AN AGENCY EVALUATION OF THE INCENTIVE PROVISIONS OF NINE HEALTH CARE REIMBURSEMENT SYSTEMS

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PREFACE

This study is concerned with the incentives for hospital cost control embedded within nine health care reimbursement systems. Specific attention is given to the impact of each system on five areas of physician behavior felt to possess potential for the reduction of hospital costs, without an accompanying reduction in health care quality. An adverse selection agency model (specifically adapted to the medical setting) is developed which is used to demonstrate the level of health care inputs that would be ordered by the physician under each reimbursement system. This information is used to rank the nine health care reimbursement systems from the standpoint of patient welfare. Since fee-for-service and DRG reimbursement do not provide an incentive for the physician to choose the action vector most appropriate to the patient, a brief discussion is given of the private information that must be revealed under each reimbursement system to allow the patient to write a forcing contract. This study concludes with recommendations for future research to increase the effectiveness of two of the health care reimbursement systems evaluated.

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NOMENCLATURE: ADVERSE

SELECTION MODEL

$d(.)$	The gross amount paid by the patient for the services provided by the physician and the hospital, where $d(.) = s(.) + t(.)$.
$\bar{d}$	The expected gross payment.
D	The set of all physician payment schedules.
$\underline{e}$	A vector representing the actions of the physician where $\underline{e} = (\rho, \alpha, \eta, \omega, \psi)$.
E	The set of all physician action vectors.
$f_1(\theta)$	The patient's subjective probability distribution (i.e. the patient's beliefs at the beginning of the period concerning θ).

$f_2(\theta)$ The physician's subjective probability distribution (i.e. the physician's beliefs at the beginning of the period concerning θ).

$G(.)$ The utility of the patient, which is an increasing function of wealth.

$\bar{H}$ The opportunity cost of hiring the physician.

$\hat{H}$ The certainty equivalent of $\bar{H}$.

$H(.)$ The utility of the physician, which is an increasing function of wealth.

j The cost of a medical audit.

P_{0i} The probability of θ_i when preventive medicine is not given at the beginning of the period.

P_{1i} The probability of θ_i when preventive medicine is given at the beginning of the period.

$s(.)$ The residual portion of $d(.)$ that the physician retains after paying $t(.)$ to the hospital.

$\bar{s}$	The expected residual payment.
$t(.)$	The portion of $d(.)$ that is paid to the hospital for services rendered.
$\bar{t}$	The expected hospital payment.
x	The gross income of the patient.
$z(p)$	The payment for preventive medicine under a fee-for-service arrangement.
α	A vector representing the level of diagnostic ancillary services chosen by the physician, where 0 represents an inadequate level, and 1 represents an adequate level.
θ	The state of nature which is the patient's state of health.
Ω	The set of all the states of nature. This is partitioned into three categories which are defined in Chapter Four.

η A vector representing the level of hospital equipment and facilities chosen by the physician, where 0 represents an inappropriate level and 1 represents an appropriate level.

ρ A vector representing the level of preventive medicine chosen by the physician, where 0 represents no preventive medicine and 1 represents an appropriate level of preventive medicine.

ω A vector representing the length of hospital stay chosen by the physician, where 0 represents an excessive level and 1 represents an appropriate level.

ψ A vector representing the level of surgical services chosen by the physician, where 0 represents and excessive level and 1 represents an appropriate level.

CHAPTER I

INTRODUCTION AND STATEMENT OF THE PROBLEM

One of the primary objectives of accounting is to provide owners and managers with the analytical tools necessary for decision making and control. Financial accounting is concerned with the revelation of private information that can be used by external users in the valuation of corporate assets and evaluation of managerial performance. Managerial accounting is concerned with the provision of information that can assist managers and other internal users in the selection of alternatives, and in the establishment of policies and procedures that will maximize the value of the firm. Managerial accounting tools have traditionally included product costing systems, budgeting systems, and cost-volume profit analysis. One managerial accounting tool that has received increasing attention in recent years is the employee fee system. With the recognition that employees are motivated by self interest, and can therefore be influenced by their form of reimbursement, managerial accountants are increasingly being asked to participate in the development and evaluation of fee systems that provide incentives for the effective utilization of firm resources.

One field where fee systems have received a substantial amount of attention in recent years is the health care industry. One reason for this concern is the increasing share of national resources being consumed by health care services. In 1965 Americans spent a total of 42 billion dollars on health care. In 1981 this figure was 287 billion dollars (U.S. Department of Commerce, 1982-1983, p. 101). One indicator of increasing hospital costs is the American Hospital Association's "Average Cost Per Patient Day Index" (ACPPD). In calculating hospital costs, this index adjusts for changes that occur over time in the volume and mix of hospital services. In 1950, the ACPPD was $15.62. In 1981 it was $251.02. Even when converted to constant dollars, the ACPPD was five times what it was in 1950, and nearly double what it was in 1966 (Eastaugh, 1981, p. 4).

A second reason for the interest in fee systems is the recognition by policy makers that the health care industry lacks many of the incentives for efficiency found in other sectors of the economy. Because of the technical nature of medical services, the consumer is not in a position to make fully competent evaluations concerning the quality and quantity of the medical care he receives. Not having the knowledge to determine the combinations of health care services that maximize his utility, he must delegate this decision to his physician who, due to the nature of the fee system, may be in a position to maximize profits at the expense of the patient by choosing less than optimally cost efficient inputs in the treatment of the patient's disease.

Similar problems exist within the hospital. Since it is the physician who selects the hospital and orders the services it will provide, many hospitals view the physician as their primary customer and consequently compete on the extensiveness of the services that they can provide. Because of this, some economists view the hospital as a physician cooperative, operated to maximize the utility of the medical staff rather than minimize the cost to the patient (Pauly and Redisch, 1973). These factors, coupled with a philosophy that health care is a right whose distribution should not be left solely to the marketplace, have all served to weaken the incentives for cost efficiency found in other sectors of the economy. Any proposal for change, therefore, must recognize the unique characteristics of the health care industry and the important role that the physician plays in cost containment.

The physician's important role in cost containment arises from the fact that he has been delegated almost complete decision making authority over health care production inputs. The physician not only provides advice on how much and what kinds of medical services the patient should consume, but provides many of the medical services to be consumed. According to Detsky (1978):

> This dual role of the physician as both the agent for demanding services and the supplier of those services is reinforced by the conditions of uncertainty, information gap, emotional nature of illness, ...and the position of trust and confidence placed in the physician and hospital (p. 38).

In an evaluation of the impact of physician behavior on health

care costs, one area believed to possess potential for cost reduction without an accompanying reduction in quality, is the hospital. In 1978, hospitals consumed approximately 40 percent of all health care expenditures. High hospital costs are a result of the industry's high investment in both labor and capital equipment. According to statistics published by the American Hospital Association, the average hospital has approximately 3.3 employees per patient (American Hospital Association, 1983, p. 185). In 1980, hospital construction costs (including the costs of furnishings and equipment) exceeded $150,000 per bed (Howard, 1984).

While the administrator and board of governors are technically responsible for the operation of the hospital, the structure of the industry is such that the actions of the physicians are a primary factor in hospital cost escalation. According to a recent article in the Wall Street Journal:

> Most hospital costs--estimates run as high as 75 percent to 80 percent--result from the decisions of physicians, . . . Although not hospital employees, physicians are the ones responsible for deciding whether a patient should be admitted, what tests should be run, what procedures are needed, and when the patient is ready for discharge (Capron, 1984, p. 16).

Because it is the physician who selects the hospital, and the services it will provide, many hospitals view themselves as the agents of the physician, not the patient. While patient utility is increased by the production of quality health care inputs at the lowest possible price, physician utility is a function of physician income, which in turn is largely dependent on the scope of hospital services provided.

Treatment at a community hospital where the physician holds medical staff privileges is preferred by the physician to treatment at a larger more specialized hospital where the patient must be referred to another physician. As a result, community hospitals will often procure complex equipment that should be reserved for larger, more specialized facilities with patient volumes adequate to justify the acquisition (Eastaugh, 1981, pp. 42-44).

In the evaluation of ways in which physician behavior might adversely affect hospital costs, five areas can be identified. These include:

1. Absence of provision of preventive medicine.
2. Excessive utilization of diagnostic ancillary services.
3. Provision of excessive levels of hospital equipment and facilities.
4. Excessive lengths of hospital stay.
5. Use of excessive surgical services.

In addressing these problem areas, one objective of national health care policy might be to create a set of incentives that induce a physician to act in the patient's best interest, while still pursuing his own self interest. One area of research that has concentrated on the problems resulting from a divergence between self interest and cooperative behavior is agency theory. In agency theory, two situations are examined in which an agent may act in a manner inconsistent with the best interests of the principal. Both of these arise as a result of the principal being unable to motivate the agent

to perform optimally the duties for which he was hired. The principal hires the agent to provide labor inputs. If these inputs can be observed by the principal, then they can serve as the basis for the employment contract. If the principal is unable to observe the inputs of the agent, then the principal must select a surrogate for these inputs. If this surrogate does not accurately portray the inputs of the agent, and if the agent is motivated to provide inputs that are different than those the principal would choose, then moral hazard is said to arise.

A second possible reason for divergence between cooperative and self interested behavior results when the agent bases his behavior on private information that cannot be verified by the principal. In this situation, the principal cannot determine whether the observed input was the appropriate choice, given the action rule that the principal wants the agent to use and the agent's private information. If the agent is motivated to misrepresent this information to implement an action rule different from that desired by the principal, then the problem of adverse selection arises.

Since agency theory has demonstrated that the form of the fee schedule can significantly influence the input decisions of the agent, this study employs the agency model to evaluate the incentive structure of nine health care reimbursement systems (all of which are identified in Chapter Two) to determine their impact on physician behavior. Each reimbursement system is analyzed to determine the action choice of the physician. The patient welfare loss, determined

by each action choice, is then used to evaluate the nine health-care reimbursement systems.

Summary of Content

Chapter One introduces the problem of health care cost escalation (focusing specifically on hospital costs) and highlights the physician's important role in hospital cost containment. In addition it introduces agency theory, an analytical tool concerned with the impact of fee systems on employee behavior. The agency framework is used in this study to evaluate the incentive structure of nine health care reimbursement systems. Chapter Two defines the term "reimbursement system" as it is used in this study and introduces the nine health care reimbursement systems to be evaluated in Chapter Five. Chapter Three defines the five hospital cost areas of physician behavior potentially impacted by these nine reimbursement systems. In Chapter Four the traditional agency model is reviewed as are previous applications of this model to both industrial and medical environments. Attention is then focused on the development of an "Adverse Selection Model - Medical Setting" which is used to evaluate the incentives for health care cost control embedded within the nine reimbursement systems. Chapter Five utilizes the "Adverse Selection Model - Medical Setting" to analyze the nine reimbursement systems and their incentive effects on the five hospital cost impact areas of physician behavior. Chapter Six ranks the nine reimbursement systems from the standpoint of patient welfare loss and discusses the

information requirements of each reimbursement system. Chapter Seven concludes with a summary of findings and recommendations.

CHAPTER II

DESCRIPTION OF REIMBURSEMENT SYSTEMS

Since many of the current proposals for health cost containment involve a restructuring of the physician-hospital relationship, any description of the behavioral impact of physician fee schedules must also include an examination of hospital fee schedules. For the purpose of this study, a reimbursement system is defined as a combination of one physician and one hospital fee schedule. In this chapter the nine reimbursement systems to be evaluated by this study are introduced.

Reimbursement Systems

First-Best Solution

The first-best solution is used as a standard. This solution represents the reimbursement solution that would be imposed by the patient on the physician if there were no private information. In this situation, the patient pays the physician a prenegotiated sum if the physician provides an appropriate level of preventive, diagnostic, and treatment services, and nothing if he does not. As with the other reimbursement systems to be introduced in this chapter, a mathematical formulation of this system will be given in Chapter Five.

Fee for Service

The second reimbursement system is the traditional reimbursement mechanism for both physicians and hospitals. Since the physician and hospital are paid for services rendered, the fee under this system is an increasing function of the complexity and quantity of services rendered. For the physician, the fee is determined by market forces. For the hospital, the fee represents full cost reimbursement for services rendered. In order to understand fee-for-service reimbursement, it is helpful to understand the voluntary and therefore loosely structured nature of the health care industry in which this system evolved.

Prior to the advent of modern medicine, most hospitals were little more than poor houses, places where the indigent ill were sent to die (Howard, 1984). These facilities were often operated by religious or charitable organizations whose limited resources mandated that the physician be privately reimbursed for his services under a fee-for-service arrangement. Since the physician was usually the only member of the health care team with any medical education, this health care system gave the doctor a great deal of autonomy in the allocation of the limited and often voluntary health care resources. From the beginning, this autonomy was viewed as a prized possession. As early as 1880 one finds the American Medical Association resisting any and all changes to fee-for-service on the grounds that they would infringe on the independence of the physician. Today fee-for-service

is still endorsed by the AMA as the most preferred physician reimbursement system.

Capitation Payment

This third reimbursement system represents the first innovative departure from fee-for-service that has been implemented on a national basis. Under the capitation payment system, a provider is paid a fixed per capita amount irrespective of the services actually rendered during a predefined period (such as an enrollment year). One organization that has designed its delivery structure around capitation payment is the Health Maintenance Organization (HMO). Gumbiner (1975) defines an HMO as a prepaid group practice in which there is a four-way arrangement among the following:

1. An organized health-care delivery system that includes health manpower and facilities capable of providing or at least arranging for all of the health services that a patient population may require.

2. An enrolled population consisting of individuals and groups of individuals who contract with the delivery system for the provision of a range of health services for which the organization assumes full responsibility.

3. A financial plan that incorporates the underwriting of the cost of the agreed upon set of services on a prenegotiated and prepaid per-person or per-family basis.

4. A management component that assures legal, fiscal, public, and professional accountability. (p. 3)

One of the primary objectives of the health maintenance organization is the creation of incentives for the physician to act in

the best economic interest of the patient, while still providing high quality medical care. One way that HMOs attempt to do this is through the elimination of the ineffeciencies caused by the economic separation of the physician and hospital. Under fee-for-service the physician is able to allocate hospital resources without cost to himself, and without effective review by hospital administration. The HMO attempts to correct this by making the physician face the cost of using hospital resources.

The concepts underlying the HMO are not new. As early as 1930 both the Kaiser Health Plan and the Health Insurance Plan of New York (HIP) were providing a broad spectrum of health care, including hospital services, for a predetermined fixed fee (Brown, 1983, p. 103). Despite the early successes of these two programs, however, the growth of HMOs has been slow (Brown 1983, p. 401). In 1980 only 4.3 percent of the American population was enrolled in Health Maintenance Organizations (Eastaugh, 1981, p. 137). One reason for this slow growth was opposition by organized medicine (Feldstein, 1979, p. 295). In some parts of the country fee-for-service physicians were successful in denying state medical association membership to HMO physicians. As state medical association membership is required for staff membership in most hospitals, the effect was to deny HMOs access to inpatient equipment and facilities. In some states medical societies sponsored legislation mandating unrealistic financial requirements for the establishment of HMOs, or perverse financial incentives (e.g. in Oregon HMOs were required to absorb all losses

while retaining none of their savings). In other states HMOs were declared illegal (Feldstein, 1979, pp. 294-297).

The HMO act of 1973 (federal legislation) removed some of the legislative barriers to HMO formation previously mandated by state law. Unfortunately, it imposed others felt by some to be equally burdensome (Brown, 1983, pp. 401-441). One such provision mandates that any organization wishing to qualify as a federal HMO must offer more extensive benefits than are offered by the majority of third party payors. As a larger benefits package raises the premium of the HMO in relation to other health insurance premiums, this provision places HMOs at a competitive disadvantage. While Congress appears to be receptive to legislative suggestions that will make the American health care delivery system more competitive, many feel that the question "Do HMOs generate real cost savings?" must be resolved before additional changes are made to the 1973 act. One problem in answering this question is the absence of comparable data bases, (e.g. the possible dissimilarity between HMO and other health insurance subscriber groups). While per-capita health costs have been shown to be lower for HMO participants then for subscriber groups of other insurance groups in general (Feldstein, 1979, p. 292), some have claimed that HMOs selectively market their plans to healthier population groups. A 1980 report from the Health Care Financing Administration to the Senate Finance Committee reported that elderly new enrollees in a Seattle HMO were much healthier then the non-HMO elderly in the same community. According to Eastaugh (1981, p.135),

this adversely affected a national drive by HMOs to improve Medicare reimbursement policies.

There are a number of forms of capitation payment. This study will examine three, each of which will be treated as a separate reimbursement system.

Capitation One. In Capitation One, a two person world is assumed where one physician contracts with one patient for the provision of comprehensive health care services. In return for these services, the physician receives a fixed capitation payment from which he must pay the hospital the full cost of all hospital services rendered.

Capitation Two. In Capitation Two, a two person world is also assumed. Here the physician contracts with a patient for the provision of physician services only. For these services the physician receives a fixed capitation payment. The patient, however, retains full responsibility for the cost of hospital services rendered, reimbursing the hospital directly for these services.

Capitation Three. In Capitation Three, the hospital is equally owned by n physicians where each physician serves one patient. Each patient pays a fixed capitation fee from which the physician owners first cover the actual hospital costs by contributing equally. The residual is kept by each physician as income.

Diagnostic Related Groups

The use of Diagnostic Related Group (DRG) reimbursement for the

payment of Medicare hospital claims was mandated by Title VI of the Social Security Amendments of 1983. Under this reimbursement system, patients are assigned according to age, sex, diagnosis, treatment procedure and discharge status, to one of 467 presently assigned DRGs. Each DRG represents an illness and carries a specific rate of reimbursement. If a provider treats a patient for less, it can keep the excess. If its costs are more, it must absorb the loss.

DRG reimbursement is the outgrowth of a federally funded study conducted during the 1970s. The objective of this study was to develop an alternative to the International Classification of Disease Adapted, Eighth Revision (ICDA-8) used to describe patient health problems. In attempting to correct this, Yale clinicians combined the ICDA-8 into eighty-three major diagnostic categories (MDCs) in accordance with three principles:

1. The major diagnostic categories were consistent in their anatomical, physiopathological classification or in the manner in which they were clinically managed.

2. The major diagnostic categories were large enough groups so that they produced statistically meaningful patient populations in each category.

3. The major diagnostic categories covered the range of the ICDA--8 codes without overlap (Ernst and Whinney, 1980, p. 3).[1]

Researchers then obtained a large quantity of patient records from New Jersey, Connecticut and South Carolina which were assigned to

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[1] This system was later adapted to the newer ICDA-9 classification system.

the eighty-three MDCs on the basis of primary diagnosis. Distributions were then developed, identifying the length of stay for each MDC. Through the use of AUTOGRP, an interactive computerized grouping algorithm, the clinicians split the eighty-three MDCs into groups which: (1) had a sizable number of patients, and (2) explained a significant amount of the variance in the distribution of the length of stay (Ernst and Whinney, 1980). In the initial study, length of stay was used as the dependent variable (i.e. as the surrogate for resource consumption). Since researchers still found significant variation in the length of stay within each of the subgroups, a second "splitting" was done using five additional variables:

1. Secondary diagnosis
2. Primary surgical procedure
3. Secondary surgical procedure
4. Age
5. Presence or absence of psychiatric services

This second split produced 383 diagnostic related groups. In subsequent studies, hospital charges were added as a surrogate for resource consumption and the number of Diagnostic Related Groups was increased to 467 (Ernst and Whinney, 1983).

During the time that the ICDA-8 study was being conducted, the federal budget was rapidly growing as the result of expanding social programs and rising hospital costs. In response to pressure from Congress, the Health Care Financing Administration (HCFA) began

studying ways to control medicare reimbursement to hospitals. These studies led to the enactment of Section 224 routine cost limits that were incorporated into the Medicare reimbursement formula in 1972. While these limits tried to control hospital costs for routine inpatient care, they did not cover ancillary service utilization or costs and did not address the impact of case mix. It was the desire to address these issues that led the Health Care Financing Administration to study the use of DRGs for reimbursement, a study that served as the basis for the Social Security Amendments of 1983.

As of the conclusion of this study, DRG reimbursement is still being implemented by the Health Care Financing Administration. As the concept underlying this reimbursement system is a fairly new development, changes are still being made and the final form of this system is still uncertain. Consequently four possible variations of DRG reimbursement are examined by this study.

DRG One. In DRG One, the physician is paid a fee-for-service, while the hospital is reimbursed according to the patient's DRG as described above. This is similar to the system originally proposed in the Yale University study.

DRG Two. DRG Two is an amended version of DRG One. Under this system the reported physician diagnosis is audited for accuracy by a Peer Review Organization (PRO). Since the

treated as a separate and distinct reimbursement system. This system is similar to that presently mandated by the federal government.

DRG Three. This reimbursement system was chosen for evaluation as it is felt by many to contain a different incentive structure than the DRG reimbursement system actually mandated by the federal government. Under this system, both the physician and hospital are paid according to diagnostic related groups. In 1983 Congress directed the Health Care Financing Administration to study the possible implementation of this health care reimbursement system.

DRG Four. This reimbursement system is an amended version of DRG Three. Under this system, the reported physician diagnosis is audited for accuracy by a Peer Review Organization (PRO). Since the implementation of an effective audit technology significantly alters physician incentives for hospital cost control, this amendment is treated as a separate and distinct reimbursement system.

Conclusion

In this chapter the nine health care reimbursement systems to be evaluated in Chapter Five were introduced. These nine systems can be grouped into four categories; The First-Best Solution, Fee-for-service, Capitation payment, and Diagnostic Related Group reimbursement. The first-best solution is not a real world reimbursement system but is included for comparison purposes only. Fee-for-service is the traditional reimbursement system. While this

system is preferred to all other systems by the American Medical Association, it is felt by many to contain adverse incentives for hospital cost control. Capitation payment is the reimbursement system upon which health maintenance organizations are based. While empirical studies have indicated that these organizations may provide health care at a lower cost than fee-for-service providers, one must be careful in drawing conclusions concerning the incentives for cost control these organizations invoke as capitation payment subscriber groups may demographically differ from those covered by fee-for-service reimbursement plans. Three variations of Capitation payment are evaluated by this study. DRG reimbursement is currently being implemented by the Health Care Financing Administration. As the final form of this reimbursement system is still uncertain, four possible variations of DRG reimbursement are examined by this study.

CHAPTER III

DESCRIPTION OF HOSPITAL COST IMPACT AREAS OF PHYSICIAN BEHAVIOR

In this chapter the five hospital cost impact areas of physician behavior to be examined by this study are introduced. These five areas were selected for examination as each is felt to contain significant potential for hospital cost savings without an accompanying reduction in the quality of health care.

Behavioral Areas

Absence of Provision of Preventive Medicine

Many critics of the American health care delivery system feel that one of its deficiencies is an overemphasis on the treatment of disease. According to this, both the patient and the economy would be better served if more resources were devoted to the prevention, versus the treatment of disease (Eastaugh, 1981, p. 19). An effective preventive medicine program consists of two components. One is health education which can reduce mortality and morbidity by altering non-healthful lifestyles. The other is early diagnosis which can increase the chance for survival while reducing treatment costs. Conceptually, preventive medicine reduces the probability of illness

occurrence and therefore the expected cost of physician and hospital services. It is assumed that the provision of preventive medicine is beneficial to the patient. An appropriate level of preventive medicine is defined as that level which optimizes the benefit to the patient. A more formal presentation of these concepts is presented in Chapter Five.

Excessive Utilization of Diagnostic Ancillary Services

One of the fastest growing components of health care costs are diagnostic ancillary services. These include those laboratory and radiology services that assist the physician in formulating the patient diagnosis. While advances in technology have provided the physician with a number of valuable diagnostic tools unavailable in the past, there is growing concern that many diagnostic procedures are being overutilized. Scitovsky (1976) reported that between 1964 and 1971, laboratory tests per hospital episode increased from 25 to 33 percent for the simple and well defined diagnostic categories of simple appendectomy and acute myocardial infarction, and increased 90 to 110 percent for perforated appendicitis and breast cancer cases, respectively. In a study of 285 hospitals conducted during the period of 1968-1971, Redisch (1978) reported that laboratory tests increased at an average annual rate of nine percent. According to Eastaugh (1981, p. 270), expenditures for laboratory tests and other nonpersonal items have the highest rate of increase of any element responsible for rising hospital costs. Jonsson and Neuhauser (1975)

report that the average American physician orders three times as many tests to decide upon a simple elective surgical diagnosis as does a comparable Swedish physician.

A possible reason that physicians overutilize ancillary diagnostic services is to supplement or increase their personal incomes. Feldstein (1979, p. 176), Reinhart (1973), and Monsma (1970, p. 157) all examined the Target Income Hypothesis. According to this, the uncertainty that patients have regarding their medical needs allows physicians to induce their own demand. The Target Income Hypothesis suggests that physicians have control over their own markets, and that as the number of physicians in a community increase, the number of tests and procedures per outpatient visit also increase. Feldstein (1979, p. 167) observes that in West Germany, where the physician/patient ratio has increased rapidly in the past decade, physician incomes have not decreased but have continued to increase. The bulk of this increase is attributed to an increased delivery of minor medical x-ray and diagnostic procedures.

Provision of Excessive Levels of Hospital Equipment and Facilities

Under fee-for-service reimbursement, physician income is a function of the complexity of services rendered. Consequently it is in the physician's best economic interest to have the hospital where he holds medical staff privileges provide as many diagnostic and treatment services as possible. Much of the governmentally funded regulation activity of the 1970's was aimed at reducing the

duplication of hospital equipment and facilities. These included the Regional Medical Program and Health Systems Agencies. Most health economists feel that these programs were not effective and that the provision of excessive levels of hospital equipment and facilities is still one of the major areas of cost ineffeciency in the health care industry (Eastaugh, 1981, pp. 187 - 205).

Excessive Lengths of Hospital Stay

Another way that hospital resources are consumed inefficiently is through excessive (non-medically justified) lengths of hospital stay. Ideally, hospital length of stay should be a function solely of the patient's medical condition. Studies have shown, however, that other factors can influence the physician's decision on when to discharge the patient. Both Rafferty (1971) and Eastaugh (1981, p. 278), for example, have shown that hospital occupancy rates can affect length of stay, that as hospital occupancy rates decrease, both the probability of hospital admission, and length of hospital stay increase. One reason for this physician behavior may be the curtailment of hospital services if certain levels of hospital occupancy are not maintained. Since the physician's income is a function of the scope of services offered by the hospital in which he holds medical staff privileges, it is clearly to his advantage to see that his hospital maintains an adequate level of patient revenue. Another reason is that the physician's charge is often directly related to the number of hospital visits.

Use of Excessive Surgical Services

The use of excessive surgical services represents another way that health care resources may be consumed inefficiently. Monsma (1970, p. 149) has shown that the demand for certain surgical procedures is directly related to the marginal revenue that the physician receives for performing that service. He demonstrates that demand will be greater for procedures that require hospitalization than for home and office visits, and that the increased demand for surgery will be concentrated among those procedures which involve the removal of organs which will not greatly impair the functioning of the individual, and for which the need for the procedure is subject to some doubt.

In trying to determine the scope of this problem, a number of empirical studies have compared surgical utilization under fee-for-service and capitation payment physician reimbursement programs. In one study conducted by the National Opinion Research Center, 400 families covered by two comprehensive insurance groups (the one an HMO and the other a traditional fee-for-service insurance group) were surveyed. While the study found no significant difference between the nonsurgical and nonobstetrical physician visits, the enrollees under the HMO had an average of 4.38 hospital surgical procedures per hundred persons per year while the enrollees under the fee-for-service plan had a rate of 7.18. The difference of 2.80 procedures per hundred persons per year was significant at the .95

confidence level (Monsma, 1970, p. 151). In a second study, Densen and associates compared surgical admissions for 50,000 Blue Cross subscribers to 50,000 enrollees in Health Insurance Plan of New York. For Blue Cross the rate was 5.02 per hundred persons per year, for Health Insurance Plan of New York the rate was 4.11. Here again, the difference was found to be significant at the .95 confidence level (Monsma, 1970, p. 155).

Lower rates for surgery under fee-for-service reimbursement have also been found in other studies. The United Steelworkers of America under various negotiated health insurance plans had an average rate of hospitalized surgeries of 3.3 per year for members covered by Kaiser Foundation Health (a California based HMO) as compared to 6.9 for those covered by Blue Cross/Blue Shield and 6.3 for those covered by commercial insurance. While these studies tend to support the hypothesis that the form of physician reimbursement may affect the demand for surgery, they must be viewed with caution as the populations from which these figures were drawn may not be homogeneous (Monsma, 1970, p. 156).

Conclusion

In this chapter the five hospital cost impact areas of physician behavior to be examined in this study were introduced. These include the provision of preventive medicine, the excessive utilization of diagnostic ancillary services, the provision of an excessive level of hospital equipment and facilities, excessive lengths of hospital stay

and the use of excessive surgical services. This study will now turn to the development of the analytical model used in evaluating the impact of nine health care reimbursement systems on these five areas of physician behavior.

CHAPTER IV

ANALYTICAL FRAMEWORK

This chapter introduces the traditional agency model, reviewing previous applications to both industrial and medical environments. Attention is then focused on the development of an "Adverse Selection Model - Medical Setting", which is used to evaluate the incentives for health cost control embedded within the nine reimbursement systems examined by this study.

Review of Traditional Agency Models

The agency problem is typically modeled in a two-person, single period setting. One person, the principal, delegates a decision or action to another person, the agent. The action choice determines an outcome which affects the welfare of both the principal and the agent. The outcome, for example, can be viewed as a monetary reward owned by the principal, a portion of which is used to pay the agent for his part in determining the outcome.

Initially, agency research focused on decision-based models. Here it was assumed that the agent would select an action $e \in E$. This action with a random state of nature, $\theta \in \Omega$, determines the cash

outcome $x = x(e,\theta)$, $x \subseteq X \subseteq R$. The principal pays some share, $d(x)$, of the outcome to the agent. Accordingly, $r(x) = x - d(x)$, represents the principal's residual share. The utility function of the principal is denoted by $G(r(x))$ with $G'(.) > 0$ and $G''(.) \leq 0$. The agent's utility function is $H(d(x))$ with $H'(.) > 0$ and $H''(.) \leq 0$. Both agent and principal are assumed to be expected utility maximizers. Moreover, if $f_1(\theta)$ and $f_2(\theta)$ are subjective probability distribution functions held by the principal and agent, it is assumed that $f_1(\theta) = f_2(\theta) = f(\theta)$.

In the decision based model it is assumed that each person acts in his own interest. It is also assumed that x is the only jointly observable outcome and that the contract between the principal and agent can be based only upon jointly observable outcomes. Furthermore, precontract information is the same for both parties. Principal and agent both know E, G(.), H(.), and Ω.

The problem faced by the principal and agent can now be stated. The agent must select the action that maximizes his expected utility given the fee schedule. The principal's problem is to select a fee schedule so as to maximize expected utility subject to two constraints:

1. The principal must at least pay the agent the agent's opportunity cost of joining the firm. The agent will not join the firm unless his expected utility is at least as great as his expected utility from selling his services in the labor market.

2. Knowledge that the agent will select the action that maximizes the agent's expected utility given the fee schedule.

In this model, the agent may choose an action different from that desired by the principal due to differences in risk attitudes. The decision-based model can be expressed as follows:

Maximize the principal's utility

$$\underset{d(x) \in D}{\text{Max}} \Sigma G(x-d(x))f(\theta) \qquad (1)$$

subject to the minimum utility requirement of the agent

$$\Sigma H(d(x))f(\theta) \geq \bar{H} \qquad (2)$$

and incentive incompatibility (the selection of the argument that maximizes the agent's utility)

$$e \in \text{argmax } \Sigma H(d(x))f(\theta) \qquad (3)$$

The next step in agency research involved extending the above model to incorporate the concept of moral hazard. This extended model is an effort-based model. The extension defines the action e, as productive effort and assumes that H(.) is a function of both d(x) and e. A common assumption is $H(d(x),e) = U(d(x)) - V(e)$ where $U'(.) > 0$, $U''(.) \leq 0$ and $V'(.) > 0$. That is, H(.) is separable and the agent is strictly risk averse and work averse. For continuous probability density functions, the summation would be replaced by integration over the relevant domain.

The problems faced by the principal and agent are the same for the effort-based model as for the decision based model. However,

incentive difficulties in the effort-based model include not only different attitudes toward risk but also the fact that the agent receives disutility from effort and the principal does not. Since x is the only jointly observable variable, an agent can select a lower effort level than desired by the principal and blame the poor outcome on an unfortunate state of nature.

Application of Agency Models to Industrial Settings

There have been numerous applications of agency theory to the industrial setting. Jensen and Meckling (1976) use agency theory to develop a theory of the ownership of the firm. They examine how conflicting objectives can be brought into equilibrium through employment contracts which tie the interests of managers to the interests of owners. According to Jensen and Meckling (1976, p. 310), "Contractual relations are the essence of the firm", and organizations are legal fictions which "...serve as a nexus for a set of contracting relationships among individuals." Topics examined by Jensen and Meckling include the determination of the optimal scale of the firm, the role of monitoring and bonding activities in reducing agency costs, and the determination of optimal equity to debt ratios.

Baiman (1982) advocates the use of agency theory as a foundation for a normative theory of managerial accounting. According to Baiman, one reason cost benefit analysis has not been applied to managerial accounting is the lack of a well defined and useful model of

individual behavior within a organization. Agency theory provides such a model. Baiman reviews literature that evaluates the value of ex post and ex ante information, and compares alternative management accounting procedures and systems.

Shavell (1979) uses agency theory to analyze the impact of insurance on individual incentives for loss prevention. In this model, the primary problem which the insurance company (principal) must resolve is moral hazard, which occurs when insurance policies reduce the motivation to "take care" (i.e. the motivation to buy locks, buckle seat belts, install smoke detectors etc.). Shavell defines a "fully optimal" insurance policy as one where the insurer can choose the individual's expenditure on preventive care and the terms of the insurance policy (premium and benefits) independently.

Application of Agency Theory to Medical Settings

Past applications of agency theory to the health care industry have been limited, most of them focusing on the contractual relationships and incentives created by health insurance contracts. Magee (1977) uses agency theory to evaluate reimbursement contracts between hospitals and health insurers. In this model, the insurance company is the principal and the hospital administrator is the agent. As Magee believes that hospital cost escalation is a result of poor managerial effeciency, the problem is to select a payment plan that will encourage hospital administrators to choose desired actions under

conditions of uncertainty. Payment systems evaluated by MaGee include payment based on cost reimbursement, payment based on expected costs, and payment based on numbers of patients treated.

In Magee's model, the hospital administrator chooses an action vector, a, from the space of available actions. These actions include capacity decisions, staffing decisions, financing decisions, as well as cost control decisions. The state of nature, $s \in S$, includes the demand for hospital services, factor input prices, the outcomes of cost control projects etc. The hospital's output, x, is a function of the administrator's action and the state of nature, x(a,s). This action pair also determines the costs incurred by the hospital during the period C(a,s). It is assumed that all revenues come from a third party. The revenue received from the payor may depend upon the action/state pair, as well as the hospital's output as reflected in the hospital's revenue function $R'(x,a,s) = R'[x(a,s),a,s] = R(a,s)$. The income of the hospital is defined as $I(a,s) = R(a,s) - C(a,s)$. Income is uncertain, as it depends upon the probability distribution defined over the state space, S, the forms of R(.) and C(.), and the actions available. The Magee model assumes that the manager has preferences for various levels of income, which are reflected in a preference function Uh[I(.)]. Given this notation, the hospital administrator's decision problem is to find a*, the solution to expression (4)

$$\text{Max} \sum Uh[I(a,s)]f(s) \qquad (4)$$

where f(s) denotes the manager's assessment of the probability that

the state s will obtain. One problem with Magee's approach is that both the patient and physician are omitted from the model. As the patient bears the ultimate cost of health care inefficiency, and as the physician allocates almost all of the health care inputs charged to the patient, this would seem to weaken this model considerably.

Brown (1979) uses agency theory to analyze the problems of moral hazard created by health insurance policies, where moral hazard is defined as the reduction in expenditures on preventive medicine and the increase in expenditures for non preventive care caused by the issuance of a policy. Brown assumes a three person world consisting of the patient, the insurer and the physician. For the sake of simplicity, hospitals are excluded. The insurer, who is better informed about the physician's actions than the patient, is concerned about the level of preventive medicine chosen by the patient, and the level of effort provided by the physician (at the request of the patient). Brown argues that while motivated like any economic man by profit, physicians are commonly acting as their patients desire. Brown believes that the escalation of hospital costs are the result of faulty incentives for the patient to reduce health care costs.

Brown's model seems to have the same limitations as Magee's. It fails to recognize that it is the physician and not the patient who selects the majority of health care inputs, that these actions may be economically motivated, and that it is the patient and not the insurance company that ultimately bears both the risk and cost of

inefficiency.

Adverse Selection Model:

Medical Setting

The decision-based or effort-based model has usually been applied to production settings where the owner is able to observe only the cash outcome. In a medical setting, however, these models are not appropriate. In a medical setting the inputs or actions of the physician are usually observable, but the information gap of the patient makes them difficult to evaluate. Essentially, the physician possesses private information. For this reason, any evaluation of health care reimbursement systems should include the development of an adverse selection agency model.

In the adverse selection model it is assumed that the principal (hereafter called the patient) hires an agent (hereafter called the physician) to provide health care inputs. The quantity and mix of these health care inputs defines the physician's action, $\underline{e}$. This is the only jointly observable phenomenon and is the basis for contracting between the patient and physician. The formal definition of $\underline{e}$ is provided later. Since the actions of the physician determine virtually all hospital costs, this model treats the physician and hospital as a single agent.

The state of nature, θ, is defined as the patient's state of health, and Ω is the set of all of the states of nature. Ω is partitioned into three subsets. The first partition is Ω_1,

where $\theta \in \Omega_1$ represents the absence of illness, and illnesses that both the physician and patient can identify as not requiring hospitalization or surgery for diagnosis or treatment. There is no private information (except as to the level of preventive medicine) in Ω_1. The second category is Ω_2, where $\theta \in \Omega_2$ represents illnesses that the physician can identify as not requiring hospitalization or surgery for treatment, but the patient cannot. The third category is Ω_3, where $\theta \in \Omega_3$ represents illnesses requiring hospitalization for surgery and treatment. All θ s are ranked according to severity of illness, with the higher θ s requiring longer treatment than the lower θ s (i.e. $\theta \in \Omega_3$ represents the most severe illnesses while $\theta \in \Omega_1$ represents the least severe illnesses).

It is assumed that the physician holds medical staff privileges in a primary care hospital. A primary care hospital is defined as an inpatient facility serving a population base large enough to justify the acquisition of noncomplex hospital equipment, but too small to fully utilize the more specialized equipment. A secondary hospital is defined as a larger or more specialized facility possessing specialized hospital equipment that <u>can</u> be fully utilized, given the hospital's larger patient volume.

The patient's total payment for health care is $d(.) = s(.) + t(.)$, where $s(.)$ is the payment made to the physician and $t(.)$ is the payment made to the hospital. The patient's residual wealth, therefore, is $r(.) = x - d(.)$, where x represents the patient's gross income.

The action $\underline{e}$ is defined as a vector of state-specific actions

$$\underline{e}_i = \left\{\underline{e}_{i1}, \underline{e}_{i2}, \cdots \underline{e}_{in}\right\} \tag{5}$$

with

$$\underline{e}_{i\theta} = (\rho, \alpha, \eta, \omega, \psi), \quad \theta = 1, 2 \cdots n \tag{6}$$

The physician's choice is viewed as a three stage process. First the physician chooses ρ at the beginning of the period and then θ occurs. The physician next chooses a level of α which reveals what θ occurred and, finally chooses η, ω, and ψ. A particular $\underline{e}_i$ reveals the physician strategy for all possible occurrences of θ. The set E is the collection of all possible physician strategies or actions. The individual components of $\underline{e}_{i\theta}$ are defined as follows:

$$\rho = \begin{cases} 0 & \text{If no preventive medicine} \\ 1 & \text{If appropriate level of preventive medicine} \end{cases}$$

$$\alpha = \begin{cases} 0 & \text{If excessive (non-medically justified) level of diagnostic ancillary services} \\ 1 & \text{If appropriate level of diagnostic ancillary services} \end{cases}$$

$$\eta = \begin{cases} 0 & \text{If excessive quantity of hospital equipment and facilities} \\ 1 & \text{If appropriate quantity of hospital equipment and facilities} \end{cases}$$

$$\omega = \begin{cases} 0 & \text{If excessive length of hospital stay} \\ 1 & \text{If appropriate length of hospital stay} \end{cases}$$

$$\psi = \begin{cases} 0 & \text{If excessive level of surgical services} \\ 1 & \text{If appropriate level of surgical services} \end{cases}$$

For each action component other than ρ, appropriate level is defined as the minimum level necessary to restore the patient to health. However, the definition of appropriate level for preventive medicine needs some further elaboration.

There are two key issues regarding appropriate preventive medicine. One is the concept of a proper quantity and the other is the assumption that the proper quantity is cost-beneficial to the patient. For simplicity it is assumed that preventive is either applied at the correct level or that it is not applied at all. With this assumption, the notion of patient benefit can be formally defined as follows:

Let P_{0i} and P_{1i} represent the probability of θ_i in the absence and presence respectively of preventive medicine. As mentioned in an earlier context, the application of preventive medicine increases the likelihood of θ_i and decreases the likelihood of all other θ. Thus $P_{11} > P_{01}$ and $P_{1i} < P_{0i}$, $i = 2 \ldots n$. A nonpecuniary benefit of preventive medicine is an increased likelihood of health. But a key assumption is that the expected cost to the patient for an action with $\rho = 1$ is less than the expected cost of the same action with $\rho = 0$.

Let $d(\theta, \underset{\rho\theta}{e}) = s(\theta, \underset{\rho\theta}{e}) + t(\theta, \underset{\rho\theta}{e})$, $\rho = 0, 1$ and $\theta = 1, 2 \ldots n$. Also let $\bar{s}_\rho = \sum_{\theta=1}^{n} P_{\rho\theta}\, s(\theta, \underset{\rho\theta}{e})$ and $\bar{t}_\rho = \sum_{\theta=1}^{n} P_{\rho\theta}\, t(\rho, \underset{\rho\theta}{e})$, $\rho = 0, 1$. Assuming an economic benefit is equivalent to assuming that $\bar{s}_1 + \bar{t}_1 < \bar{s}_0 + \bar{t}_0$. In addition to the usual assumptions, the following assumptions are

made:

1. All illnesses are treatable and curable by the end of the period.

2. Death is not a state of nature.[1]

3. There is a finite number of illnesses.

4. The more severe the illness, the lower the probability of its occurrence.

5. The provision of preventive medicine decreases the probability of every illness during the period (this is referred to as the probability revision assumption).

6. The physician can always identify the true state of nature, θ, and is qualified to treat all illnesses.

7. Hospitals have no source of funds other than patient revenue and cannot therefore provide preventive, diagnostic or treatment services unless hospital reimbursement is at least at a level that covers costs (this is referred to as the actual cost reimbursement assumption).

8. In all reimbursement systems, hospital costs are a function

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[1] For the purpose of simplification, this model is only concerned with those illnesses that can be cured, and do not result in the death of the patient. Any conclusions of this study, therefore, are subject to this limitation.

of the volume and complexity of hospital services rendered (this is referred to as the hospital volume/complexity assumption).

9. In all reimbursement systems but Capitation Payment, physician charges are a function of the volume and complexity of physician services rendered (this is referred to as the physician volume - complexity assumption).

10. The physician will always provide at least the minimum level of α, η, ω and ψ necessary to cure the patient. In addition, the physician will never provide an excessive level of α, η, ω or ψ if the provision of such services would harm the patient (this is referred to as the minimum ethics assumption).

11. Whenever a physician is faced with two or more actions, both of which have equal benefit to the physician, but one of which benefits the patient more than the other, the physician will choose that action that benefits the patient most (this is referred to as the non perverse-behavior assumption).[2]

The patient has nine reimbursement systems to evaluate. It is assumed that the physician is risk averse.[3] Given this assumption,

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[2] A complete listing of <u>all</u> assumptions of the model are given in Appendix A.

[3] For increasing utility functions, a decision maker is assumed to be risk averse if and only if his certainty equivalent for any non degenerate lottery is less than the expected consequence of that lottery. In the Adverse Selection Model - Medical Setting, this means that $\hat{H} < \bar{H}$.

and the above development, the patient's problem can be expressed as follows

$$\underset{d \in D}{\text{Max}} \Sigma \left\{ x - d(.) \right\} \; f(\theta) \tag{7}$$

subject to

$$\Sigma H(s(.)) f(\theta) \geq \bar{H} \tag{8}$$

$$E(H(s(.)) \mid \underline{e}^*, s(.)) > E(H(s(.)) \mid \underline{e}, s(.)) \tag{9}$$

for all $\underline{e} \in E$ and $\underline{e} \neq \underline{e}^*$

where $\underline{e}^*$ is the optimal action from the standpoint of the physician.

Of the nine reimbursement systems, the patient will choose the one which maximizes his expected residual wealth subject to (8), a constraint requiring a minimum payment to the physician and (9), the notion that the physician will choose an action that maximizes his expected utility for a given reimbursement system. Notice that this model will evaluate the nine reimbursement systems but that it will not attempt to explicitly identify a second best solution (i.e. the optimal reimbursement system in the presence of private information).

The arguments of s(.) and d(.) are left unspecified. The reason for this is that the nine systems differ in specifying the contracting variable. Generally, $\underline{e}$ is the contracting variable between the patient and physician, although t(.) is at times based on the declared by the physician.

The evaluation of the nine systems will proceed in two steps. First, for a given reimbursement system the resulting optimal action choice of the physician is identified. This action choice analysis is

presented in Chapter Five. Second, given the action choices of the physician for each reimbursement system, the effect on the objective function is determined. This welfare measure of the patient is used to evaluate the nine systems. This analysis appears in Chapter Six.

A significant difference in the above model that will affect subsequent analysis is the allowance of private information. Specifically, the physician knows the actual θ and the appropriate action associated with the actual θ. The patient knows the action taken but cannot evaluate the action as to its propriety. Because of this the physician can declare a θ different from the actual θ and may choose an inappropriate action for the actual θ (although it may seem appropriate for the declared θ). This capacity creates a special contracting problem for the patient, referred to as adverse selection. Clearly, the patient must attempt to identify a reimbursement system that discourages the misuse of private information.

Summary

While the applications of agency theory to industrial settings are numerous, the use of this analytical model in the health care industry has been more limited. Agency theory has been used to study the impact of health insurance on incentives for cost control. In all of the studies evaluated, however, the focus for this control has been on the patient, the hospital administrator or the third party payor rather than on the physician. Since the physician is responsible for seventy-five to eighty percent of the cost of all health care inputs,

and since he possesses superior information that may allow him to select combinations of inputs that are not in the best interest of the patient, previous agency theory models may not be entirely appropriate. In this chapter the an adverse selection model was introduced. This model is designed specifically for the health care field and is the model that will be used to evaluate the nine health care reimbursement systems.

CHAPTER V

PHYSICIAN ACTION CHOICE

AN AGENCY ANALYSIS

In this chapter the physician incentives for cost control embedded within each of the nine health care reimbursement systems are analyzed. In each system it will be assumed that the patient hires a physician to provide preventive, diagnostic and treatment services. The patient's gross payment for these services will be defined as $d(.) = s(.) + t(.)$, where $s(.)$ represents the patient's payment to the physician, and $t(.)$ represents the patient's payment to the hospital. By assumption, the patient's payment to the hospital is the actual cost incurred by the hospital.

First-Best Solution

The first-best solution represents the reimbursement system that would be imposed by the patient on the physician if there is no private information. Here the patient knows the state of nature, θ, and the appropriate action. From the patient's standpoint, the optimal action is $\underline{e}_a = (\underline{e}_{a1}, \underline{e}_{a2}, \cdots \underline{e}_{an})$ where $\underline{e}_{a\theta} = (1,1,1,1,1)$ for all θ. Since the patient can observe and evaluate $\underline{e}$ and θ, the minimum payment required to achieve $\underline{e}_a$ is $t(\theta, \underline{e}_a) + \hat{H}$, where $t(\theta, \underline{e}_a)$

is the actual hospital cost of an appropriate action, and $\hat{H}$ is the minimum cash payment required to obtain the services of the physician (i.e. the certainty equivalent of $\bar{H}$). In the first-best solution, the physician's payment

$$s = \begin{cases} \hat{H} \text{ if } \underline{e} = \underline{e}_a & (10) \\ 0 \text{ if } \underline{e} \neq \underline{e}_a & (11) \end{cases}$$

forces $\underline{e}_a$. The actual payment for a given θ is $d = \hat{H} + t(\theta, \underline{e}_a)$, and the expected payment is $\hat{H} + \bar{t}_a$, where $\bar{t}_a$ is the expected hospital payment for the appropriate action vector. The patient's welfare measure is $x - \hat{H} - \bar{t}_a$, and $\hat{H} + \bar{t}_a$ defines the welfare loss of health care in the absence of private information.

Define $\underline{e}_k = (\underline{e}_{k1}, \underline{e}_{k2}, \cdots \underline{e}_{kn})$ where $\underline{e}_{ki} = (0,1,1,1,1)$. Since no private information exists and actions are observable, the patient could force $\underline{e}_k$ by setting

$$s = \begin{cases} \hat{H} \text{ if } \underline{e} = \underline{e}_k & (12) \\ 0 \text{ if } \underline{e} \neq \underline{e}_k & (13) \end{cases}$$

In this case the actual payment for a given θ is $d = \hat{H} + t(\theta, \underline{e}_k)$ and the expected payment is $\hat{H} + \bar{t}_k$. However, by the definition of preventive medicine given in Chapter Four, $\hat{H} + \bar{t}_a < \hat{H} + \bar{t}_k$ which implies $\bar{t}_a < \bar{t}_k$. That is, for the first-best solution if preventive medicine is cost-beneficial, it must all come from a reduction in the expected hospital cost.

Fee-for-Service

In a fee-for-service reimbursement system the patient makes a gross payment, $d(\theta,\underline{e}_i) = s(\theta,\underline{e}_i) + t(\theta,\underline{e}_i)$ which the provider accepts as reimbursement for specific preventive, diagnostic, and treatment services for a specific θ. It is assumed that s(.) is made directly to the physician, and that t(.) is made directly to the hospital. It is also assumed that there are n states of nature and m action choices.

Let $\underline{e}_{i\theta} = (\underline{e}_{i1}, \underline{e}_{i2}, \cdots \underline{e}_{in})$ be the ith action, where $\underline{e}_{i\theta}$ is the specific action associated with the state of nature, θ. Thus the specific action $\underline{e}_{i\theta}$ determines $d(\theta,\underline{e}_{i\theta})$, and consequently the component reimbursement schedules $s(\theta,\underline{e}_{i\theta})$ and $t(\theta,\underline{e}_{i\theta})$.

Proposition 1: In fee-for-service, the physician's optimal action corresponds to one of the following two actions:

$$\underline{e}_f = (\underline{e}_{f1}, \underline{e}_{f2}, \cdots \underline{e}_{fn}) \tag{14}$$

$$\underline{e}_g = (\underline{e}_{g1}, \underline{e}_{g2}, \cdots \underline{e}_{gn}) \tag{15}$$

and

$$\underline{e}_{\theta i} = \begin{cases} (\rho,1,1,1,1) \text{ if } \theta \in \Omega_1 & (16) \\ (\rho,0,0,0,0) \text{ if } \theta \in \Omega_2 & (17) \\ (\rho,0,0,0,1) \text{ if } \theta \in \Omega_3 & (18) \end{cases}$$

where i = f if $\rho = 0$ and i = g if $\rho = 1$, respectively.

Proof: Partition the set of specific action choices so that:

$$E_0 = \left\{ \underline{e}_{i\theta} \mid \rho = 0 \right\} \tag{19}$$

$$E_1 = \left\{ \underline{e}_{i\theta} \mid \rho = 1 \right\} \tag{20}$$

First consider E_0. If $\theta \in \Omega_1$ occurs, then the only physician involvement is ρ. All other components are chosen correctly by default. Thus define $\underline{e}_{f1} = (0,1,1,1,1)$ for $\theta \in \Omega_1$. This implies $\underline{e}_{f1}$ is the first component of all $\underline{e}_i$ formed from E_0. Let $\underline{e}_{f\theta} = (0,0,0,0,0), \theta \in \Omega_2$. By the physician volume-complexity assumption $s(\theta,\underline{e}_{f\theta}) > s(\theta,\underline{e}_{i\theta})$, $i \neq f$, for $\theta \in \Omega_2$. Next consider $\underline{e}_{i\theta}, \theta \in \Omega_3$. By the minimum ethics assumption $\psi = 1$ must occur for all $\underline{e}_{i\theta}, \theta \in \Omega_3$. Define $\underline{e}_{f\theta} = (0,0,0,0,1)$, $\theta \in \Omega_3$. Again, by the physician volume-complexity assumption $s(\theta,\underline{e}_{f\theta}) > s(\theta,\underline{e}_{i\theta})$, $i \neq f$, for $\theta \in \Omega_3$. Consequently, $\underline{e}_f$ dominates all feasible $\underline{e}_i$ formed from $\underline{e}_{i\theta} \in E_0$.

Finally, consider $\underline{e}_{i\theta} \in E_1$. By similar argument, $\underline{e}_g$ dominates all other $\underline{e}_i$ formed from $\underline{e}_{i\theta} \in E_1$. Since any $\underline{e}_i$ must have either $\rho = 0$ or $\rho = 1$, the physician's choice is narrowed to $\underline{e}_f$ and $\underline{e}_g$. Q.E.D.

Analysis of Physicians Action

Choice Fee-for-Service

Since the greatest benefit accrues to the patient through the selection of action choice $\underline{e}_a$ (previously defined), the fee-for-service reimbursement system clearly does not provide an incentive for the physician to select those inputs that will maximize

the welfare of the patient. Insight as to why this occurs under the fee-for-service reimbursement system is given below.

Provision of Preventive Medicine: If one defines

$$s(\theta,\underline{e}_g) = s(\theta,\underline{e}_f) + z(p) \tag{21}$$

where z(p) equals the payment to the physician for preventive medicine services under fee-for-service reimbursement, then the following corollary can be stated:

Corollary 1A: Under fee-for-service reimbursement, a risk-neutral physician will provide preventive medicine if and only if

$$z(p) - \Sigma(P_{0\theta} - P_{1\theta})s(\theta,\underline{e}_{f\theta}) > 0 \tag{22}$$

Proof:

Necessary Condition: Suppose a physician is risk neutral. A physician will choose $\underline{e}_g$ if

$$E(s(\theta,\underline{e}_g)) > E(s(\theta,\underline{e}_f)) \tag{23}$$

By equation (21),

$$E(s(\theta,\underline{e}_g)) = E(s(\theta,\underline{e}_f) + E(z(p)) \tag{24}$$

$$E(s(\theta,\underline{e}_g)) = \Sigma P_{1\theta}(s(\theta,\underline{e}_f)) + z(p) \tag{25}$$

Substituting (25) into (23),

$$\Sigma P_{1\theta}(s(\theta,\underline{e}_f)) + z(p) > E(s(\theta,\underline{e}_f)) \tag{26}$$

$$z(p) + \Sigma P_{1\theta}(s(\theta,\underline{e}_f)) > \Sigma P_{0\theta}(s(\theta,\underline{e}_f) \tag{27}$$

$$z(p) - \Sigma(P_{0\theta} - P_{1\theta})s(\theta,\underline{e}_f) > 0 \tag{28}$$

Sufficient Condition:

Suppose that equation (22) is true (i.e. that the amount that a physician will receive for providing preventive medicine at the beginning of the period is greater than the expected value of the payment for diagnostic and treatment services that he will lose by providing preventive medicine at the beginning of the period).

$$z(p) - \Sigma (P_{0\theta} - P_{1\theta}) s(\theta, \underline{e}_f) > 0 \tag{29}$$

$$z(p) - \Sigma P_{0\theta} (s(\theta, \underline{e}_f)) + \Sigma P_{1\theta} (s(\theta, \underline{e}_f)) > 0 \tag{30}$$

$$z(p) + \Sigma P_{1\theta} (s(\theta, \underline{e}_f)) > \Sigma P_{0\theta} (s(\theta, \underline{e}_f)) \tag{31}$$

$$E(s(\underline{e}_g)) > E(s(\underline{e}_f)) \tag{32}$$

Equation 32 implies a risk-neutral physician will provide preventive medicine.

In deciding upon the provision of preventive medicine services, the physician will be influenced by the price that he can charge for those services, and the impact of those services on future treatment revenues. If the price that the physician can charge for those services is lower than the price he can charge for treatment services, or if the provision of preventive medicine will reduce the expected future revenues for treatment revenues by an amount that is greater than the payment he will receive for providing preventive medicine services, then it will be to the physician's economic interest to build a medical practice that emphasizes the treatment, rather than the prevention of disease.

In the current health care market, the charge for most preventive

services is lower than that which can be generated through the diagnosis and treatment of disease. In addition, the provision of preventive medicine can significantly reduce the cost of health care through a reduction in morbidity and mortality rates. Consequently the provision of large amounts of preventive medicine is not in the best economic interest of the physician. One of the justifications given for the establishment of the governmentally funded public health service was the disinterest of the private medical sector in the provision of preventive medicine. Given the incentive structure of the fee-for-service reimbursement system, the reasons for this disinterest are clearly evident.

Utilization of Diagnostic Ancillary Services: The ability of the physician to enhance his income by ordering excessive inputs is constrained by two factors: (1) a set of professional ethics which dictate that the physician will not take an action that will harm the patient (the minimum ethics assumption) and (2) the fear of detection (i.e. providing an incorrect diagnosis or treatment that the patient then determines is wrong). Few diagnostic procedures are potentially harmful to the patient. Should the physician overutilize these procedures, the probability of detection is small as the patient would not present himself to the physician if he did not feel that he was in need of some kind of diagnostic service, and few if any patients seek a second medical opinion regarding the need for diagnostic procedures.

Since physician income increases with the volume and complexity of services rendered, a physician working under fee-for-service will

have an economic incentive to choose an excessive level of diagnostic services. This is consistent with the empirical findings of Reinhart (1973) reviewed earlier in this proposal, and with those of Maloney and Rogers (1979) who have demonstrated that diagnostic ancillary tests are a major source of unnecessary costs.

Duplication of Hospital Equipment and Facilities: In fee-for-service, inappropriate levels of hospitalization dominate appropriate levels. Since physician income is a function of the complexity of services rendered, it is in the physician's best economic interest to have the hospital where he holds medical staff privileges provide as many diagnostic and treatment services as possible. If the physician's marginal revenue was impacted by the cost of specialized hospital equipment, the acquisition of such equipment would be restricted to those items for which there was a large enough patient volume to reasonably amortize acquisition and operating costs. Since it is the hospital, and not the physician that pays the fixed costs of such equipment, and since hospitals under fee-for-service are able to pass these costs directly to the patient, excessive levels of hospital equipment and facilities dominate appropriate levels.

Length of Hospital Stay: Since the fee the physician charges is often correlated with the length of hospital stay, and since physicians are susceptable to pressures to maintain that level of hospital occupancy required to support those services deemed necessary

for the maximization of personal income, the fee-for-service physician has an incentive to order excessive lengths of hospital stay.

Use of Surgical Services: Since physician income is a function of the volume and complexity of services provided, the provision of an excessive level of surgical services provides greater revenue than the provision of an appropriate level. As was mentioned earlier, however, the ability of the physician to enhance his income by ordering excessive input is constrained by two factors: (1) a set of professional ethics which dictate that the physician will not take an action that will harm the patient, and (2) the fear of detection.

Since non-medically justified surgery in the presence of serious illness would be health threatening (or even life threatening), and since the probability of the patient detecting an incorrect or excessive diagnosis or treatment increases as the severity of illness increases (due to the greater probability that the patient will seek a second medical opinion), unnecessary surgery in fee-for-service is most likely to occur when $\theta \in \Omega_2$ (i.e. a non-serious illness where the patient is unable to evaluate the need for surgery). This is consistent with the findings of Monsma (1970, p. 149) that non-medically justified surgery is concentrated among those procedures which will not greatly impair the functioning of the individual, and for which the need for the procedure is subject to some doubt.

Capitation-One

In Capitation-One the patient pays the physician a prenegotiated amount Q*, which remains fixed for the contract period regardless of the services actually rendered by the physician and hospital. In calculating this fixed payment, Q* is chosen such that

$$\Sigma P_{1\theta}\ H(Q - t(\theta, \underline{e}_a) = \bar{H} \tag{33}$$

Where the solution to the equation (33) is defined as Q*. In Capitation-One it is assumed that Q* is paid directly to the physician, who in turn makes a payment to the hospital of $t(\theta, \underline{e}_i)$. The physician's income is therefore the residual defined by $s(\theta, \underline{e}_i) = Q^* - t(\theta, \underline{e}_i)$. Given this background, the following proposition can be stated.

Proposition 2: Given Q*, a Capitation-One physician will choose $\underline{e}_a$.

Proof: Let $E_1 = \{\underline{e} \mid \rho = 1\}$ and $E_0 = \{\underline{e} \mid \rho = 0\}$. Choose $\underline{e}_i \in E_1$ where $i \neq a$. For any $i \neq a$, excessive services are provided implying $\bar{t}_i > \bar{t}_a$. But if this occurs the physician's income would drop below $\hat{H}$ and therefore he would not choose $\underline{e}_i \neq \underline{e}_a$. For $\underline{e}_i \in E_0$, the choice of any $i \neq k$ also implies that $\bar{t}_i > \bar{t}_k$. So $i \neq k$ would not be chosen. Now $\bar{t}_k > \bar{t}_a$ by definition of the cost-benefit nature of preventive medicine, and so choice of $\underline{e}_k$ would also result in a physician income below $\hat{H}$. Thus $\underline{e} = \underline{e}_a$ is the only feasible action choice for the physician, Q.E.D.

Capitation-Two

In Capitation-Two the physician contracts with the patient for the provision of physician services only. The patient pays the physician a lump sum, $s = \hat{H}$, which remains fixed for the period regardless of the physician services rendered. The patient pays the hospital $t(\theta,\underline{e}_i)$ which represents full reimbursement of the cost of hospital services rendered. For a contract year, the actual payment for health care, therefore, is $d = \hat{H} + t(\theta,\underline{e}_i)$ and the expected payment is $E(d) = \hat{H} + \bar{t}_i$. Given this background, the following proposition can be stated:

Proposition 3: In Capitation-Two, the physician's optimal action choice is $\underline{e}_a$:

Proof: Since the physician is paid $s = \hat{H}$ regardless of the action vector chosen, by the non-perverse behavior assumption the physician will choose the action vector which benefits the patient most, which has been shown to be $\underline{e}_a$.

Capitation-Three

In Capitation-Three, the ability of a hospital to serve more than one physician produces a different capitation payment for the patient. Consider n one patient - one physician models with a hospital capable of serving n patients. Also assume that the hospital is owned by the n physicians. Each physician contracts with his patient for a fixed

payment. From this fixed payment the physician pays the hospital, and keeps the residual. Because of diversification, the amount each physician must pay the hospital is determinable.

Let $t_i(\theta, \underline{e}_a)$ be the actual cost function for physician i. Assume that $\tilde{t}_i$ is independent, identically distributed for i = 1, 2, ... n.[1] Thus the total hospital cost for Capitation-Three can be expressed as:

$$\tilde{C} = \tilde{t}_1 + \tilde{t}_2 + \ldots \tilde{t}_n \tag{34}$$

and the average cost per patient is

$$\tilde{C}/n = \tilde{A} = (\tilde{t}_1 + \tilde{t}_2 + \ldots \tilde{t}_n)/n \tag{35}$$

thus

$$E(\tilde{A}) = \Sigma t_i/n = nt_a/n = \bar{t}_a \tag{36}$$

Furthermore

$$\mathrm{Var}(\tilde{A}) = \Sigma \mathrm{Var}(t_i)/n^2 = \mathrm{Var}(\tilde{t}_a)/n \tag{37}$$

whence

$$\lim_{n \to \infty} \mathrm{Var}(\tilde{t}_a)/n = 0 \tag{38}$$

Accordingly, Capitation-Three diversifies away the variability in $\tilde{t}_a$. Since the size of n required to achieve the benefits of diversification is an empirical issue, it will simply be assumed that diversification is a practical possibility.[2] Diversification implies

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[1] $\tilde{t}$ being independent and identically distributed implies $\tilde{t}_1 = \tilde{t}_2 = \ldots = \tilde{t}_n = \tilde{t}_a$.

[2] In portfolio theory it has been shown that the security specific risk can be eliminated when $n \to \infty$ where n is the number of securities in a portfolio. In practical terms, empirical studies have shown that $n \approx 16$ is large enough to achieve the benefits of diversification.

that a hospital can be paid $\bar{t}_a$ by each patient, and as a result recover its actual operating costs.

For a physician to agree to employment in Capitation-Three, he must receive $\hat{H}$ (i.e. the market-set minimum salary). Now define the capitation payment to be $d = \hat{H} + \bar{t}_a$. Since at the end of the period each physician will be paid 1/n of the total capitation payment less the total actual hospital cost, each physician in Capitation-Three should receive $\hat{H}$ (provided of course that physician behavior is such that the actual hospital cost is no more than $\bar{t}_a$). But the physician has an incentive to see that hospital costs are appropriate as the following proposition will establish:

Proposition 4: Given Q^*, a Capitation-Three physician will choose $\underline{e}_a$.

Proof: Let $E_1 = \{\underline{e} \mid \rho = 1\}$ and $E_0 = \{\underline{e} \mid \rho = 0\}$. Choose $\underline{e}_i \in E_1$ where $i \neq a$. For any $i \neq a$, excessive services are provided implying $\bar{t}_i > \bar{t}_a$. But if this occurs the physician's salary would drop below $\hat{H}$ and therefore he would not choose $\underline{e}_i \neq \underline{e}_a$. For $\underline{e}_i \in E_0$ the choice of any $i \neq k$ also implies that $\bar{t}_i > \bar{t}_k$. So $i \neq k$ would not be chosen. Now $\bar{t}_k > \bar{t}_a$ by definition of the cost-benefit nature of preventive medicine, and so choice of $\underline{e}_k$ would also result in a physician salary below $\hat{H}$. Thus $\underline{e}_a$ is the only feasible action choice for the physician.

Although reservations have been expressed previously concerning previous studies that have compared fee-for-service reimbursement to capitation payment, the above findings are consistent with empirical

studies evaluating the operational performance of Health Maintenance Organizations. Eastaugh (1981, p. 142) reports that in a comparison of HMOs to fee-for-service, that HMOs achieve a ten to thirty percent cost savings through the lower utilization of hospital equipment and facilities. In a study conducted by Feldstein (1979), hospital days per year per 1000 population were shown to be 552 for HMO patients as compared to 1155 for fee-for-service patients. The same study indicated significantly lower HMO surgical rates for minor surgical procedures. The rates for tonsillectomies, for example, was shown to be one third to one half lower for HMO enrollees than for fee-for-service patients.

DRG-One

In DRG-One, the patient makes a payment $d(\bar{\theta},\underline{e}_i)$ which the health care providers accept as full reimbursement for specific preventive, diagnostic and treatment services for a specific $\bar{\theta}$. In this model, θ represents the true diagnosis, while $\bar{\theta}$ represents the diagnosis declared by the physician, which may or may not be the same as the true diagnosis. In DRG-One, payment is based upon the declared diagnosis. It is assumed that $d(\bar{\theta},\underline{e}_i)$ is paid to the physician, who pays the hospital $t(\bar{\theta},\underline{e}_i)$ and retains $s(\bar{\theta},\underline{e}_i)$. For the physician, $s(\bar{\theta},\underline{e}_i)$ is a function of the volume and complexity of physician services actually provided. For the hospital, $t(\bar{\theta},\underline{e}_i)$ is a fixed amount that is paid upon the declaration of $\bar{\theta}$, regardless of the volume and quantity of hospital services actually provided. There is

one and only one lump sum hospital payment, $t(\bar{\theta},\underline{e}_i)$, for each declared state of illness, $\bar{\theta}$. This fixed amount represents the hospital cost for the action vector $\underline{e}_{k\theta} = (0,1,1,1,1)$ for all θ. DRG-One, therefore, provides full hospital reimbursement for appropriate levels of all hospital inputs but preventive medicine. It provides no hospital reimbursement for preventive medicine.

A possible reason that DRG-One fails to provide full hospital reimbursement for an appropriate level of preventive medicine is that the provision of preventive medicine is not θ dependent and it is difficult, therefore, for anyone but the physician to know what the appropriate level is. For diagnostic and treatment services, appropriate levels of service are defined as those that restore the patient to a state of health at the lowest possible cost. This criterion is useless for preventive medicine as the patient may already be well, and even if he is not, the provision of these services will not restore the patient to health but will merely reduce the probability that he will acquire additional illnesses. With no criterion for the definition of an appropriate level of preventive medicine, the designers of this reimbursement system excluded hospital payment for this service. Since the DRG-One physician is still under fee-for-service, he could choose to provide (and be paid for) an appropriate level of preventive medicine. Unfortunately, however, preventive medicine requires some hospital services, which would not be paid for. Thus, by the actual cost reimbursement assumption, a DRG-One physician will not provide

preventive medicine. Accordingly, in determining the optimal physician action, one must restrict attention to $\underline{e} \in E$ where $E_0 = \{\underline{e} \mid \rho = 0\}$. The following proposition identifies the optimal physician action choice for a DRG reimbursement system.

Proposition 5: In DRG-One, the physician's action choice will be

$$\underline{e}_h = (\underline{e}_{h1}, \underline{e}_{h2} \cdots \underline{e}_{hn}) \tag{39}$$

where

$$\underline{e}_{h\theta} = \begin{cases} (0,1,1,1,1) \text{ if } \theta \in \Omega - \Omega_2 & (40) \\ (0,0,0,0,0) \text{ if } \theta \in \Omega_2 & (41) \end{cases}$$

Proof: For $\theta = \theta_1$, $\underline{e}_{h1} = (0,1,1,1,1)$ by default. For $\theta \in \Omega_3$, the physician will choose $\psi = 1$ by the minimum ethics assumption, and must, consequently, disclose $\bar{\theta} = \theta$. Since the true θ has been revealed by the physician, the hospital will be reimbursed only for the cost of an appropriate level of care for θ. Thus by the actual cost reimbursement assumption, the physician must also set $\alpha = \eta = \omega = 1$. Hence $\underline{e}_{h\theta} = (0,1,1,1,1)$ for $\theta \in \Omega - \Omega_2$.

Now consider $\theta \in \Omega_2$. Here a physician can declare $\bar{\theta} > \theta$ and not threaten the well being of the patient. By the physician volume - complexity assumption, the "appropriate" action for $\bar{\theta}$ will yield a higher payoff to the physician than that associated with θ, and will simultaneously reimburse the hospital for the actual costs associated with $\bar{\theta}$. Moreover, an appropriate action for $\bar{\theta}$ is inappropriate for θ. Thus, $\underline{e}_{h\theta} = (0,0,0,0,0)$ for $\theta \in \Omega_2$. Q.E.D.

While DRG-One reimbursement is new enough that there are still no empirical studies on the impact of this system on physician behavior, the above findings seem consistent with the activities of the health care industry during the first year of implementation. A survey by this author of American Hospital Association literature indicates that significant attention is being given to the training of physicians in techniques that can be used to increase the severity of declared diagnoses. In addition, a recent interview with the manager of Ernst and Whinney responsible for health care customers in Oklahoma, reveals that while some hospitals have attempted to implement DRG cost accounting packages that will assist with cost control, the greatest demand is for software packages that identify on a case by case basis the most costly billable diagnoses (Powell, 1984).

DRG-Two

Because Congress is concerned about the potential for inappropriate diagnostic coding, it has called for the establishment of Peer Review Organizations (PROs) whose purpose will be to audit medical records to verify diagnostic accuracy (Ernst and Whinney, 1983). Since the presence of an audit function will alter physician incentives for hospital cost control, this addition is significant enough to warrant analysis as a new and separate health care reimbursement system. This system is simply DRG-One with an audit. The principal purpose of the audit is to reveal whether the declared corresponds to the actual θ. It is assumed that the audit technology

exists to reveal the true θ. The effect of an audit on physician behavior is revealed by the following proposition:

Proposition 6: In DRG-Two, the physician's action choice will be $\underline{e}_k$.

Proof: By Proposition 5 an audit is only required for $\theta \in \Omega_2$. An audit occurs after the provision of treatment but before payment is made to the physician and hospital. The audit can, therefore, affect the amount paid to the hospital. The audit will reveal the true θ, and the hospital will receive a payment based on an appropriate level of care for the true θ. By the actual cost reimbursement assumption the physician cannot take any action that will result in less than full cost reimbursement to the hospital. To do so would result in the insolvency of the hospital and the loss of its services by the physician. Since the physician's income is a function of the complexity of volume of services rendered, both of which are hospital dependent, the loss of hospital services would in turn result in a reduction of physician income. Consequently, the physician, anticipating an audit, must choose $\underline{e}_{k\theta} = (0,1,1,1,1)$ for $\theta \in \Omega_2$. Q.E.D.

DRG-Three

In DRG-Three the patient makes a gross payment of $d(\bar{\theta},\underline{e}_i) = s(\bar{\theta},\underline{e}_i) + t(\bar{\theta},\underline{e}_i)$, where $s(\bar{\theta},\underline{e}_i)$ represents the payment to the physician, and $t(\bar{\theta},\underline{e}_i)$ represents the payment to the hospital. In DRG-Three, $t(\bar{\theta},\underline{e}_i)$ is the hospital's cost of the action vector

$\underline{e}_{k\theta} = (0,1,1,1,1)$ appropriate to θ, and $s(\theta,\underline{e}_i)$ represents physician reimbursement for the selection of diagnostic and treatment services appropriate to θ. Given this notation, the following proposition can be stated:

Proposition 7: In DRG-Three, the physician's action choice will be $\underline{e}_h$.

Proof: For $\theta \in \Omega_1$, the only physician involvement is ρ, all other action components are chosen correctly by default. Since DRG-Three makes no provision for the payment of preventive medicine, the physician will choose $\underline{e}_h = (0,1,1,1,1)$. Now examine $\theta \in \Omega_3$. By the minimum ethics assumption the physician will choose $\psi = 1$. Since DRG-Three reveals the appropriate level of hospital reimbursement for each θ, the physician will declare $\bar{\theta} = \theta$ to obtain adequate reimbursement. Since the hospital cost of inappropriate or excessive levels of care exceeds the cost of an appropriate level of care, and since the actual cost reimbursement assumption dictates that the hospital cannot provide services unless its reimbursement is at least equal to cost, the physician must choose α,η,ω and $\psi = 1$. Consequently for $\theta \in \Omega_3$, the physician's action choice will be $\underline{e}_{h\theta} = (0,1,1,1,1)$. Finally consider $\theta \in \Omega_2$. Define $\underline{e}_{hu} = (0,0,0,0,0)$. Since $s(\bar{\theta},\underline{e}_{hu})$ is greater than all other $s(\theta,\underline{e}_h)$, $\theta \neq u$, the physician will be motivated to choose inappropriate levels of α,η,ω and ψ if he can solve the hospital reimbursement problem. Since an inappropriate level of care for

one θ, may be appropriate for a higher level of θ, in $\theta \in \Omega_2$, the physician will declare $\bar{\theta} > \theta$ and choose $\underline{e}_{h\theta} = (0,0,0,0,0)$.

DRG-Four

DRG-Four is identical to DRG-Three, except that all declarations of θ in $\theta \in \Omega_2$ are audited by a Peer Review Organization. Given this background, the following proposition can be stated:

Proposition 8: In DRG-Four, the physician's action choice will be $\underline{e}_k$.

Proof: Since DRG-Four provides no physician reimbursement for the provision of preventive medicine, the physician's optimal choice for this action component is $\rho = 0$ for all θ. Now examine the physician's selection for the other action components. In $\theta \in \Omega_1$, the physician's action choice for α, η, ω and ψ are chosen correctly by default. Hence $\underline{e}_{k\theta} = (0,1,1,1,1)$ for $\theta \in \Omega_1$. For all other components the audit will force the physician to choose the true θ. Here, however, the incentive is direct as the physician's payment is directly dependent upon $\bar{\theta}$.

Conclusion

Chapter Five used the Adverse Selection - Medical Setting Model to reveal physician action choices under differing health reimbursement systems. The nine systems evaluated yielded five action choices, $\underline{e}_a$, $\underline{e}_f$, $\underline{e}_g$, $\underline{e}_h$ and $\underline{e}_k$. Each of these action choices was defined and explained in this chapter. In Chapter Six, these five

action choices are used to rank the health care reimbursement systems from the standpoint of patient welfare.

CHAPTER VI

COMPARISON OF HEALTH CARE REIMBURSEMENT SYSTEMS

In this chapter six existing or proposed health care reimbursement systems are evaluated. The standard for evaluation is the welfare a patient would receive from the first-best solution. Physician risk-aversion is first assumed. This condition is then relaxed and a ranking is provided for physician risk-neutrality. Since fee-for-service and DRG reimbursement do not provide the incentives for the physician to select the action vector most appropriate to the patient, this chapter concludes with an examination of the private information disclosure requirements that have been made in an attempt to enable the patient to write a better contract.

System Ranking

Physician Risk-Aversion

In Chapter Four the patient's utility was defined as $G(x-d(.))$. In all of the analysis it is assumed that $G(x-d(.)) = x - d(.)$. A risk-neutral patient will maximize this utility through the selection of the reimbursement system with the lowest $d(.)$, where $d(.)$ is defined as the patient welfare loss. In the first-best

solution the actual payment for a particular state of nature is $d = \hat{H} + t(\theta, \underline{e}_a)$ and the expected payment is $E(d) = \hat{H} + \bar{t}_a$. Since d is the minimum payment required to restore a patient to a state of health, the first-best solution is a standard by which the other eight reimbursement systems can be evaluated.

It has previously been shown that changing the physician payment component of DRG reimbursement does not alter the physician action choice. That is, the physician action choice in DRG-One is the same as in DRG-Three, and the physician action choice in DRG-Two is the same as in DRG-Four. Furthermore, the cost of each action choice is the same. Consequently, only DRG-One and DRG-Two will be discussed in this chapter.

The welfare measure for a risk-neutral patient is $E(x) - E(d) = \bar{x} - \bar{d}$. Calculating $\bar{d}$ will therefore provide a measure by which each reimbursement system can be evaluated. As indicated, if no private information exists then $\bar{d} = \hat{H} + \bar{t}_a$ is the lowest possible welfare loss. Furthermore, paying $\bar{d}$ insures the action $\underline{e}_a$. Thus the first-best solution is formally defined as the pair $(\hat{H} + \bar{t}_a, \underline{e}_a)$. If a reimbursement system can induce $\underline{e}_a$ for the same cost, then the private information of the physician will not adversely affect the patient.

Of the six proposed or existing systems evaluated in this chapter, both Capitation-Two and Capitation-Three are able to achieve $\underline{e}_a$ at an expected cost equal to $\hat{H} + \bar{t}_a$. These two systems actually duplicate the first-best solution. Thus both reimbursement systems

can be fully endorsed theoretically as they achieve the appropriate physician action at the lowest possible cost.

Now consider Capitation-One. Here d is chosen so that $\Sigma P_{1\theta} H(d - t(\theta,\underline{e}_a) = \bar{H}$, and the physician payment is defined by $s_c = d - t(\theta,\underline{e})$ where $\underline{e} = \underline{e}_a$. Let $\bar{s}_c = \Sigma s_c(\theta,e_a)P_{1\theta}$. Since $\hat{H} < \bar{s}_c$ (Kenney and Raiffa, 1976, p. 149), $\hat{H} + \bar{t}_a < \bar{s}_c + \bar{t}_a$ for strict risk-aversion, and both Capitation-Two and Capitation-Three dominate Capitation-One.

It can also be shown that Capitation-Two and Capitation-Three dominate the fee-for-service and DRG reimbursement systems. For fee-for-service, $s(\theta,\underline{e}_a) + t(\theta,\underline{e}_a) < s(\theta,\underline{e}_g) + t(\theta,\underline{e}_g) < s(\theta,\underline{e}_f) + t(\theta,\underline{e}_f)$ with strict inequalities holding for at least one θ. Thus $\bar{s}_a + \bar{t}_a < \bar{s}_g + \bar{t}_g < \bar{s}_f + \bar{t}_f$. Consequently, fee-for-service is more costly to the patient than either Capitation-Two or Capitation-Three.

As previously mentioned, for DRG models only DRG-One and DRG-Two are evaluated since the action choices and costs are identical to DRG-Three and DRG-Four, respectively. First consider DRG-Two. Here the action choice is $\underline{e}_k$ and the expected cost is $\bar{s}_k + \bar{t}_k + A$, where A is the audit cost. But $\bar{s}_k + \bar{t}_k > \bar{s}_a + \bar{t}_a$ because of the cost-benefit definition of preventive medicine. Therefore $\bar{s}_k + \bar{t}_k + A > \bar{s}_a + \bar{t}_a$. Clearly, Capitation-Two and Capitation-Three both dominate DRG-Two.

Finally, let $s(\theta,\underline{e}_h)$ and $t(\theta,\underline{e}_h)$ be the payments for DRG-One. Because of excessive services, $s(\theta,\underline{e}_h) + t(\theta,\underline{e}_h) > s(\theta,\underline{e}_k) + t(\theta,\underline{e}_k)$

with strict inequality holding for at least one θ. Thus, $\bar{s}_h + \bar{t}_h > \bar{s}_k + \bar{t}_k > \bar{s}_a + \bar{t}_a$ and DRG-One is more costly than Capitation-Two and Capitation-Three.

Since Capitation-Two and Capitation-Three achieve the first-best solution, the best that any reimbursement system can do is to equal the performance of these two systems. The result of the above analysis reveals that the popular fee-for-service reimbursement system and the DRG reimbursement system both allow the physician to exploit private information for economic benefit. The result of this exploitation is higher medical costs for the patient. The above development can be summarized by the following proposition:

Proposition 9: The two capitation payment reimbursement systems identified as Capitation-Two and Capitation-Three are at least as good as any existing or proposed reimbursement systems.

Proposition 9 states the preference of Capitation-Two and Capitation-Three over other systems. However, so far no preference ranking concerning the remaining, less preferred systems, has been developed. The expected cost for each system is:

Capitation-One:	$\bar{s}_c + \bar{t}_a$
Fee-for-service:	$\bar{s}_f + \bar{t}_f$ when $\rho = 0$; $\bar{s}_g + \bar{t}_g$ when $\rho = 1$
DRG-One	$\bar{s}_h + \bar{t}_h$
DRG-Two	$\bar{s}_k + \bar{t}_k + A$

Clearly, $\bar{t}_a < \bar{t}_i$, $i = f, g, h, k$, but the relationship of $\bar{s}_c$ to $\bar{s}_i$ is

ambiguous. However, it is known that the physician income distribution of Capitation-One provides only $\bar{H}$ to the physician, whereas the other systems provide more than $\bar{H}$. This suggests that $\bar{s}_c$ may be less than $\bar{s}_i$. This observation coupled with the fact that $\bar{t}_a < \bar{t}_i$, suggests that capitation payment may be superior to the remaining three systems. However, no definitive conclusion seems possible.

Comparison of fee-for-service to DRG-One or DRG-Two is clouded by the fact that $\rho = 1$ is possible for fee-for-service but not for the DRGs. If one compares only the case of $\rho = 0$, then DRG-One dominates the fee-for-service system. For $\rho = 0$, an examination of $\underline{e}_f$ and $\underline{e}_h$ reveals that $s(\theta, \underline{e}_h) < s(\theta, \underline{e}_f)$ in $\theta \in \Omega - \Omega_3$ and $s(\theta, \underline{e}_h) < s(\theta, \underline{e}_f)$ for $\theta \in \Omega_3$. A similar relationship holds for t_h and t_f.

If $A = 0$ then DRG-Two dominates DRG-One since $s(\theta, \underline{e}_k) < s(\theta, \underline{e}_h)$ with strict inequality holding for $\theta \in \Omega_2$. A similar relationship also holds for t_k and t_h. In this case DRG-Two is also preferred to fee-for-service when $\rho = 0$. But when $A > 0$ is true, the relative ranking is again ambiguous. All of this simply means the preference among the remaining four systems is ambiguous and conditional on more specific facts. For example, claims that DRG reimbursement systems will lower medical costs to the patient depends on the frequency and importance of preventive medicine provision within a fee-for-service system.

Physician Risk Neutrality

A somewhat finer ranking of the health care reimbursement systems can be obtained if the assumption of physician risk-aversion is relaxed. If risk-neutrality is assumed, the payment to the physician for Capitation-Two and Capitation-Three is still $\hat{H} + t_a$. However, for Capitation-One, $\Sigma P_{1\theta}(d - t(\theta,\underline{e}_a)) = \bar{H} = \hat{H}$ implies $d = \hat{H} + \bar{t}_a$. This outcome reveals that the only difference between Capitation-One and the other two capitation payment systems is the payment of a risk premium when risk-aversion is assumed. For Capitation-One, the physician has an uncertain income distribution requiring a risk premium when risk-aversion is assumed, but of course no such premium exists when risk-neutrality is assumed. In the real world the physician has multiple patients and thereby may diversify out of much of the variability in an income distribution created by only one patient. If true, the implication may be that all three capitation payment systems are equally attractive.

For the fee-for-service and DRG reimbursement systems, excessive services still exist. These systems, therefore, cost more than the first-best solution. But it is now clear that the Capitation-One system is preferred to either fee-for-service or DRG reimbursement. Risk-neutrality, however, does not help clarify the relationship between fee-for-service reimbursement and DRG reimbursement.

Information Requirements of Health Reimbursement Systems

Since the fee-for-service and DRG reimbursement systems evaluated in this study do not provide the incentives for the physician to select the action vector that would maximize the welfare of the patient, this chapter now focuses on the private information disclosure requirements that have been made in an attempt to enable the patient to write a better contract.

To write a contract that will force the physician to select an appropriate level of preventive, diagnostic, and treatment services, it is necessary for the patient to know the true θ, as well as the level of $\underline{e}$ appropriate to θ. One way that this information can be revealed is to require a second medical opinion. Second opinions have been required by health insurance companies for many years. As second opinions are inconvenient and costly, their use has primarily been restricted to those patients with major illnesses. Nevertheless, this practice is felt by many to have resulted in a significant reduction in unnecessary surgery (Business Week, October 15, 1984, p. 144).

In 1972, Congress tried to obtain information on θ and $\underline{e}$ through Public Law 92-603. This act mandated the establishment of Professional Standards Review Organizations (PSROs) whose primary responsibility was to assure that the health care services paid for by Medicare, Medicaid, and the Child Care Services Program were medically necessary, met professionally recognized standards of care, and were

provided at the most economical level consistent with quality care. PSRO activities included both concurrent and retrospective audits of individual medical records. Despite a sizeable Federal expenditure on this program, studies by both the General Accounting Office and the Congressional Budget Office have reported that this program was not cost effective (Luecke and Freeman, 1981, p. 56). One reason may be that the audit technology necessary to disclose θ and $\underline{e}$ does not exist.

Audits have been used for many years in financial environments to reveal the private information necessary for owners to properly motivate managers. There are several reasons that these audits are successful: (1) economic events are quantifiable, (2) the rules for recording these events are well defined and broadly accepted, and, (3) financial transactions as recorded in accounting records are supported by verifiable external evidence. This is not true in the health care environment. While some of the information recorded in the medical record concerning the patient's true condition is quantifiable or externally verifiable (laboratory test results and X-rays are examples), much of the information is in the form of subjective observations which are not quantifiable nor easily verified once the patient has left the hospital. In addition, the formats used to record this information are not consistent, but vary from hospital to hospital, and from physician to physician. Even if effective audit technology existed, medical audits are still costly. They consume large amounts of physician time, and they require extensive

documentation and administration.

Through the Social Security Amendments of 1983, congress mandated DRG reimbursement. Under this system, the patient is still dependent upon medical audits for the revelation of θ. The signal for the appropriate level of $\underline{e}$, however, is built into the reimbursement system itself. The designers of DRG Reimbursement recognized that the complex nature of medical practice makes it difficult to communicate the appropriate level of inputs in a manner that can be understood by nontechnical patients. Consequently it is the cost of an appropriate level of inputs that is revealed, rather than the level of the inputs themselves. Since this cost is communicated to the patient in the form of a lump sum (i.e. the cost of the individual components of the physician's action vector are not revealed), DRGs are not easily adjusted for changes in technology, nor for those differences in regional demographic and environmental conditions that are known to impact hospital resource consumption. An improvement to this system, therefore might be to reveal the cost of each of the major components of the DRG (i.e the cost allocated to nursing service, pharmacy, radiology, laboratory, etc.) so that these components could be individually adjusted as technology changes or as legitimate demographic differences in health care costs are documented.

While DRGs do provide a signal regarding the appropriate level of diagnostic and treatment services, they provide no signal for an appropriate level of preventive services. One reason is that it is difficult to identify what an appropriate level is. For diagnostic

and treatment services, appropriate services are defined as those that restore the patient to a state of health at the lowest possible price. This criterion is useless for defining appropriate preventive medicine, as the patient is already well. With no criterion for the definition of appropriate preventive medicine, the designers of the DRG Reimbursement system chose to exclude payment for this service.

Of all of the health care reimbursement systems examined by this study, the only systems in which the revelation of private information is not necessary for the attainment of the action vector most appropriate for the patient are those involving capitation payment. In these systems the incentives for the physician to select the appropriate action choice are imbedded within the reimbursement mechanism itself.

Summary

This chapter provides a partial ranking of six health care reimbursement systems. Given the assumptions of this model as discussed in Chapter Five, if physician risk-aversion is assumed, only two reimbursement systems, Capitation-Two and Capitation-Three, achieve the first-best solution. These dominate Capitation-One, fee-for-service and DRG reimbursement. Comparison of Capitation-One to fee-for-service and DRG reimbursement is clouded by the uncertain relation between $\bar{s}_c$ and $\bar{s}_i$. Comparison of fee-for-service to DRG-One or DRG-Two is clouded by the fact that $\rho = 1$ is possible in fee-for-service reimbursement but not in DRG reimbursement. If $A = 0$

then DRG-Two dominates DRG-One and fee-for-service reimbursement. When $A > 0$ is true then the relative ranking is ambiguous. All of this simply means that the preference among the remaining four systems is ambiguous and conditional on more specific facts.

If physician risk-neutrality is assumed, then the risk premium (which is the difference between $\hat{H}$ and $\bar{H}$) disappears and Capitation-One achieves the first-best solution. Since the physician is able to diversify away the variability in income distribution caused by one patient, physician risk-neutrality may be a realistic assumption. If physician risk-neutrality exists, then all three capitation payment reimbursement systems may be equally attractive. Risk-neutrality, however, does not clarify the relationship between fee-for-service reimbursement and DRG reimbursement.

Since fee-for-service and DRG reimbursement do not provide the incentives for the physician to select the action vector most appropriate to the patient, this chapter concluded with an examination of the private information disclosure requirements that have been made in an attempt to enable the patient to write a better contract.

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

The objective of this study was to evaluate the incentives for cost control contained within nine health care reimbursement systems. One of these systems, the first-best solution, was included for comparison purposes only. The other eight represent the major reimbursement systems presently found or proposed for the health care industry. To evaluate these incentives, an "Adverse Selection - Medical Setting" agency model was developed. This model differs from the usual agency model in that the primary problem addressed is adverse selection, rather than moral hazard. This model was used to demonstrate the level of health care inputs that would be chosen by a physician under each health care reimbursement system. This action choice was then used to determine the patient's welfare loss, which in turn was used to rank the reimbursement systems from the standpoint of patient welfare.

Summary of Findings

Given the assumptions of this model as discussed in Chapter Five, if physician risk-aversion is assumed, then the most preferred health care reimbursement systems are Capitation-Two and Capitation-Three. Both of these achieve the first-best solution (the

provision of $\underline{e}_a$ at $\hat{H} + \bar{t}_a$). Capitation-One also achieves $\underline{e}_a$. Here, however, the payment is $\bar{s}_c + \bar{t}_a$. For a risk-averse physician, $\bar{s}_c > \hat{H}$. The difference $(\bar{H} - \hat{H})$ is a risk premium that the patient must pay the physician to assume the risks of income variability. Consequently, Capitation-One is dominated by Capitation-Two and Capitation-Three. Comparison of Capitation-One to fee-for-service and DRG reimbursement is clouded by the uncertainty regarding the relationship of the physician payment under fee-for-service and DRG reimbursement, $\bar{s}_i$, to the physician payment under Capitation-One, $\bar{s}_c$. Comparison of Fee-for-service reimbursement to DRG-One and DRG-Two is clouded by the possibility that the physician may choose preventive medicine under fee-for-service reimbursement but not under DRG reimbursement. DRG-Two can be shown to dominate DRG-One only when an audit cost of zero is assumed. When a positive audit cost is assumed, the relative ranking is again ambiguous.

If risk neutrality is assumed, then the only change in the partial ranking is that Capitation-One, Capitation-Two and Capitation-Three all achieve the first-best solution. This is possible since $\hat{H} = \bar{H}$ for the risk neutral physician. In this situation it is no longer necessary for the patient to pay the physician a risk premium to induce him to work under Capitation-One. Since the physician may be able to diversify away the variability in income caused by the treatment of only one patient, risk neutrality may be a realistic assumption.

Since fee-for-service and DRG reimbursement do not provide the

incentives for the physician to select the action vector most appropriate to the patient, several attempts have been made to mandate the disclosure of private information. While these disclosures may enable the patient to write a better contract, their ability to solve the problem of adverse selection is unclear. For one thing, the approaches are costly (e.g., second opinions and audits) and this alone would increase the cost to the patient above $\hat{H} + \bar{t}_a$ even if $\underset{\sim}{e}_a$ is ultimately forced. More promising is the capitation payment approach.

Limitations

As with most analytical models, simplifying assumptions are made that must be evaluated for their influence on the external validity of this study. In Chapter Five, Corollary 1A assumes physician risk-neutrality. In a real world setting this assumption may be difficult to justify. The existance of a large malpractice insurance industry is evidence that many physicians would rather pay a certainty equivalent in the form of a premium than face the uncertain economic exposure from a malpractice suit. Since Corollary 1A does not alter the fee-for-service physician's action choice as defined on page 45, the assumption of physician risk-aversion in this chapter does not influence the reimbursement system ranking that occurs in Chapter Six where physician risk-aversion and risk neutrality are considered separately.

The Adverse Selection Model developed in this study assumes that

all illnesses are treatable and curable by the end of the period and that death is not a state of nature. Certainly these assumptions are not consistent with the real world. Future studies utilizing this methodology may wish to treat non-curable illness and death as additional states of nature. Given this change, an appropriate physician action vector might then consist of the the minimum services necessary to restore a non-terminal patient to as high a state of health as possible, or make the terminal patient as comfortable as possible. Since the patient's utility would still not be increased through the provision of "excessive services," it is the feeling of the author that this addition would not alter the conclusions of this model.

The Adverse Selection Model assumes that hospitals have no sources of funds other than patient revenues. In the real world this is not entirely true as many hospitals have fund raising programs. Since most of these do not cover more than a small proportion of total operating expenses, the concept that hospitals cannot indefinately provide services unless hospital reimbursement is at least at a level that covers costs is still correct.

The assumption is made that physicians will always provide at least the minimum level of diagnostic and treatment services necessary to cure the patient, regardless of the reimbursement system chosen. This assumption seems reasonable given a standard of professional ethics and the threat of malpractice or professional censure. While it is possible that there are physicians that knowingly choose not to

cure their patients, the author feels that if these exist at all, that they constitute a very small proportion of the profession.

The assumption is made that utility is a function of wealth. There are obviously other factors from which individuals receive utility such as service to humanity.

In addition to all of these limitations, the author wishes to acknowledge the general limitations to the agency model as described by Baiman (1982, p. 177). These include the assumption of a single agent, an exogenous labor market, and a single period world.

Recommendations

Capitation Payment

Since capitation payment has been shown to be superior to all other forms of reimbursement evaluated by this study, the first recommendation is that greater attention be given to the national implementation of this reimbursement system. While capitation payment has been around since 1930, in 1980 there were only 236 Health Maintenance Organizations operating in the United States. Of these, only 5.5 percent had over 100,000 members, 61 percent having fewer than 15,000 members (Brown, 1983 p. 401). Several reasons may be cited for the slow growth of this form of health care reimbursement.

Public Education. One reason that HMOs have not grown rapidly is that most people are still unaware of what a Health Maintenance Organization is. Prior to 1978 it was illegal in most states for HMOs

to advertise. By statute, HMOs were prohibited from communicating their costs, benefits or even organizational structures to the public. Partially as a result of this, a 1980 poll revealed that 79 percent of the public was still unfamiliar with the term "Health Maintenance Organization" (Brown, 1983, p. 402). Certainly for HMOs to experience the type of growth needed to significantly impact health care costs, a better job needs to be done of communicating the role that HMOs can play in changing the incentives for physician cost behavior.

Legal Opposition. A second reason for the slow growth of Health Maintenance Organizations was opposition from organized medicine. State medical associations have been very effective in lobbying for legislation curtailing prepaid group practice. Traditional constraints have included:

1. Statutes prohibiting the corporate practice of medicine (Eastaugh, 1981, p. 296).

2. The regulation of direct health service health plans as though they were indemnity insurance plans, including excessive monetary reserve requirements, restrictions on investment in facilities, and adequate provision for capital requirements in rate regulation (Birnbaum, 1976, p 19).

3. Restrictions on hospital staff privileges for physicians practicing under anything but fee-for-service reimbursement (Feldstein, 1979, p. 295).

4. Internal Revenue Service rulings that discriminate against

group practice corporations (Detsky, 1978, p. 116).

Some of these restrictions were removed by the Health Maintenance Act of 1973. Unfortunately, several Senators saw this act as a vehicle to achieve broader social objectives and saddled the industry with new requirements, in many ways more restrictive than those the act originally intended to remove (Brown, 1983, pp. 239 - 344). This act required, for example, that Health Maintenance Organizations offer a broader range of services than the fee-for-service insurance plans with which they competed, including mental health services, alcohol and drug rehabilitation and preventive dental care. The result was to price many HMOs out of the market. In addition, capitation payment organizations were required to have open enrollments and to meet what were felt to be unrealistic financial requirements (Brown, 1983, pp. 304 - 309). To encourage compliance, HMOs that were unwilling, or unable to meet these requirements, were not exempted from punative state statutes.

In 1978 the open enrollment provision of the Health Maintenance Act of 1973 was dropped, as was the requirement HMOs provide services not required of other insurance plans. Several legislative barriers still remain, however. Presently tax laws do not allow as favorable a tax treatment for non-profit HMOs as other non-profit health care organizations. The differences are in the areas of local property taxes, tax shelters for retirement benefits of high income employees, and the ability to use charitable contributions as tax write-offs (Detsky, 1978, p. 117). This puts HMOs at a competitive disadvantage

with respect to non-profit hospitals. A recommendation of this study, therefore, is that consideration be given to a redrafting of this section of the tax code.

In most states, the ability of HMOs to expand is restricted by certificate-of-need laws (Feldstein, 1979, p. 248). These laws attempt to restrain increases in health care costs through restrictions on the expansion of hospital beds and equipment (Feldstein, 1979, p. 243). While the objective of these statutes is commendable, they do favor existing health care providers and have been effectively used to prohibit capitation payment plans from building their own health care facilities. It might be productive, therefore, to evaluate the possible exemption of capitation payment plans from health planning regulations, at least until this reimbursement system has established itself in the marketplace.

Non-legal Barriers. Not all of the barriers to the establishment of HMOs on a national basis are legal. Some are economic. One problem that many capitation payment groups have run into is the large amount of capital required to start the traditional HMO. From the beginning state medical societies made it impossible for capitation physicians to join the medical staffs of community hospitals (Feldstein, 1979, p. 295). Consequently, most of the early plans were forced to build their own inpatient facilities. While hospital staff restrictions against group practice physicians have been lifted in most states, there are those who still feel that HMOs can only succeed in controlling costs if they own the hospitals in which their

physicians practice (Eastaugh, 1981, p. 143). The success of other models, however, suggests that HMOs can be cost effective even when their physicians practice out of hospitals controlled by fee-for-service physicians (Eastaugh, 1981, pp. 141 - 144). Further research needs to be done in identifying those forms of capitation payment that are not only cost effective, but easy to implement. One organization with that potential is the Preferred Provider Organization (PPO). PPOs are groups of physicians who market their services to employee groups under a prenegotiated payment schedule. All have the following common characteristics (Lundy and Blacker, 1983):

1. They consist of panels of health care providers, some of which may be hospitals.

2. They market services to employee groups or unions for a prenegotiated payment.

3. They discount rates in return for increased patient volumes and commitments to prompt payment.

4. They employ hospital utilization controls.

Most PPOs market their services on a discounted fee-for-service basis (Lundy and Blacker, 1983). There is no reason, however, that capitation payment could not be used as well. Provided that an adequate number of capitation payment PPOs could be found, one useful study might compare the operating costs of these organizations to the traditional (i.e. Kaiser model) HMO.

DRG Reimbursement

Although capitation payment has been shown to be be analytically superior to DRG reimbursement, the significant political and financial investment made by Congress and the Administration in the enactment of the Social Security Amendments of 1983 might indicate that this reimbursement system will be around for many years to come. Since literally billions dollars will be channeled through this program, research directed at improving this reimbursement system appears warranted.

Since it has been demonstrated that the revelation of private information can reduce the patient's welfare loss, attention should be given to the development of an audit technology that will enable medical audits to reveal, at a reasonable cost, the true state of nature. There exists in the accounting field a large body of knowledge on the audit technology necessary to reveal private information. It is possible that much of this might be applied to the field of medical audits. Without an effective audit technology, the DRG reimbursement system cannot achieve its objective of effective hospital cost control.

Certain services traditionally provided by hospitals are not easily accommodated by DRG reimbursement. One of these is medical education. Congress has recognized that teaching hospitals legitimately have higher costs, and has directed the Health Care Financing Administration to see that these are adequately reimbursed.

As an equitable method to include these costs in the DRG has yet to be developed, (Ernst and Whinney, 1983) the development of such a system might be a useful field of study.

In the program used by the Yale Study to calculate the lump sum payment for each DRG, "hospital length of stay" was used as the surrogate for "resource consumption." Since it is known that the intensity of medical inputs is not homogeneous over the entire hospital length of stay, a productive study might focus its attention on the discovery of a better surrogate.

Many hospitals have traditionally shifted the economic risk of serious illness by undercharging for the more complex products and services, and overcharging for the less complex products and services (Howard, 1984). Under Fee-for-service reimbursement it was not important that hospital charges be highly correlated as the hospital could always increase its prices if it appeared that charges were not going to cover costs, and as patients had no recourse but to pay the hospital what was billed.

Since hospital charges were used as the surrogate for hospital costs in the development of DRGs, it might be interesting to evaluate the impact that DRGs will have on the future mixture and availability of hospital services. If the use of a biased surrogate causes DRGs to under-reimburse hospitals for the more complex procedures, then the large speciality centers may have a difficult time surviving DRG reimbursement, and certain patients with the more complicated illnesses might eventually find themselves excluded from the health

care marketplace. Empirical verification of these trends might be useful. Other studies might focus on finding a more suitable surrogate for hospital costs than hospital charges, or on the development of DRG costing techniques that will reveal true costs, thus eliminating the need for a surrogate.

With the resolvement of the hospital charges versus hospital costs issue, it is possible that DRG reimbursement might achieve the objective of providing a quantifiable standard of resource consumption by category of illness. Even if this occurs, however, one significant criticism of this reimbursement system will still remain, this system is not "outcome oriented." In the formulation of the regression used to define each DRG, the dependent variable used was resource consumption rather than rate-of-cure. It seems to the author that a more appropriate reimbursement system would be concerned with both the quality and the cost, of health of care. One of the side benefits of DRG reimbursement will be an expanded base of medical information. To receive reimbursement, it will be necessary for hospitals to accumulate both financial and medical information for each patient in each DRG. Attention should be given to determining if this expanded data base can be used to refine DRGs and improve medical decision making on a local level.

Summary

Chapter Seven reviewed the findings of this study and recommended several future areas of study. Since the Capitation Payment

reimbursement dominates all other systems examined, greater attention should be given to the national implementation of capitation payment. One reason for the slow growth of HMOs is public unawareness of the benefits of this reimbursement mechanism. Public opinion polls have indicated that most consumers do not understand the impact that reimbursement incentives have on physician cost behavior, and the role that HMOs can play in changing these incentives. One recommendation, therefore, is greater public education.

A second reason for the slow growth of HMOs has been opposition from organized medicine. While the HMO Act of 1973, and its 1978 amendment removed some of the legal barriers to the establishment of capitation payment forms of organization, others remain. Several areas of study were suggested that might help ease the legal problems faced by prospective HMOs.

A third reason for the slow growth of HMOs is the significant capital investment required to start a capitation payment plan. One useful area of study, therefore, might direct its attention to the development of new forms of capitation payment that are cheaper to implement that some of the traditional models.

Although capitation payment has been shown to be be analytically superior to DRG reimbursement, the significant political and financial resources that were invested by congress and the administration in the enactment of the Social Security Amendments of 1983 might indicate that this reimbursement system will be around for many years to come. Since literally billions of Medicare and Medicaid dollars will be

channeled through this program, several studies directed at improving this reimbursement system were suggested. These include studies to develop the audit technology necessary to reveal private information in a medical setting, studies to discover better surrogates for resource consumption and hospital costs, studies on the impact of DRG reimbursement on the future mixture and availability of hospital services, and studies on ways in which the DRG reimbursement system can be made more "outcome oriented."

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APPENDIX A

ASSUMPTIONS OF THE ADVERSE SELECTION MODEL

1. The patient can observe, but is unable to evaluate the actions of the physician.

2. The states of nature are discrete.

3. The patient is unable to determine the true state of nature.

4. The physician can always determine the true state of nature perfectly. The physician is qualified to treat all illnesses.

5. The utility of the patient, and the utility of the physician, are both functions of wealth.

6. We assume a one period world, with a finite number of illnesses.

7. The states of nature are ranked according to the severity of illness. The higher states of nature require a longer treatment than the lower states of nature.

8. The more severe the illness, the lower the probability of its occurrence.

9. The physician holds medical staff privileges in a primary care hospital, where a primary care hospital is defined as an inpatient facility serving a population base large enough to justify the acquisition of noncomplex hospital equipment, but too small to fully utilize the the more specialized equipment.

10. In all reimbursement systems but capitation payment, physician charges are a function of the volume and complexity of physician services rendered (this is referred to as the physician volume - complexity assumption).

11. Hospitals have no source of patient funds other than patient revenue and cannot therefore provide preventive, diagnostic or treatment services unless hospital reimbursement is at least at a level that covers costs (this is referred to as the hospital actual cost reimbursement assumption).

12. In all reimbursement systems, hospital costs are a function of the volume and complexity of hospital services rendered (this is referred to as the hospital volume - complexity assumption).

13. The action of the physician is a sequential three stage process, (1) the physician provides preventive medicine at the beginning of the period and then the state of nature occurs, (2) the physician next chooses a level of diagnostic services necessary to determine the state of nature, and (3) then chooses the treatment.

14. The physician will always provide at least the minimum level of diagnostic and treatment services needed to cure the patient, regardless of the reimbursement system chosen by the patient. In addition, the physician will never provide an excessive level of diagnostic and treatment services if the provision of such services would harm the patient (this is referred to as the minimum ethics assumption).

15. All illnesses are treatable and curable by the end of the period.

16. Death is not a state of nature.

17. The provision of preventive medicine at the beginning of the period decreases the probability of every illness during the period.

18. Whenever a physician is faced with two or more actions, both of which have equal benefit to the physician, but one of which benefits the patient more than the other, the physician will

choose that action that benefits the patient most (this is referred to as the non-perverse behavior assumption).

APPENDIX B

GLOSSARY OF TERMS

Actual Cost Reimbursement Assumption: The assumption made in this study that hospitals have no source of funds other than patient revenues and cannot, therefore, provide preventive, diagnostic or treatment services unless they are reimbursed at a level at least equal with to cost.

Adverse Selection Model - Medical Setting: An adaptation of the traditional agency model which is used in this study to demonstrate the appropriate physician action choice under each of the nine health care reimbursement systems.

Ancillary Services: Services other than room, board, and other professional services provided by the hospital. Examples include X-ray, and laboratory services.

Capitation Payment: A method of payment for health care services in which the provider is paid a fixed per-capita amount irrespective of the services actually rendered during a predefined period, such as an enrollment year. Three forms of capitation payment are examined in this study.

Capitation Payment - PPO: For the purpose of this study, a Capitation Payment - PPO is a group of physicians who contract on a capitation basis for the provision of physician services. In the model employed in this study, the PPO assumes no responsibility for cost of hospital care.

Certificate-of-Need Laws: These state statutes attempt to control the growing intensity of medical care through a review process mandatory for investment in equipment or facilities exceeding some specified dollar amount.

Community Hospital: A primary care hospital.

Community Rating: A method whereby the insurer determines the premium rate based on the average costs of all subscribers in a specific industry or catchment area, and all individuals pay the same rate. Community rating spreads the cost of illness over all the subscribers and does not charge higher rates to those currently less healthy than the average person.

Concurrent Review: The monitoring, during the time that a patient is hospitalized, of the delivery of care provided.

Diagnosis: A commonly accepted term to describe a disease.

Diagnostic Ancillary Services: Those ancillary services used by a physician to determine the true diagnosis.

Diagnostic Related Group (DRG): A system of classifying patients according to type of disease. It was developed by researchers at Yale University and contains 467 mutually exclusive and exhaustive disease categories or groups. Medicare's prospective payment system is based on DRGs.

Diagnostic Related Group Reimbursement: A reimbursement system wherein the provider is paid a fixed fee for each DRG (illness category) treated , regardless of the services provided in the treatment of that illness.

Fee-for-service Reimbursement: The traditional reimbursement mechanism for both the physician and hospital. For the physician, the fee is determined by market forces, for the hospital, it represents full cost reimbursement for the hospital services rendered.

First-Best Solution Reimbursement: The reimbursement system that would be imposed on the physician if there were no private information. Under this system, the patient would pay the physician a prenegotiated amount if the physician provided an appropriate level of preventive, diagnostic and treatment services, and nothing if he did not.

Health Care Financing Administration (HCFA): The federal agency to whom Congress has delegated responsibility for the administration of the Medicare program.

Health Maintenance Organization: A medical organization that provides and assures the provision of comprehensive health services for an enrolled group of persons under a prepaid capitation arrangement.

Hospital Volume - Complexity Assumption: The assumption made in this study that hospital costs are a function of the volume and complexity of services rendered.

Kaiser Model: An HMO that owns the hospitals in which its physicians practice.

Length of Stay (LOS): The length of an inpatient's stay in a hospital, reported as the number of days spent in a facility per admission or discharge.

Medicaid: A federal-state matching program whose designated beneficiary group is the poor. The role of the federal government is primarily one of sharing the costs of the program with the states, who are themselves responsible for defining the eligibility requirements and determining the benefit coverage.

Medical Education: Teaching activities (e.g., training programs for nurses, interns, and residents).

Medical Education Costs: The cost of approved medical education programs. Generally, approved educational activities mean formally organized or planned programs of study engaged in by hospitals to

enhance the quality of care in an institution.

Medical Record: A record maintained by the hospital in which the patient's diagnosis, treatment, and response to treatment is recorded.

Medicare: A limited national health insurance program for individuals eligible for Social Security benefits. Recipient benefits include hospital care, skilled nursing facility care following a hospital stay, and home health care services.

Minimum Ethics Assumption: The assumption made in this study that the physician will always provide the minimum level of diagnostic and treatment services needed to restore the patient to a state of health and will never provide an excessive level of these services if the provision of such services would harm the patient.

Morbidity: The rate of disease or proportion of diseased persons.

Mortality: The death rate.

Open Enrollment: A provision of the HMO Act of 1973 specifying that Federal HMOs must allow, for at least 30 days each year, the enrollment of any individual, regardless of past medical history or existing medical conditions. The premium for these individuals was to be determined using a "community rating." This provision was removed by a 1978 amendment 30 days each year, the enrollment of any individual, regardless of past medical history or existing medical

conditions. The premium for these individuals was to be determined using a "community rating." This provision was removed by a 1978 amendment.

Opportunity Cost of Employment: The amount that must be paid to a physician to induce him to work for a patient or medical organization.

Patient Welfare Loss: Defined in this study the total payment by the patient for health care.

Peer Review Organization (PRO): An entity composed of a substantial number of doctors of medicine or osteopathy, representative of the practicing physicians in an area, and judged by the Secretary of Health and Human Services to be capable of auditing health care. These organizations are currently replacing PSROs and will be responsible for medical auditing under DRG Reimbursement.

Physician Action Vector: A vector of medical inputs selected by the physician in the treatment of a specific illness.

Physician Volume - Complexity Assumption: The assumption made in this paper that in all reimbursement systems but capitation payment, the physician's charge is a function of the volume and complexity of services rendered.

Preferred Provider Organizations (PRO): A payment arrangement whereby groups of physicians contract with corporations or unions to

provide medical services.

Preventive Medicine: Those physician and hospital services which when rendered to a patient reduce the likelihood of future disease.

Primary Hospital: An inpatient health care facility whose primary function is to provide non-specialized hospital care.

Professional Standards Review Organization (PSRO): Physician or other professional medical organizations (established by the 1972 amendments to the Social Security Act and financed 100 percent by the federal government) that were charged with the responsibility of ensuring that payments for Medicare and Medicaid were medically necessary, provided in accordance with professional standards, and rendered in an appropriate setting. The Peer Review Improvement Act of 1982 repealed the PSRO program (effective September 3, 1982) and provided instead for the establishment of a utilization and quality control peer review program. Under the existing law, PSROs will not be terminated until a contract with a peer review organization is established in the same geographic area.

Probability Revision Assumption: The assumption made in this study that the provision of preventive medicine decreases the probability of every illness during the period.

Reimbursement System: For the purpose of this paper, a reimbursement system is defined as one physician and one hospital fee schedule.

Retrospective Review: The audit of hospital admission and treatment after a patient has been discharged.

Severity of Illness: The relative level of loss of function and mortality normally caused by a particular illness.

Specialty Hospital: An inpatient health care facility whose primary objective is to provide the more complex or specialized levels of hospital care.

State of Nature: The patient's state of health.

Target Income Hypothesis: A theory that physicians have control over their own markets and thus can create their own demand to achieve specific targeted incomes.

Third-party Payer: An organization that pays for or insures health or medical expenses on behalf of its beneficiaries or subscribers. Third party payers act as the agent between the provider and the consumer. Third-party payers include Medicare, Medicaid, Blue Cross, Blue Shield, and commercial insurance companies.

Utilization Review: The monitoring of activities involved in the treatment of patients. There are three main reasons for utilization review: (1) it is required by law for Medicare payment; (2) it is necessary for JCAH accreditation; and (3) it is useful in internal management.

VITA

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