4.5 billion in 1970 to $22.8 billion in 1980 and were projected to rise another 33 percent by 1982 (1). Similarly, it was reported that health care spending in 1981 had reached 9.8 percent of the gross national product. Federal spending for Medicare accounts for $73 billion, of which $42 billion was spent on hospital care alone (3). At the same time, hospital expenditures for drugs in the United States have increased from $1 billion in 1972 to $3 billion in 1982 (4).

In fact, the government has been attempting to shape the health field since before World War I leading to substantive legislation at the federal level in the 1940s (5). In the early 1960s, the growth of the gross national product was reasonably strong, inflation was moderate, and
health care costs, although high, were deemed affordable. It is to be noted that the legislation from the 1940s, 1950s, and early 1960s was supply oriented. But in the late 1960s, the philosophy began to change. Federal and state governments began to be more concerned with cost. Restraints on expansion of the number of inpatient beds and greater interest in containing cost became an important approach by health policy planners (2,5,7). Several laws had been passed concerning health care programs including: Medicare and Medicaid (1965), Neighborhood Health Center support (1965), and the Comprehensive Health Planning Act (1966). Further, Bills, et al., (2) reported that "... Congressional programs were passed and included the Nixon Administration's Economic Stabilization Program operated from August 1971 to April 1974 which included specific rules to limit cost increases in hospitals nationwide. In addition, the introduction of the Carter Administration's hospital-cost containment proposal in early 1977 and the subsequent consideration of that proposed by Congress increased the states' interest and the regulators' ability to restrain cost increases."

It was noted that the traditional cost-based reimbursement system had a lot of problems in terms of fairness, comprehensiveness, and sensitivity to the major variables affecting hospital cost. Davies, et al., (8) demonstrated the shortfall encountered with the traditional reimbursement system which includes:
a- The use of patient day as a unit of service for cost and reimbursement.
b- The lack of true incentives for health care providers to contain costs.
c- A definition of cost that does not cover the full financial elements of the hospital.
d- Most traditional systems do not apply to all payers, but rather some defined subset of major payers.
e- Lack of comparability of costs across institutions.
f- Institutionalized cost behavior of high cost providers.
g- Lack of sensitivity and fairness with respect to case-mix (the type of services an institution provides) differences [for definition of case-mix data items, see Appendix A].

Davies suggested that because of these and other problems, hospital administrators, hospital regulators, legislators, and other interested parties have examined alternative health care provider reimbursement methodologies. The most widely publicized alternative was the use of Diagnosis Related Groups (DRGs) to classify patients into homogeneous groups to reimburse hospitals. The DRG alternative is one method of Prospective Payment System (PPS). Other methods of PPS include: Capitation, Preferred Provider Organizations (PPOs), Health Maintenance Organizations (HMOs), etc. However, discussion of these methods is beyond the scope of this study.
Curtiss in two separate reports (9,10) and others (11) indicated that the most recent and pervasive changes were imposed by Congress in PL97-248, "The Tax Equity and Fiscal Responsibility Act (TEFRA) of 1982" signed by President Reagan on September 3, 1982. The TEFRA cost-per-case imposed limits on Medicare payments to hospitals, which represent approximately 40% of average hospital revenue. TEFRA limits were applied only to hospital fiscal years beginning on October 1, 1982 to September 30, 1983. Beginning October 1, 1983, hospitals were to be paid at a fixed rate for care provided to a Medicare inpatient within a particular DRG. The DRG system will be phased in over fiscal years 1984-1987, i.e., there will be a gradual transition from cost based reimbursement to rate-based set retrospectively.

In general, these reports indicated that there is a change from the eras of exciting, new opportunities, chance of creativity in clinical implementation, system development and improving of quality of care to a different dilemma, that is, an era of lack of money (12). However, Enright (7) emphasized that "whereas hospitals in the past were rewarded for spending more, now they will be rewarded for cutting cost and improving productivity."

On the other hand, several writers (1,12) pointed out that the bulk of the increase in hospital expenditures was attributable to factors outside the control of hospital managers, such as inflation and the growth and aging of the
population. Zilz (12) summarized the problem by saying that the problem has many factors including: increased United States population, increased number of elderly, health care expenditures rising faster than inflation in other industries, and a mismanagement of health care resources.

1. What are DRGs?

1. A. Definition

Diagnosis related groups (DRGs) represent a homogeneous grouping of patients who require roughly the same treatment of care, and thus it is assumed they will use similar amounts of hospital resources. In other words, it is assumed that the quality and nature of the resources consumed by patients are similar within a DRG, yet different across DRGs (3,6). The criteria that were used to define DRGs are (13):

a- All patients were to be assigned to a DRG (exhaustive) and any given patient was to be assigned to one and only one DRG (exclusive).

b- These DRGs should be manageable in number; that is, no more than 500 DRGs.

c- Differences in length of stay (LOS) were not statistically significant.

d- They are based on the Uniform Hospital Discharge Data set: diagnosis, surgical procedures, patient age, and discharge status.
1. B. Development and Purpose

DRGs were developed primarily at Yale-New Haven Hospital in the early 1970s by health services researchers, Robert Fetter, John Thompson, and Richard Averil. The researchers were interested in defining expected LOS so that utilization review activities could be focused on atypical patients (2,3,6,9,13). The creators of DRGs believed that DRGs would identify and describe the hospital's major products, and therefore, be used for cost control and for determining hospital reimbursement categories and rates (3).

1. C. Classification

Doremus, et al., (18) and others (1,6,15,16,17) reported that to date there have been two sets of DRGs developed. The original set, based upon the ICDA-8 coding scheme, included medically similar patients, and were categorized into 83 major diagnostic categories (MDCs) based on the primary diagnosis. These MDCs subsequently underwent a subgrouping analysis based upon LOS consideration. This was achieved using an interactive computer system known as "AUTOGP" (automatic grouping system). AUTOGP was designed to facilitate rapid analysis of complex medical information yielding results of a uniquely high statistical and medical quality (16). This original set of the 83 MDCs consisted of 383 DRGs. The latest set, based upon the more extensive ICD-9-CM coding scheme, was develop-
ed by the Health Care Financing Administration (HCFA), and consisted of 467 DRGs aggregated into 23 MDCs (3,9,13,18).

It is important to mention that the first generation DRG system had several limitations. The most important limitations were low clinical coherence and limited acceptance of the system by physicians. Furthermore, the comparatively small, geographically unrepresentative sample of patients used to develop DRGs undermined applicability of the system nationwide (13). Bills, et al., (2) in their study showed that evaluation of the early phases of state efforts to control hospital costs led to discouraging conclusions about the effectiveness of such programs. However, the new DRGs specify separate payment rates for urban and rural areas, expand the number of DRGs, and propose adjustments for differences in area hospital wage levels compared to national averages (20).

Beginning in October 1983, DRGs became the basis of payment for the federal government's version of the prospective payment plan for hospitals. Curtiss (9) wrote that the prospective payment system is revolutionary in that hospital reimbursement for Medicare patients will be based almost exclusively on DRG rates, regardless of actual hospital cost.

It was stated by others (3,19,21) that hospitals receive the same rate for all patients within a DRG regardless of LOS or amount of services consumed, i.e., what a hospital receives for the care of a patient will be di-
agnosis-related but not related to what the hospital spends. Thus a clear incentive exists for administrators to minimize costs because reduced expenditures will mean more hospital income.

1. D. Impact on Hospitals

It is clear that rate-based reimbursement puts hospitals at a financial risk to varying degrees, depending upon the unit of service to which the price is fixed (9). Therefore, for the sake of institutional survival, administrators will be initiating programs that are designed to minimize services to individual patients without compromising treatment success (21).

In contrast to the traditional reimbursement system, where hospitals are paid after services have been provided to patients, prospective rate-setting programs set a pre-established fixed charge for a service prior to the period for which the service is to apply (17,19).

It is theorized that it could be possible to compare relative performance between hospitals. As a result, efficient hospitals can be identified and rewarded. This incentive will encourage efficiency which will help control hospital costs.

1. E. Participating States

Maryland, Massachusetts, New Jersey, and New York will not have to participate in the new plan for a few
years because these four states have their own cost-containment program (12,23). All other states are scheduled for a phase in plan over four years, which began in October 1983.

1. F. Hospitals Covered Under PPS

Prospective pricing applies to all hospitals (including rural hospitals operating fewer than 50 beds) with the exception of the following (7,9,11,20,24):

1. Long term care hospitals (average LOS over 25 days).
2. Pediatric hospitals and units (patients under 18 years of age).
3. Certified psychiatric hospitals.
4. Rehabilitation hospitals.
5. Psychiatric and rehabilitation units of general hospitals, if these units have separate admission and discharge policies.
6. Hospitals that can establish sole community provider status by providing the sole source of local care and geographical separation from alternate sources of hospital care.
7. Hospitals treating a high volume of low income or Medicare beneficiaries and public hospitals.
8. Regional referral centers.
9. Specific cases (patients) with extraordinarily long LOS "Outliers." See Appendix B for definition of outliers.

2. Expectations About DRGs

Being a new experiment, DRGs are in the center of public debate with roughly an equal number of supporters and detractors and, perhaps, a large group uncommitted (5).

2. A. i. Fears and Limitations (6,17,25)

Under PPS, there is a fear of inaccurate reviewing, explanation, or coding of patient data, which may result in misrepresentation, and therefore, cannot be used to measure resources or to accurately predict reimbursement needs. This is particularly true since the overall system relies on abstract data that may contain misclassification and coding errors which can fail to include all diagnoses.

Van Etten (27) pointed out three major problems encountered that may affect the success of the new system. First, the clinical and financial information are separate. Second, clinicians are not integrated into the management process. Thirdly, there is improper management of productivity in terms of intermediate and endproduct management. In addition, collecting detailed quality assurance data is either impractical for most hospitals or it requires a tremendous amount of additional work for hospitals (26).

On the other hand, Kreitzer, et al., (17) and others (6,28) reported early that the overall DRG concept has
failed to consider the most essential patient characteristic, namely, severity of illness. They believe that this characteristic correlates with the intensity of services provided and the amount of resources utilized. Horn (29) in her study reported a positive relationship between severity of illness and the hospital and laboratory charges, LOS, number of consultations, and mortality rates.

Several studies addressed the hospital's behaviour in response to the new reimbursement system. Wagner (30) suggested that "...getting a patient well, quickly, and with minimum use of resources can create an incentive payment, but it may leave you (the hospital) with a patient complaining about a high bill for what he or she perceives as a short stay with little service." Similarly, it was stated by others (26) that "Some hospitals might curtail needed services to patients, thereby cutting costs and increasing profits."

In addition, there is a concern that hospitals will deny or restrict access to care rather than meeting the challenge of managing better and being more cost effective (20). Further, prospective payment systems give hospitals incentives to discharge the patient early. However, as stated by Nestler (26), such behaviours are unlikely, since the attending physician is not going to discharge a patient prematurely.

Another potential problem was expressed by McNerney (5) in that the hospital will shift from a philosophy of
cure to one of treating symptoms. This point was supported by Hally (14) who mentioned that the most threatening aspect of the DRGs payment system is its impact on patient care. In his opinion, many diagnoses can neither be clearly defined nor treated in a similar manner. He added that the problem with DRGs is it simply measures cost efficiency and does not consider whether or not the patient is cured. Moreover, he mentioned that there is a risk that the product will be cheapened to reduce costs which sacrifices patient care.

Escalating diagnosis by coding cases into higher cost DRGs, termed "DRG creep," as well as discharging patients early and readmitting them, or "gaming" the system by admitting lower-cost illness, represent another limitation of the system (5,6,9,31). Mahonly, (31) executive director of the area I Professional Standard Review Organizations (PSROs) in Madison, however, said that "the PSRO can easily detect that practice." This could be true since the quality review systems as established by the PSROs contain the following elements:

1. Admission certification;
2. Continued stay review;
3. Validation of diagnoses and procedures;
4. Ancillary review;
5. Discharge planning;
6. Medical care evaluation studies; and
7. Profile analysis.
Curtiss (9) stressed that the Department of Health and Human Services (HHS) plans to combat DRG creep through a use-review program of hospital and physician admission patterns, as well as a DRG verification audit.

Additional fears and negative views include the following (1, 5, 14, 26, 32, 33):

a- Hospitals will be paid approximately the same standard fees and therefore will enjoy little surplus in the long run.

b- The new system may put some hospitals at risk if they cannot share services with another hospital to provide care for certain types of its patients.

c- The new system unavoidably introduces more work on the medical records staff in terms of DRG documentation and chart review.

d- Some hospital officials claim DRG reimbursement slows improvement in the quality of medical care by making it more difficult for hospitals to obtain needed, improved technology.

e- There is fear that the physician's preoccupation with price will lead to increasing the adversarial relationship between the medical staff and the hospital, which may lead to unbundling of services (5).

2. A. ii. Adverse Effects of DRGs on Hospital Pharmacists

DRGs created additional pressures on hospital pharmacists which can be summarized as follows (12, 23, 27, 32):
1. Conflicting pressure from hospital administrators, representatives of drug industries, and physicians' prescribing patterns.

2. They are no longer an important revenue center.

3. Expected to assume responsibility for no more than cost.

4. Concern regarding distribution costs and how they affect total cost, e.g., unit dose.

5. To balance quality and services with financial management issues to cope with the health care environment of the future.

2. B. Positive Views

In spite of the previously listed negative views, some of which have already been solved or are being solved, there are tremendous positive views and good news regarding DRGs (1,2,5,6,15,20,21,25,27,30,31,34,35):

1. DRG reimbursement encourages physicians, nurses, heads of ancillary departments, financial officers, and other staff members to work together as a team to render care efficiently and to expedite the flow of correct paperwork.

2. Patient care must be monitored since the pricing system set up incentives to discharge a patient as quickly as possible and to restrain unnecessary testing.

3. Pharmacists will no longer use high drug charges in order to provide more revenue to the hospital.
4. The new system gives significant additional influence and authority to the pharmacists.

5. DRGs will require hospital pharmacists to restrict their formularies, and make greater use of generic drugs.

6. DRGs may prove to be an effective way to monitor and control costs and utilization of hospital services.

7. The DRG system will facilitate the preparation of annual management reports by the State Department of Health.

8. It allows determining those DRGs for which the hospital may exceed the average in LOS or in the cost of service rendered. These DRGs could be monitored on a regular basis.

9. PPS significantly decreases the annual rate of increase in hospital costs (2).

10. DRGs can be used not only for reimbursement but also for budgeting, planning, and quality assurance programs.

11. It will force hospitals to supply the best possible patient care at the lowest cost.

12. Physicians may integrate "cost" as a part of the equation of hospital care.

13. Computerization becomes crucial for the hospital to identify potential financial problems. Computers perform data organization and report preparation in a timely and accurate manner. In addition, it explores an institution's "market basket" of service (35).

14. DRGs can be used as a unit for comparison and payment especially in the competitive environments.
It is concluded that DRGs will provide previously unavailable information and will serve as a promising system to monitor and control hospital resource utilization. In addition, the DRG system encourages hospital pharmacists to put their expertise into practice by educating the physician on cost-effective drug therapy alternatives.

3. Hospital Strategies For Survival

The current financial and competitive pressures are forcing institutions to develop new strategies for survival. Strategies must be employed to develop incentives to reduce the cost of inpatient acute-care services and to increase productivity (38).

Several reports (15,16,18,25) emphasized that reviewing and confirming the accuracy of diagnostic and surgical data by appropriate retrospective audit should be initiated as the first step. Also, apparent contradiction between clinical and billing data should be eliminated for the current case-mix based on DRGs in order to measure resource use precisely and predict reimbursement accurately. Further, these data found in the medical records should be improved to the extent that they can be considered reliable not only for case mix determination but also for management reporting, quality assurance, utilization review, diagnostic costing, program planning and research.

Mills, et al., (16) believe that AUTOGP makes an important contribution by handling complex data analysis
especially when large numbers of observations are involved with many variables identified per observation. Mills added that "in such cases efficient data management is crucial if the analysis is to be cost effective."

Sankey, et al., (37) have shown that the use of a more accurate method of cost allocation will assist hospital administrators in determining whether charges accurately reflect the cost of the resources used to care for individual patients. Cost allocation should provide hospital managers with one of the instruments they need to improve planning, budgeting, and hospital operations.

On the other hand, Crane, et al., (36) pointed out that costs have to be managed first before they can be contained. She found that 20 percent of her drug items account for 80 percent of her drug revenue. She concluded that "It is prudent to separate the vital few from the trivial many."

Medical records staff must thoroughly familiarize themselves with DRG documentation and perfect their ability to search and to interpret the charts in order to gather all relevant information.

For these complicated issues, Grimaldi (1) stressed that hospitals need a full time employee who not only coordinates departmental efforts to function with DRGs but also who is able to establish a good working relationship with diverse groups of personnel. This employee is the "DRG coordinator." The DRG coordinator will identify
DRGs and departments that are encountering cost problems.

Zilz (12) and others (3) reported that there is no doubt that administrative reorganization is a must. For example, if an efficient hospital is competing with many inefficient hospitals, the inefficient hospitals will stop providing services, because they are losing money, or they become more efficient to survive. In Zilz' words, "the bottom line is survival of our hospital at any cost ... through either discontinuing services, addressing the prescribing influence, reducing laboratory orders, freezing salary, and assigning proper personnel who efficiently do a specific job."

Several institutional strategies were suggested by Bonney (38) in responding to the financial pressure that have been outlined. The best strategy for institutional survival in his opinion is diversification. Horizontal diversification includes expanding hospital business into similar and complementary lines. Vertical diversification is described as establishing services other than those providing acute care. Health services include consultation in areas in which they have expertise, continuing medical education or renting or buying health equipment. Nonhealth care business is unlimited and may include real estate, restaurants, etc. Bonney added that marketing strategies, either to physicians or to payers, is another major alternative that should be considered.

In addition, development of information systems, is
important for hospitals to operate under PPS and to know the cost of treating patients in a specific DRG. This information system will help to establish a mechanism to determine the cost per DRG which would reflect the profitability of a particular service (38).

Another strategy Bonney (38) has suggested is to reduce acute care inpatient services and to increase productivity. He wrote that one way to achieve this is to reduce the peak service demand for ancillary services.

Improving medical practice and proper utilization of ancillary services is another strategy that will result in high profitability (5,27). Figure 1 represent the relationship between case-mix, medical practice, productivity, and profitability from the chief financial officer point of view, as suggested by Van Etten (27). He pointed out that there is a significant difference in LOS, admission rate, and ancillary utilization by states and hospitals. Van Etten attributed that to the differences in medical practice which, as he mentioned, can be controlled by case mix which in turn leads to increased profitability.

It is to be concluded that the future belongs to those who can identify community health care needs and then organize and market a delivery system to efficiently, effectively, and economically meet the need. In contrast, Bonney (38) commented that "Those hospitals that play "ostrich" by burying their heads in the sand and continue with "business as usual" will be soon out of business."
Figure 1. The Relationship between Case Mix, Medical Practice, Productivity, and Profitability.
4. Pharmacy Management Strategies

In the era of constrained reimbursement and intense competition, pharmacy departments are making reducing cost a top priority (39). Hospital pharmacists have a great and unusual opportunity to reduce pharmacy operating expenses by eliminating unnecessary prescribed drugs and reducing drug cost through the use of therapeutically equivalent drugs.

Specific recommendations (12,23,27,34,40-43) have been made to control pharmacy costs and are summarized as follow:

1. Reduce the price per unit purchased.
2. Decrease the size and dollar value of drug inventory.
3. Implement a restricted drug formulary.
4. Perform drug use reviews.
5. Educate physicians on the relative cost of alternative therapies.
6. Educate the patient and physician about medication errors.
7. Reduce drug serum assays.
8. Use efficient dispensing and distribution of drugs.
10. Work closer with other departments.
11. Computerize the detection of drug interactions, allergies, etc.
12. Reduce drug deliveries to nursing units.
13. Quantify and reduce pharmacy waste.
14. Identify and label expensive drugs in the pharmacy.
15. Notify head nurses of the cost of expired drugs.
16. Remove skin test products from nursing units and change to unit dose issue.
17. Perform comparative analyses of drug cost within the hospital and between hospitals.

Raymond (44) suggested that pharmacy department strategies should be targeted at three major areas, human resources in terms of productivity and efficiency, material resources in terms of cost control and product decision making, and system resources in terms of installment of audit trail, documentation of use, and cooperation between health care providers.

Another approach for pharmacy cost management was reported by Crane, et al., (36) who pointed out that there are three major factors that should be kept in balance:

1. Administrative management: purchasing, inventory, negotiation, and price comparison.

2. Clinical management: providing current and continuous support to physicians regarding drug cost and alternatives, patient education programs, influence prescription habits, and drug utilization review.

3. Distributive management: equipment and personnel management, dosage form and unit dose distribution, checking dose frequency and schedules, and personnel efficiency distribution.

The pharmacy's focus, therefore, could be to identify
outlier case-type, bridge the gap between medical and administrative staff, be concerned about cost not charges, increase productivity, and provide a system to collect and analyze data related to drug costs and case type (27).

Upton and associates (45) reported in their study that the pharmacist's consultation services to physicians regarding drug selection and regimen design, coupled with patient compliance counseling, documented an annual saving in retail drug costs of $200 per patient. Upton added that "in addition to cost-saving, the average number of dosage units was reduced from 7.6 to 4.5, thereby encouraging improved compliance."

Another area of the pharmacist's expertise when considering a drug for formulary status is to verify the manufacturer's claims regarding the introduction of a new and more expensive agent. One example of claims that should be verified includes that of reducing hospital stay requiring fewer doses before a cure is achieved (7).

Controlling drug costs in hospitals has been reported in many other studies (4,39,46). Mehl (4) listed several indicators that can be utilized for this purpose. These indicators include: calculating drug cost inflation index, cost per patient day and per clinic visit, cost per prescription, pharmacological-cost indicator, disease-drug cost indicators, intravenous solution, and radiopharmaceutical-cost index.

Purchasing, inventory control, and waste reduction
techniques to minimize non-personnel expenditures were reported by Abramowitz (39) and McAllister III (46). They wrote that cost-saving purchasing mechanisms including competitive bidding, contract negotiation, group purchasing, and primary wholesaler purchasing were proven to be effective.

In the era of prospective pricing, the hospital pharmacist will acquire new financial, clinical, and communication skills as well as new relationships with administrators, physicians, and nurses. McAllister stressed that for the hospital pharmacist to succeed, he must follow market trends, follow institutional use patterns, and understand the complicated interrelationship between supply and demand and input and output to maximize the effectiveness of purchasing and inventory control efforts.

Finally, changing prescribing patterns were reported by Abramowitz (47) as an effective way to control financial variables. Using pharmacists to advise physicians regarding appropriate drug therapy will ensure the highest quality pharmaceutical services at the lowest possible cost. The author suggested that enough flexibility should be allowed for more costly services or therapies to be used when required but those less costly should be used when sufficient. He further added that the key to controlling prescribing patterns will be through pharmacist involvement with formulary management, closing and maintaining the
formulary, Pharmacy and Therapeutics Committee, drug monographs, automatic stop orders, decreasing therapeutic duplicates, and restriction of drug use.

All of the above mentioned skills and relationships will provide the pharmacist with factors necessary to succeed in the new reimbursement environment.

5. Impact of DRGs on Physicians

In the past, the physician dictated the level of hospital care provided to patients with little or no regard to cost. Now, cost will become an important factor since hospitals have an incentive to minimize expenditures (21).

There are two components of cost, the hospital component (laboratory procedures, drugs, etc.), and the professional component (prescribing patterns, operating room hours, etc.). The second component is more difficult to manage. Shapleigh (27) in her study showed that there is evidence indicating a significant variation in medical practice patterns. On the other hand, she pointed out that there is a dichotomy between the hospital's payment incentives and those of physicians.

For the hospital to survive in the changing reimbursement environment, physicians' strategies should be aimed at the following (9, 20, 27):

1. Manage and limit hospital resource usage.
2. Educational need about cost of drugs especially antibiotics, laboratory work, and unit of services.
3. Synchronization of physician incentives with hospital incentives.


5. Incentives to increase outpatient and home health care services.


It is predicted that doctors and hospitals will have a new interest in reform and collegial working relationships under the PPS for the sake of institutional survival (1,5).

Van Etten (23) mentioned that "We developed a sophisticated financial system but we have not developed information that shows clinical and financial cost." He added that "...Everyone describes his own cost, e.g., pharmacy cost, laboratory cost, but nobody describes the case cost or the endproduct cost."

To date, very few studies, if any, have been published evaluating and correlating clinical data to the variability of the patient's pharmacy charges within a DRG category. Upton and associates (46) proposed a specific plan of attack focusing on an analysis of expensive DRGs. Evaluating DRGs with high pharmacy charges was suggested as the first step in the analysis. Upton's plan was to intensify pharmacists' monitoring of patients having diagnoses with high pharmacy charges.
6. Purpose of the Study

The purpose of this study is to evaluate financial and clinical data of patients within a selected DRG. The data obtained from such analysis will be used to design a system whereby clinical pharmacists may improve the hospital's reimbursement potential.

Based upon Upton's proposed plan, this study is designed to evaluate all DRGs in a community hospital in an attempt to focus on those DRGs which represent the greatest financial pressure to the pharmacy department and, therefore, to the institution.

Clinical and financial data of patients within the expensive DRG, will be collected from their medical and financial records for subsequent statistical analysis with special consideration to pharmacy charges.

The ultimate objective of this study, though, is to provide a list of measures or parameters that may affect the patient's hospital charges. Using these parameters, the clinical pharmacists will be able to intensify their monitoring of patients with high pharmacy charges in an attempt to reduce their impact on patients' charges.
METHODOLOGY

This study was designed to review and analyze DRGs at St. Joseph's Hospital, in Stockton, California. The main objective was to determine the relationship between clinical and financial data for patients within a DRG. The second objective was to identify patient-specific information that may reflect high pharmacy charges and the need for clinical pharmacy intervention. The third objective was to propose criteria that may predict which patients need to be monitored in an attempt to control pharmacy charges within a selected DRG category.

A. Patient Population

All patients admitted to St. Joseph's Hospital, Stockton, California, a 316-bed community hospital, between January 1, 1983, and August 31, 1983, were retrospectively assigned to DRGs. The Medical Records staff at the institution assigned a total of 10,550 patients to 390 DRGs using the system described by Grimaldi and Micheletti (1), the Medicare DRG list published in the Federal Register (49), and the International Classification of Diseases (50,51).

Medical records staff were assisted in assigning DRGs by a computer program provided by Shared Medical Systems. Shared Medical System Corporation, 2041 Rosecrans Avenue, Suite 287, El Segundo, CA 90245.
which uses a computerized decision tree for categorizing patients.

B. Study Design

For the purpose of the present study, the 390 DRGs were ranked based upon their total pharmacy charges per DRG. From this original ranking, the top 20 DRGs were defined as the 20 most expensive DRGs for the pharmacy department (48). Subsequently, the following data were compiled for the defined 20 most expensive DRGs:

1. Number of patients per DRG.
2. Major diagnostic category (MDC).
3. Total and mean pharmacy charge per DRG.
4. Total and mean hospital charge per DRG.
5. Mean length of stay (LOS) per DRG.
6. Pharmacy charge as a percentage of hospital charge within each DRG.
7. DRG distribution and total pharmacy charge by MDC.

The 20 most expensive DRGs, for the pharmacy department, by total pharmacy charges are listed in Table I.

The compiled data were analyzed and correlated from different perspectives to select the most expensive DRG category (see page 32). Surgical and neoplastic categories were excluded by the study protocol. The most expensive medical category was subsequently chosen for the study as the prototype.

The top five medical DRGs, excluding neoplastic categories, ranked by the average hospital charges, average
Table I

The 20 Most Expensive DRGs by Total Pharmacy Charges for January-August 1983.

<table>
<thead>
<tr>
<th>DRG</th>
<th>Title</th>
<th>MDC</th>
<th>Number of Patients</th>
<th>Total Pharmacy Charges($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>107</td>
<td>Coronary bypass (with &amp; without catheterization)</td>
<td>5</td>
<td>171</td>
<td>461,435</td>
</tr>
<tr>
<td>82</td>
<td>Respiratory neoplasm</td>
<td>4</td>
<td>136</td>
<td>103,921</td>
</tr>
<tr>
<td>148</td>
<td>Major small &amp; large bowel procedures; over age 69 or secondary diagnosis or both</td>
<td>6</td>
<td>76</td>
<td>91,247</td>
</tr>
<tr>
<td>127</td>
<td>Heart failure &amp; shock</td>
<td>5</td>
<td>196</td>
<td>78,524</td>
</tr>
<tr>
<td>88</td>
<td>Chronic obstructive pulmonary disease</td>
<td>4</td>
<td>110</td>
<td>77,931</td>
</tr>
<tr>
<td>14</td>
<td>Specific cerebrovascular disorders except transient ischemic attacks</td>
<td>1</td>
<td>172</td>
<td>72,075</td>
</tr>
<tr>
<td>96</td>
<td>Bronchitis &amp; asthma; over age 69 or secondary diagnosis or both</td>
<td>4</td>
<td>121</td>
<td>65,879</td>
</tr>
<tr>
<td>154</td>
<td>Stomach, esophageal, and duodenal procedures; over age 69 or secondary diagnosis or both</td>
<td>6</td>
<td>35</td>
<td>65,148</td>
</tr>
<tr>
<td>105</td>
<td>Cardiac valve procedure with pump (with &amp; without catheterization)</td>
<td>5</td>
<td>15</td>
<td>64,138</td>
</tr>
<tr>
<td>89</td>
<td>Simple pneumonia &amp; pleurisy; over age 69 or secondary diagnosis or both</td>
<td>4</td>
<td>113</td>
<td>60,992</td>
</tr>
<tr>
<td>197</td>
<td>Total cholecystectomy with &amp; without common duct exploration; over age 69 or secondary diagnosis or both</td>
<td>7</td>
<td>95</td>
<td>57,127</td>
</tr>
<tr>
<td>122</td>
<td>Circulatory disorders with acute myocardial infarction with and without cardiovascular complications; discharge alive</td>
<td>5</td>
<td>141</td>
<td>56,488</td>
</tr>
</tbody>
</table>
Table I (continued)

<table>
<thead>
<tr>
<th>DRG</th>
<th>Title</th>
<th>Number of Patients</th>
<th>MDCa</th>
<th>Total Pharmacy Charges($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>182</td>
<td>Esophagitis, gastroenteritis, and miscellaneous digestive diseases;</td>
<td>6</td>
<td>223</td>
<td>55,998</td>
</tr>
<tr>
<td></td>
<td>over age 69 or secondary diagnosis or both</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>403</td>
<td>Lymphoma or leukemia; over age 69 or secondary diagnosis or both</td>
<td>17</td>
<td>56</td>
<td>55,111</td>
</tr>
<tr>
<td>132</td>
<td>Atherosclerosis; over age 69 or secondary diagnosis or both</td>
<td>5</td>
<td>203</td>
<td>52,252</td>
</tr>
<tr>
<td>125</td>
<td>Circulatory disorders (except acute myocardial infarction) with cardiac catheterization; uncomplicated primary diagnosis</td>
<td>5</td>
<td>442</td>
<td>51,923</td>
</tr>
<tr>
<td>354</td>
<td>Nonradical hysterectomy; over age 69 or secondary diagnosis or both</td>
<td>13</td>
<td>206</td>
<td>51,607</td>
</tr>
<tr>
<td>370</td>
<td>Cesarean section with secondary diagnosis</td>
<td>14</td>
<td>191</td>
<td>51,543</td>
</tr>
<tr>
<td>110</td>
<td>Major reconstructive vascular procedure; over age 69 or secondary</td>
<td>5</td>
<td>50</td>
<td>50,448</td>
</tr>
<tr>
<td></td>
<td>diagnosis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>366</td>
<td>Malignancy of female reproductive system; over age 69 or secondary</td>
<td>13</td>
<td>56</td>
<td>45,371</td>
</tr>
<tr>
<td></td>
<td>diagnosis</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a Based upon system described in Reference 1, pp. 290,308.
b Major Diagnostic Category.
pharmacy charges, and average LOS are represented in Figure 2, 3, and 4 respectively.

Based upon an evaluation of the data in Table I and Figures 2, 3, and 4, DRG 88 (Chronic Obstructive Pulmonary Disease) was selected for further study. It was assumed that DRG 88, the medical DRG with high total pharmacy charge, offered the greatest potential for investigation with positive results. In addition, in 1983 DRG 88 had a high mean hospital charge, LOS, and over 100 patients were assigned to it.

DRG 88 is in MDC 4, Diseases and Disorders of the Respiratory System. The DRG classification tree for that particular MDC is schematically represented in Figure 5.

C. Sample Selection

All patients within the selected medical DRG were ranked based upon their total pharmacy charges. Patients' frequency distribution by pharmacy charges is presented in Figure 6.

Based upon the frequency distribution by pharmacy charges, three subgroups were identified: below the median pharmacy charges (Group 1 < $450), between the median and mean pharmacy charges (Group 2, $451-900), and above the mean pharmacy charges (Group 3 > $900).

Figure 7 shows the distribution of patients within the three groups, namely, group 1, 2, and 3.

Fifteen patient were randomly selected from each
Figure 2. The Top Five Medical DRGs by Average Hospital Charges.
Figure 3. The Top Five Medical DRGs by Average Pharmacy Charges.
Figure 4. The Top Five Medical DRGs by Average Length of Stay
Figure 5. Classification Tree of Major Diagnostic Category 4 (MDC 4) (Diseases and Disorders of the Respiratory System)
* Adapted from Reference 1, pp. 228-31.
Figure 6. Frequency Distribution of Patients versus Total Pharmacy Charges
Figure 7. Distribution of Patients in the Three Selected Groups

Total Pharmacy Charges (Dollars)

0 450 900 1,451 1,900 4,500 6,500

0 10 20 30 40 50

Number of Patients
group using a table of random numbers (53). Patients who
died during hospitalization and those classified as out-
liers were included in the random selection of patients.

D. Data Collection

Comparative clinical and financial data, for the 15
patients in the three groups, were collected using a spe-
cially designed data form. This data form includes:

1. Patient medical record number.
2. Patient's age, sex, and weight.
3. Number of admissions.
4. Primary and secondary diagnoses.
5. Number of consultations.
6. Patient's medical history.
7. Number of individual laboratory test orders:
   - Number of x-ray orders.
   - Number of microbiology (culture/sensitivity) tests.
   - Number of arterial blood gas (A.B.G.) orders.
   - Number of chemistry panel 1 & 2 orders (see App. C).
   - Number of urine analysis orders.
   - Number of electrocardiogram (E.K.G.) orders.
   - Number of blood analysis orders.
   - Number of drug serum levels performed.
   - Total number of laboratory orders.
8. Total number of drug dosage units.

Refer to the frequency with which drug order codes
were processed for billing purposes applied at
St. Joseph's Hospital, Stockton, California.
9. Total pharmacy and hospital charges.
11. Operating room procedures.
12. Discharge status.

E. Data Analysis

Clinical data were abstracted from each patient's record, whereas financial data were compiled from the computer printout provided by the institution's billing office.

Data for 17 variables for each of the 45 patients were manually collected, organized, and tabulated for subsequent computer data entry and analysis.

The compiled data of the randomly selected 45 patients, representing the three groups, were subsequently analyzed using a computer-based program.

Basic statistics including mean, standard deviation, and the standard error were calculated. A correlation matrix of the 17 variables was performed to provide a useful tool to identify clinically and financially correlated variables. In addition, order statistics including maximum, minimum, range, midrange, 25-th percentile, and 75-th percentile were computed for all the selected 17 variables.

A separate one-way analysis of variance (ANOVA) was performed using the Hewlett-Packard, HP 86, Basic Statistics and Manipulation Pac, Hewlett-Packard Company, 1010 N.E. Circle Blvd., Corvallis, OR 97330.
performed for each of the 17 variables to determine the degree of significant difference among the three groups. For those variables which showed a significant difference for F-Test, a Scheffe's Post-hoc test (54) was performed. This test evaluates individual differences among the means of the three groups. Further, this procedure will identify the group within each variable with the greatest probability for having high values within the selected DRG category.
RESULTS

As previously indicated, the 10,550 patients admitted to the hospital were retrospectively assigned to 390 DRGs. The top 20 most expensive DRGs for the pharmacy department in terms of total pharmacy charges are listed in Table I.

Table II shows the distribution of the most expensive DRGs within the major diagnostic categories (MDC). Additional financial data on the top 20 DRGs are presented in Table III.

Table IV ranks the most expensive DRGs in six different ways, namely, total pharmacy charges per DRG, number of patients, pharmacy charges per patient, hospital charges per patient, pharmacy charges as percentage of hospital charges, and LOS per patient.

The top five most expensive medical DRGs based upon average hospital charges, average pharmacy charges, and average LOS are presented in Figure 2, 3, and 4, respectively.

DRG 88 (Chronic Obstructive Pulmonary Disease) was chosen as the most expensive DRG category for the pharmacy department. This DRG category includes a total of 110 patients, about half of them (54 patients) were Medicare patients. Their mean age was 69.2 years (range 50-89) and their total pharmacy charges were $77,931 (range $11,40-6492.30) with a mean of $708.70.

The patient frequency distribution shown in Figures
Table II

Distribution of the 20 Most Expensive DRGs by MDC.

<table>
<thead>
<tr>
<th>MDC</th>
<th>Description of MDC</th>
<th>Number of DRGs in MDC&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Total Pharmacy Charges per MDC ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Diseases and disorders of the circulatory system.</td>
<td>7</td>
<td>815,208</td>
</tr>
<tr>
<td>4</td>
<td>Diseases and disorders of the respiratory system</td>
<td>4</td>
<td>308,723</td>
</tr>
<tr>
<td>6</td>
<td>Diseases and disorders of the digestive system</td>
<td>3</td>
<td>212,393</td>
</tr>
<tr>
<td>13</td>
<td>Diseases and disorders of the female reproductive system</td>
<td>2</td>
<td>96,978</td>
</tr>
<tr>
<td>1</td>
<td>Diseases and disorders of the nervous system</td>
<td>1</td>
<td>72,075</td>
</tr>
<tr>
<td>7</td>
<td>Diseases and disorders of the hepatobiliary system and pancreas</td>
<td>1</td>
<td>57,127</td>
</tr>
<tr>
<td>17</td>
<td>Myeloproliferative disorders and poorly differentiated malignancy and other neoplasm</td>
<td>1</td>
<td>55,111</td>
</tr>
<tr>
<td>14</td>
<td>Pregnancy, childbirth, and the puerperium</td>
<td>1</td>
<td>51,543</td>
</tr>
</tbody>
</table>

<sup>a</sup> Represents the number of DRGs to which patients with this MDC were assigned during the study period.
Table III
Pharmacy and Hospital Charges per Patient\(^a\) for the 20 Most Expensive DRGs for January-August 1983.

<table>
<thead>
<tr>
<th>DRG</th>
<th>LOS (days)</th>
<th>Pharmacy Charges per Patient ($)</th>
<th>Hospital Charges per Patient ($)</th>
<th>Pharmacy Charges as % of Hospital Charges</th>
</tr>
</thead>
<tbody>
<tr>
<td>107</td>
<td>13.2 ±9.7</td>
<td>2,698 ±1,692</td>
<td>24,123 ±11,160</td>
<td>11.2</td>
</tr>
<tr>
<td>82</td>
<td>10.0 ±13.4</td>
<td>764 ±850</td>
<td>5,021 ±5,520</td>
<td>15.2</td>
</tr>
<tr>
<td>148</td>
<td>13.4 ±8.4</td>
<td>1,201 ±1,579</td>
<td>8,690 ±6,582</td>
<td>13.8</td>
</tr>
<tr>
<td>127</td>
<td>7.4 ±10.6</td>
<td>401 ±565</td>
<td>4,662 ±4,755</td>
<td>8.6</td>
</tr>
<tr>
<td>88</td>
<td>9.5 ±8.6</td>
<td>709 ±864</td>
<td>6,429 ±6,948</td>
<td>11.0</td>
</tr>
<tr>
<td>14</td>
<td>9.6 ±13.9</td>
<td>419 ±844</td>
<td>5,923 ±7,454</td>
<td>7.8</td>
</tr>
<tr>
<td>96</td>
<td>6.9 ±5.5</td>
<td>545 ±660</td>
<td>4,813 ±5,184</td>
<td>11.3</td>
</tr>
<tr>
<td>154</td>
<td>14.8 ±12.6</td>
<td>1,861 ±2,372</td>
<td>12,872 ±15,814</td>
<td>14.5</td>
</tr>
<tr>
<td>105</td>
<td>19.1 ±10.1</td>
<td>4,267 ±2,499</td>
<td>35,758 ±19,250</td>
<td>12.0</td>
</tr>
<tr>
<td>89</td>
<td>7.4 ±5.7</td>
<td>540 ±548</td>
<td>4,699 ±4,584</td>
<td>11.5</td>
</tr>
<tr>
<td>197</td>
<td>9.2 ±5.5</td>
<td>601 ±795</td>
<td>5,950 ±5,624</td>
<td>10.1</td>
</tr>
<tr>
<td>122</td>
<td>10.7 ±26.9</td>
<td>401 ±760</td>
<td>6,923 ±10,967</td>
<td>5.8</td>
</tr>
<tr>
<td>182</td>
<td>4.9 ±3.9</td>
<td>251 ±370</td>
<td>2,443 ±1,992</td>
<td>10.3</td>
</tr>
<tr>
<td>403</td>
<td>11.0 ±9.9</td>
<td>984 ±1,154</td>
<td>5,982 ±5,901</td>
<td>16.5</td>
</tr>
<tr>
<td>132</td>
<td>6.2 ±5.7</td>
<td>257 ±572</td>
<td>4,004 ±5,808</td>
<td>6.4</td>
</tr>
<tr>
<td>125</td>
<td>2.7 ±2.6</td>
<td>118 ±248</td>
<td>2,872 ±2,126</td>
<td>4.1</td>
</tr>
<tr>
<td>354</td>
<td>6.7 ±3.9</td>
<td>251 ±487</td>
<td>3,730 ±2,183</td>
<td>6.8</td>
</tr>
<tr>
<td>370</td>
<td>5.2 ±3.5</td>
<td>270 ±869</td>
<td>2,935 ±2,115</td>
<td>9.2</td>
</tr>
<tr>
<td>110</td>
<td>11.9 ±6.9</td>
<td>1,009 ±1,225</td>
<td>11,679 ±10,759</td>
<td>8.6</td>
</tr>
<tr>
<td>366</td>
<td>4.1 ±8.2</td>
<td>810 ±545</td>
<td>2,534 ±3,220</td>
<td>32.0</td>
</tr>
</tbody>
</table>

\(^a\) Reported as the mean ± S.D.

\(^b\) Listed in decreasing order based upon total pharmacy charges per DRG, which are reported in Table I.
Table IV

The 20 Most Expensive DRGs within Various Measures of Hospital and Pharmacy Charges.

<table>
<thead>
<tr>
<th>DRG</th>
<th>Total Pharmacy Charges per DRG</th>
<th>Number of Patients</th>
<th>Pharmacy Charge per Patient</th>
<th>Hospital Charge per Patient</th>
<th>Pharmacy Charges as % of Hospital Charges</th>
<th>LOS per Patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>107</td>
<td>1</td>
<td>8</td>
<td>2</td>
<td>2</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>82</td>
<td>2</td>
<td>10</td>
<td>8</td>
<td>11</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>148</td>
<td>3</td>
<td>15</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>127</td>
<td>4</td>
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<tr>
<td>88</td>
<td>5</td>
<td>13</td>
<td>9</td>
<td>7</td>
<td>10</td>
<td>10</td>
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<tr>
<td>14</td>
<td>6</td>
<td>7</td>
<td>13</td>
<td>10</td>
<td>16</td>
<td>9</td>
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<tr>
<td>96</td>
<td>7</td>
<td>11</td>
<td>11</td>
<td>12</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>154</td>
<td>8</td>
<td>19</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>2</td>
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<tr>
<td>105</td>
<td>9</td>
<td>20</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>89</td>
<td>10</td>
<td>12</td>
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<td>13</td>
<td>7</td>
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<td>15</td>
<td>6</td>
<td>19</td>
<td>7</td>
</tr>
<tr>
<td>182</td>
<td>13</td>
<td>2</td>
<td>18</td>
<td>20</td>
<td>11</td>
<td>18</td>
</tr>
<tr>
<td>403</td>
<td>14</td>
<td>17</td>
<td>6</td>
<td>8</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>132</td>
<td>15</td>
<td>4</td>
<td>17</td>
<td>15</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td>125</td>
<td>16</td>
<td>1</td>
<td>20</td>
<td>18</td>
<td>20</td>
<td>20</td>
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<tr>
<td>354</td>
<td>17</td>
<td>3</td>
<td>19</td>
<td>16</td>
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<tr>
<td>370</td>
<td>18</td>
<td>6</td>
<td>16</td>
<td>17</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>110</td>
<td>19</td>
<td>18</td>
<td>5</td>
<td>4</td>
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<td>5</td>
</tr>
<tr>
<td>366</td>
<td>20</td>
<td>16</td>
<td>7</td>
<td>19</td>
<td>1</td>
<td>19</td>
</tr>
</tbody>
</table>
6 and 7 illustrates the three distinct three groups used in this study. The three groups had an average age of 69.3 years. Approximately 78 percent of them were males (35 patients). Medicare patients represent 36 percent (16 patients). The total pharmacy charges were $38,268 with a mean of $850.40. Approximately 72.7 percent of the 45 patients had pharmacy charges below the mean (see Table VI and VII). The total hospital charges for the 45 patients were $317,502 with a mean of $7055.60. The average LOS was calculated to be 9.7 days. Demographic data of the three groups are summarized in Table V.

There were three deaths among the 45 patients. It is important to point out that the three deaths, all in group 3, were patients with the highest pharmacy charges, and of these three, two were labeled as pharmacy charge "Outliers" (mean pharmacy charges plus two standard deviations).

It was found that the most prescribed drug categories for the 45 selected patients were: spasmytics, anti-infective agents, hormones and synthetic substances, autonomic drugs, C.N.S drugs, electrolytes, cardiovascular and vasodilating agents.

Seventeen variables, which were proposed to correlate with high pharmacy charges, were selected for analysis. These variables are: age, weight, number of admissions, number of consultations, LOS, pharmacy charges, hospital charges, number of drug dosage units, number of x-ray
Table V
Demographic Data of the Three Groups.

<table>
<thead>
<tr>
<th>Data</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population Size</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>45</td>
</tr>
<tr>
<td>Mean age</td>
<td>69.2</td>
<td>69.6</td>
<td>69.0</td>
<td>69.3</td>
</tr>
<tr>
<td>Sex (M:F)</td>
<td>11:4</td>
<td>11:4</td>
<td>13:2</td>
<td>35:10</td>
</tr>
<tr>
<td>Medicare Patients</td>
<td>6</td>
<td>3</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>Smokers</td>
<td>12</td>
<td>13</td>
<td>12</td>
<td>37</td>
</tr>
<tr>
<td>Special Care Days</td>
<td>3</td>
<td>13</td>
<td>48</td>
<td>64</td>
</tr>
<tr>
<td>Number of Deaths</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
orders, number of microbiology tests, number of A.B.G.
orders, number of chemistry panel 1 and 2 orders, number
of urine analyses, number of drug serum level orders, and
the total number of laboratory orders. Basic statistics
of the 17 variables of the randomly selected 45 patients
are summarized in Tables VI and VII.

The correlation matrix of the 17 variables was calcu-
lated. The most significant findings are the following:

1. Age, weight, and number of admissions of the 45
patients did not seem to correlate well with the rest of
the 17 variables (correlation coefficient, r < 0.3).

2. LOS was highly correlated with pharmacy charges
(0.859), hospital charges (0.915), number of drug dosage
units (0.907), number of drug level orders (0.838), number
of total laboratory orders (0.858), number of x-ray orders
(0.834), number of microbiology orders (0.618), number of
blood analyses (0.784), number of A.B.G. orders (0.700),
and number of chemistry panel 1 and 2 orders (0.754).

3. Pharmacy charges were highly correlated with hos-
pital charges (0.949), number of drug level orders (0.784),
number of total laboratory orders (0.910), number of A.B.G.
orders (0.813), number of drug dosage units (0.944), number
of blood analyses (0.844), number of x-ray orders (0.885),
number of microbiology orders (0.677), and number of chem-
istry panel 1 and 2 orders (0.766).

4. Hospital charges correlated well with the number
of drug dosage units (0.922), the total number of labora-
Table VI

Order Statistics of the Selected Seventeen Variables.

<table>
<thead>
<tr>
<th>Variable Names</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Midrange</th>
<th>Median</th>
<th>25-th</th>
<th>75-th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>92</td>
<td>50</td>
<td>71</td>
<td>69</td>
<td>62</td>
<td>73</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>140</td>
<td>36</td>
<td>88</td>
<td>70</td>
<td>56</td>
<td>80</td>
</tr>
<tr>
<td># of Admissions</td>
<td>21</td>
<td>1</td>
<td>11</td>
<td>5</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td># of Consultations</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Length of Stay</td>
<td>41</td>
<td>1</td>
<td>21</td>
<td>8</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>Pharmacy Charges</td>
<td>6492.3</td>
<td>27.3</td>
<td>3259.8</td>
<td>495.2</td>
<td>327</td>
<td>968.3</td>
</tr>
<tr>
<td>Hospital Charges</td>
<td>53636.9</td>
<td>928.1</td>
<td>27282.5</td>
<td>4887</td>
<td>3333</td>
<td>7617</td>
</tr>
<tr>
<td># of DrugDosage Unit</td>
<td>454</td>
<td>4</td>
<td>229</td>
<td>62</td>
<td>33</td>
<td>108</td>
</tr>
<tr>
<td># of X-Ray</td>
<td>26</td>
<td>0</td>
<td>13</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td># of Microbiology</td>
<td>12</td>
<td>0</td>
<td>6</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td># of A. B. G</td>
<td>49</td>
<td>0</td>
<td>24.5</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td># of Chemistry Panel</td>
<td>1 and 2</td>
<td>23</td>
<td>0</td>
<td>11.5</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td># of Urine Analysis</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td># of E. K. G</td>
<td>3</td>
<td>0</td>
<td>1.5</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td># of Blood Analysis</td>
<td>30</td>
<td>0</td>
<td>15</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td># of Drug Levels</td>
<td>24</td>
<td>0</td>
<td>12</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td># of Total Labs.</td>
<td>165</td>
<td>3</td>
<td>84</td>
<td>13</td>
<td>8</td>
<td>23</td>
</tr>
</tbody>
</table>
Table VII

Basic Statistics of the Selected Seventeen Variables.

<table>
<thead>
<tr>
<th>Variable Names</th>
<th>Mean (N=45)</th>
<th>Standard Deviation</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>69.3</td>
<td>10.2</td>
<td>1.5</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>70.2</td>
<td>18.6</td>
<td>2.8</td>
</tr>
<tr>
<td># of Admissions</td>
<td>5.7</td>
<td>4.8</td>
<td>0.7</td>
</tr>
<tr>
<td># of Consultations</td>
<td>0.4</td>
<td>0.6</td>
<td>0.1</td>
</tr>
<tr>
<td>L O S</td>
<td>9.7</td>
<td>6.6</td>
<td>0.9</td>
</tr>
<tr>
<td>Pharmacy Charges</td>
<td>850.4</td>
<td>1067.4</td>
<td>159.1</td>
</tr>
<tr>
<td>Hospital Charges</td>
<td>7055.6</td>
<td>7930.5</td>
<td>1182.2</td>
</tr>
<tr>
<td># of Drug Dosage Unit</td>
<td>84.6</td>
<td>80.5</td>
<td>12.0</td>
</tr>
<tr>
<td># of X-Ray</td>
<td>2.2</td>
<td>3.9</td>
<td>0.6</td>
</tr>
<tr>
<td># of Microbiology</td>
<td>2.4</td>
<td>2.9</td>
<td>0.4</td>
</tr>
<tr>
<td># of A. B. G</td>
<td>4.5</td>
<td>7.9</td>
<td>1.2</td>
</tr>
<tr>
<td># of Chem. Panel 1 &amp; 2</td>
<td>4.2</td>
<td>4.7</td>
<td>0.7</td>
</tr>
<tr>
<td># of Urine Analysis</td>
<td>0.5</td>
<td>0.6</td>
<td>0.1</td>
</tr>
<tr>
<td># of E. K. G</td>
<td>0.8</td>
<td>0.7</td>
<td>0.1</td>
</tr>
<tr>
<td># of Blood Analysis</td>
<td>2.3</td>
<td>4.4</td>
<td>0.7</td>
</tr>
<tr>
<td># of Drug Levels</td>
<td>2.9</td>
<td>4.1</td>
<td>0.6</td>
</tr>
<tr>
<td># of Total Laboratories</td>
<td>19.9</td>
<td>24.8</td>
<td>3.7</td>
</tr>
</tbody>
</table>
tory orders (0.964), number of x-ray orders (0.948), number of A.B.G. orders (0.894), number of blood analysis orders (0.919), the number of drug level orders (0.870), number of microbiology orders (0.628), and number of chemistry panel 1 and 2 orders (0.743).

5. The number of drug level orders correlates well with the number of total laboratory orders (0.899), number of x-ray orders (0.824), number of A.B.G. orders (0.809), number of blood analysis orders (0.814), number of microbiology orders (0.560), and number of chemistry panel 1 and 2 orders (0.690).

6. The number of blood analyses correlated with the number of x-ray orders (0.933), number of A.B.G. orders (0.846), number of chemistry panel 1 and 2 orders (0.671), and the number of microbiology orders (0.564).

One-way analysis of variance results, shown in Table VIII, revealed that there was no significant difference between the three groups regarding age, weight, number of admissions, number of urine analyses, number of E.K.G. orders, or the number of blood analysis orders. In contrast, it was found that differences in LOS, pharmacy charges, hospital charges, number of drug dosage units, number of chemistry panel 1 and 2 orders, and the number of drug level orders were highly significant (P<0.001). In addition, differences among the three groups regarding number of consultations, number of microbiology tests, number of A.B.G. orders, and the total number of labora-
### Table VIII

**One-Way Analysis of Variance.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Names</strong></td>
<td>Group 1</td>
<td>Group 2</td>
<td>Group 3</td>
</tr>
<tr>
<td>Age</td>
<td>69.2</td>
<td>69.6</td>
<td>69.0</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>65.5</td>
<td>67.3</td>
<td>77.7</td>
</tr>
<tr>
<td># of Admissions</td>
<td>6.7</td>
<td>5.1</td>
<td>5.3</td>
</tr>
<tr>
<td># of Consultations</td>
<td>0.3</td>
<td>0.3</td>
<td>0.7</td>
</tr>
<tr>
<td>L O S</td>
<td>6.1</td>
<td>8.3</td>
<td>14.9</td>
</tr>
<tr>
<td>Pharmacy Charges</td>
<td>238.5</td>
<td>508.2</td>
<td>1768.3</td>
</tr>
<tr>
<td>Hospital Charges</td>
<td>3281.7</td>
<td>5274.0</td>
<td>12611.0</td>
</tr>
<tr>
<td># of Drug Dosage Unit</td>
<td>30.8</td>
<td>60.8</td>
<td>162.3</td>
</tr>
<tr>
<td># of X-Ray</td>
<td>1.2</td>
<td>1.3</td>
<td>4.1</td>
</tr>
<tr>
<td># of Microbiology</td>
<td>1.6</td>
<td>1.5</td>
<td>4.0</td>
</tr>
<tr>
<td># of A. B. G</td>
<td>1.8</td>
<td>2.6</td>
<td>9.1</td>
</tr>
<tr>
<td># of Chemistry Panel 1 and 2</td>
<td>2.1</td>
<td>2.3</td>
<td>7.7</td>
</tr>
<tr>
<td># of E. K. G</td>
<td>0.7</td>
<td>0.7</td>
<td>0.9</td>
</tr>
<tr>
<td># of Urine Analysis</td>
<td>0.4</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td># of Blood Analysis</td>
<td>1.4</td>
<td>1.6</td>
<td>3.8</td>
</tr>
<tr>
<td># of Drug Levels</td>
<td>1.2</td>
<td>1.9</td>
<td>5.8</td>
</tr>
<tr>
<td># of Total Labs.</td>
<td>10.5</td>
<td>12.9</td>
<td>36.2</td>
</tr>
</tbody>
</table>

NS= No significant difference.
tory orders were found to be significant (P< 0.05).

Results of Scheffe's test for the ten statistically significant variables are presented in Table IX. The results revealed that the mean number of consultations and microbiology tests among group 1, 2, and 3 was not statistically significant. However, the difference between group 3 mean and the averaged mean of group 1 and 2 was statistically significant (P< 0.05). On the other hand, the difference between group 3 and either group 1 or group 2 regarding LOS, pharmacy charges, hospital charges, the number of drug dosage units, number of chemistry panel 1 and 2, and number of drug level orders was found to be statistically significant (P< 0.05).

In addition, it was found that the difference between group 1 and group 2 with regard to these ten variables was not statistically significant.

The number of A.B.G. ordered showed a statistically significant difference between group 1 and 3. However, no statistical difference was found to exist between group 1 and 2 or even between group 2 and 3.

One of the important findings was that LOS, pharmacy charges, hospital charges, the total number of laboratory orders, number of drug dosage units, and number of drug level orders are highly correlated. In addition, Table VIII shows that the mean difference among the three groups regarding these six variables was highly significant (P< 0.005).
Table IX
Summary Results of Scheffe's S Test.

<table>
<thead>
<tr>
<th>Variable Names</th>
<th>Group 1 &amp; 3</th>
<th>Group 2 &amp; 3</th>
<th>Group 1 &amp; 2</th>
<th>Group 3 Vs. Group 1 &amp; 2</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Consultations</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>P&lt;0.05</td>
</tr>
<tr>
<td>L O S</td>
<td>P&lt;0.01</td>
<td>P&lt;0.01</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Pharmacy Charges</td>
<td>P&lt;0.01</td>
<td>P&lt;0.01</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Hospital Charges</td>
<td>P&lt;0.01</td>
<td>P&lt;0.05</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td># of Drug Dosage Unit</td>
<td>P&lt;0.01</td>
<td>P&lt;0.01</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td># of Microbiology</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>P&lt;0.05</td>
</tr>
<tr>
<td># of A. B. G</td>
<td>P&lt;0.05</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td># of Chemistry Panel 1 and 2</td>
<td>P&lt;0.01</td>
<td>P&lt;0.01</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td># of Drug Levels</td>
<td>P&lt;0.01</td>
<td>P&lt;0.05</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td># of Total Laboratories</td>
<td>P&lt;0.05</td>
<td>P&lt;0.05</td>
<td>NS</td>
<td></td>
</tr>
</tbody>
</table>

* Variables having a statistically significant F-Test value.

NS= No significant difference.
DISCUSSION

It was theorized that identifying the 20 most expensive DRGs, based upon pharmacy charges, would serve as the initial step for the pharmacy department to respond to the prospective payment system. The analysis of the top 20 DRGs revealed that DRG 107 (Coronary Bypass) had the highest total pharmacy charges and was second, next to DRG 105 (Cardiac Valve Procedure With Pump), with respect to average hospital charges.

Major diagnostic category 5 (Diseases and Disorders of the Circulatory System) was the highest for the total hospital charges. This was expected since the hospital provides the only open-heart surgery services in the community (48).

Table IV demonstrates that the ranking based upon mean hospital charges per patient and the mean LOS are quite similar. However, further statistical evaluation of LOS and hospital charges is required for these parameters to be used as reliable predictors of DRGs with expensive pharmacy charges. Therefore, Directors of Pharmacy should be cautioned when attempting to identify DRGs for special attention.

It is important to point out that the actual ranks reported in Tables I-IV may not be applicable to other hospitals due to variation of charge systems from one
hospital to another. However, the method could be applied to other institutions. The problem of assuring that the charges reported in this study accurately reflect the cost of providing pharmaceutical services is an important limitation of the study approach. An ideal approach for establishing pharmacy priorities would be to determine the actual direct and indirect costs per case and compare those costs with the actual reimbursement. However, data on actual costs are generally not available in most hospitals (48).

Only medical DRGs were included in the analysis of this study. Surgical and neoplastic categories were excluded from the study since these two categories utilize either non-drug procedures, high cost equipment, and/or investigational chemotherapeutic agents.

DRG 88 (Chronic Obstructive Pulmonary Diseases- COPD) was found to fit the criteria established to select the most expensive DRG category (see page 32). This medical category had the highest average pharmacy charges, high mean hospital charges, LOS, and patient census (see Table I and Figures 2, 3, and 4).

Being a chronic disease, the number of admissions per patient in DRG 88 varied greatly from one to 21 admissions (Table VI). In contrast, the number of consultations varied from zero to two consultations per patient. There were two cases that exhibited the maximum number of consultations. These two cases also had the
highest pharmacy charges of the patients reviewed. Therefore, patients requiring medical consultations should be carefully monitored.

It was calculated that about 72 percent of the selected 45 patients had pharmacy charges below the mean. That is an encouraging result since the pharmacist's efforts could therefore be focused on about one-fourth of the patients assigned to this particular DRG rather than the entire population.

It was found that the average LOS, average pharmacy charges, and average hospital charges of the randomly selected 45 patients, although slightly higher, were similar to those calculated for the entire population of DRG 88 (9.7 days, $850, $7055 versus 9.5 days, $709, and $6429 respectively). This indicates that the randomly selected 45 patients may closely represent DRG 88 patients. That finding is also important since the statistical analysis will be expected to reflect the same outcomes when applied to the rest of the patients within the selected DRG, i.e., it is a representative sample.

Correlation matrix results of the 17 variables revealed that there was no correlation between age, weight, or the number of admissions and the rest of the 17 variables. For example, being an old patient does not mean having high pharmacy or hospital charges. Similarly, neither the frequency of admission nor being obese had an effect on pharmacy charges. Further, the differences
among the three identified groups for those same three variables were not statistically significant. Therefore, these three variables may be excluded as being important predictors of high pharmacy charges.

It was found that LOS, pharmacy charges, hospital charges, and number of drug dosage units within the selected DRG were highly correlated. Further, the difference among the three groups regarding the above mentioned four variables was highly significant. Therefore, there was a direct relationship between LOS, hospital charges, and pharmacy charges within DRG 88.

More impressively, hospital charges were found to be correlated very well with the number of drug dosage units, number of drug level orders, and the total number of laboratory tests performed, in addition to its correlation with LOS and pharmacy charges. This is an important indicator that could be utilized by pharmacy staff to intensively monitor abnormal patients. For example, by comparing the means of the mean values of the 17 variables of group 2 and group 3 presented in Table VIII, the following patients may be candidates for intensive monitoring by clinical pharmacists:

a. Patients requiring more than ten drug dosage units per day (range 5.2-13.9). This was calculated as a follows:

a

These mathematical calculations were similarly performed for all the 17 variables of group 2 & 3 presented in Table VIII.
Number of drug dosage units (DDUs) per day = \(\frac{\text{Mean DDUs of group 2 + 3}}{2}\) / \(\frac{\text{Mean LOS of group 2 + 3}}{2}\)

\[\begin{align*}
\text{DDUs per day} &= \frac{(60.8 + 162.3)}{2} \frac{111.55}{2} \\
&= \frac{(8.3 + 14.9)}{2} \frac{11.6}{2} \\
&= 9.6
\end{align*}\]

Range of the DDUs = the DDUs of group 2/ mean LOS to the DDUs of group 3/ mean LOS

\[\begin{align*}
60.8 & \quad 162.3 \\
11.6 & \quad 11.6
\end{align*}\]

b. Patients requiring more than four drug serum level analyses (range 1.9-5.8) during their stay.

c. Patients receiving more than 25 laboratory tests (range 12.9-36.2) throughout their stay.

d. Patients having a LOS of more than 12 days (range 8.3-14.9).

e. Patients having pharmacy charges of more than $98 per day (range $43.81-$152.44).

Priorities to re-evaluate and redirect pharmaceutical as well as other hospital resources to those patients will be a reasonable goal.

It is expected that patients with a high number of consultations and total number of laboratory orders may indicate a severely ill patient and therefore, may be expected to consume a high number of drug dosage units. Since drug dosage units correlate with pharmacy charges and hospital charges, those patients may be expected to have high hospital charges.
It is important to point out that although patients selected for this study were not all Medicare patients (see Table V), it is predicted that analysis of DRG 88 restricted to Medicare patients may reveal higher pharmacy and hospital charges. However, the significance and validity of such an assumption requires further investigation.

In reviewing the patients' medical records, it was found that the most frequently prescribed drugs for patients within DRG 88 were in the following categories:

1. Spasmolytics (e.g., Theophylline).
2. Anti-infective drugs (e.g., Ampicillin).
3. Hormones and synthetic substances (e.g., Hydrocortisone).
4. Autonomic drugs: Sympathomimetic agents (e.g., Metaproterenol and Albuterol).
5. C.N.S. drugs: Sedative and hypnotics (e.g., Diazepam).
6. Electrolytic, caloric, and water balance: Diuretics (e.g., Furosemide).
7. Cardiovascular drugs: Cardiac (e.g., Digoxin).
8. Cardiovascular drugs: Vasodilating agents (e.g., Nitroglycerin).

As a result, clinical pharmacists should review drug doses and route and frequency of administration of these drug

\*Based upon the American Hospital Formulary Service Classification, 1982.
categories. In addition, therapeutically equivalent alternative drugs with lower costs should be purchased and administered.

Eighty two percent of the selected 45 patients were found to be chronic or heavy smokers (37 patients). The rest of the 45 patients (8 patients) were either non-smokers or their smoking status was not reported in their medical records. Therefore, although it is apparent that smokers are approximately equally distributed among the three patient groups, smoking status may be further investigated and statistically tested as being a predisposing factor for recurrent pulmonary problems, high pharmacy and hospital charges, and frequent hospital admission.

There were three deaths among the randomly selected 45 patients, all in group 3. The first case was a 50 year old female who had a LOS of 10 days, and a total number of laboratory orders of 46. She had a non-Hodgkins lymphoma of the lung and died from pulmonary fibrosis and respiratory failure. The second case was a 61 year old male who had a LOS of 20 days and 45 laboratory tests. That patient had a long history of myocardial arrhythmia and diabetes mellitus. Surgical exploration was performed because of unknown diagnosis and sepsis of unknown etiology. The surgical exploration led to increased LOS with the resultant high hospital charges. The third case was a 84 year old male who had been hospitalized for 41
days and had a total of 165 laboratory tests. He had bulla of his upper lobe, in addition to a *Pseudomonas* infection and lung cancer. This severely ill patient died from the combination of respiratory and renal failure. These three deaths represent the three most expensive patients regarding both pharmacy and hospital charges. Therefore, patients admitted with serious secondary diagnoses or those who are apparently severely ill should be intensively monitored.

Finally, it is important to emphasize that none of the proposed parameters may be expected to influence pharmacy or hospital charges by itself but rather they should be considered as interdependent parameters. In addition, it should be acknowledged that these parameters could not be applied immediately upon a patient's admission. However, these parameters may be expected to be used for patients who are likely to exceed the proposed values.
SUMMARY AND CONCLUSION

The Prospective Payment System is revolutionary in that hospitals will be reimbursed based upon DRG rates or other payment system regardless of the actual hospital cost, the amount of service rendered, or LOS. Therefore, there is a clear incentive for hospitals to minimize costs in order to survive. A correlation between clinical and financial data was suggested to describe the case cost or the end product cost. Yet, no study was published to achieve this goal. Because of the current payment system, pharmacy departments are establishing cost reduction as a top priority. Evaluating DRGs with high pharmacy charges was suggested as the first step.

The present study establishes the second step in the process: to identify predictors of expensive DRGs for the pharmacy department. Expensive DRGs based upon their total pharmacy charges were evaluated in an attempt to identify and propose predictors that may influence pharmacy charges. It is suggested that clinical pharmacists, guided by these predictors, will intensify their monitoring of patients within DRG 88 to reduce pharmacy costs.

Diagnosis Related Group 88, COPD, was identified as the most expensive medical DRG for the pharmacy department. This DRG consisted of 110 patients admitted during a nine month period in 1983. For the purpose of the
present study, 45 out of 110 patients were randomly selected from three distinct subgroups. Seventeen variables were chosen to determine if they may directly correlate with pharmacy charges.

Results of the correlation matrix for the selected 17 variables showed no significant correlation between age, weight, and number of admissions and the rest of the 17 variables. Therefore, it is suggested that these three variables are not appropriate predictors of patients in DRG 88 with high pharmacy charges.

The number of drug dosage units, number of drug level orders, and pharmacy charges were significantly correlated with hospital charges and patient's LOS. Therefore, the total number of drug dosage units consumed, number of drug level analyses, and pharmacy charges may serve as predictors of high hospital charges and long LOS.

On the other hand, the difference among the three groups regarding number of admissions, number of x-ray orders, number of E.K.G., the number of blood analysis orders, number of urine analysis orders, age, or weight were found to be statistically insignificant. Therefore, these variables may not be predictors of high pharmacy or hospital charges within DRG 88.

Scheffe's test showed no significant difference between the mean of group 1 and 2 for the ten statistically significant variables (see Table VIII). However, there is a highly significant difference between the mean of group
3 and 1 as well as those of group 3 and 2 (P< 0.01) with the exception of the number of microbiology orders, number of consultations, and number of A.B.G. orders (see Table IX). Therefore, group 2 and 3 represent the "break" point to which pharmaceutical service efforts should be directed to effectively reduce pharmacy charges.

In summary, this study attempted to provide a useful guide for clinical pharmacists on how to deal with prospective payment system by identifying those DRGs creating financial problems for the pharmacy department. In addition, this study proposed a methodological plan that can be used in other institutions. Clinical pharmacists could then adjust their resources and personnel to encompass exceptional cases.

Finally, the following patient characteristics and criteria, based upon the mean values of group 2 and 3 presented in Table VIII, are proposed as predictors of patients who may have high pharmacy and hospital charges:

1. Patient age, weight, number of admissions, number of x-ray orders, number of E.K.G. tests, number of urine analyses, or number of blood analysis orders are expected to have no influence on pharmacy charges or hospital charges.

2. Patients who have a LOS of more than 12 days.

3. Patients requiring one or more consultations.

4. Patients receiving more than ten drug dosage units per day.
5. Patients requiring microbiology or culture and sensitivity tests exceeding three tests throughout his hospital stay.

6. Patients requiring more than six A.B.G. tests.

7. Patients requiring more than five combined chemistry panel 1 and 2 analyses.

8. Patients receiving more than a total of 25 laboratory tests.

9. Patients receiving more than four drug level analyses.

10. Patients having pharmacy charges of more than $98 per day and / or hospital charges of more than $771 per day.
REFERENCES


30. Wagner, D. A. "Comment on Reimbursement Under DRGs:


42. Lantos, R. L. "How Do Hospital Directors Plan to Cope With the Constraints of DRGs?" Pharmacy Times. pp. 80-88, (May) 1984.


45. Upton, J. H., Crouch, J. B., and Douglas, J. B.


APPENDIX A
Definition of Case-Mix Data Items.

1. Admission class:
The circumstances under which the patient entered the hospital and should include separate categories for at least emergency/urgent and elective.

2. Admission diagnosis:
The diagnosis provided on admission as explaining the reason for admission (coded using ICD-9-CM).

3. Attending service:
The major department in which a patient is treated and is determined by the specialty of the physician attending to the principal diagnosis.

4. Major diagnosis:
That diagnosis accounting for the greatest resource consumption during a patient stay (i.e., accounting for the greatest number of days or costs for the stay).

5. Major Procedure:
That procedure most related to major diagnosis.

6. Principal diagnosis:
That condition established after study as being chiefly responsible for occasioning the admission of patient to the hospital for care (coded using ICD-9-CM).

7. Principal procedure:
a-The only procedure performed,
b-The only therapeutic procedure performed or
c-The therapeutic procedure performed that is most related to the principal diagnosis. The number and types of procedures performed which determined which of these rules apply (coded using ICM-9-CM).

8. Secondary diagnosis:
Conditions that exist at the time of admission or developed subsequently which reflect the treatment received and/or LOS. The record should allow for at least five secondary diagnoses.

Adopted from Reference 6, Appendix A, pp. 79-81.
APPENDIX B

Definition of Outliers. a

Outliers

Those patients with unusually long (day outliers) or costly (cost outliers) stay for a particular DRG. This additional amount is intended to cover the marginal (incremental) cost of treating atypical patients.

A. Day outliers

Patients whose length of stay (excluding days not covered by plan A) exceed the average (mean stay for a DRG by 20 days or 1.9 Standard Deviation units), whichever results in a smaller number of days.

Additional payment for day outliers are made automatically on a per diem basis, i.e., the hospital does not have to request additional payment.

B. Cost outliers

Patients whose charges adjusted to cost exceed the DRG payment rate by the larger of $12,000 or multiple of 1.5 times the relevant DRG payment rate, whichever yields the greater amount.

Unlike day outliers, cost outliers are handled on an exceptional basis, i.e., a hospital must submit a written request to its intermediary for additional payment.

a Based upon definition mentioned in Reference 52, pp. 7-11.
### APPENDIX C

#### Chemistry Panel 1 and 2 Order Forms

**Chemistry Panel 1**

<table>
<thead>
<tr>
<th>Test</th>
<th>Normal Range</th>
<th>Unit</th>
<th>Test</th>
<th>Normal Range</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrolyte Profile</td>
<td></td>
<td></td>
<td>Glucose fasting (70-110)</td>
<td></td>
<td>mg/dl</td>
</tr>
<tr>
<td>Sodium (136-143)</td>
<td>m mol/L</td>
<td></td>
<td>Glucose:</td>
<td></td>
<td>mg/dl</td>
</tr>
<tr>
<td>Potassium (3.5-4.6)</td>
<td>m mol/L</td>
<td></td>
<td>B.U.N. (5-24)</td>
<td></td>
<td>mg/dl</td>
</tr>
<tr>
<td>Chloride (98-106)</td>
<td>m mol/L</td>
<td></td>
<td>Creatinine (0.8-1.2)</td>
<td></td>
<td>mg/dl</td>
</tr>
<tr>
<td>Carbon Dioxide (24-32)</td>
<td>m mol/L</td>
<td></td>
<td>Uric Acid (7.3-8.1)</td>
<td></td>
<td>mg/dl</td>
</tr>
<tr>
<td>Anion Gap (Na⁺-Cl⁻+ CO₂⁻)</td>
<td>(5-16)</td>
<td></td>
<td>Tot. Prot. with Alb. &amp; GLOB</td>
<td></td>
<td>g/dl</td>
</tr>
<tr>
<td>Calcium (8.5-10.1)</td>
<td>mg/dl</td>
<td></td>
<td>Bilirubin total (less than 1.5)</td>
<td></td>
<td>mg/dl</td>
</tr>
<tr>
<td>Phosphorus (2.5-4.9)</td>
<td>mg/dl</td>
<td></td>
<td>Bilirubin direct (less than 0.4)</td>
<td></td>
<td>mg/dl</td>
</tr>
<tr>
<td>Magnesium (1.8-2.4)</td>
<td>mg/dl</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Osmolality (265-305)</td>
<td>mOsm/Kg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lactic Acid (0.5-2.2)</td>
<td>mEq/L</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Chemistry Panel 2**

<table>
<thead>
<tr>
<th>Test</th>
<th>Normal Range</th>
<th>Unit</th>
<th>Test</th>
<th>Normal Range</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₄* Uptake</td>
<td></td>
<td></td>
<td>T₂*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free Thyroxin Index, T₂ &amp; T₄*</td>
<td></td>
<td></td>
<td>T₂ By RIA*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TSH*</td>
<td></td>
<td></td>
<td>Haptoglobin normal (27-139)</td>
<td>mg/dl</td>
<td></td>
</tr>
<tr>
<td>Neonatal PKU, T₄, Galactosemia*</td>
<td></td>
<td></td>
<td>Glucose Tolerance</td>
<td></td>
<td>Hrs.</td>
</tr>
<tr>
<td>Serum iron (42-136)</td>
<td>mcg/dl</td>
<td></td>
<td>Serum iron (42-136)</td>
<td>mcg/dl</td>
<td></td>
</tr>
<tr>
<td>CPK (9-56)</td>
<td>IU/L</td>
<td></td>
<td>TIBC (250-350)</td>
<td>mcg/dl</td>
<td></td>
</tr>
<tr>
<td>LDH (43-99)</td>
<td>IU/L</td>
<td></td>
<td>Saturation (14-47)</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>CPK Isoenzyme</td>
<td></td>
<td></td>
<td>Haptoglobin normal (27-139)</td>
<td>mg/dl</td>
<td></td>
</tr>
<tr>
<td>LDH Isoenzyme</td>
<td></td>
<td></td>
<td>Serum B-HCG* Quantitative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac Profile</td>
<td></td>
<td></td>
<td>Serum B-HCG* Quantitative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac Rehab Profile</td>
<td></td>
<td></td>
<td>Serum B-HCG* Quantitative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potassium (3.5-4.6)</td>
<td>mmol/L</td>
<td></td>
<td>Serum B-HCG* Quantitative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glucose (70-110)</td>
<td>mg/dl</td>
<td></td>
<td>Serum B-HCG* Quantitative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cholesterol (120-280)</td>
<td>mg/dl</td>
<td></td>
<td>Serum B-HCG* Quantitative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triglyceride (100-200)</td>
<td>mg/dl</td>
<td></td>
<td>Serum B-HCG* Quantitative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HDL Cholesterol (M 32-72)</td>
<td>mg/dl</td>
<td></td>
<td>Serum B-HCG* Quantitative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ferritin*</td>
<td></td>
<td></td>
<td>Serum B-HCG* Quantitative</td>
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<td></td>
</tr>
<tr>
<td>Total Cholesterol: HDL Chol.</td>
<td></td>
<td></td>
<td>Serum B-HCG* Quantitative</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Some values are given in IU/L, mg/dl, or mcg/dl.