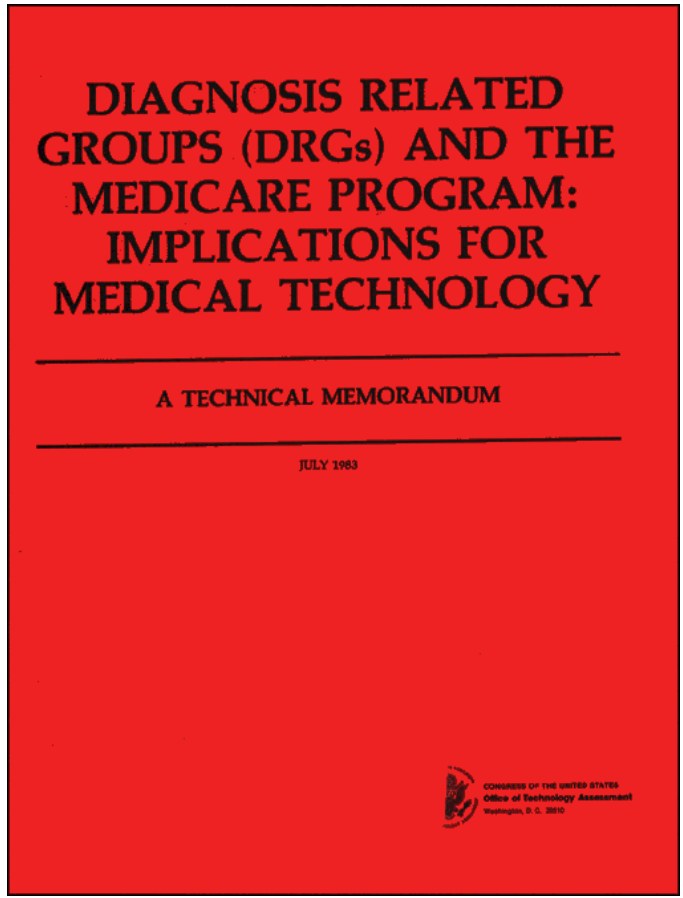
Diagnosis Related Groups (DRGs) and the Medicare Program: Implications for Medical Technology

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Preface

The increase in the cost of hospital care has been a persistent and growing problem for both the Medicare program and the general public for more than is years. A substantial portion of the increase in hospital costs has been attributed to an increase in the use of new and existing medical technologies.

Congress recently legislated a new prospective per-case payment system for the Medicare program. Hospitals will be paid a specific, predetermined amount for each patient treated, regardless of the number or types of services provided. The amount paid will depend primarily on the Diagnosis Related Group (DRG) into which the patient is classified. The implementation of per-case payment has rested on the availability of an acceptable method of measuring a hospital's case mix. DRGs are just one of several approaches to measuring hospital case mix. Their importance is heightened by their adoption in the new national Medicare prospective payment system.

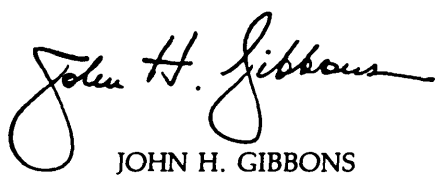
The House Committee on Energy and Commerce and its Subcommittee on Health and the Environment requested that OTA examine DRGs and their implications for use in the Medicare program as part of a larger assessment on ***Medical Technology and Costs of the Medicare Program.***

This technical memorandum presents the results of that examination. It reviews the development of DRGs and compares them to alternative case-mix measures. It examines the validity and reliability of the DRG classification system and the accuracy of DRG coding. It provides examples of proposed and actual uses of DRGs in hospital payment. Finally, and most important, the technical memorandum includes a thorough analysis of the implications for medical technology use and adoption of using DRGs as an integral part of a per-case payment system.

A principal finding is that while DRGs are ready for use in a per case payment system, their implementation needs to be closely monitored, because there is little experience with their use in this context. In ***the long run, the success of DRG payment will rest on its flexibility and aptability to changing costs and technologies.*** Four findings concern this need for periodic adjustment:

1. the requirement for regular reestimation of relative DRG prices implies a need for continued collection of hospital cost and charge data;
2. procedures allowing for the adjustment of DRG rates conditional on a hospital's adoption of a technology maybe important to stimulate adoption of desirable but cost-raising technologies;
3. the DRG adjustment process requires supporting evidence about the effectiveness, risks, and costs of new technologies; and
4. the adjustment process should guard against proliferation of DRGs.

This memorandum was guided by the advisory panel for the OTA assessment on *Medical Technology and Costs of the Medicare Program,* chaired by Stuart H. Altman. In addition, a large number of persons in the Federal and State Governments and in the health services research field were consulted. Key OTA staff involved in the analysis and writing of the technical memorandum were Judith L. Wagner, Cynthia P. King, and Anne Kesselman Burns.



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Glossary of Acronyms and Terms

Glossary of Acronyms

AHA — American Hospital Association
CPD – cost per discharge
CPHA — Commission on Professional and Hospital Activities
CT – computed tomography
DHHS — Department of Health and Human Services
DRGs — Diagnosis Related Groups
EEG – electroencephalogram
GIR — Guaranteed Inpatient Revenue
HCFA — Health Care Financing Administration
IOM — Institute of Medicine
IPPB – intermittent positive pressure breathing
LOS — length of stay
MDCS — Major Diagnostic Categories
NCHS — National Center for Health Statistics
OTA — Office of Technology Assessment
PAS — Professional Activity Study
PCB – preliminary cost base
PMCS — Patient Management Categories
PROS — Peer Review Organizations
PSROS — Professional Standards Review Organizations
SMSA — Standard Metropolitan Statistical Area
TEFRA — Tax Equity and Fiscal Responsibility Act of **1982**

Glossary of Terms

Capital costs: Costs associated with the use of capital facilities and equipment, including depreciation and interest expenses.

Case mix: The relative frequency of admissions of various types of patients, reflecting different needs for hospital resources. There are many ways of measuring case mix, some based on patients' diagnoses or the severity of their illnesses, some on the utilization of services, and some on the characteristics of the hospital or area in which it is located.

Coinsurance: A form of cost-sharing whereby the insured pays a percentage of total cost. (Also see ***copayment.)***

Copayment: A form of cost-sharing whereby the insured pays a specific amount at the point of consumption, e.g., **$10** per visit. (Also see ***coinsurance.)***

Cost-sharing: The general set of financing arrangements whereby the consumer must pay some out-of-pocket cost to receive care, either at the time of initiation of care, or during the time of the provision of health care services, or both.

Deductible: A form of cost-sharing in which the insured incurs an initial expense of a specified amount within a given time period (e.g., $250 per year) before the insurer assumes liability for any additional costs of covered services.

Diagnosis Related Groups (DRGs): A classification system that groups patients according to principal diagnosis, presence of a surgical procedure, age, presence or absence of significant comorbidities or complications, and other relevant criteria.

DRG inflation: An increase over time in the number of separately identified case-mix classification groups.

DRG payment: Any per-case hospital payment method in which differences in case mix are taken into account using DRGs to classify case types.

Effectiveness: Same as efficacy (see below) except that it refers to " . . . average or actual conditions of use."

Efficacy: The probability of benefit to individuals in a defined population from a medical technology applied for a given medical problem under ideal conditions of use.

Fee-for-service: A method of paying for medical care on a retrospective basis by which each service actually received by an individual bears a related charge.

Length of stay (LOS): The number of days a patient remains in the hospital from admission to discharge.

Medicaid: A Federal program that is administered and operated individually by each participating State government that provides medical benefits to certain low-income persons in need of health and medical care.

Medical technology: The drugs, devices, and medical and surgical procedures used in medical care, and the organizational and supportive systems within which such care is provided.

Medicare: A nationwide, federally administered health insurance program, authorized in **1965** to cover the cost of hospitalization, medical care, and some related services for eligible persons over age **65,** persons receiving Social Security Disability Insurance payments for 2 years, and persons with end-stage renal disease. Medicare consists of two separate but coordinated programs–hospital insurance (part A) and supplementary medical insurance (part B). Health insurance protection is available to insured persons without regard to income.

Pass-throughs: In a per-case payment system, pass-throughs are elements of hospital cost that are paid on the basis of cost-based reimbursement.

Per-case payment: Any prospective hospital payment system with fixed rates of payment based on the hos-

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pital admission, not on the number and types of services or number of days of care provided.

Professional Standards **Review Organizations (PSROs):** Community-based, physician-directed, nonprofit agencies established under the Social Security Amendments of **1972** to monitor the quality and appropriateness of institutional health care provided to Medicare and Medicaid beneficiaries.

Prospective **payment:** Hospital payment programs where rates are set prior to the period during which they apply and where the hospital incurs at least some financial risk.

Recalibration: Periodic changes in relative DRG prices, including assignment of prices to new DRGs.

Reliability: A measure of the consistency of a method in producing results. A reliable test gives the same results when applied more than once under the same conditions. Also called "precision. "

Retrospective cost-based reimbursement: A payment method in which hospitals are paid their incurred costs of treating patients after the treatment has occurred.

Risk: A measure of the probability of an adverse or untoward outcome and the severity of the resultant harm to health of individuals in a defined population associated with use of a medical technology applied for a given medical problem under specified conditions of use.

Safety: A judgment of the acceptability of risk (see above) in a specified situation.

Technology: The application of organized knowledge to practical ends.

Technology **assessment: A** comprehensive form of policy research that examines the technical, economic, and social consequences of technological applications. It is especially concerned with unintended, indirect, or delayed social impacts. In health policy, the term has also come to mean any form of policy analysis concerned with medical technology, especially the evaluation of efficacy and safety. The comprehensive form of technology assessment is then termed "comprehensive technology assessment ."

Utilization and quality control peer review organizations (PROS): Physician organizations established by the Tax Equity and Fiscal Responsibility Act of 1982 (Public Law 97-248) to replace PSROs (see definition). Hospitals are mandated to contract with PROS to review quality of care and appropriateness of admissions and readmissions.

Validity: A measure of the extent to which an observed situation reflects the "true" situation. ***Internal validity*** is a measure of the extent to which study results reflect the true relationship of a "risk factor" (e.g., treatment or technology) to the outcome of interest in study subjects. ***External validity*** is a measure of the extent to which study results can be generalized beyond the study sample.

Chapter 1

Introduction and Summary

Chapter 1

Introduction and Summary

BACKGROUND

The increase in the cost of hospital care has been a persistent and growing problem for both the Medicare program and the general public for more than 15 years. A substantial portion of the increase in hospital costs has been attributed to an increase in the use of new and existing medical technologies. * Medicare expenditures for inpatient hospital services have increased more than tenfold since its inception—from about $3 billion in 1967 to more than $33 billion in 1982. From 1979 to 1982, the average cost of a day of hospital care increased at an annual rate of almost 18 percent, and Medicare expenditures for hospital services increased at a rate of over 19 percent. In 1982, hospital costs increased by 15.5 percent, three times the rate of inflation in the economy as a whole.

While the fiscal health of the program suffers as a result of hospital cost inflation, Medicare has contributed to the problem through its traditional hospital payment policy. Until October 1982, Medicare employed a retrospective cost-based reimbursement approach whereby hospitals could recover from Medicare most of what they spent for Medicare beneficiaries. Consequently, hospitals had little incentive to control costs. Hospitals have thus been encouraged to acquire and use more technology and to expand their capacity to produce a wider scope of more complex services.

The Medicare program has historically provided leadership for other hospital payment policies. Other third-party payers, including State Medicaid programs and private insurers, have also generally used cost-based reimbursement as their approach to hospital payment. In fact, until 1981, State Medicaid programs were required to follow Medicare's principles of reimbursement for hospitals unless they applied for and received a waiver from the Federal Government for an alternative system.

However, as early as the late 1960's, some of these other payers began the search for alternatives to retrospective cost-based reimbursement. State-legislated and voluntary programs using alternative payment schemes have appeared throughout the 1970's. These programs have been broadly termed "prospective payment," where rates are set prior to the period during which they apply and the hospital incurs at least some financial risk. They have varied widely in design. For example, some control the amounts hospitals could charge for specific services; others pay hospitals an all-inclusive rate per day of hospital care. But paying by the day sets up incentives for hospitals to increase lengths of stay and admissions, and controlled charges also encourage hospitals to increase the number of services they provide.

Recently, a new kind of prospective payment has emerged: per-case payment. Under this form of payment, the hospital is paid a specific amount for each patient treated, regardless of the number or types of services provided. Thus, the hospital is rewarded for reducing the cost of treating a patient over the entire course of the hospital stay. Per-case payment removes the incentive to provide more technologies and encourages the hospital and its physicians to consider explicitly the benefits of additional services against their added costs.

Per-case payment cannot survive for long without a method to adjust for differences in the kinds of patients that hospitals treat. If hospitals were paid the same amount for each admission regardless of its clinical characteristics, over time they would be encouraged to treat patients who ***are*** less ill and to avoid the cases that require more resources. Thus, the implementation of per-case payment has rested on the availability of an acceptable method of measuring the hospital's case mix.

● **OTA has defined medical technology as the drugs, devices, and medical and surgical procedures used in medical care, and the organizational and supportive systems within which such care is delivered. In this technical memorandum, the focus is on drugs, devices, and procedures, but many of the points apply to the system technologies.**

Case mix has been defined in various ways. In this technical memorandum, it refers to the relative frequency of admissions of various types of patients, reflecting different needs for hospital resources. There are many ways of measuring case mix, some based on patients' diagnoses or the severity of their illnesses, some on the utilization of services, and some on the characteristics of the hospital or area in which it is located.

Diagnosis Related Groups (DRGs) are just one of several approaches to measuring hospital case mix. Their importance is heightened by their recent adoption for use in the new national Medicare prospective payment system. Beginning in October 1983, Medicare will phase in a per-case payment system using DRGs as the case-mix measure. As part of a larger assessment on Med ***ical Technology and Costs of the Medicare Program,*** the Office of Technology Assessment (OTA) was requested by the House Committee on Energy and Commerce and its Subcommittee on Health and the Environment to examine DRGs and their implications for use in the Medicare program.

This technical memorandum, Diagnosis ***Rekted Groups (DRGs) and the Medicare Program: Im***plications ***for Medical Technology*** presents the results of that examination. As with all OTA technical memoranda, it contains no policy options for congressional consideration. It is intended to be a comprehensive and independent assessment of DRGs in the context of a per-case payment system. In its study of DRGs as a case-mix measure, it reviews their development and compares them to alternative case-mix measures. It examines the validity and reliability of the DRG classification system, the accuracy of DRG coding, and the administrative feasibility of administering a DRG-based payment system. It provides examples of proposed and actual uses of DRGs in hospital paymerit. ' Finally, the technical memorandum includes a thorough analysis of the implications for medical technology use and adoption of using DRGs as an integral part of a per-case payment system. This analysis includes a review of the key features of design of DRG payment systems that affect medical technology and a discussion of the implications of technological change for the administration of a DRG payment system over time.

Two issues of concern to policymakers are not included in this technical memorandum. First, it does not address the effect of DRG payment on the costs of the Medicare program; rather, it discusses the incentives that will be established by such a system. Second, it does not discuss whether and to what extent DRG payment under Medicare will lead to savings in Medicare program costs at the expense of other payers. These critical issues are presently under debate by other agencies and organizations.

● **A detailed account of one actual use—the experimental use of DRGs for hospital payment in New Jersey-is presented in a separate working paper.**

SUMMARY

Alternative Case-Mix Measures

An examination of several case-mix measures for their validity and acceptability in a per-case payment system reveals DRGs to be the best available measure. The Disease Staging and the Severity of Illness Index methods of measuring case mix provide more information about the severity of the condition of the patients, but both require more data than are generally available and both are based on subjective methods. Neither measure has reached the stage of development where it is suitable for widespread implementation in a payment context. Nevertheless, the existence of these alternative approaches does reinforce the concern of some health providers and policymakers regarding the adequacy of DRGs in distinguishing differences in the relative severity of patients' conditions in any given DRG.

Another case-mix measure, Patient Management Categories (PMCS), is also in the developmental stage and will be tested soon. PMCs differ from other case-mix measures, including DRGs, in that they are normative. Physicians specify an optimal set of clinical care components

based on a patient's clinical characteristics, including both final diagnosis and reason for admission. This set of clinical care components is the basis for the relative cost weights of PMCs. This system appears unique in that it recognizes that optimal patient management should be the focus of a system that seeks to encourage efficiency. Thus, the further development of PMCs should be encouraged.

The use of DRGs in the Medicare per-case payment system is appropriate since they are more refined than the alternative case-mix measures. Both statistical and clinical considerations support this conclusion. Since DRGs can be assigned based on the information already processed on the discharge abstracts of patients' medical records, it is superior to the other measures in its administrative feasibility. However, empirical evidence must still be collected on all of the alternative measures to compare them in the context of payment.

DRG Payment and the Use of Medical Technology

There are two general incentives inherent in any per-case payment system: 1) to reduce the cost to the hospital of each inpatient case stay, and 2) to increase the number of inpatient admissions. Cost per case can be reduced by using fewer technological services, including ancillary services, reducing the number of inpatient days, or both. This incentive may result in specialization among hospitals for services that require a minimum number of patients to maintain profitability. This specialization may imply lower access to care for some Medicare patients. There are built-in constraints of unknown magnitude on the possibility of adverse effects on access and quality. One constraint is the fact that physicians are the decisionmakers, and they continue to have financial, ethical, and legal reasons to practice high-quality medicine.

The direction and strength of general incentives for any particular hospital are altered by key features of the DRG payment system, including: 1) the proportion of the hospital's case load covered by DRG payment, 2) the treatment of costs as pass-throughs, * 3) the methods of DRG rate construction, 4) the methods of updating DRG rates, and 5) the level of risk and reward built into the payment system. Thus, a DRG payment system may include a variety of specific approaches to payment with some predictable effects on medical technology.

DRG payment incentives may be expected to affect technology use in the following ways:

- Overall, the number and intensity of ancillary procedures provided to inpatients can be expected to decrease, but the use of procedures that can be shown to lower the cost per case will increase.
- The settings of technology use are likely to be influenced by DRG payment, but the incentives work in conflicting directions and are sensitive to the key features of program design. It remains to be seen which incentive will dominate for which procedures. DRG payment will encourage the movement of technologies into the home, particularly those for post-hospital care.
- DRG payment is likely to influence the specialization of services, but the magnitude and direction of these effects is unknown. The incentives to reduce costs encourage concentration of capital-intensive technologies in fewer institutions. Conversely, the increasing competition among hospitals for physicians and patients will create incentives for the widespread acquisition of some technologies.
- A change in technology product mix is likely to result from downward pressure on the price and quantity of supplies and, if capital is included in the DRG rate, capital equipment. Greater product standardization can be expected as more expensive models and procedures are eased out of the market through competition.

*"Pass-throughs" are elements of hospital cost that are not controlled by the per-case payment system. Cost-based reimbursement, as a whole, can be interpreted as a payment method in which all cost categories are passed through.

Effects of DRG Payment on Technological Change in Medicine

Perhaps even more important than how DRG payment affects the use of presently available medical technologies is how DRG payment will affect technological change in medicine—the adoption of new technologies and discarding of old ones. DRG payment will influence hospitals' decisions to adopt new medical technologies and may therefore alter the rate and direction of technological change in medicine.

Although no empirical studies on the effect of DRG payment on adoption of technologies are available, studies of other kinds of prospective payment systems suggest that hospitals can and do respond to changes in financial incentives in these decisions. In general, technologies that are cost-reducing to hospitals will be encouraged; cost-raising technologies will be discouraged. However, much depends on the strength and design of the program. In particular, the methods of providing rewards for cost reductions, treating capital costs, and updating DRG prices have important implications for technological change. Though DRG payment does not imply that technological change will approach a standstill, its directions are likely to be altered, and the adoption of technologies that are cost-raising to the hospital is likely to decline by an unknown quantity.

The longrun viability of any DRG payment system depends on its ability to both adapt to and encourage appropriate technological change in medicine. The methods and procedures used to adjust the average payment level, relative DRG rates, and the DRG categories themselves are critical to the survival of the system. The objectives of the adjustment process are to maintain equality across DRGs in the ratios of price to cost of efficient care and to promote the adoption of appropriate new technologies. There are at least five potential processes of adjustment. They vary according to whether the adjustment is conditional on hospitals' actual adoption of new technology, who requests the adjustment, and when in the stage of a new technology's diffusion the adjustment is made. None of these processes alone is sufficient to adjust the system adequately for technological change.

Implementation Issues

Other considerations for the feasibility of using DRGs as the case-mix measure in the Medicare payment system include two important aspects of implementation of this new system: 1) data and coding issues, and 2) hospital administrative issues. Accurate and timely patient-level data are clearly important to the efficient and effective operation of the DRG system. In the past, evaluations of patient discharge data have found them to be unreliable. However, it is important to note that these abstracts had not been produced for payment purposes. When payment depends on the accuracy and timeliness of discharge abstracts, their importance increases, and data reliability should improve. Monitoring by utilization and quality control peer review organizations as mandated by the new Medicare law, should give hospitals added incentive to improve their data collection and coding.

Such improvements in information quality implies a need for several education programs for medical staff, hospital administrators, and medical records personnel. Error detection, feedback, and training would be important parts of data programs. It should be noted that these types of improvements are likely to be more expensive and time-consuming. Some of these costs will vary among the individual hospitals depending on their current practices. For example, some hospitals might need to adopt computer capability for medical records, while others might need to add to their medical records staff.

Findings and Conclusions

- Although the new Medicare law provides for a DRG-based per-case payment system, DRGs have been inadequately evaluated for their validity as an indicator of patient resource needs and for their impact on medical technology in per-case payment. Thus, it is critical that the new system's implementation be carefully monitored.

- Programs of quality assurance and utilization review will be required to counter the incentives of the per-case payment system to underprovide services and inappropriately admit and discharge patients.
- The treatment of capital costs will affect the use of medical technology. The diversity in hospitals' ages, debt structures, and future needs for expansion and closure argue for hospital-specific determinations of capital payment levels, probably at the State level.
- Periodic reestimation of relative DRG rates to reflect changes in the costs of various DRGs is essential to a workable program. This implies a need for a continuing source of cost and charge data to support the process.
- Methods for updating DRG rates that are conditional on technology adoption maybe important to stimulate desirable but cost-raising technologies, Frequent creation of new technology-specific DRGs, however, can ultimately undermine the incentives of per-case payment.
- The DRG adjustment process requires supporting evidence about the effectiveness, risks, and costs of new technologies. Resources must be adequate for necessary research and the activities of groups such as the Prospective Payment Assessment Commission.
- It is fortunate that the new Medicare law does not discourage individual States from establishing alternative prospective payment systems. These alternative systems will allow experimentation with different payment system configurations, including the use of other case-mix measures as they become more refined.
- The reliance of the DRG classification system on **accurate and** timely data collection and coding will necessitate improvement of hospitals' medical records procedures and performance. Educational programs for physicians, nurses, hospital administrators, and medical records personnel could be initiated.

ORGANIZATION OF THE TECHNICAL MEMORANDUM

This technical memorandum is organized in six chapters. Chapter 2 reviews and evaluates several alternative approaches to case-mix measurement for payment purposes. In addition to DRGs, Disease Staging, Severity of Illness Index, and PMCs are briefly examined. Chapter 3 analyzes the incentives for hospitals to use medical technologies under a prospective per-case payment system based on DRGs. The effects of DRG payment on technological change in medicine is the focus of chapter 4. Implementation issues regarding data and administration are briefly described in chapter **5.** Chapter 6 provides an overview and expansion of the conclusions reached in previous chapters.

Appendix A includes a list of the Health Program Advisory Committee and acknowledgments of assistance in the preparation of this technical memorandum. Appendix B provides a descriptive overview of the development of DRGs, and appendix C contains brief descriptions of per-case payment systems that have been designed by the States.

A separate working paper is entitled "Using Diagnosis Related Groups (DRGs) in Hospital Payment: The New Jersey Experience" was written by Joanne Finley under contract to OTA. It is a detailed description of the New Jersey experience with an all-payer prospective payment system based on DRGs. *

***Available from the National Technical Information Service (NTIS).**

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Chapter 2

A Brief Review and Evaluation of Alternative Approaches to Case - Mix Measurement

Chapter 2

A Brief Review and Evaluation of Alternative Approaches to Case-Mix Measurement*

INTRODUCTION

Policymakers, hospital administrators, and health services researchers have long recognized the diversity of hospitals' outputs. Efforts to analyze hospital behavior and to establish effective and equitable reimbursement systems have been complicated by this diversity of hospital products, which include education and research as well as patient care.

For two decades, researchers have grappled with the measurement of hospitals' patient care output. While enormous progress has been made during that period, there remains no consensus about the most appropriate method of case-mix measurement. Failure to reach such a consensus is not surprising. Several substantial barriers have stood in the way, including the variety of purposes case-mix measures have been designed to serve and the significant data requirements associated with any but the most rudimentary measures. The variation in the purposes to be served has been a barrier, because it appears that the "optimal" measure may be different if it is to be used for reimbursement, quality assurance, management, or for some other purpose. Data requirements stem from the need, irrespective of the specific measure, to obtain detailed information about the patients for which the case-mix measure is to be defined. Even in the smallest hospitals, admissions total about 2,000 annually; in the largest institutions, more than 40,000 patients are admitted each year. Even in this age of computers, the national number of admissions—3l million*—is formidable.

This chapter presents a brief overview of the development of case-mix measures, from the early rudimentary techniques to the most recent advances. It is intended to provide a frame of reference against which Diagnosis Related Groups (DRGs) can be assessed. It is not intended to provide a detailed review of past or current approaches to case-mix measurement. Such detail can be found in the references cited throughout the chapter or, alternatively, in an excellent review article by Hornbrook (38).

"Total admissions to non-Federal short-term general hospitals in 1980.

EARLY APPROACHES

The earliest measures of patient care output were developed at the institutional level. That is, the initial measures represented one or more indices, developed for the hospital as a whole, that were designed to reflect a dimension of hospital performance assumed to be associated with case mix. These measures included average length of stay (LOS), surgery rates, relative volume of outpatient visits, number of births, and other similar indicators. Data to construct such measures were readily available from published sources, such as the American Hospital Association's annual survey of hospitals.

It was recognized that simple summary indices such as these were no better than crude surrogates for case mix. However, including such measures in an analysis of interhospital cost variation, for example, seemed preferable to excluding any output characteristics, and for a number of years

● This chapter is based on a paper prepared for OTA by Nancy L. Kelly, Diane E. Hamilton, and Ralph E. Berry of Policy Analysis, Inc.

there were no alternatives. But the empirical evidence indicated that these measures did not explain very much of the interhospital variation in costs (see, e.g., 44). Clearly, the low explanatory power resulted in part from the unidimensionality of the measures. The ratio of surgical operations to admissions, for example, fails to distinguish hospitals performing a great deal of complicated, high-risk surgery from those performing equal numbers of simpler, more common procedures. Similarly, a long LOS may be experienced by patients with acute and severe illnesses or by patients with chronic conditions awaiting discharge to a nursing home.

Often, additional surrogate measures were used along with those described above. The added measures described characteristics of the hospital, rather than the patient population, but they were considered to be highly correlated with case mix. The earliest surrogate was the absolute size of the hospital, measured in terms of numbers of beds or admissions. Case mix was assumed to be more complex in larger hospitals than in smaller facilities. Teaching status is another commonly used surrogate; it is widely believed that teaching hospitals treat a more severely ill mix of patients than nonteaching hospitals. Similarly, physician staff characteristics have occasionally been identified as useful surrogates. Measures of the scope of facilities and services have also been used as indicators of the case mix of patients treated, under the assumption that hospitals are equipped to treat a particular array of illnesses. While size, teaching status, physician staff composition, and scope of services undoubtedly have some predictive power with respect to case mix, the evidence suggests that this power is far from perfect (see, e.g., 4s).

A later development among the early approaches involved the linkage of demographic and economic characteristics of the hospital's "market area" (from sources such as the U.S. Bureau of Census) to the hospital-specific information. This was based on the further assumption that unmeasured dimensions of case mix, not contained in the institutional measures, could be obtained from the characteristics of the area in which the hospital was located. Examples of the characteristics thought to be important were the age distribution of the population (especially the proportion over age 65), median income and education levels, and the numbers of Medicaid recipients. Even such indirect measures as urban versus rural location and/or population density were considered. Associated with each of these characteristics was an underlying hypothesis about its effect on the case mix of area hospitals. For example, a high proportion of poor and/or elderly people in the surrounding area was thought to be more closely associated with severe illnesses than a high proportion of well-educated, moderate income households (70). Broad descriptors of the area, such as population density, have often been considered as surrogates for differences in lifestyle, which in turn, lead to differences in health status.

While it can be argued that they add important information to the limited hospital-specific indices, the market area characteristics also must be viewed as particularly crude surrogates for case mix. The chief drawback of these measures lies in their imprecision. Given current data sources, it is not possible to accurately identify, on a national scale, the precise market area from which the hospital draws its patients. This is especially difficult in urban areas, where many hospitals are clustered in a small geographic area, and where some of the hospitals are referral centers for a much larger region. Except for the relatively few States in which patient origin data are collected, counties or Standard Metropolitan Statistical Areas are typically the only geographic units for which data can be obtained. At best, these will be rough approximations of the true market areas for most of the Nation's hospitals.

It should be noted that the measures that have been labeled "early" are, in fact, still widely in use in research on hospital costs and behavior today. Although, as mentioned previously, considerable advances have been made in the area of case-mix measurement, none of the more recent developments is yet widely available, nor are the requisite input data. As the next section describes, the data requirements of the principal alternatives have placed new demands on traditional recordkeeping and data collection procedures. Gradually, however, alternative measures are likely to become more widely available as existing systems respond to these demands.

RECENT DEVELOPMENTS: DESCRIPTION AND EVALUATION OF NEW APPROACHES

Dimensions of Case Mix

Recognition that case-mix measurement was an important problem—and probably a necessary tool for developing solutions to such longstanding dilemmas as hospital cost inflation-aroused considerable interest as well as funding for a number of research and development efforts. As a result, several important advances have been made. Before they are described, however, a conceptual framework for viewing the problem of case-mix measurement will be presented as background.

Perhaps the first "advance" that motivated the new developments was the recognition that the patient, not the institution, was the appropriate unit of analysis. No matter what the hospital was equipped to do, where it was located, or who served on its physician staff, the types of patients it treated during the course of a given year were the true determinants of the hospital's patient care output. The "condition" of the patients in that population was believed to dictate treatment patterns and, consequently, resource use within the hospital. Further, it is useful to consider "condition" as having two key dimensions: the ***nature of theproldem*** underlying hospitalization (usually indicated by the diagnosis or diagnoses), and the ***relative severity*** of that problem.

A major difficulty facing evaluators of case-mix measures lies in choosing the appropriate frame of reference for such an evaluation. For instance, some measures, such as DRGs, were developed specifically (though not exclusively) to account for differences in resource use. Other approaches do not explicitly address resource use, although they may in fact be highly correlated with this indicator. An evaluation of how well a given measure explains variation in resource use, therefore, should in fairness recognize the purpose that the measure was designed to serve (though this may not alter the conclusions reached).

Related to this issue are the different perspectives of potential users of case-mix measures and their implications for the validity and acceptability of a given measure. For example, measures that seem intuitively reasonable, exhibit high explanatory power in statistical analysis, and can be constructed from readily available data sources may be perfectly acceptable to officials of reimbursement agencies, but they may have no meaning or legitimacy for clinicians. Conversely, measures that are acceptable to clinicians may be infeasible to employ in a large-scale, national program. It seems unlikely that a single measure will satisfy the requirements of all potential users, though some approaches will come closer than others. The likelihood that different conclusions will be reached by different groups of users is not necessarily a problem, however, since alternate approaches may productively be used in tandem.

Against this background, two broad categories of approaches will be described. The first consists of institutional measures, which (to distinguish them from the early, traditional approaches) are derived from data describing the diagnostic composition of the hospital's patients. Included in this category are the "ad hoc" grouping methods (45), the Resource Need Index (100), and information theory measures (17,33). The second category consists of patient-level measures. Of these, the most well known is DRGs. The other approaches reviewed in this chapter include two major efforts to measure severity of illness within a disease entity: Disease Staging **(24)** and the Severity of Illness Index (30,31). Finally, the discussion includes a new approach to defining patient categories and assessing treatment patterns, known as Patient Management Categories ***(PMCs) (107).*** These last three approaches should be viewed as potential alternatives to DRGs, although the Severity of Illness Index can also be viewed as a complement to them.

Hospital-Level Measures

The institutional-level measures referred to above all represent aggregations of patient data designed to capture the overall case-mix complexity of, and the resource implications for, a particular hospital. Of these, the most rudimentary can be termed the "ad hoc" grouping techniques.

These involve the collection of diagnostic information for patients from a sample of hospitals and aggregating those data in ways that appear to be analytically meaningful. For example, Lave and Lave (45) used this approach to define a set of characteristics for each hospital they studied. In their study, a set consisted of proportions of patients in broad diagnostic categories, such as cardiovascular diseases. The categories selected were assumed to distinguish groups of patients that have different resource requirements, although no data were available to directly evaluate that hypothesis.

A measure that takes resource use directly into account is the Resource Need Index (RNI), developed by the Commission on Professional and Hospital Activities (100). The construction of RNI is a two-step process. The first step involves the development of "relative need units" for each diagnosis (or diagnostic category). The units, which are based entirely on charge information, represent the ratio of average charges for a particular diagnosis to overall average charges. RNI is then constructed as the average number of relative need units for a given hospital. RNI thus makes a start at the simultaneous evaluation of diagnosis and resource use, though a possible drawback lies in its reliance on charges as the sole indicators of resource requirements. To the extent that differences between charges and costs differ by type of service, hospitals' charges may not reflect actual resource use very precisely.

Finally, information theory measures have also been derived for the institution as a whole. Studies by Evans and Walker (17) and Horn and Schumacher (33) have employed this approach to case-mix measurement. Information theory measures are based on the assumptions that rare conditions are complex and tend to be treated by a few specialized hospitals. In contrast, common conditions are assumed to be less complex and likely to be uniformly distributed across hospitals. The measure is derived mathematically from the proportions of cases in each diagnostic category. The highest scores for this measure will therefore go to the "most complex" hospitals—i.e., those that treat the uncommon diseases. The specific resource requirements of any of the diseases, including the rare ones, are not explicitly considered in the information theory approach. Instead, its validity in measuring case-mix complexity rests on the validity of underlying assumptions.

The only common threads in these divergent techniques are their use of diagnostic data and their assumptions about the appropriateness of aggregating the information to the hospital level. While this aggregation is undoubtedly convenient, it involves considerable simplification and, as a consequence, loss of information. Some, such as Klastorin and Watts (44), have considered the issue of hospital-level case-mix indices and have concluded that summary indices may not be comparable across hospitals. However, the thrust of most recent research in the area of case-mix measurement has been toward the development of patient-level measures. Though it is possible to aggregate these measures into a hospitalwide index (and indeed several such indices have already been constructed), such aggregation has not been a principal focus of the development process.

Patient-Level Measures

Diagnosis Related Groups

DRGs are undoubtedly the most well known of the patient classification systems that have been introduced during recent years. As this section indicates, however, several major alternatives now exist that differ from DRGs both conceptually and in practice. All of the prominent systems are described briefly in this chapter. A more complete description of DRG development methods can be found in appendix B.

The development of DRGs has been ongoing since the late 1960's, and it is appropriate to view the concept as one that is continuously evolving. The evolution of DRGs has involved both conceptual refinements and technical improvements, spurred by the availability of more and better quality input data and by feedback from a wide variety of observers and users of DRGs. It is likely that the evolution will continue as relevant data increase in availability and improve in quality and as the concept is subjected to more and more scrutiny.

The first version of DRGs to be widely disseminated was a set of 383 categories, described by

their developers in 1980 (19). Subsequently, in early 1982, a second and much revised set of 467 categories was issued (103). This revised set bore little resemblance to the "original" 383, as it was based on different definitional procedures and a different coding convention. Both sets had several common objectives. Both were designed to identify patients with similar expected resource use, measured by length of hospital stay. Both versions were defined so as to be medically meaningful to physicians, the key decisionmakers within the hospital with respect to patient care, though the operationalization of this objective varied significantly between the two. Finally, both sets of DRGs were deliberately based on data that are commonly available, and both sets sought to be limited to "manageable" numbers of groups.

In general, the broad outlines for the construction of both sets of DRGs were the same for each version. Actual patient stays in a sample of hospitals were the units of analysis. Each patient's principal diagnosis—i.e., the principal reason (after study) for his/her hospitalization—was coded using a detailed coding system that allowed for many thousands of possibilities. The first step, therefore, was to collapse the detailed diagnosis codes into meaningful, but broad, subcategories called "Major Diagnostic Categories (MDCS). " These MDCs were then further subdivided, using a combination of statistical analysis and medical judgment, according to other characteristics that accounted for differences in resource use within each MDC. (The remainder of this discussion will focus on the current set; a comparison of the two can be found in app. B.)

The major differences, however, appear to outweigh the similarities. Significantly modified procedures were used to develop the **467** DRGs. These differences included the involvement of a far greater number of participants, many of them clinicians, which accompanied a shift in the fundamental orientation of the development process. Whereas the development of the 383 DRGs had involved both statistical analysis and expert clinical judgment, the balance between the two components was relatively more even than it became in the revised method, in which the balance was shifted in favor of clinical judgment.

The current set of **467** DRGs was derived from 23 MDCs, most of which were defined around organ systems of the body (in conformance with the organization of medical practice). Subdividing MDCs into DRGs was performed by expert panels comprising physicians and others in the health industry. Their decisions were guided by several criteria that had been established. For example, the guidelines required that the initial partition (when possible) be based on the presence or absence of a surgical procedure performed in an operating room. Panels were also instructed to rank order surgical procedures according to resource intensity and to assign patients with multiple procedures to the procedure involving the greatest intensity. In addition to considering the type of surgery performed, the nature of coexisting conditions and complications were explicitly evaluated. "Substantial" conditions and complications were distinguished from those less significant. Surgery, coexisting conditions, and complications were all viewed as indicators of severity of illness. Finally, other variables were taken into account when the experts determined that they were relevant. Examples of other factors used for subdivision include death and "left hospital against medical advice. "

Though clinical judgments dominated the decisionmaking process, statistical analysis was used to aid those judgments. Patient-level data were made available by several organizations, principally the Professional Activity Study of the Commission for Professional and Hospital Activities. These data were viewed to be representative of national treatment patterns. Reduction in variance for LOS was examined for possible partitioning variables, but the fact that variance may have been significantly reduced by a particular variable did not guarantee that that variable would be included in the DRG definition. The need to group patients with clinically related diseases, above all, dictated which measures would be used.

The outcome of this process was a mutually exclusive and exhaustive set of 467 DRGs. * By de-

***In operation, there are 468 DRGs, the last for patients who have received an operating room procedure unrelated to their MDC.**

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sign, DRGs can be determined from discharge abstract data, which are commonly available in computerized form. A computer algorithm is available to classify each patient into the appropriate DRG. As a consequence, use of this classification system poses few administrative burdens. As the following chapter will describe, little empirical research has been conducted to date on the current set of DRGs. Some recent evidence indicates that there still remains substantial within-DRG variation in resource use. For example, one analysis of a random sample of cases in 12 high-volume DRGs applicable to older patients in New Jersey hospitals found that 13.6 percent of discharges had a LOS more than two times the average of cases in that category (75). Analysis of Medicare discharges for 1979 also showed a wide range of within-DRG variation around the mean cost per discharge. For both the old 383 DRG and the new 467 DRG classification systems, it was found that DRGs had coefficients of variation ranging from about 0.2 to 1.5 in the Medicare population (93). A coefficient of variation of 0.2 can be interpreted as indicating that roughly two-thirds of patients in the DRG have costs within 20 percent above or below the mean cost of the DRG. A coefficient of 1.5 indicates that about two-thirds of patients in the DRG lie within Iso percent of the mean cost. The new DRGs do not appear to increase the homogeneity of the groups with respect to their actual consumption of resources. Finally, the extent to which DRGs are acceptable to clinicians is unclear.

New Jersey and several other States have used DRGs in hospital payment systems with varyingly degrees of success. Appendix C contains brief descriptions of several State per-case payment systems, some of which used DRGs.

Disease Staging

Apart from DRGs, the most prominent patient-level measure in the literature is Disease Staging. Both Disease Staging and the Severity of Illness Index (to be described subsequently) were developed to address the perceived need to measure the severity of the patient's illness as well as his or her diagnosis. Severity has been defined as the risk of death or permanent impairment resulting from the illness (38).

Staging consists of the specification of progressive levels of severity for disease in terms of the events and pathophysiological observations that characterize each stage (24). As described in Hornbrook (38), staging involves the segmentation of a disease entity into five primary stages, which are defined as follows:

- Stage O: No disease present, or diagnosis unknown.
- Stage 1: Disease is certain and no complications are present either local or systemic.
- Stage 2: Disease process is limited to an organ or system; significantly increased risk of complications.
- Stage 3: Significantly greater problem than stage 2: multiple site involvement; generalized systemic involvement; poor prognosis.
- Stage 4: Death or most severe stage possible (i.e., the final event of the illness).

Six, rather than five, primary stages are used for cancers, to maintain consistency with previous work. (In fact, staging was first used in oncology in clinical trials of new treatments to incorporate illness severity into experimental design and evaluation (38).) Substages have also been defined for the cancers.

Stage assignments can be made by a computer algorithm, based on data recorded on discharge abstracts. Computer-assigned stages, however, may represent underestimates of the stages that technicians would derive manually from medical records. Again, according to Hornbrook (38), underestimates may occur for two reasons: 1) the primary diagnostic coding systems used for discharge abstracts are not sufficiently precise, and 2) insufficient data are included on the discharge abstracts.

Staging is the product of physicians' judgments about the ***biological progression*** of a given disease. First and foremost, it was developed to be a clinically meaningful concept. The extent to which costs, charges, or LOS varied within stages was not considered during the development process. Although some limited evaluation has indicated that the stages of a disease are indeed systematically related to differences in those other measures (6,23), the relationship between the stages of a disease and resource consumption has

not yet been investigated in depth. Further, it has not been demonstrated that the individual stages are homogeneous with respect to resource use (23). In addition, the stages are not necessarily comparable across diseases, as each disease entity is staged separately. Consequently, stage 2 of a surgical condition may be much more serious than stage 2 of a medical condition and thus require more resources during treatment.

The primary advantages of Disease Staging lie in its apparent meaningfulness to clinicians, as well as in the direct way in which the stages capture the biological severity of illness within a given diagnosis. Staging has the added advantage of requiring only information commonly available on computerized discharge abstract data (although some precision is sacrificed when computerized methods are used). A significant drawback lies in the likelihood that certain diseases cannot be staged. (In general, medical conditions are more difficult to stage than surgical.) The fact that resource consumption was not an explicit consideration in developing the stages (and as a result may or may not be captured by them) may be a serious drawback if stages were used in a reimbursement context. Moreover, since stages are based on single diseases and on the prognosis for each patient, they ignore concurrent conditions and other patient characteristics which affect resource use, such as social, economic, and psychological factors **(38).**

Severity of Illness Index

Still more recent than staging is a measure that was developed to reflect the overall severity of illness of the patient, and not just the severity of the principal diagnosis. The Severity of Illness Index, developed at Johns Hopkins University (31), classifies patients into four severity levels. Unlike the staging procedure, this Severity of Illness Index is not disease-specific but instead was designed to apply to all conditions treated in the medicine, surgery, obstetrics/gynecology, and pediatrics departments of hospitals. Developed in conjunction with a panel of physicians and nurses, the index is built from seven criteria deemed to be the best indicators of overall illness severity. These include:

- stage of the principal diagnosis;
- complications of the principal condition;
- concurrent, interacting conditions that affect the course of hospital treatment;
- dependency on the hospital staff;
- extent of nonoperating room procedures;
- rate of response to therapy, or rate of recovery; and
- impairment remaining after therapy for the acute aspect of the hospitalization.

Data relevant to each of the above criteria are obtained from the patient's medical record. Abstraction of data is performed manually, by a trained rater. Based on the combined pattern of severity levels within each of the seven criteria, the rater makes a judgment about the overall severity of the patient's condition. The overall index can range from 1 (least severe) to 4 (most severe).

The Severity of Illness Index may be used as an adjunct to other patient classification systems, such as DRGs. In that context, refined categories of severity can be developed within categories of patients. Current research, however, suggests that a preferred use of the Severity of Illness Index would be in conjunction with a very broad classification system, such as the 23 MDCsdescribed earlier (30).

The major advantage of the Severity of Illness Index, particularly for payment purposes, would appear to be the extent to which it explains variation in resource use. In a comparative analysis involving six disease conditions, Horn and colleagues (36) found that the Severity of Illness Index produced groups that were more homogeneous than DRGs, Disease Staging, or PMCS (to be discussed subsequently). Homogeneity was assessed with respect to total charges, LOS, laboratory charges, routine charges, and often radiology charges. The index has also been shown to be a good predictor of resource use (35). This explanatory power may, in part, result from the method used to ascribe a severity level to a given patient. Although the seven criteria do not explicitly address resource use, some of the criteria (e.g., extent of nonoperating room procedures) are clearly correlated with it, and there may be

a tendency on the part of raters to take it into account when forming a judgment about overall severity (38).

A drawback of the Severity of Illness Index is its reliance on manual abstraction of data from the medical record and on the judgments of individual raters. Although recordkeeping systems could be modified in such a way that the data necessary to construct the Severity of Illness Index would be available on computerized discharge abstracts, in general, discharge abstract systems are currently inadequate for this purpose. Thus, assignment of severity levels by this method is relatively costly. Also, so long as subjective judgments are employed in assigning the index values, there are likely to be problems with the reliability and acceptability of the measure.

The acceptability of the Severity of Illness of Index to clinicians is currently unclear. Although the development of the index was in conjunction with physicians and nurses, there is as yet no indication of how meaningful the index is to clinicians around the country. At present, the chief advantage of this approach seems to be its success in accounting statistically for variation in resource use.

Patient Management Categories

A criticism that has been leveled at all case-mix measures based on discharge diagnosis is that the diagnosis at discharge is not the only relevant diagnostic information **(106).** Instead, it is argued that diagnosis at the time of admission determines the course of treatment that the physician will employ. In other words, not only the diagnosis of the patient, but also the reason for admission, will affect the ultimate LOS and total costs/charges. Reasons underlying admission can range from observation to chemotherapy to major surgery, all of which have vastly different implications for resource use. Young and colleagues (106) also have argued for the development of a measurement system that avoids building in ***actual*** treatment patterns, regardless of their appropriateness. They favor a method that is more normative—i.e., one that views patient characteristics and management without regard to current treatment patterns that may result from discretionary decisions, differences in the availability of particular facilities and services, inefficiencies, etc.

As a consequence, Young and colleagues (105) at Blue Cross of Western Pennsylvania have developed an alternative patient classification system, whereby patients are classified into PMCs * PMCsdiffer from most of the other systems, including DRGs, in that they are based primarily on the patient's clinical characteristics. The definitions of PMCsdo not hinge on how the patient was treated while in the hospital. PMCsdiffer in other ways as well, as will be discussed subsequently.

Like the other case-mix measures (all to varying degrees), PMCshave been developed in consultation with physicians so that they represent clinically meaningful entities. Both final diagnosis ***and*** reason for admission are considered simultaneously in defining the categories. PMCs have been designed to take levels of severity into account, again from a clinical perspective. For each PMC, physicians have specified components of care (i.e., diagnostic services, treatment procedures, and expected LOS) that, in their view, are required for the effective management of the typical patient. Thus, a "patient management path" has been associated with each PMC. These components of care then form the basis for the derivation of relative cost weights for each PMC. Weights are based on actual cost data from six participating hospitals that have been adjusted and allocated to the components of care. The identification of patient management paths and relative costs during the development process is another distinguishing feature of the PMC approach.

Currently, PMCs are still being defined, although it is anticipated that the process will be completed by the end of the summer of 1983. Computer software is also being developed that will enable the automated mapping of patients into PMCs. Although discharge abstract data typically do not include information on reason for admission, Hornbrook (38) reports that preliminary research indicates that valid mapping into

● **Much of the substance of this discussion was drawn from unpublished documents provided by Wanda W. Young (ICM,IOS).**

PMCS may be possible without collecting additional data.

The principal advantage of PMCs over either DRGs or staging would appear to derive from the joint consideration, during the development process, of payment ***and*** patient management. While the system was designed for use in a payment context, actual patterns of use (as has been noted) were not directly considered in defining the categories. However, the relative cost of each PMC ***is*** calculated as part of the development process. This can presumably be incorporated into a payment procedure. What is most unique to this system, however, is its recognition that patient management should be the focus of any system that seeks to encourage efficiency and the deliberate attempt on the part of the developers to produce a system that would simultaneously be meaningful to physicians and facilitate efficiency improvements in the management of patient care.

Because the system is not yet completed, it is premature to make comparisons between it and other alternatives. For the same reason, no empirical evaluations have yet been performed. Clearly, however, PMCs represent an interesting innovation in the area of case-mix measurement that has considerable potential.

SUMMARY

Until recent years, case mix has been measured by hospital-level surrogates for patient care output. These measures have been derived from readily available sources of data and generally represent crude volume and performance measures along with relevant characteristics of the hospital (e.g., teaching status) and location.

The early measures have been useful in explaining some of the observed interhospital variations, but it is apparent that these measures do not contain the amount of information necessary to accurately capture interhospital case mix differences. As a result, considerable effort has been devoted in the past decade to developing new and improved measures of patient care output. The most well known of these advances, DRGs, are the subject of this technical memorandum. Other advances, including both substitutes for and complements to DRGs, have also been reviewed briefly in this chapter.

The major advances in measuring health care output have been in the area of severity of illness measurement. Disease Staging and the Severity of Illness Index were both designed to provide a framework for classifying diseases according to the relative severity of the patient's condition. Both have required extensive developmental work and testing, which are still underway. Use of either measure would require more data than are generally available at the present time, though the staging approach can be employed using data that are normally included in hospitals' computerized records. Neither measure has reached the point where it is suitable for widespread implementation in a reimbursement context. However, the existence of such measures, at a minimum, serves as a reminder that the relative severity of patients' illnesses is important to consider when measuring case mix.

Patient Management Categories represent the newest of the major advances in case-mix measurement. It will still be some time before the system is fully operational and adequate testing can be performed. In the short term, however, this method of patient classification again represents a reminder that currently used methods may not be appropriately targeted.

This review of alternative methods of measuring hospital case mix has revealed that early methods are lacking in precision and that the new approaches (with the exception of DRGs) are not yet ready for widespread use. CIearly, any "refined" system that tackles patient-level case-mix information will require considerably more data than has been employed (or even available) in the past. Feasibility considerations, therefore, should include the relative administrative burdens associated with each measure as well as the stage

of development each measure has reached. Most importantly, the conceptual differences among the alternatives should be evaluated (as well as the statistical evidence) in order to assess the appropriateness of each for the purposes it is to serve.

Chapter 3

DRG Payment and the Use of Medical Technology

Chapter 3

DRG Payment and the Use of Medical Technology

INTRODUCTION

The use of Diagnosis Related Groups (DRGs) in hospital payment has grown from an experiment in a handful of hospitals to national Medicare policy in just 3 years. At the time of passage of the 1983 Social Security Amendments (Public Law 98-21), which established a national Medicare prospective payment system using DRGs, the Medicare program was planning to use DRGs to implement the hospital expenditure control provisions of the Tax Equity and Fiscal Responsibility Act of 1982 (TEFRA). Before that, DRG payment had been used for only 2 years in 26 hospitals in New Jersey and even fewer in Maryland. *

*See app. C for detailed descriptions of selected DRG payment systems.

The rapid acceptance of DRG payment in the absence of much experience argues for a careful look at its implications, both good and bad, for medical technology. DRG payment methods establish incentives for the use of medical technologies both within and outside of hospitals that differ markedly from those of retrospective cost-based reimbursement and other kinds of prospective payment. These new incentives have implications for the efficiency and quality of care delivered to Medicare beneficiaries. This chapter will examine the implications of DRG payment for the amount, characteristics, prices, and settings of medical technology use.

DRG PAYMENT: AN OVERVIEW

Theoretically, DRGs could be used in any hospital payment method, including retrospective cost-based reimbursement, but their importance in payment comes from their use as part of prospective per-case payment systems. ***Per-case payment*** refers to any prospective hospital payment system with fixed rates of payment based on the hospital admission, not on the number and types of services or number of days of care provided. Per-case payment is a radical departure from traditional cost-based reimbursement and even from other kinds of prospective payment. One of the unique features of a per-case payment system is that it cannot survive for long without a way to adjust payment for differences in case mix; otherwise serious inequities among hospitals would be likely to develop, and selective admitting strategies would be encouraged.

DRGs represent only one possible approach to characterizing hospital case mix; but as the previous chapters demonstrate, the DRG system is the only explicit case-mix measurement approach that is now ready for use in a payment system. It is not surprising, then, that the search for a case-mix adjuster has led to DRGs. ***DRG payment*** is defined here as any per-case hospital payment method in which differences in case mix are taken into account using DRGs to classify case types. Appendix C provides examples of various types of per-case payment methods that have been applied or suggested for ***use*** by third-party payers.

Per-case payment is possible without the use of DRGs, but any such method must somehow adjust for case mix, if only implicitly. One frequently used approach to per-case payment that does not use DRGs or any other explicit case-mix measure is to tie each hospital's future rate per case to its own costs per case in a fixed base year (2). The base year cost is presumably a reflection

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of the mix of cases treated by the hospital in that year. So long as it can be assumed that the hospital's case mix is stable and not subject to manipulation, this is a reasonable, though imprecise, implicit case-mix adjustment method. As time passes, however, the assumptions of stability and nonmanipulation of case mix become more and more tenuous, requiring ever more cumbersome appeals processes or revisions than in a system with explicit case-mix adjustment. *

There are two general approaches to the use of DRGs in per-case payment: 1) DRG-specific prices per case; and 2) a single rate per case that reflects the hospital's case mix determined by a DRG-based case-mix category. The first approach, DRG-specific prices per case, requires the payer to issue a separate rate for each DRG. The payer may pay a unique rate for each DRG in each hospital, the same amount for each DRG regardless of the hospital in which care is rendered, or different amounts for any given DRG depending on the location or particular characteristics of the hospital.

The case-mix category approach requires that hospitals be classified into a number of groups based on similarities in their case mixes. All hospitals in a group would be paid a uniform rate per case. A DRG case-mix index is a categorization method in which each hospital is assigned a unique index value reflecting the relative resource requirements of its particular patients. The index value is determined by a formula using DRGs.

The two approaches to DRG payment–DRG-specific prices and DRG-based case-mix adjusters—do not differ much from one another. The principal difference is in the time period on which case-mix measurement is based. A DRG index must be constructed on the basis of case mix in some prior time period, perhaps the most recently completed fiscal year. A DRG-specific pricing system adjusts for changes in case mix as they occur. Thus, any fluctuations in case mix that occur either by chance or by a hospital's actions, such as the introduction of a new service, would be reflected immediately in a DRG-specific pricing system but would enter a DRG case-mix adjustment system only as time passes.

Both kinds of DRG payment—DRG prices and DRG case-mix indexes—have two essential components: the average level of payment per case; and the relative weights applied to each DRG. The average payment level determines how stringent or generous the payment system is as a whole, while the relative DRG weights or prices determine the profitability of one DRG relative to another. The financial incentives of a DRG payment system depend on both the average level and the relative weights.

● **Other criticisms can be lodged against this implicit case-mix adjustment method. The most important is that it rewards past inefficiency. Hospitals which have been relatively efficient in treating patients will have a lower cost base than those which have been less so prior to initiation of the per-case system. This criticism can also be made of some DRG payment systems, particularly those in which rate per DRG is based totally or partially on the hospital's own cost per DRG.**

DRG PAYMENT AND THE USE OF MEDICAL TECHNOLOGY

Appendix C describes eight per-case payment systems, five of which use DRGs. Three DRG payment systems have already been implemented, and one was recently enacted for the Medicare program. This section presents an analysis of the expected effects of per-case payment, and specifically DRG payment, on access to and use of medical technologies. For the purposes of this technical memorandum, medical technology is defined as the drugs, devices, and medical and surgical procedures used in medical care and the organizational and supportive systems within which such care is provided. In this technical memorandum, the focus is on drugs, devices, and procedures, but many of the points apply to the system technologies.

DRG payment establishes a new set of financial incentives for hospital behavior that differs from those found under both cost-based reimbursement and other kinds of prospective hospital payment. These incentives are rooted in per-case

payment itself, but their effects differ with the particular case-mix measure adopted. For example, while financial incentives facing hospitals are generally the same under the old 383 DRGs and the new 467 DRGs, their strength and the ability of hospitals to respond to them may differ. This discussion concentrates on the new DRGs on the assumption that they are more refined than the old DRGs and, at present, are more practical than any alternative case-mix measurement approach (see ch. 2). It should be understood that the basic incentives are the result of paying by the case and will remain to some extent regardless of the case-mix measurement approach taken.

Despite the fact that DRG payment has been embraced by Congress and the administration in the past 9 months, there is no empirical evidence available on its effect on access to or use of medical technologies. Evaluations of New Jersey's and Maryland's DRG systems on the use of services within or outside of hospitals are not yet available. These programs are themselves so new or of such limited scope that they cannot offer empirical evidence on which to draw conclusions.

Evidence does exist on the effect of other types of prospective hospital payment on the use of medical technologies. As part of a comprehensive study of nine State-legislated hospital ratesetting systems, Worthington and Piro (102) found that programs that pay hospitals on the basis of a per-diem rate all produced an increase in hospitals' average lengths of stay (LOS) and occupancy rates. This result would be expected from a per-diem ratesetting system in which the longer patients stay, the more revenue the hospital receives. However, a per-diem ratesetting program should also encourage increases in rates of inpatient admission, but no such admission effects were found. These findings suggest that manipulating admission rates may be more difficult than increasing the length of hospital stay for those already admitted. Taken as a whole, however, the results do suggest that decisionmakers in hospitals respond in predictable ways to financial incentives for the use of hospital services. Consequently, in the absence of empirical evidence on the effects of DRG payment on medical technology use, an assessment of the direction and strength of its financial incentives is reasonable.

General Incentives of DRG Payment

To understand how DRG payment affects incentives to ***use*** particular medical technologies, it is helpful first to examine incentives affecting the use of hospital and other health services in general. These general incentives ultimately translate into specific demands for medical technologies.

DRG payment creates two fundamental incentives: to reduce the cost to the hospital of each inpatient hospital stay; and to increase the number of inpatient admissions.

Incentives To Reduce Cost Per Case

The incentive to reduce cost per case is the motivation for per-case payment in the first place. Per-case payment is predicated on the belief that hospitals have many opportunities to save money by operating more efficiently and offering a more cost-effective mix of services, Per-case payment rewards hospitals that take advantage of these opportunities.

Reductions in cost per admission can be achieved by reducing LOS, the number or mix of services provided during the stay, or the prices paid for inputs into the production of hospital services. Reductions in LOS are likely to have the greatest immediate effects on per-case costs, although such savings would be lower for hospitals already operating at low occupancy rates. A reduction in occupancy rate does not result in a proportional reduction in operating costs, because many of these (e.g., utilities, housekeeping, administration) may be largely fixed. Thus, in hospitals with low occupancy, the incentive to reduce LOS, though present, will be less than in hospitals with a high daily census and a backlog of potential admissions. Recent studies have demonstrated that the well-known regional differences in average LOS in the United States persist even when diagnosis and severity of illness are taken into account (37,89). Thus, there may be substantial room for reduction of LOS in some areas of the country.

Shorter LOS could have positive or negative effects on patients' health. * On the one hand, hospitalization itself carries the risk of iatrogenic illness; shorter lengths of stay reduce this risk. Psychological factors associated with hospitalization may also be important in adversely affecting outcomes. On the other hand, too early discharge could place patients at risk of inadequate care and threaten recovery. For example, patients with serious infections have often remained hospitalized simply to receive long-term intravenous antibiotic therapy. There is suggestive evidence that hospital-sponsored home antibiotic therapy programs can save total hospital costs and be safe if accompanied by adequate patient training and monitoring (43,82). However, the potential for inadequate education and followup by hospital personnel exists. While financial incentives under DRG payment would encourage home intravenous antibiotic therapy, they would also discourage the expenditure of resources to educate and monitor patients adequately.

The incentives inherent in DRG payment regarding the use of particular ancillary services are complex. The cost of ancillary services whose use would, on the average, shorten hospital LOS, would be weighed against the savings from reductions in LOS. The effect on any particular ancillary service would depend on the nature of these cost tradeoffs. For example, hospitals might provide more high-cost antibiotics prophylactically if these were shown to substantially reduce the average LOS through reductions in hospital-acquired infection rates. Or, as another example, liaison psychiatric services, which appear to shorten LOS of postoperative elderly patients (47), might be provided more frequently under DRG payment than under cost-based reimbursement. A probable byproduct of DRG payment will be an increase in the demand for and supply of information on such cost tradeoffs. Nevertheless, if the consensus is correct that ancillary services, particularly diagnostic tests, have been provided in the past without adequate consideration for their impact on total hospital costs (1,26,52,56) then the net effect of per-case payment would be to reduce the intensity or amount of these services per stay.

The incentive to reduce the price of technologies such as drugs and medical supplies is obvious. In the past 10 years, hospitals have increasingly embraced membership in group purchasing plans and generic substitution programs. For example, hospital membership in pharmacy purchasing groups grew from 40 to 88 percent between 1975 and 1981 (16,83). Generic substitution–the automatic substitution of a less costly but chemically equivalent generic drug for a prescribed brand-name drug—has become commonplace in U.S. hospitals: 96 percent of hospitals responding to a national survey in 1981 reported having such programs (16). The pressure to find new ways to save on the purchase of drugs and supplies should continue. A logical outcome of this trend is a decline in product variation as hospitals and their purchasing groups seek further price reductions and strengthen the competitive position of products with high sales volumes.

Incentives **To Increase Admissions**

DRG payment encourages hospitals to increase admissions selectively. Whereas cost- and charge-based reimbursement gave the hospital an incentive to keep occupancy rates high by increasing either admissions or LOS, only admissions produce or increase revenue under DRG payment. Every new admission generates new revenue (in the amount of the DRG price) and new costs. Serving patients in some DRGs will be more profitable than in others, because those DRGs will have higher ratios of price to cost. The hospital would naturally want to encourage the more profitable admissions. If the average level of payment is high enough that all DRGs are profitable, then the hospital has an incentive to increase admissions in general, but the most profitable admissions should still be sought more vigorously.

A variety of mechanisms is available to increase admissions selectively, including recruitment of physicians in key specialties, adoption of services useful in certain DRGs, and marketing campaigns targeted to preferred patients or their physicians. These strategies may be called "competitive" in that they are designed to draw patients from other hospitals.

***This topic is the subject of OTA's Health Technology Case Study #24, "Variations in Hospital Length of Stay: Their Relationship to Health Outcomes. "**

As competition for admissions increases under per-case payment, some specialization in service delivery can be expected (5). Since the per-unit costs of major services often decline as service volumes increase, hospitals with high service volumes in specific DRGs will find them more profitable, and those with low volumes less. When a hospital finds that a service is unprofitable and when the prospects for more efficient operation or increases in volume are dim, it may abandon the service. For example, a hospital in New Jersey recently closed its hyperbaric chamber because it was found to be unprofitable under DRG payment. Those in need of hyperbaric services (primarily divers) will be referred to a hospital in New York City **(64).** However, competition for admissions can also drive hospitals to maintain unprofitable services if their existence is important to the maintenance of the hospital's position with physicians or patients.

Specialization in service delivery may have desirable effects on quality as well as cost, since for many services there is a positive relationship between quality and volume (5). However, these gains in quality and cost could be partially or totally offset by reductions in patient access to services. Since it is difficult to predict the kinds of services that will be subject to specialization under DRG payment, the desirability of future patterns of service availability is unknown. As DRG payment is implemented nationwide, patterns of service specialization among hospitals should be carefully monitored.

Hospitals may turn to noncompetitive strategies to increase admissions and lower per-case costs. For example, physicians or staff might be encouraged directly or indirectly to hospitalize marginally ill patients and to discharge and readmit patients at a later date for deferrable procedures that might otherwise be performed as part of a single stay. This "revolving door" incentive is a new phenomenon, unique to per-case payment. For example, a patient under treatment for pneumonia might be found during the course of the hospital stay to have a urological condition requiring a deferrable therapeutic procedure. Rather than initiate therapy during the first stay, the physician might discharge the patient for readmission at a later date. This strategy is both easy for physicians to implement and difficult for third-party payers to control.

The incentive to increase admissions selectively has its counterpart in an incentive to avoid admitting unprofitable patients. Patient selection strategies could conceivably be used to exclude patients in unprofitable DRGs or unprofitable patients within a DRG. But there are important restrictions on the potential for direct manipulation of case loads. Although hospitals may be able to avoid admissions in some unprofitable DRGs by not offering the necessary facilities or services, for many patients the DRG is unknown at the time of admission. Moreover, to discriminate against the less profitable (i.e., more costly) patients within a specific DRG, two conditions would have to hold. First, the physician would have to be able to predict with reasonable accuracy the relative costliness of different patients within the same DRG at the time of admission; and second, the physician would have to be induced not to admit his or her more costly (and presumably sicker) patients. These conditions are simply unlikely to be met frequently.

Of course, a hospital could simply choose not to participate in the DRG payment system by refusing all such patients. While this response is infeasible in an all-payer system, it might be attractive to some hospitals in a Medicare-only system. Total nonparticipation would be financially attractive to a hospital if the average DRG payment level were to lie below the additional (marginal) costs of serving patients in any DRG, but it is unlikely in the foreseeable future that the payment level, which is calculated on the basis of fully allocated average operating ***costs,*** will be less than marginal costs for all DRGs in most hospitals. A hospital could decide that the losses in some DRGs outweigh the surplus available in others, but with Medicare accounting for about 30 percent of hospitals' revenues, this situation would also be rare. Thus, the probability that many hospitals will refuse to serve any DRG patients at all is low.

Constraints on Financial Incentives

Whether the financial incentives to reduce LOS and the cost per case and to increase admissions will lead hospitals to overadmit patients and

underprovide services is an empirical question. The potential is real, but the possibility of adverse effects on access and quality of care under DRG payment is moderated by several built-in constraints whose strength is unknown at present.

First, the physician, not the hospital administrator, makes the decision to admit and discharge patients and order procedures. The physician's income often is dependent on hospitalization, as in the case of surgical admissions. Physician visits to hospitalized patients may be more lucrative relative to their time requirements than are office visits (28). Perhaps most important, the physician's professional and ethical standards protect the patient from the withholding of needed care. And, in a DRG payment system not covering all payers, the physician would still be likely to engage in a uniform style of practice for all patients.

It is often asserted that defensive medicine—practices that are employed directly in response to fears of malpractice lawsuits—would limit the willingness of physicians and hospitals to engage in practices that threaten the outcome of care (91). The strength of the influence of malpractice on physician behavior is arguable. There are no direct objective data on how much defensive medicine is practiced today or how much it costs. Physicians have claimed in some surveys that they perform more tests than they otherwise would **(67, 85);** in other surveys that they perform fewer tests (29) due to malpractice lawsuits.

Hospitals themselves are subject to malpractice suits, which have risen dramatically since the first lawsuit was decided against a hospital in **1961 (60,66).** Approximately **75** to **80** percent of all malpractice claims arise from medical care provided in hospitals **(60).** An Institute of Medicine (IOM) study found in 1978 that a relatively small number of institutions had formal programs for managing such risks (60), but their frequency and importance is growing (71). Even if objective estimates were available on the extent of defensive medicine and risk management under present conditions, it would be dangerous to generalize these results to a DRG payment system, where the financial incentives conflict with the incentives to practice defensive medicine. Thus, at this time, one can only conjecture about the potential strength of defensive medicine.

To the extent that it does function as a deterrent to the underprovision of services, defensive medicine may be less effective in protecting the elderly or disabled. There is a general consensus among experts that these patients are less "litigious," in that they are less likely to sue physicians if they are harmed. A commonly cited reason for this is the fact that malpractice lawyers work on a contingency basis and rarely accept cases in which the claimant would not receive a large compensation award. Most elderly and disabled persons would be awarded less money than younger patients, because part of the compensation award is based on lost wages (60), and the elderly and disabled generally have lower income potential. Table 1 shows that the elderly received less money in closed malpractice cases in 1978 regardless of the severity of the injury suffered (61).

Table 1.—Malpractice Claims Paid, 1978

		Age of injured person						
Severity of injury		Under 18	18-24	25-34	35-44	45-54	55-54	65 and over
Emotional only	Avg. indem.	2,473	8,298	7,105	7,052	4,749	969	6,401
Temporary: insignificant	Avg. indem.	3,274	3,080	3,029	3,332	3,027	2,354	1,123
Temporary: minor	Avg. indem.	7,233	7,330	10,106	7,552	11,071	7,444	6,753
Temporary: major	Avg. indem.	14,039	13,020	21,771	22,437	19,582	19,169	15,333
Permanent: minor	Avg. indem.	43,260	31,639	33,513	37,247	34,400	32,205	18,233
Permanent: significant	Avg. indem.	151,908	90,539	93,221	87,979	89,435	66,038	43,176
Permanent: major	Avg. indem.	244,156	151,519	173,063	238,696	197,461	93,361	33,292
Permanent: grave	Avg. indem.	415,982	347,417	388,474	361,507	258,034	182,325	56,620
Death	Avg. indem.	31,419	53,134	114,844	138,495	75,231	53,402	29,234
All other	Avg. indem.	6,333	6,491	6,913	10,129	8,522	6,875	2,000
Total	Avg. indem.	87,127	32,761	41,607	54,857	46,312	32,605	15,768

SOURCE: National Association of Insurance Commissioners, *Malpractice Claims Final Compilation* (Medical Malpractice Closed Claims 1975-1978), vol. 2, No. 2, September 1980, table 2.8, p. 59.

The incentive to increase admissions could conceivably be limited by the reluctance of patients to be hospitalized for marginal indications or be subjected to the "revolving door." The Medicare beneficiary is currently responsible for a deductible of **$304** upon hospitalization (18). It might be argued that this financial disincentive to hospitalization would moderate the incentive to admit Medicare patients. Yet the deductible is not likely to act as an effective deterrent to hospital admission. First, approximately **65** percent of Medicare beneficiaries have private supplementary insurance ("Medigap" coverage) which often pays for part or all of the deductible. Second, the elderly patient is unlikely to question "doctor's orders" in a decision involving hospitalization. Third, the deductible will not adequately discourage readmission because the beneficiary is liable for the deductible upon a readmission only if it occurs more than 60 days later than the previous episode of hospitalization.1

In summary, natural limits do exist on the inclination or ability of hospitals to overadmit, discharge too rapidly, and underprovide services. Yet, the magnitude of these constraints is unknown, and the protection of the elderly in particular may be relatively weak. Programs to monitor hospital performance may be necessary to identify behavior that is ultimately costly or harmful resulting from the economic incentives inherent in DRG payment.

Key Features of DRG Payment Systems That Affect Hospital Incentives

The effects of any DRG payment system on decisions in hospitals and, hence, on medical technology use are influenced by five critical elements of program design:

1. the proportion of the hospital's case load covered by DRG payment,
2. the treatment of costs as pass-throughs,
3. the methods of DRG rate construction,
4. the methods of updating DRG rates, and
5. the level of risk and reward built into the payment system.

'Social Security Act, sees, 1861(a) and 1813(a).

The Proportion of the Hospital's Case Load Covered by DRG Payment

Every case excluded or exempted from the DRG payment system will weaken its incentives. Exclusion of major payer categories from the system, for example, will limit its leverage on hospitals. *

Under the new Medicare law, about 32 percent of the revenues of non-Federal short-term hospitals will be subject to DRG payment (27), except in the few States with DRG payment systems covering other payers as well. DRG payment could become even less important if States develop alternative prospective payment systems, as the law allows them to do. Yet, a payment system with control over about one-third of hospitals' revenues is not inconsequential. To the extent that it does force changes in hospitals' behavior and does not merely shift costs to other payers, Medicare's DRG payment system will influence the use of medical technologies by all kinds of patients. Many changes in physicians' practice patterns or hospitals' purchasing decisions will probably be applied broadly across all patients. And, if a hospital decides to eliminate a service to discourage unprofitable DRGs, the service would be unavailable to all patients.

The leverage of a DRG payment system can be reduced by exclusions built into the system itself. For example, recognition of "outliers," cases with unusually high or low resource use, may reduce the strength of DRG incentives. Approximately **20** percent of all cases in New Jersey's all-payer system, comprising 35 percent of hospitals' costs, fall into the system's outlier category (15). And the State's criteria for declaring a case an outlier have become more generous over time (97).

The treatment of outliers complicates hospitals' incentives. Exclusion of low-cost cases from DRG payment is an important strategy for discouraging potentially unnecessary hospitalizations, particularly for surgery that could be performed on an outpatient basis. Otherwise, in DRGs containing both simple and complicated procedures, the hospital will have an incentive to admit the simple surgeries as inpatients. At the high end of the

***Failure to cover all payers has important implications for equity among payers, but that topic is beyond the scope of this memorandum.**

cost distribution, there may be incentives to increase LOS in order to qualify a patient as an outlier. The strength of these incentives depends on the location of the cutoff points-whether they involve only a few or many patients—and the payment method for outliers. New Jersey's DRG system, which pays both high and low outliers on the basis of controlled charges, provides an incentive to manipulate LOS in high-cost patients. The Medicare system, which as currently legislated has no low-cost outliers, may encourage potentially unnecessary admissions.

DRG payment systems could conceivably exclude certain types of cases or DRG categories on the rationale that these categories or services need to be treated in a special way. Patients treated in burn care centers or psychiatric services, for example, could be excluded from DRG payment on the grounds that these patients present unique medical and social problems. However justified such exclusions are, they would nevertheless weaken the impact of DRG payment and, depending on how they are paid, could encourage admissions in these categories.

Treatment of Costs as Pass-Throughs

"Pass-throughs" are elements of hospital cost that are not controlled by the per-case payment system. Cost-based reimbursement, as a whole, can be interpreted as a payment method in which all cost categories are passed through. Per-case payment systems that directly link a hospital's per-case rates in a given year to its own previous year's costs are only minor departures from pass-through payment. Effective removal of pass-throughs requires a break in the link between the hospital's own current costs and its future rate of payment.

Individual cost categories are treated as pass-throughs to varying degrees under different DRG payment systems. During its first 3 years of operation, Medicare will treat capital costs (depreciation and interest payments) as complete pass-throughs: the hospital will be reimbursed for whatever capital costs are incurred. New Jersey has established a capital facilities allowance for buildings and fixed plant and equipment that is designed to meet the hospital's need for cash to pay off existing debt and to fund the downpayment for replacement or additions approved by the health planning agency. For major movable equipment, such as beds and laboratory instruments, the State allows a depreciation rate that is adjusted for inflation in replacement costs. Thus, except to the extent that the State's health planning agency limits bed expansion or the acquisition of equipment, the New Jersey system passes through capital costs.

Like New Jersey, Maryland has specific capital allowances, but in the case of major movable equipment, the hospital's asset value is calculated in a base year and adjusted in subsequent years with inflation factors. The allowance for movable equipment is unaffected by the hospital's subsequent capital expenditure decisions except for special cases in which the ratesetting commission may make exceptions **(42).**

Other common pass-through categories under per-case payment are the costs of medical education (i.e., stipends of interns and residents, and teaching faculty costs), malpractice premiums, and utility expenses. Treatment of one or more categories of cost as pass-throughs under DRG payment renders these inputs to patient care free to the hospital at the same time that the effective price of all other inputs has been increased because of their inclusion in a per-case prospective system (46). In the absence of other effective controls, this change in the relative price of inputs gives hospitals an incentive to expand pass-through inputs.

The Medicare law also excludes from per-case payment an important product of hospitals: outpatient services. These services will continue to be reimbursed on a retrospective cost basis (and the patient is responsible for **20** percent coinsurance). Consequently, hospitals have a strong incentive to increase outpatient service volumes as a way of shifting fixed and overhead costs from inpatient to outpatient categories. Ancillary departments, such as radiology, clinical laboratory, physical therapy, and occupational therapy, will be encouraged to compete for business with independent providers of these services. New hospital-based home health services, which also escape the DRG system for now, are strongly en-

couraged both for their contribution to profitability and their prospects for reducing inpatient LOS (7,39,51,54).

Methods of DRG Rate Construction

The methods used to construct the relative weights or prices of each DRG can affect hospitals' incentives. The important issue is how the ratio of cost to price varies among the patients served by the hospital. This ratio of cost to price should be constant across all patients; if not, incentives will exist to manipulate case load (i.e., to encourage low-cost or discourage high-cost admissions). Though it is virtually infeasible to devise a per-case payment system that does not have some variation in the ratio of cost to price, the method of rate construction determines how great the variation is and which patients are paid according to relatively high and low rates.

There are two sources of variation across patients in the ratio of cost to price: within-DRG variation and across-DRG variation. Within-DRG variation stems from the inherent heterogeneity of patients' resource needs in a particular DRG. Any per-case payment method that establishes a single price (or weight) for all patients in a case-mix category will result in some within-group differences in the ratio of cost to price. This cannot be avoided, but the extent of the problem may depend on the case-mix classification system. The relative performance of DRGs and other case-mix classification systems with respect to within-group variation has been discussed in chapter 2. The method of DRG price or weight construction does not alter this kind of variation. Policies regarding the handling of "outlier" cases, discussed earlier, are more germane to this issue.

Conversely, across-DRG variation is determined largely by the method of construction of relative DRG prices or weights. In theory, relative DRG prices should reflect the relative costs of efficient and clinically optimal patient care across DRGs **(5,69).** This would encourage hospitals to specialize in those services that they can provide efficiently and to search for ways to further reduce costs. In practice: however, efficient care is difficult to identify and even harder to measure, and at present, all DRG rates are constructed from empirical estimates of DRG costs. The DRG case-mix index under TEFRA and the DRG prices of the new Medicare system are estimated from the average operating costs in a national sample of Medicare hospital claims. Maryland uses the hospital's own average revenue per case in a fixed base year to develop relative DRG weights specific to the hospital. New Jersey combines average statewide costs with the hospital's own average cost of treating each DRG to arrive at a hospital-specific price. *

None of these methods assures that the relative weights reflect efficient relative costs. Suppose that patients in one DRG are treated relatively efficiently and uniformly throughout all hospitals while those in another are subject to a great deal of inefficient care. By Medicare's average cost calculation, the inefficient DRG would be assigned a higher rate than it should be relative to the efficiently produced DRG. It is important to recognize both the reality of this problem and the opportunity for mitigating it over time. As hospitals respond to the incentives of DRG payment, increases in their efficiency can be expected. Over time, as DRG relative prices are recalibrated using hospitals' updated cost data, the disparities in cost-to-price ratios should diminish. Without recalibration, whatever disparities in cost-to-price ratios existed at the beginning will remain.

The method used to allocate hospitals' costs to particular DRGs presents a more enduring problem for relative prices. The Medicare method relies on hospitals' charges to reflect average costs, where the DRG weight construction method is based on the hospitals' charges for services. These charges are deflated by hospital-and-department-specific cost-to-charge ratios calculated from the Medicare cost reports. While this deflator reduces some of the distortions created by interdepartmental subsidies, there remains a residual cross-subsidy of procedures and cases within departments. Cohen has claimed that this method compresses the relative weight scale by underestimating the true cost of complex cases and overestimating the true cost of simple cases **(9).** Routine care is charged at a flat rate per day, regardless of case

*See app. C for details.

severity, and some ancillary services, such as the use of operating rooms, are billed on the basis of time, not on the basis of resources needed to conduct more complex procedures. Though the extent of the bias is unknown, it implies that the charge-based cost weights are likely to penalize the more complex DRGs.

New Jersey intends to improve on this method by directly observing the use of nursing time by patients in various DRGs in selected hospitals (22). Direct observation of resource use is costly and has some methodological problems (94), but the results of these studies should provide valuable information on the magnitude of this problem.

Methods of Updating Relative DRG Prices

As the cost of efficient care in each DRG changes over time, so, too, should the relative DRG price. If it were reasonable to expect that costs would increase or decrease uniformly across all DRGs, then the only issue would be whether the average payment level is sufficiently high to cover the costs of efficient operation. But, uniform cost increases are highly unlikely: From year to year, some DRGs will experience cost-saving technological innovations; others will experience cost-raising ones. The relative prices of inputs (personnel, supplies, energy, etc.) also change, with consequences for relative DRG costs. In the absence of any changes in DRG prices, the ratio of DRG price to efficient cost would show increasing divergence across DRG categories. As these ratios diverge, certain DRGs will become more profitable, others less so, and hospitals will have greater incentives to engage in patient selection strategies. Therefore, the mechanisms employed to update, or recalibrate, relative DRG prices influence the Iongrun incentives of the system. Recalibration must depend on information if it is to avoid being completely arbitrary; thus, these updating mechanisms must include specification of the data and information systems available to support them.

There are three basic approaches to recalibrating relative DRG payment rates: empirical cost estimation techniques, central policy decision adjustments, and provider appeals.

All DRG pricing systems have originally been established with empirical estimates of the relative cost of various DRGs. Periodic reestimation of relative costs based on updated data merely repeats the process at reasonable intervals. New Jersey employs a ratesetting method that, at least in theory, annually reestimates relative DRG costs. The Medicare law calls for changes in DRG relative rates at least every 4 years, but the methods to be used to recalibrate DRGs are unspecified. The law establishes an independent panel of experts—the Prospective Payment Assessment Commission—to recommend changes in relative prices to the Secretary of the Department of Health and Human Services (DHHS) who will authorize the changes. Presumably, the methods used by the Commission will include reestimation of DRG costs.

Central policy adjustments in DRG rates occur when those in charge of ratesetting determine that certain changes in relative prices are justified to take account of new technology or changes in clinical practice. The Prospective Payment Assessment Commission is specifically charged with making recommendations about such adjustments. The Commission, and DHHS, will therefore require an information base that exceeds that needed for empirical cost estimation. Data on the cost and clinical effectiveness of new technology will also have to be collected and synthesized.

Provider-initiated appeals or petitions for changes in relative rates represent the third avenue for relative DRG rate adjustments. Like policy adjustments, provider appeals can be used to adjust rates for changing technology, but this approach allows more flexibility in responding to the needs of particular hospitals. The burden of producing data to justify changes in DRG prices rests to a greater degree on the appealing institution. New Jersey has instituted a DRG appeals mechanism to specifically account for changing technology. The new Medicare system prohibits appeals of rates per se, but it does permit hospitals to appeal for additional payments for “outlier” cases whose estimated per-case costs are extraordinarily high. The effective price of DRGs containing new technologies (e.g., organ transplants), may be altered through this process.

Risk and Reward

The degree to which the hospital is able to generate surplus revenues and appropriate them to its own use will influence the strength of incentives to provide technologies more efficiently and can also affect the hospital's access to sources of capital. The ability to generate surplus depends on both the average level of payment and the rules governing hospitals' ability to keep surplus and liability for deficits. One program may emphasize the risk side, putting hospitals entirely at risk for losses without allowing them to keep surplus, while another may offer both substantial risks and rewards.

Traditional cost-based reimbursement is essentially a "no risk/no reward" system. DRG payment systems vary widely in this regard. Hospitals in New Jersey and Maryland can keep any surpluses attained from cutting costs per case and must bear the full burden of cost increases. However, both systems limit the revenue gains or losses attributable to changes in admissions to their estimated marginal costs or savings. In New Jersey, the potential for continued surplus-building in subsequent years is reduced somewhat by periodic recalibration of DRG prices reflecting changes in costs. In Maryland, however, the benefits of cost reductions (and the penalties for cost increases) are maintained in subsequent years, because DRG weights are not updated. Under the temporary provisions of TEFRA, the hospital reaps little reward for keeping its per-case costs low (a maximum of 5 percent of its per-case rate) but bears the full penalty of exceeding the per-case limit. Under the new Medicare law, the hospital bears the full burden of a loss and reaps the full rewards of a surplus, regardless of their source. The hospital keeps the full portion of any surplus due to increases in admissions. Thus, under the Medicare law, hospitals will have strong incentives both to reduce costs and increase profitable admissions.

Technology-Specific Effects of DRG Payment

How do the general incentives of DRG payment translate into specific effects on the use of medical technologies? The previous sections demonstrate both the complexity of the underlying incentives and the impact of program design on their direction and strength. DRG payment will not have a uniform effect on medical technologies and in some instances technologies will be subject to conflicting incentives. From the discussions above it can b; concluded that:

- Overall, the number and intensity of ancillary procedures provided to inpatients can be expected to decrease, but the use of procedures that can be shown to lower the cost per case will increase.
- The settings of technology use are likely to be influenced by DRG payment, but the incentives work in conflicting directions and are sensitive to the key features of program design. In the absence of an outlier policy for low-cost patients, DRG payment encourages inpatient admissions for simple procedures. On the other hand, the exclusion of outpatient costs gives hospitals an incentive to offer outpatient procedures. It remains to be seen which incentive will dominate for which procedures. DRG payment will encourage the movement of technologies, particularly those for posthospital care, into the home and other nonhospital sites of care.
- DRG payment is likely to influence the specialization of services, but the magnitude and direction of these effects is unknown. The incentives to reduce costs encourage concentration of capital-intensive technologies in fewer institutions. Conversely, the increasing competition among hospitals for physicians and patients will create incentives for the widespread acquisition of some technologies.
- A change in technology product mix is likely to result from downward pressure on the price and quantity of supplies and, if capital is included in the DRG rate, capital equipment. Greater product standardization can be expected as more expensive models and procedures are eased out of the market through competition.

Implications for Utilization Review and Quality Assurance

Per-case payment introduces much needed incentives for cost control in hospitals, but it also

has potential negative implications for quality of care, access to care, and systemwide costs. The incentives in DRG payment for hospitals to potentially manipulate case load, overadmit patients, discharge patients too early, and underprovide ancillary technologies argue for safeguards in the form of quality and utilization review.

Review functions under Medicare have always had two partially conflicting objectives: quality assurance and cost containment. Under DRG payment, these dual objectives remain. Utilization review will be necessary both to avoid costly increases in admissions and readmissions, and quality audits will be necessary to protect inpatients from the underprovision of technologies and from too early discharge.

Both types of review overlap because of the tradeoff between quality and cost that becomes more explicit with per-case payment. For example, physicians may become more selective in their ordering of diagnostic tests. Some tests may add to the cost per case but give better patient outcomes. Other tests can be avoided with little consequence for outcomes. Review processes that recognize the balance between cost and quality become critical under DRG payment.

Historically, the responsibility for quality assurance and utilization review has been shared by hospitals, intermediaries, and Professional Standards Review Organizations (PSROs). Hospitals have been required to have programs of quality assurance and utilization review as conditions of participation in the Medicare program[2] as well as for accreditation by the Joint Commission on Accreditation of Hospitals. Before the PSRO law was implemented, Medicare fiscal intermediaries were required to perform independent utilization reviews and thereafter remained the reviewers of last resort in areas without active PSROs (68). Congress instituted the PSRO program in the 1972 Social Security Act amendments (Public Law 92-603), establishing independent physician review organizations with the dual objectives of quality assurance and cost containment.

In 1982, Congress replaced the PSRO program with utilization and quality control peer review organizations (PROS) (Public Law 97-248). PROS will be physician organizations whose performance will be evaluated by the degree to which they meet objectives for quality assurance and cost containment specified in 2-year contracts with DHHS. Under the new Medicare DRG payment system, hospitals must enter into agreements with PROS for review of the quality of care and the appropriateness of admissions and readmissions.

The integration of cost-containment and quality-assurance objectives in a single physician-run independent review organization such as a PRO is both necessary and troublesome. Because the inherent tradeoff between cost and quality is bound up in every review decision, it would be impossible to separate the two. Yet, it is difficult for those responsible for conducting review and for those funding such efforts to maintain a balance between the two objectives. The history of PSROs is instructive. Although the original intent of Congress was that PSROs were to both contain costs and assure quality, Federal evaluations of the program focused largely on the cost-containment objectives (86,87,88,91). The difficulty of specifying and measuring criteria for quality of care added to the relative obscurity of this objective. The critical question to Federal policymakers was whether PSROs were cost saving to the Medicare program—i. e., did they reduce inpatient hospital utilization sufficiently to cover the program costs? On the other hand, at the local level, PSROs emphasized quality assurance (25, 59).

Whether PROS can strike an appropriate balance between the cost containment and quality assurance objectives remains to be seen. It is important that at the Federal level the real need for quality assurance presented by DRG payment be recognized.

[2] 42 CFR 405J.

Chapter 4

Effects of DRG Payment on Technological Change in Medicine

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Effects of DRG Payment on Technological Change in Medicine

INTRODUCTION

Perhaps even more important than how Diagnosis Related Group (DRG) payment affects the use of presently available medical technologies is how DRG payment will affect technological change in medicine—the adoption of new technologies and discarding of old ones. As a society, we value technological progress, the "introduction to practice of new and more useful ways of serving human purposes" (73). Technological change should act as a filtering process, continually winnowing out the less useful in favor of more useful technologies. To what extent can DRG payment be expected to improve or hinder this process? Since DRG payment will influence hospitals' incentives to adopt new medical technologies, it may therefore ultimately alter the rate and direction of technological change in medicine. This chapter will examine the implications of DRG payment for technological change.

Conversely, technological change occurring due to other forces will inevitably require adjustments in a DRG payment system itself, if the system is to continue to function effectively. These adjustments range from changes in the relative rates of payment across DRGs to changes in the definitions of DRGs themselves. Thus, a DRG payment system must encompass procedures for timely adjustment to new knowledge and technological conditions as they arise. This chapter will explore the reasons for this conclusion and will also examine the kinds of information and procedures that will be needed to monitor the performance of a DRG payment system over time.

EVIDENCE OF EFFECT ON TECHNOLOGICAL CHANGE

Empirical evidence on the effect of DRG payment on the adoption of new technologies is unavailable, but studies of other kinds of prospective payment systems suggest that hospitals can and do respond to changes in financial incentives in their decisions regarding the adoption of new technologies. Three studies of the impact of hospital prospective payment programs on the adoption of new services and technologies provide evidence of the response of hospitals to changes in financial incentives.

Joskow (41) analyzed the effect of ratesetting programs on the availability of computed tomography (CT) scanning in hospitals. The number of CT scanners in a State in 1980 was found to be negatively related to the number of years that ratesetting had been in effect in the State. Hospital ratesetting also led to a shift in the location of CT scanners to physicians' offices.

Cromwell and Kanak (11) recently analyzed the impact of 15 State ratesetting programs on the availability of 13 different services in the hospital between **1969** and **1978.** Table **2** summarizes the results. New York had the most consistently negative effects on the availability of all types of services. New Jersey's DRG ratesetting program also appeared to generally reduce the availability of complex services, with the exception of electroencephalogram (EEG) services. Other States' programs showed no consistent impact on service adoption. It is interesting to note that the service upon which ratesetting had the highest and most widespread negative effect is social work, a labor-intensive, not equipment-intensive, hospital service.

In still another study of hospital payment and technology diffusion, Wagner, et al. **(95),** investigated the impact of prospective payment in

Table 2.—Ratesetting Regression Coefficients, Selected Facilities and Services

State program	Complex services						Quality enhancing			Community services			
	Radio-therapy	ICU	Open heart	EEG	Radio-isotopes	Burn care	Physical therapy	Premature nursery	Pathology lab	Social work	Outpatient department	Emergency department	Psychiatric emergency
Arizona:													
Voluntary, 1974-78	0.10[a]	—	—	-0.06[b]	—	—	—	-0.06[c]	—	-0.05[c]	—	—	—
Connecticut:													
Voluntary, 1969-72	—	—	—	—	—	—			—	—	—	—	—
Mandatory, 1975-78	—	—	—	—	—	—	-0.11[a]	—	—	—	—	—	—
Kentucky:													
Voluntary, 1975-78	—	—	—	-0.04[c]	—	—	0.05[b]	—	—	—	—	0.03[c]	-0.04[b]
Maryland:													
Mandatory, 1975-78	—	-0.12[c]	—	-0.15[a]	—	—	—	0.17[a]	—	-0.13[b]	—	—	—
Mandatory, 1976-78	—	—	—	—	—	—	—	-0.13[a]	—	-0.10[a]	—		
Massachusetts:													
Mandatory, 1975-78	—	-0.07[b]			—	—	—	—	—	-0.06[c]	—	—	—
Mandatory, 1976-78			—	—	—	—	—	—	—	—	—	—	—
Minnesota:													
Voluntary			—	-0.70[a]	—	—	-0.04[c]	—	-0.04[c]	-0.08[a]	—	—	—
Mandatory, 1978	—	-0.08[b]			—	—	—	—	—	-0.07[c]	—	—	—
Mandatory, Rev. 78			—	—	—	—	—	—	—	-0.09[c]	—	—	—
Nebraska:													
Voluntary, 1973-78			-0.06[b]	—	—	0.07[a]	—	0.14[a]	—	—	—	—	—
New Jersey:													
Mandatory, 1975-78	—	-0.08[a]	-0.10[a]	0.04[c]	—	-0.03[b]	0.05[c]	0.08[a]			-0.06[b]	—	—
New York:													
Mandatory, 1971-78			-0.04[a]	—	-0.04[b]	—			—	—	—	0.03[b]	—
Mandatory, 1976-78	-0.06[a]	-0.03[c]	-0.03[a]	-0.04[a]	-0.02[c]	-0.02[a]	—	0.05[a]	—	0.05[a]	—	-0.03[a]	—
Rhode Island:													
Mandatory, 1973-78					-0.14[c]	—	—	—	—	—	—	—	—
Western Pennsylvania:													
Voluntary, 1971-78	-0.14[a]	-0.08[a]	—	—	0.06[c]	-0.02[b]	—	-0.08[a]	—	—	—	—	0.06[b]
Washington:													
Mandatory, 1976-78					—	0.02[b]	—	—		—	—	—	—
Mandatory, 1978	—	—	—	—	—	0.02[b]	—	—	—	-0.05[c]	—	—	—
Wisconsin:													
Mandatory, 1973-78	—	—	—	—	-0.05[a]	—	0.08[a]	-0.09[a]	—	0.06[a]	—		

[a]Significant at the 95-percent confidence level.
[b]Significant at the 90-percent confidence level.
[c]Significant at the 85-percent confidence level.

SOURCE: J. Cromwell and J. Kanak, "The Effects of Reimbursement Programs on Hospital Adoption and Service Sharing," *Health Care Review* 4(2):67, December 1982.

three States (New York, Maryland, * and Indiana) on the adoption of five new pieces of capital equipment: electronic fetal monitoring, gastroendoscopy, volumetric infusion pumps, automated bacterial susceptibility testing, and computerized energy management systems. The first three technologies probably raise the daily cost of care, although their effect on the average cost per case is unknown. The latter two are investments in cost-saving equipment. The New York ratesetting system was found consistently to lead to adoption of fewer units of the cost-raising technologies and to increase the probability of large hospitals' adopting the cost-saving equipment. However, the prospective payment programs in Maryland and Indiana showed no such consistent effects on hospitals' adoption behavior.

Together these studies imply that prospective payment does affect the adoption of new technology in predictable ways, but that much depends on the strength and design of the program. New York's system, the oldest and most restrictive ratesetting program, has clearly altered the extent of availability of new technology. Since its inception in 1970, New York's system has put a heavy emphasis on financial risk to the hospital while at the same time offering little financial reward. Other systems may be too new, too small, or too weak to show longrun consequences.

***The test of the Maryland system did not discriminate between hospitals paid by the case and those on the State's conventional ratesetting system.**

CLASSIFICATION OF NEW HOSPITAL TECHNOLOGIES

DRG payment incentives do not affect the introduction of new technologies uniformly. This is partly because of variation in the cost implications of medical technologies. But it is also because medical technologies may be adopted (or not adopted) according to their clinical benefits (or risks). These clinical implications naturally vary widely. However, for the purpose of analysis, it is necessary to classify new hospital technologies according to criteria that highlight the likely effect of DRG payment on their diffusion into the practice of medicine. The most basic distinction is due to the per-case nature of DRG payment. Thus, hospital medical technologies can be viewed as those whose adoption decreases the hospital's total cost per case—cost-saving technology-and those whose adoption increases the hospital's total cost per case—cost-raising technology.

Cost-saving technology would include a new technology that provides a particular service less expensively, or one that reduces the required number of services or length of stay (LOS) sufficiently to justify the investment. A cost-saving technology in one hospital may be cost-raising in another. The expected volume of use is often an important factor in determining whether a technology will be cost-saving. For example, capital equipment that replaces other procedures may be cost-saving in a large hospital but cost-raising in a small one. Had CT head scanning been introduced in an era of DRG payment, it may well have been justified on the basis of per-case cost reductions in hospitals with large neurology or trauma services (40,84). Yet its introduction into hospitals with lower neurological case loads would probably have required justification on other grounds, such as improvements in patient access or outcome.

Many new procedures and therapies introduced in the past have raised the cost of hospital stays, even in high-volume institutions. Presumably, these cost-raising technologies improve patients' health outcomes or reduce patients' medical care expenditures outside of the hospital. Of course, some new cost-raising technologies have neither improved patient outcomes nor saved systemwide medical care costs. Gastric freezing, a technology of the mid-1960's is a good example (21). Some have claimed that intermittent positive pressure breathing (IPPB), a respiratory therapy technology, provides another example (74).

Hospital technologies can be further classified according to their effects on capital and operating costs per case. Table 3 describes four kinds of technological innovation categorized by their ex-

Table 3.—Four Types of Technological Innovations and Effects on Capital Cost, Operating Cost, and Total Cost

Type of innovation	Direction of effect on: Capital cost per case	Operating cost per case	Total cost per case
1. Cost-raising, quality-enhancing new technology	+	+	+
II. Operating cost-saving innovations			
A.	+	–	+
B.	+	–	–
III. Capital cost-saving innovations			
A.	-	+	+
B.	-	+	–
IV. Service/procedure disadoption	-		–

SOURCE: Office of Technology Assessment.

pected effects on capital, operating, and total costs per case. Type technology, which raises all components of hospital cost per case, represents the classic cost-raising, quality-enhancing technology that would be introduced for its presumed patient benefits. Intensive care monitoring is an example of such a technology. Type II represents a broad range of capital investments that would save operating costs during the patient's stay. Automation technologies fall into this category, but so, too, do new diagnostic or therapeutic procedures that reduce LOS or intensity of care. These "operating cost-saving" technologies may or may not lower the total per-case cost of care, depending on the relationship between capital and operating costs. Type III technologies involve new, simpler approaches to care, in which expendable labor, materials, or supplies are substituted for capital equipment. The abandonment of a capital cost-saving technology falls into this category, as does a new labor-intensive test that replaces less effective but automated laboratory procedures. Finally, Type IVrepresents the disadoption of a service or procedure resulting from new knowledge of its lack of clinical efficacy or safety. The rapid decline in recent years in the use of IPPB therapy following publication of evidence on its lack of efficacy in many clinical settings is a good example.

GENERAL INCENTIVES FOR TECHNOLOGICAL CHANGE IN DRG PAYMENT

Although there is no empirical evidence, it is possible to describe the incentives regarding technological change under DRG payment. Many observers have pointed out that per-case payment systems, in which future levels of payment are largely independent of the hospital's own historical costs, create incentives for hospitals to adopt cost-saving technologies. Yet because technologies are neither cost-saving nor cost-raising independent of the context in which they are used, all hospitals cannot be expected to adopt the same technologies. The introduction of new capital-intensive cost-saving technologies in a DRG payment environment is likely to speed up the process of specialization as small hospitals become unable to reap the cost-saving benefits of some investments. Some technologies that depend on high volume to be cost-saving could be provided to smaller hospitals on a contract basis by large hospitals or independent laboratories. The feasibility of such arrangements would vary with the specific uses of a technology and the geographical and competitive environment in which the hospitals operate.

The introduction of new "cost-raising" technologies is discouraged, but not eliminated, under DRG payment compared to cost-based payment.

Under cost-based payment, the additional hospital costs of new technologies are fully covered; hospitals therefore have no financial incentives not to adopt such innovations. Under DRG payment, the adoption of new cost-raising technology is not met with an automatic increase in revenues to cover the additional cost. New technology will have to compete with alternative uses of funds, such as employee wage and benefit increases, additional nursing staff, etc. New technology may beat an additional disadvantage relative to other uses of funds because of the relative uncertainty about its benefits in the early stages of diffusion **(72).** The implications are obvious: with limited resources, hospitals will need to assess new technologies more closely and ration resources more carefully.

Nevertheless, the introduction of promising new technologies, even those that are cost-raising to the hospital, will be attractive to hospitals as they compete for physician loyalties and, ultimately, the admissions they represent. For example, despite its high capital and operating cost, nuclear magnetic resonance imaging, a new medical imaging technology still in the investigational phase, may be highly desirable to hospitals that seek to protect their admissions base from encroachment by other hospitals. The importance of this incentive as a constraining force to the previous incentive is unknown. Thus, though DRG payment, in general, does not imply that technological change will aproach a standstill, its directions are likely to be altered, and the adoption of technologies that are cost-raising to the hospitals is likely to decline by an unknown quantity.

KEY FEATURES OF PROGRAM DESIGN THAT AFFECT TECHNOLOGICAL CHANGE

As with its impact on technology use, the impact of DRG payment on technological change will be influenced by the key features of program design. In particular, the methods of providing rewards for cost reductions, treating capital costs, and updating DRG prices have important implications for technological change.

Risk and Reward

The ability of hospitals to generate and keep surplus sufficient to fund investments in new technology depends to a large extent on the average payment level of the payment system as a whole. A DRG payment system can be either restrictive or generous. A restrictive payment policy will encourage rapid adoption of cost-saving technologies but will discourage investments in cost-raising technologies. A more generous payment level may reduce the pressure for the adoption of cost-saving technology but will also provide surplus for cost-raising investments.

Treatment of Capital Costs

The exclusion of capital costs in the DRG payment rates will change hospitals' incentives to introduce certain kinds of new technologies. * Table 4 describes how the incentives provided by DRG payment are influenced by the capital payment mechanism. Capital payment methods do not alter the direction of such incentives as long as the effect of a new technology on total cost per case is in the same direction as its effect on operating costs. For example, DRG payment provides a disincentive to adopt most cost-raising, quality-enhancing (Type I) technologies regardless of the way in which capital is handled. Capital cost pass-throughs weaken the disincentive not to adopt this kind of technology, but they do not

***Exclusion of costs from DRG payment rates is referred to as treating those costs as "pass-throughs." Under some DRG payment systems, pass-throughs have been subjected to different kinds of controls. (See app. C for a description of New Jersey's and Maryland's systems.)**

Table 4.—impact of Technological Innovation on Per-Case Costs

Type of innovation	Direction of effect on: Capital cost per case	Operating cost per case	Total cost With per case	Incentives for adoption: capital in rate	without capital in rate
1. Cost-raising, quality-enhancing new technology	+	+	+	1	1
II. Operating cost-saving innovations					
A	+	–	+	1	!
B	+	–	–	f	f
III. Capital cost-saving innovations					
A	–	+	+	1	1
B	–	+	–	I	1
IV. Service/procedure disadoption	–	–		t	1

SOURCE: Office of Technology Assessment.

remove it. New technologies with high capital costs, but only small increases in operating costs, would be affected less by DRG payment with a capital cost pass-through than by DRG payment with capital built into the rate. Similarly, capital disinvestments (Type IV), occasioned perhaps by the introduction of a simple procedure to replace a capital-intensive one or simply by the abandonment of an ineffective technology, are encouraged by DRG payment regardless of the way in which capital costs are treated.

Operating cost-saving (Type II) and capital cost-saving (Type III) technologies can lead to situations where the incentives for hospitals to adopt may actually be reversed by the policy regarding payment of capital. Of particular concern is the incentive under a pass-through to adopt expensive capital equipment that reduces operating costs but raises total cost per case. Like regulated utilities, where allowed profits are computed as a percentage of the amount of equity capital, hospitals can be expected over time to become too capital-intensive (3).

The Social Security Amendments of 1983 (Public Law 98-21) provide for capital to be treated as a pass-through under the new DRG payment system. Capital technologies will continue to be paid retrospectively on the basis of reasonable costs. However, the inadequacy of this method was recognized by Congress in the new law. The law requires the Department of Health and Human Services (DHHS) to submit a report to Congress by October 20, 1984 on payment for hospital capital. The intention of the law is that at the end of 3 years, Congress will have legislated a new capital policy that will deviate from present cost-based reimbursement. Although the issues in capital formation policy are complex and beyond the scope of this technical memorandum, any policy that eliminates the pass-through will have desirable effects on the consistency of hospital technology acquisition decisions.

Methods of Updating DRG Prices and Categories

The longrun viability of any DRG payment system depends on its ability to both adapt to and encourage appropriate technological change in medicine. A payment system that is rigid in the face of medical progress will become unacceptable to providers, patients, and the public. Consequently, the methods and procedures used to adjust the average payment level, relative DRG rates, and the DRG categories themselves are critical to the longrun survival of the system.

The primary objective of a DRG price adjustment process is to maintain equality across DRGs in the ratios of price to the cost of efficient care. This objective implies that as new cost-saving technology becomes available for use in certain DRGs, the relative prices of these DRGs should be adjusted downward to reflect the new efficiencies. Alternatively, the development of new cost-raising technologies that improve patient outcomes enough to justify their use should be met with increases in the prices of relevant DRGs. Adjusting relative prices to reflect technological change as it occurs provides appropriate incentives for efficiency and specialization in the delivery of hospital care.

But to simply adjust prices in reaction to technological change is insufficient. A second objective of the price adjustment process is to encourage hospitals to adopt ***appropriate*** new technology. The previous sections concluded that while DRG payment encourages the adoption of cost-saving technology, it reduces hospitals' incentives to adopt new cost-raising technologies. Depending on the general restrictiveness of the payment system, the effects may be to discourage diffusion and perhaps even the development of costly but effective new hospital technologies. The DRG price adjustment process can be used to counteract this incentive for deserving technologies.

There are two general methods of DRG price adjustment: conditional adjustments and unconditional adjustments. Conditional DRG rate adjustments are those granted only to hospitals actually adopting a new technology; unconditional rate adjustments are those that apply to all hospitals (or to a class of hospitals) whether or not they use the new technology. There are three possible unconditional adjustment processes:

- ***Periodic empirical reestimation of relative DRG costs.*** —This method is statistical and reactive in nature; as technological change alters the costs of serving specific DRGs, the calculated rates change. The process is also gradual, because estimated relative weights based on average costs across both adopters and nonadopters of a new technology would only partially reflect the effects of the new technology on the efficient cost of accepted care. Only in the final stages of diffusion when the new technology is uniformly applied across all hospitals would the estimated relative costs reflect the technology's full effect.
- ***Application of a technology factor.*** —This method employs an annual percentage increase in the average rate of payment for all DRGs to provide funds for the adoption of cost-raising technology. * For example, the new Medicare law requires that the annual increase in the average payment level reflect technological change as well as general inflation, but the amount of increase is not statutorily specified. Inclusion of such a factor in the annual rate increase gives hospitals funds to use for any purpose, including technology adoption.
- ***Central policy decision to change relative DRG rates.*** —-A designated State or national agency can make purposeful adjustments in relative DRG rates to reflect a change in technological conditions. The new Medicare law specifies that the Prospective Payment Assessment Commission make recommendations regarding periodic adjustments in relative DRG rates to reflect changing technology. This Commission could recommend an increase in the rate paid for a particular DRG relative to other DRGs as a means of funding the acquisition of a cost-raising technology. Of course, hospitals treating patients in the DRG with the increased rate would be free to use the additional revenue for any purpose.

Conditional adjustments in DRG prices can be accomplished by two general mechanisms:

- ***Provider-initiated appeal.*** —Individual hospitals contemplating adopting a new technology can request an adjustment of rates in specific DRGs to fund its acquisition. Presumably, hospitals would not request reductions in rates due to cost-saving innovations. Instead, this approach is potentially useful for case-by-case exceptions to DRG rates to pay for new cost-raising technology. The new Medicare law specifically prohibits hospitals from appealing DRG rates, but appeals are allowed for very high cost "outlier" patients on a case-by-case basis. The State of New Jersey has a DRG appeals mechanism that is intended to bring to the surface new technologies in need of extra payment. To qualify as a DRG appeal, the new technology must be shown to affect one or more DRGs accounting for at least 10 percent of the hospital's costs or admissions and to affect one or more hospitals other than the applicant (63).
- ***Creation of new DRGs. —New*** DRGs, differentiated from preexisting ones by the use of a specific technology, can be created as

***In theory, a negative technology factor could be used to reduce funds in anticipation of cost reductions, but it has not been applied in this manner in any State system.**

a way of paying a hospital only if it actually adopts and uses the technology. The new DRG would be assigned a price reflecting the higher or lower resource costs associated with the use of the new technology. For example, liver transplantation might become its own DRG, although the Medicare program does not yet pay for such procedures. When and if the new procedure is considered ready for payment, a DRG price will be assigned that can be obtained by any hospital performing the procedure. Those hospitals not performing transplant operations will not receive the additional revenue, because they will have no patients in that DRG.

The first objective of DRG rate adjustment—the maintenance of equal ratios of price to the cost of efficient care among DRGs—depends largely on unconditional rate adjustments. Although periodic reestimation of DRG costs represents a gradual adjustment to new technology, it is a reasonable method for adapting to cost-saving technological imovation. Because cost reductions would be reflected only gradually in relative rates, hospitals adopting such innovations would reap a positive, albeit declining, return on their investments over a long period. Hospitals lagging in adoption of cost-saving innovation would gradually be subjected to greater penalties. Thus, the reestimation process is a gentle adjustment method which nevertheless embodies strong incentives for hospital efficiency.

Central policy decisions to force more rapid adjustment of payment rates to new cost-saving technologies are also feasible and may be useful from time to time. Yet, it maybe difficult early in the availability of a new technology to predict how large a saving to expect and how such savings are likely to vary among hospitals. Since the incentives to adopt new cost-saving technology are already strong in DRG payment, radical reductions in specific DRG rates are likely to be more disruptive than useful.

The second objective of a DRG adjustment process-encouraging the adoption of appropriate technologies, particularly those that are cost-raising to the hospital-may use either conditional or unconditional adjustment methods. But no one method alone is completely satisfactory for this purpose. Periodic reestimation of DRG costs is not likely to be sufficient to induce hospitals to adopt desirable cost-increasing technologies, especially very expensive ones. Early adopters would bear the full extra costs of such a new technology, but the updated weights based on averaging costs across both adopters and nonadopters would not reflect the full increase in per-case costs. Hence, the initial stages of the diffusion process would be underfinanced.

Inclusion of a general technology factor in the annual average rate of increase does provide funds for the adoption of new cost-raising technology. However, this kind of across-the-board increase rewards innovative and noninnovative hospitals alike and may even cushion some hospitals against the need to become more efficient, because they are free to spend the additional revenue however they choose. Consequently, a technology factor is an inefficient approach to encouraging the adoption of cost-raising technology, since it is likely to fund less of such innovation than the cost of the approach to third-party payem.

The same criticism can be made of central policy decisions to increase the relative rates of certain DRGs. The hospital would be free to use the extra payment from an adjusted DRG price for any purpose. Thus, centrally mandated rate adjustments would give equal reward to adopters and nonadopters.

Yet, conditional adjustment mechanisms, such as creation of new DRGs or individual provider appeals, have their own shortcomings. Creation of new DRGs may appear on the surface to be an ideal approach, but it has serious deficiencies as the major tool. The prospect of DRG inflation—the gradual increase in the number of categories-has severe implications for management of data and information. If the experience with medical procedure nomenclature is any guide, the rate of increase in the number of categories can be expected to be high (55). The first revision in DRG nomenclature increased the number of categories by 22 percent. The additional data required on hospitals' claims to make fine distinctions in DRG assignments would certainly add an administrative burden on hospitals and payers.

Second, and more important, over time DRG payment would come to look more and more like fee-for-service medicine, where the amount of payment is inextricably linked to the procedures performed. Financial incentives to perform profitable combinations of procedures could develop. In addition, substitution of a new cost-saving procedure for a more expensive one would be discouraged if it were to bump a patient out of the higher priced category into a lower priced one. Thus, the uncontrolled expansion of categories can create a more rigid, less cost-effective health care delivery system.

Reliance on case-by-case hospital appeals of DRG rates is likely to be administratively costly and cumbersome compared to other methods. Unfortunately, there is little experience to date with New Jersey's DRG appeals process, and even if there were, it is unclear whether the experience of a single State is germane to operation of a national appeals process. Nevertheless, the New Jersey appeals process bears watching as a potential model for adoption in a more general DRG payment system.

It is worth noting that any approach to updating relative DRGs to account for new cost-raising technology requires information on which to base conclusions about the readiness of a new medical technology for payment. In effect, technology assessments are needed to support the decision process. For example, should the relative rates of those DRGs using hyperalimentation be adjusted to reflect the additional costs of this technology? Such questions would of necessity transcend case-by-case appeals processes. A mechanism and adequate resources for conducting integrated and comprehensive assessments of such questions ***are*** important for supporting the DRG adjustment process. The Prospective Payment Assessment Commission established by the Medicare law is empowered to conduct or fund such assessments, but other research resources may also be usefully employed in providing information to support such critical decisions.

COVERAGE POLICY, DRG PAYMENT, AND TECHNOLOGICAL CHANGE

Since its inception, the Medicare law has mandated that a specific technology or service must be a "covered" benefit, i.e., a benefit eligible for payment, in order for providers to be reimbursed for its provision. Although Medicare specifies broad categories of covered benefits, specific technologies, particularly new ones, require individual coverage determinations. Such coverage decisions are governed by section **1862** of the Social Security Act, which excludes payment for items and services that are "not reasonable and necessary" for diagnosis, treatment, or improved services. "Reasonable and necessary" lacks precise definition: the Medicare program applies the terms to technologies that are generally accepted by the medical community as being safe and effective and are perceived to have moved beyond experimental status to clinical application.

These coverage requirements have acted as a barrier to adopting new, untested technologies and, in a passive way, have discouraged the abandonment of outmoded technologies. Although the extent to which coverage policy has been an effective "technology watchdog" varies among particular technologies, it is generally accepted as ***in***fluencing the diffusion of technologies. Under the new Medicare law, the provisions of section **1862** remain. Since DRG payment will also affect the rate and direction of technological change, the relation of the two, coverage policy and DRG payment, has implications for medical technology in the Medicare program.

At this time, the interactions between Medicare coverage policy and DRG payment as mandated in Public Law 98-21 are limited to the hospital portion of inpatient services. As noted previously, outpatient services and physician services-provided in or out of the hospital—are not included in the DRG system. Instead, they are paid for as before the law's enactment: outpatient services are

reimbursed on a reasonable cost basis, and physician services are reimbursed on a reasonable charge basis.

The ability of coverage decisions to assist in appropriate technological change depends in part on the identification of new technologies and new uses of established technologies. If a technology that is part of the hospital portion of inpatient services (now paid by DRG payment) comes to the Medicare program's attention as "new," a determination of its safety and efficacy will still be required. Although DRGs are generally constructed according to diagnosis (and not treatment), there are several ways to identify new technologies under the newly mandated DRG payment system. A few still-to-be-covered technologies, the most obvious being heart transplant, are specific DRGs. Program administrators also will have the potential to identify established surgical procedures in reviewing claims for DRG payment, but will not be able to identify new surgical procedures by claims review.

Another opportunity for identifying new technologies will occur when hospitals appeal their payment levels for "outlier" cases. Many of these cases will be high-cost outliers precisely because new and costly technologies will have been employed. If a new procedure is not covered, denial of an outlier claim is a likely prospect.

Finally, new technologies and new uses of established technologies will be recognized during the process of adjusting DRG rates. Indeed, updating DRG prices appears to offer the most significant opportunity of identifying such technologies for coverage purposes. The decision to adjust DRG rates can therefore be considered a quasi-coverage decision itself.

Under current Medicare coverage policy, once a new technology is identified and brought to the attention of program administrators, the Health Care Financing Administration (HCFA) arranges for the Public Health Service to conduct an assessment to ascertain the safety and efficacy of the technology. HCFA subsequently determines the coverage status of the technology based, in part, on the results of the technology assessment.

For the DRG payment system, changes in DRG relative weights or prices will be made, in part, to reflect technological change. Because this process* must include identification of new technologies, it is reasonable that some of the techniques, including technology assessments, used to adjust DRG rates will be similar to those used for supporting coverage decisions. For example, the Prospective Payment Assessment Commission has been given broad powers to assess medical technology and the appropriateness of medical practice patterns in performing this task. It is this Commission that must make recommendations to the Secretary of DHHS concerning the appropriate payment rate for hospital services according to its findings.

Thus, both the coverage process and the process of adjusting DRG rates share a similar "approval for payment" function. They differ in that a coverage determination focuses on specific technologies while adjusting DRG payment rates focuses on the larger entity of a diagnostic group, which includes particular technologies. Moreover, the DRG rate adjustment process must include issues of cost as an integral issue, while the coverage process at present does not consider cost issues. Nonetheless, the technology assessments performed for both processes no doubt will be similar. The potential for duplication is not to be ignored.

Whether technologies will be subject to a double review of safety and efficacy for payment purposes will depend on the approach chosen to update DRG prices. Irrespective of approach, it is reasonable to assume that hospitals' adoption of cost-raising technologies will be made evident to HCFA for DRG payment and for coverage policy. However, some approaches to updating DRG rates, i.e., provider appeals, would not surface cost-saving technologies. Because specific technologies will not be identified on the DRG hospital claims form, the adoption by a hospital of a new, uncovered, cost-saving technology would not become known to HCFA through hospital claims

***As noted in the previous section, the specific mechanisms of the process have not yet been determined.**

review. However, as in the past, HCFA will rely on physician claims and other sources to provide information to stimulate the initiation of a technology assessment solely for coverage purposes.

Many new technologies, especially those that are cost-raising, could conceivably be faced with the prospect of a double barrier to introduction—an assessment for coverage purposes and an assessment for DRG rate adjustment. Although the evaluations may differ for the two purposes, the processes appear to be sufficiently similar to warrant coordinated Government effort. The unintended confluence of the two administrative processes needs to be examined in order to conserve Federal resources and to promote the diffusion of appropriate technologies.

Chapter 5

Selected Implementation Issues: The Hospital Perspective

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The preceding chapters have examined potential hospital behavior toward technology use and adoption when faced with a prospective per-case payment system based on Diagnosis Related Groups (DRGs). As noted earlier, potential behavior toward technology is predicted to vary as specific features of a system vary. In addition to the general and specific incentives provided by the system, a number of issues concerning implementation arise that should be noted by policymakers. These issues assume even greater importance in view of the recently legislated Medicare payment system. Thus, this chapter will briefly examine issues involving the implementation of a DRG reporting system to support per-case payment. It will not focus on implementation issues from the perspectives of the Health Care Financing Administration (HCFA) of the Department of Health and Human Services or the intermediaries who will also be involved in the operation of the new system.

Implementation issues encompass a variety of problems with varying cost implications. Two important aspects of implementation of the new Medicare DRG payment system will be described in this chapter: data and coding issues and hospital administrative issues. Data issues exist because of the reliance of the classification process on data summaries (discharge abstracts) of the patients' hospital medical records. These issues include classification and coding errors, and DRG "gaming" or "creep." Administrative issues exist because the administrative burden to hospitals obviously increases when any new type of payment system is introduced, particularly one as complex as a DRG payment system is likely to be. For example, hospitals will need to institute procedures to improve the quality of information, including a reduction in missing data in medical charts.

PATIENT DATA ISSUES

Classification and Coding Errors

Because assignment of patients to DRGs requires data from the patients' discharge abstracts, the accuracy and timeliness of these data have come under question. Several studies have been undertaken under the auspices of the Institute of Medicine (IOM) of the National Academy of Sciences to determine just how accurate and timely the data are, and how various procedures might be employed to ensure data reliability **(57,58,59).**

In each study, a sample of patient records was reabstracted by a trained field team of Registered Record Administrators and compared with the original data compiled by either the abstract services (for the first study), HCFA (for the Medicare data in the second study), or the National Center for Health Statistics (NCHS) (for the third study). For diagnosis and procedures, two types of data discrepancies were possible. Ordering discrepancies would reflect problems in determining which of several diagnoses or procedures should be regarded as principal. Coding discrepancies would reflect errors in assigning a diagnosis or procedure code number.

Findings from these studies indicated that hospital data on admission date, discharge date, and sex were highly reliable; however, this was not the case when diagnosis and procedure data were examined. For all diagnoses combined, when codes were compared (up to four digits), Medicare data were reliable in only **59.5** to **64.1** percent of the cases. In the study of abstract service data, the comparable figures had been ***66.8*** to 77.5 percent, and in the NCHS study, 63.4 to 86.0 percent. Further, Medicare data concerning the pres-

● **This chapter incorporates work by Diane E. Hamilton, Ralph E. Berry, and Nancy L. Kelly of Policy Analysis, Inc.**

ence of **additional diagnoses were reliable** in 74.5 percent of the cases, and the reliability level for Medicare principal procedures was ***78.9*** percent. Finally, in the abstract service and NCHS studies, the field team concluded that in **4.6** percent of the cases, the correct diagnosis code was a matter of judgment. This was **also** true for **1.7** percent of all procedures in the Medicare study.

It should be noted, however, that the data used in IOM studies were for 1974 and 1977. A second and even more important consideration is that the studies were based on detailed coding of diagnoses and procedures; therefore, discrepancy rates did not reflect error rates that might occur when cases were aggregated into DRGs. In fact, in a study of coding error at the DRG level, reliability increased to **76.7 percent (69). A third problem with extrapolating from these studies is that the discharge abstracts studied were not produced for payment purposes. When payment depends on the accuracy** and timeliness of discharge abstracts, their importance increases and data reliability should improve. Monitoring by peer review organizations (PROS) in the new system should give hospitals added incentive to improve their data collection and coding procedures.

The dependence of payment on coded diagnoses and procedures in a DRG payment system raises the possibility of deliberate changes in coding conventions. Several authors **(4,77,91) have noted that the ability** to maximize payment by changing diagnosis codes could be a serious problem. "DRG creep" was defined by Simborg as a deliberate and systematic shift in a hospital's reported case mix in order to improve payment (77). As described in chapter ***2,*** the primary basis for subdivision of cases into discrete DRGs is the principal diagnosis. Using the original DRG classification system, Simborg pointed out that by changing the sequence of discharge diagnoses for patients with more than one diagnosis, a higher priced DRG can result. If done systematically, perhaps using sophisticated computer programs, a more costly case mix would result.

It should be noted that the potential for "coding creep" exists with all available case-mix measures and is potentially even more problematic with those requiring subjective severity determination. To some extent, the new DRGs limit the discretion permitted in the assignment of DRGs, reducing but not eliminating the "upcoding" possibilities that the original DRG system offered. Under the modified DRG system, only significant, predetermined secondary diagnoses (complications and comorbidities) or age can lead to a case being included in a higher cost DRG; i.e., sequence no longer matters. In addition, a surgical procedure hierarchy is now used to assign patients who had surgery to DRG categories. Where there are multiple medical and surgical conditions, the one involving the major surgical procedure becomes the principal one. Thus, surgery takes precedence.

Data processing sophistication should increase within the hospitals in response to the new Medicare payment system. For example, it would pay a hospital to use its computer to screen for uncomplicated cases or certain DRGs that the medical records department should review for potential undercoding (77). DRG creep, or deliberate overcoming, can be controlled in two ways. First, PROS or other review organizations can screen certain DRGs for overcoming. This function was specifically assigned to PROS by the new Medicare law. Second, the potential gains from DRG creep would diminish if DRG prices are regularly reestimated. New prices or weights would reflect the new distribution of patients among DRGs and the new average costs per DRG. Over time, reestimation of weights would cause the more profitable DRGs to become less profitable, and the less profitable ones more profitable. Thus, one could expect a gradual decline in the potential for "gaming" via DRG creep with periodic reestimation of DRG prices.

Clearly, these improvements can be expected from the hospital industry as administrators, medical records persomel, and particularly physicians become more aware of the reimbursement implications of inaccurate data. Obviously, improvements of this type have potentially significant resource implications for the hospital industry, as well as third party payment agencies. These costs should be considered when the potential impact of a DRG reimbursement system is assessed. New Jersey has conducted educational programs for medical records personnel, physicians, nurses, and hospital administrators. Data accuracy has improved subsequently **(22,76), though some** DRG creep may exist in New Jersey (14).

HOSPITAL ADMINISTRATIVE ISSUES

The foregoing discussion of problems in data accuracy and timeliness in the use of DRGs is indicative of the need for improvements in the procedures used for data abstraction and coding. Researchers who have examined some of the problems have suggested several areas in which improvements should be made.

First, because a great deal of the error is introduced at the hospital level, programs to improve the quality of the information should be instituted. These might include additional training for persons abstracting information from the medical record, routinization of hospital procedures so that activities of billing personnel could be limited to information transfer (rather than interpretation of the medical record data), and instructional programs for physicians in classifying diagnoses, determining principal diagnosis, and completing the medical record* (12). Again, New Jersey has implemented these suggestions and has found them to be successful **(22,48,49).**

The medical record should also be completed in a timely fashion in order to bill third parties as soon after discharge as possible. In this case, physicians must be encouraged to complete the medical record as soon after discharge as possible. Also, for some hospitals, additional medical records personnel may be necessary.

A third suggestion for improving data quality is to establish direct, timely links among error detection, feedback, and training (10). (In fact, the New Jersey system has instituted many editing and educational initiatives throughout that State.) It is suggested that this error detection should include, as a supplement to data checks by the computer, a regular program for independently reabstracting samples of records. New Jersey Professional Standards Review Organizations have done this to monitor DRG assignments of patients to DRGs **(14). As stated** earlier, however, these types of improvements are not without cost or time implications, and there is some evidence to suggest that these improvements may increase the average cost of preparing a bill under a DRG-based payment system.

Some preliminary results of the effect of DRG payment on hospital behavior and performance are available from the New Jersey DRG payment experience **(98).** To assess the effect of the experimental DRG-based payment system on hospital organization and procedures, comparisons were made between matched samples of participating and nonparticipating hospitals. Based on that comparison, the following conclusions were reached:

1. the importance of the medical records departments has increased dramatically in participating hospitals. This was considered to be the result of the required expansion of the departments' functions and personnel, as well as the need for better trained personnel;
2. the medical staff in the participating hospitals has become more directly involved in hospital operations; and
3. the quantity and type of information collected in DRG hospitals has expanded, allowing for the development of more sophisticated management information systems.

A second portion of the New Jersey analysis examined the quality and timeliness of data before and after the institution of the new payment system and found that while data accuracy improved, the length of time needed to produce the data increased. Although the abstract face sheet incompletion rate decreased, the amount of time required by the medical records and patient billing departments increased. The author stated that as hospitals become more experienced with the system, it is likely that the time needed to process data will decrease ***(98).***

The details of the methods of the New Jersey evaluation are not yet publicly available, so that interpretation of the results must be preliminary. Nevertheless, there is some indication that imposition of a DRG-based reimbursement scheme requires additional administrative resources. The

● **Demlo and** *her* **colleagues (12) have also suggested that if the practice of determining principal diagnosis by referring to the first-listed item on the face sheet of the medical record continues, the medical record format itself might be revised so that the conditions are recorded in order of priority with the principal diagnosis listed first.**

magnitude of these additional resources and the **implications for Medicare payment cannot necessarily be inferred from this preliminary analysis. Some hospitals could be expected to incur larger cost increases than others as a result of differences in current hospital procedures. It is hoped by proponents that the increased administrative burden would be offset by the cost savings attributable to the imposition of a flat-rate, prospective payment system.**

Chapter 6

Findings and Conclusions

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DRG EVALUATION ISSUES

Diagnosis Related Groups (DRGs) were developed as a method for characterizing hospitals' case mix using data commonly available on hospital discharge abstracts. Although the motivation behind their original development was unrelated to their use in hospital payment systems, they were ready for implementation at a time when a consensus was developing that hospitals should be paid for their outputs (treated cases) rather than for their inputs (services or days of care). As the only system of case-mix classification currently practical for use with per-case payment, it is understandable that DRGs have been selected for use in the Medicare program.

Nevertheless, it is important for those who would use DRGs to recognize that in their present state of refinement (i.e., the **467** DRG classification) they have been inadequately evaluated for their validity as an indicator of patient resource needs and for their impact on medical technology in per-case payment. In light of the budget crisis facing the part A Medicare trust funds in the upcoming years, to move to DRG payment is reasonable. But given how little anyone knows about what to expect from DRG payment, it is ***critical*** that its implementation be carefully monitored, particularly with respect to its effect on the use and adoption of medical technology.

DRG PAYMENT ISSUES

Although there exists little empirical evidence about the effect of DRG payment on the adoption and use of medical technology, ***potential problems with various aspects of program design can be identified.***

First, just as cost-based reimbursement has created inappropriate incentives regarding the use and adoption of medical technology, so too does DRG payment, but the incentives are new and different. Whereas overuse of inpatient services and too lengthy hospitalization were problems under cost-based reimbursement, underprovision of services and inappropriate admission and discharges may be a problem under DRG payment. These incentives will require programs of quality assurance and utilization review designed specifically to deal with them.

Second the incentives affecting the use of medical technology depend on several important aspects of system design. In particular, the way in which capital costs are treated will affect incentives to use and adopt medical technologies. In drafting the Medicare law, Congress recognized that treating capital costs as a pass-through item is not an optimal longrun approach. Hospitals are **likely to become too capital-intensive over time as a result. The diversity** in hospitals' ages, debt structures, and future needs for expansion or closure all argue for hospital-specific determinations of the capital payment levels. These issues are inevitably intertwined with planning for health facilities and are therefore most amenable to treatment on a State level.

Third, **DRGs must be updated to both reflect and induce desirable technological change if the system is to remain responsive** to the needs of all patients. ***Periodic reestimation of relative DRG rates to reflect changes in the costs of various DRGs is essential to a workable program.*** Reestimation guards against growing divergence in the ratios of DRG cost to DRG price, and it also counteracts the potentially deleterious effects of DRG creep. How frequently such reestimation should occur is a debatable issue. The new Medicare law mandates recalibration at least every 4 years, but this interval may be too long. More frequent, perhaps annual, reestimation has disadvantages in increased administrative burden on program administrators and reporting requirements on hospitals. But these administrative costs

might be offset by the enhanced ability of the Federal Government to capture cost savings as they occur and by the strengthened incentives to adopt cost-saving innovations more quickly. Annual reestimation would also be more effective in controlling the longrun incentives for DRG creep than would infrequent reestimation. Whatever its interval, reestimating relative DRG costs implies the need for a continuing source of cost and charge data to support the process. Plans for altering Medicare billing forms and cost reporting requirements should proceed with these requirements in mind.

Methods for updating DRG rates that are conditional upon technology adoption may be important to stimulate desirable but cost-raising innovations. The adjustment process should allow for differentiation in rates between adopters and nonadopters of new medical technologies whose diffusion needs to be stimulated. Creation of new DRGs and provider appeals represent the only viable conditional adjustment methods, and each of these has shortcomings. In particular, heavy reliance on new DRGs runs the risk in the long run of creating a fee-for-service system in the hospital, the precise opposite of what DRG payment is intended to do. Provider appeals conjure up visions of administrative bureaucracy and delays which detract from the otherwise attractive simplicity of DRG payment. Yet, appeals may bean important vehicle for encouraging new technologies. New Jersey's DRG appeals mechanism should provide some insight into its usefulness in this regard.

The DRG adjustment process requires supporting mechanisms for identifying and assessing new hospital cost-raising technologies. Judgments about the readiness of new technologies for payment under one or more DRGs need to be supported by evidence about their effectiveness, risks, and costs. While the Medicare law established a Prospective Payment Assessment Commission whose purpose, among others, is to collect such information, adequate research resources are necessary to support the process.

The reliance of the DRG classification system on accurate and timely data collection and coding will necessitate improvement of hospital's medical records procedures and performance. Educational programs for physicians, nurses, hospital administrators, and medical records personnel should be initiated. Monitoring of information quality both within hospitals and by the mandated peer review organizations will be necessary.

IMPLICATIONS FOR RESEARCH AND EVALUATION

Although a conclusion of this memorandum is that DRGs are ready for use in per-case payment and that they are currently superior for this purpose to any other measure, the importance of a good case-mix measure in making per-case payment a viable longrun payment strategy implies that research on alternative measures must continue. It is too early to consider DRGs the basis for all future changes in case-mix measurement. The new Medicare law requires the Department of Health and Human Services (DHHS) to study the appropriateness of modifying DRGs to account for illness severity or other factors. This study should be enlightening, but by itself it is not enough. DHHS has an excellent record for support of the development of DRGs and other case-mix measurement techniques. Continued aggressive Federal support for development and refinement of promising alternatives is required to reap real improvements in case-mix measurement techniques.

So little is known about the magnitude of the effects of DRG payment on the utilization of services and technologies in the health care system that systematic study of these effects is needed. Studies need to be designed now to evaluate the effect of DRG payment on rates of admissions, lengths of stay, and the use of ancillary, outpatient, and nonhospital care. The new Medicare law mandates a study of its impact on hospital admissions. Such a study could be part of a larger investigation of the law's effects.

Since the effects of DRG payment on access to and quality of care are unknown at present, these factors should be closely monitored as the Medicare program is implemented. Patterns of service specialization are likely to change, and while these results may have benefits, they may leave pockets of inadequate access in some areas. The hallmark of the Medicare program has been the great increase in access of the elderly to mainstream medical care. The effect of DRG payment on access, particularly through hospitals' decisions to open and close services, merits close scrutiny in the coming years.

The importance of pass-throughs in altering the incentives of hospitals argues for careful study of ways to expand the scope of DRG payment. The Medicare law mandates separate studies of two important elements that are currently pass-through items: capital and teaching costs.

Finally, the remaining questions about the impact of specific elements of program design in altering general hospital incentives provided by per-case payment make study of State-level alternative prospective payment systems an attractive prospect. Although States need not adopt per-case payment, the law encourages them to design systems that they can be reasonably confident will do at least as well as the Medicare system in containing hospital costs. Evaluations of such systems, as mandated in the new law, will provide important information to support future improvements in payment system design.

IMPLICATIONS FOR PAYMENT SYSTEM ORGANIZATION

The relatively untested introduction of a national per-case payment system using DRGs as the case-mix measure is a bold step toward improving the efficiency of hospital care. But the system as designed in the new Medicare law is imperfect, and the details of program administration are still to be worked out. DRGs are the best case-mix indicators currently ready for use in a payment system, but there are other measures under development with equal or perhaps even greater promise. Moreover, there are many potential useful approaches to prospective payment and even to per-case payment. It is therefore fortunate that the new Medicare law does not discourage individual States from establishing alternative prospective payment systems. These alternative systems will allow for experimentation with different payment system configurations, including the use of other case-mix measures as they become ***more*** refined.

By statute, alternative prospective payment systems must cover a high proportion of the State's inpatient admissions. The inclusion of payers in addition to Medicare in prospective payment will strengthen its incentives. Furthermore, there are many components of per-case payment that appear to be suited to decentralized administration. For example, utilization review, provider-initiated appeals, and decisions regarding payment for capital costs are more amenable to decentralized administrative structures.

When these administrative issues are considered in conjunction with the potential for sharing administrative costs with other payers, considerable attention should be given to the possibility that the future of DRG payment rests on the degree to which the States join with Medicare to devise all-payer systems. The incentives analyzed in previous sections would all be strengthened under all-payer systems.

Appendixes

Appendix A.— Health Program Advisory Committee and Acknowledgments

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Appendix B.—A Brief Review of the Development of DRGs*

Overview and Historical Perspective

The development of Diagnosis Related Groups (DRGs) has been ongoing since the late 1960's, and it is appropriate to view the concept as one that is continuously evolving. To this point, the evolution of DRGs has involved both conceptual refinements and technical improvements, spurred by the availability of more and better quality input data and by feedback from a wide variety of observers and users of DRGs. It is likely that the evolution will continue as relevant data increase in availability and improve in quality and as the concept is subjected to more and more scrutiny.

The first version of DRGs to be widely disseminated was a set of 383 categories, described by their developers in 1980 (19). Subsequently, in early 1982, a second and much revised set of 467 categories was issued (103). This revised set bore little resemblance to the "original" 383, as it was based on different definitional procedures and a different coding convention. Both sets had several common objectives. Both were designed to identify patients with similar expected resource use, measured by length of hospital stay. (The advantages and disadvantages of the length of stay criterion will be discussed subsequently.) Both versions were defined so as to be medically meaningful to physicians, the key decisionmakers within the hospital with respect to patient care, though the operationalization of this objective varied significantly between the two. Finally, both sets of DRGs were deliberately based on data that are commonly available, and both sets sought to be limited to "manageable" numbers of groups.

In general, the broad outlines for the construction of both sets of DRGs were the same for each version. Actual patient stays in a sample of hospitals were the units of analysis. Each patient's principal diagnosis—i.e., the reason (after study) that the patient was admitted—was coded using a detailed coding system that allowed for many thousands of possibilities. The first step, therefore, was to collapse the detailed diagnosis codes into meaningful, but broad, subcategories called "Major Diagnostic Categories" (MDCS). MDCs were then further subdivided, using a combination of statistical analysis and medical judgment, according to other characteristics that accounted for differences in resource use within the MDC.

The major differences, however, may appear to outweigh the similarities. Significantly modified procedures were used to develop the 467 DRGs. These differences included the involvement of a far greater number of participants, many of them clinicians, which accompanied a shift in the fundamental orientation of the development process. Whereas the development of the 383 DRGs had involved both statistical analysis and expert clinical judgment, the balance between the two components was relatively more even than it became in the revised method, in which the balance was shifted in favor of clinical judgment.

In addition, there were a number of differences in the specific features of the development process. The differences were so extensive that there is very little correspondence between the two sets of DRGs. In the remainder of this appendix, the procedures used to create each of the two sets will be summarized and the similarities and differences among them will be examined.

Development of the "Original" 383 DRGs**

The original 383 DRGs were developed from data for approximately 500,000 patients. Most of these were from New Jersey hospitals, though additional data were also available from a large hospital in Connecticut and for a sample of patients reviewed under the Federal Professional Standards Review Organization program. Before the data were analyzed, cases thought to be misleading or unrepresentative were eliminated from further consideration. These included deaths, miscodes, and patients with extremely long lengths of stay (LOS). The reason for this exclusion was that the overriding objective of the process was to describe a "typical" patient. Apparently, aberrant cases were disregarded.

As a first step, clinicians classified the patient records into 83 mutually exclusive and exhaustive MDCs. MDCs were based on both the etiology (or cause) of the disorder and the organ system involved. The 83 MDCs thus contained a number of categories that were applicable to the same organ system. For example, MDCs relating to the respiratory system included malignancies of the respiratory system, pneumonia, acute upper respiratory infections and influenza, asthma, bronchitis, and other lung and pleural diseases.

* This appendix is based on a paper prepared for OTA by Nancy L. Kelly, Diane E. Hamilton, and Ralph E. Berry of Policy Analysis, Inc.

** Much of the substance of this section was derived from Fetter and colleagues (19).

Analysis was then performed to determine if each MDC should be further subdivided in order to reduce the variance in length of hospital stay. LOS, as noted earlier, was selected because it was viewed as a key indicator of resource use and the best such indicator for which data were available. Justification for its use was the close correspondence between LOS, case complexity, and cost that has previously been reported in the literature (19). Particularly because of the per diem based rate structure of many of the existing reimbursement systems, LOS was considered to be a reasonably accurate and accepted measure of resource use. In addition, the consistency with which this measure was reported was considered a practical advantage. More direct measures of resource use, such as charges, were (and are) not only more difficult to obtain, but they are more difficult to make comparable across areas, due to wage and price differences, and across hospitals, due to differing markups. Consequently, LOS became the focus of the statistical analysis and strongly influenced the final form of the diagnostic categories.

Many have argued that while the number of days a patient is hospitalized is one indicator of resource consumption, LOS by itself may not be an accurate indicator of total patient treatment costs (4,13). This becomes even more evident when one considers different treatment patterns, including the many different ancillary procedures possible, that may occur with different patients in the same DRG.

The use of LOS as the primary measure of resource consumption also contributes to the lack of homogeneity within the original DRGs formed. For instance, the old DRGs grouped together in a single category lung cancer patients with a short diagnostic workup, a lengthy chemotherapy treatment, or a terminal admission (4). Researchers have suggested that clinical data in addition to those already used in the original DRG classification system are needed in order to construct groups that are more homogeneous from both a clinical and resource consumption standpoint (4,13). For instance, age, socioeconomic status, and type of admission have been suggested as important elements in classifying patients into homogeneous groups (4).

Subdivision of MDCs resulted from an iterative process, during which statistical output was reviewed by clinicians in order to determine which grouping alternatives best satisfied both medical and statistical criteria. The statistical analysis involved the assessment of whether within-group variance in LOS was significantly reduced when the patients were subdivided according to secondary diagnosis, primary and secondary surgical procedures, and age. For example, if LOS among all pneumonia patients was highly variable, but it was much more similar within groups of elderly and nonelderly patients, then a decision would be made to divide the MDC "Pneumonia" further, according to whether or not the patient was 65 or older. A next step might involve examining the improvement in LOS homogeneity (or, more technically, the "reduction in variance" in LOS) when elderly and nonelderly patients were further subdivided according to the presence or absence of a secondary diagnosis. The process would continue until it was determined that further subdivision would not significantly reduce the variance, would not be medically meaningful, would result in too many groups, or would result in too few cases contained in a group.

The number of variables investigated was deliberately limited to a small number to reduce the complexity of the analysis. However, they consisted of the variables that the developers considered to be the key discriminators among the characteristics for which data could be obtained from hospital records. Others, such as sex, were tested but did not prove to be important in explaining variations in LOS.

The process of defining DRGs was therefore a complicated one, involving both subjective and objective techniques. Although a consistent approach was maintained within each MDC, few firm guidelines were employed during the initial development phase. However, it appears that, during the formation of the original DRGs, a slight edge was given to the statistical criteria. One result of this was that some MDCs, such as acute myocardial infarction, were not subdivided at all and that others, such as fractures, were subdivided into as many as 13 DRGs. Also, this approach resulted in variation across MDCs in the criterion (or criteria) for subdivision. For some, such as appendicitis, secondary diagnosis was the criterion for subdivision; while for pneumonia, age, surgery, and secondary diagnosis were all used. This difference was accepted insofar as it was seen to reflect variation in relevant patient characteristics.

The result was a set of 383 groups that simultaneously satisfied the criteria established for distinctiveness, medical meaningfulness, and size. It is worth noting once again that the 383 DRGs were based on input data derived from a sample of patients that was mainly limited to the northeast region. The result thus reflected the composition of cases in that sample, as well as the medical practice patterns employed in the hospitals from which these patients were discharged. Also, judgments about the alternative grouping configurations were made by a small group of clinicians whose views may not have been representative of physicians nationally. The possibility that the initial set of DRGs

was not generalizable was raised by many critics (38, 106). This issue was addressed in the subsequent development process.

Most of the evaluation of DRGs to date has focused on the original 383, as the modified set was disseminated only recently. In part in response to criticism from the medical community, researchers, administrators, and others, modifications to the DRG development process were begun in the late 1970's. The modified procedures will be described in the following section.

Development of the Modified 467 DRGs*

The revised set of DRGs has been described as a "major departure" from the original 383 (103). The opportunity for reevaluation and revision of the original set arose with the promulgation, in 1979, of a revised diagnostic coding scheme, known as the International Classification of Diseases, 9th Revision, Clinical Modification, or ICD-9-CM for short. The introduction of the ICD-9-CM coding convention was designed in part to increase precision in diagnosis and procedure coding. Its introduction meant that the two previous coding systems (known as ICDA-8 and HICD-2), in which the 383 DRGs had been defined, would be superseded in hospitals' medical records departments. As the ICD-9-CM system could be related back to the earlier coding schemes (though with some loss of information), the implementation of the new system did not in itself cause the 383 DRGs to become obsolete. However, the original DRGs were defined from a less refined coding system and thus could not benefit from the increased precision of ICD-9-CM unless they were redefined.

Revision of the DRG classification scheme was undertaken not only to take advantage of the improved diagnosis coding, but also to remedy perceived deficiencies in the earlier approach. Criticisms that had been leveled at the earlier system mostly concerned the limitations inherent in the input data, the small number of variables considered, and the lack of clinical homogeneity within some of the individual groups (32,103, 106). Some who used the original DRGs argued that they were not medically meaningful. For example, Williams and his colleagues (99) used a Delphi technique to identify the cause and significance of problems with the original 383 DRGs. Specifically, physicians, hospital administrators, and university researchers who were involved in the New Jersey DRG experiment were surveyed several times in order to reach a consensus on clinically inappropriate patient assignments within the original DRGs. The 38 experts who participated in this study identified and ranked 16 categories of problems that caused inappropriate assignments. Most important to them was that "some DRGs combine clinically similar patients, who nevertheless require different treatments" (99). They also identified 37 of the original 383 DRGs as categories likely to contain patients whose clinical status was not appropriately recognized. Physicians and hospital administrators identified different reasons for the problems, but they specified the same problematic DRGs (99).

Several of the problems identified by Williams and colleagues concerned the medical meaningfulness of DRG-based case-mix measures. Some who have used the original DRGs argue that they are not medically meaningful because patients with very different medical problems are grouped together (4). For instance, old DRG 301 groups together all patients whose principal diagnosis is "replacement of hip with prosthetic device, biopsy of bone, and spinal fusion." In addition, DRGs fail to subdivide some broad diagnostic groups. The original DRG 121, for instance, includes all patients with acute myocardial infarction.

As a result of such criticisms, significant changes were made in the organization and orientation of the development process, the manner in which decisions were made, and the nature of the input data. Specifically, a more structured organization was used to administer the classification process and to guide the decisionmaking. A large number of participants from the medical profession, as well as other areas within the health industry (e.g., medical records) were involved. For this later phase, data were made available by the Commission for Professional and Hospital Activities from the Professional Activity Study (PAS). This meant that a nationally representative sample of patients could be selected and analyzed, thus improving the generalizability of the results.

DRG development procedures were substantially altered during this second phase. The major change was in the basic orientation of the decisionmaking, in that strong emphasis was placed on the clinical, rather than statistical, validity of DRGs, The first manifestation of this change was in the redefinition of MDCs. Rather than using the 83 MDCs defined previously, the revised approach redefined a total of only 23 MDCs, most of which were confined to a single organ system. To return to the example used earlier, diseases of the respiratory system, which were represented by six MDCs in the earlier methodology, were represented by a single MDC in the modified approach. Only a few MDCs (e.g., burns) remained the same. The purpose of this change was to bring MDCs into conformance with the organization of medical practice, in which, for the most part, specialties are defined around

● Much of the substance of this section was derived from Yale University (103).

the various organ systems. This also appeared to facilitate the increased use of expert clinical judgment in developing MDC subdivisions.

Additional changes were made in the process after the redefinition of MDCs. An important change in the analysis was the retention of patients who died. Another was the development and use of more precise guidelines for subdividing MDCs than had been used previously. An outgrowth of this was more consistency in the application of criteria for subdivision. For example, the guidelines required that the initial partition (when possible) be based on the presence or absence of a surgical procedure performed in an operating room. The need for grouping patients with clinically related diseases was continually stressed in the guidelines.

Several important modifications were made in the variables used to subdivide MDCs, primarily to capture severity of illness more precisely. One such modification instructed the expert panels to rank order surgical procedures according to resource use intensity and to assign patients with multiple procedures to the procedure involving the greatest intensity. This meant that the type of surgical procedure became an important consideration in the new DRG development, whereas in the original grouping procedure, only the presence or absence of surgery was taken into account. In addition to considering the type of surgery performed, the nature of existing comorbidity (i.e., coexisting conditions) and complications was explicitly evaluated based on the specific ICD-9-CM codes contained in the patient's discharge abstract. Again, "substantial" comorbidity and complications were distinguished from those considered to be less significant. "Substantial" was defined to include conditions likely to increase LOS by at least 1 day for at least 75 percent of the cases. In many instances, a composite variable indicating whether or not the patient was aged 70 or more and/or had substantial comorbidity or complications proved to be an important determinant of resource use.

Finally, other variables in addition to diagnosis, procedures, and age were taken into account when the experts judged that the additional factors were relevant. For example, for the MDC "Pregnancy, Childbirth, and the Puerperium," the initial division is made according to whether or not the patient was "delivered this admission." With respect to substance abuse, the initial split is according to whether or not the patient "left [the hospital] against medical advice." Death was also included as a possible criterion for subdivision.

While, as noted earlier, the modified process was much more dependent on clinical judgment, statistical analysis again was used to aid decisionmaking. Reduction in variance for LOS was again examined for each partitioning variable considered, but the fact that variance was significantly reduced by a particular variable did not guarantee that that variable would be included in the modified DRG definition. Clinical coherence, above all, dictated which measures would be used.

The modified approach resulted in the definition of 467 DRGs, * which bear little resemblance to the original 383. To the extent that the original groups can be "mapped" into the revised ones, it is clear that while some of the original groups were further subdivided by the new process, others were collapsed into fewer categories. For example, the original DRG 121 was "acute myocardial infarction" (AMI), undifferentiated. In the new configuration, AMI patients are classified into three DRGs:

- circulatory disorders with AMI and cardiovascular complications, discharged alive;
- circulatory disorders with AMI, without cardiovascular complications, discharged alive; and
- circulator disorders with AMI, expired.

In an example of the opposite effect, bronchitis and asthma were divided into three bronchitis- and three asthma-related DRGs under the original system. The modified set includes only a total of three DRGs for bronchitis and asthma combined.

Comparison of Alternative Sets of DRGs

Table B-1 presents a summary of the fundamental similarities and differences between the original 383 DRGs and the modified set of 467. Most of the specific areas shown in the table have been discussed in the previous section. This concluding section, therefore, will focus on the implications of the changes made.

Clearly, the major thrust of all of the methodological changes was to improve the medical meaningfulness of DRGs. To the extent that this was accomplished, it should result in the increased acceptability of the DRG scheme to physicians, who manage the medical care provided to hospital inpatients. As a consequence, the necessary interactions between clinical staff and hospital administrators should be improved. The development of a medically meaningful grouping scheme has always been a clear objective of those who originated the concept of DRGs.

The enhancement of the "clinical coherence" of DRGs was attempted in several important ways:

- by increasing the number of clinician participants and the role of clinicians in DRG development;

* A 468th DRG has also been defined to account for patients who have received an operating room procedure unrelated to their MDC. This "outlier" category is not normally included in descriptions or evaluations of the system.

Table B.1.—Summary of Similarities and Differences Between the Original and Modified DRGs

Original DRGs	Modified DRGs
Based on data for patients from New Jersey and Connecticut, and a sample of Medicare/Medicaid patients (deaths excluded)	Based on nationally representative sample of patients derived from PAS data (deaths retained)
Based on ICDA-8 (or HICD-2) diagnostic coding scheme	Based on [CD-9-CM diagnostic coding scheme
Result from subdivision of 83 broad subcategories of diagnoses (MDCs) based on organ system and etiology	Result from subdivision of 23 broad subcategories of diagnoses (MDCs) based on organ system only
Subdivision of MDCs based on statistical analysis and clinical judgment	Subdivision of MDCs based on clinical judgment and statistical analysis
Variables used to subdivide MDCs include presence/absence of secondary diagnoses and surgery as well as age	Variables used to subdivide MDCs include type of surgery and comorbidity/complications, age, death, and other relevant criteria
Subdivisions not uniform across DRGs	When possible, first subdivision based upon presence/absence of operating room procedure; generally, tighter guidelines for subdivision were applied
End result: 383 mutually exclusive and exhaustive DRGs	End result: 467 mutuallv exclusive and exhaustive DRGs

SOURCE: Office of Technology Assessment.

- by tying the initial subdivisions (MDCs) to major organ systems, in conformance with the delineation of medical specialties;
- by taking the specific nature of surgical procedures and comorbidity/complications into account in forming the groups; and
- by extending the number of characteristics used to partition MDCs when appropriate.

It would appear that significant strides have been made towards the objective of medical meaningfulness. These would also seem to be important strides if physician behavior is to be the target of management or cost control efforts.

It is unclear whether grouping according to clinical similarities was attained at the expense of statistical validity, and if so, whether it is important. The deemphasis of statistical analysis as a mechanism for decisionmaking in forming the groups implies that the new groups may be less internally homogeneous and distinct from each other than the original set. Admittedly, however, the basis for evaluation of within-group homogeneity and between-group heterogeneity—LOS—is an imperfect criterion for indicating resource consumption. Preliminary evidence does indicate, however, that the groups achieve similar reductions in variance for charges as they do for LOS (103). Data available for about 330,000 New Jersey discharges (including cost data) were analyzed, and the results indicated that the distribution of costs was similar to that of LOS for most DRGs. In the few instances where there were significant differences, modifications were made to the relevant DRGs.

Appendix C.— Examples of Per-Case and DRG Payment Systems

Diagnosis Related Groups (DRGs) have been used in three State ratesetting systems, as well as in the Medicare reimbursement system under the Tax Equity and Fiscal Responsibility Act of 1982 (TEFRA) and the Social Security Amendments of 1983 (Public Law 98-21). TEFRA was designed as a temporary response to the problem of hospital cost-containment and specifically called for the Secretary of the Department of Health and Human Services (DHHS) to develop a proposal for a permanent system of prospective payment under Medicare. A December 1982 proposal by the former Secretary of DHHS, Richard Schweiker, called for the creation of a national DRG-specific payment system for Medicare beneficiaries (91). In April 1983, a Medicare DRG payment system was enacted into law with features similar to those suggested in the Schweiker proposal. The new system will be phased in over a 3-year period beginning in October 1983.

Theoretically, DRGs could be used in any hospital payment method, including retrospective cost-based reimbursement, but their importance in payment derives from their use as part of prospective per-case payment systems. *Per-case payment* refers to any prospective hospital payment system with fixed rates of payment based on the hospital admission, not on the bundle of services or number of days of care provided. *DRG payment* is defined here as any per-case hospital payment method in which differences in case mix are taken into account using DRGs to classify case types.

New Jersey is currently the only State in which all patients and all hospitals are subject to DRG-specific rates per case. * Maryland currently uses a case-mix index approach in about 30 of its 51 hospitals, and the current Medicare hospital reimbursement system established by TEFRA sets maximum limits on per-case payment using a DRG case-mix index. Georgia has experimented with the use of DRGs to define hospital groups for per-case payment but is no longer using the system.

New Jersey began using the old 383 DRGs and is now using the modified 467 DRGs in its payment system. The new Medicare system bases payment on the new DRGs. A Medicare case-mix index was developed for TEFRA using the 467 DRGs. Georgia's experiment with hospital groupings was based on the old 383 DRGs. These programs are described in this section.

Several other States are using, and the American Hospital Association (AI-IA) once proposed as a model system, per-case payment systems that do not explicitly adjust for case mix. Descriptions of selected per-case systems are presented below as well.

DRG-Specific Rates Per Case: New Jersey*

In 1978, New Jersey passed a law mandating the gradual implementation of a per-case payment system covering all payers. A Hospital Rate-Setting Commission was given the power to adopt an approach that ties payment rates directly to the patient's DRG. (Much of the developmental work for this ratesetting method was funded by a $3 million Federal Health Care Financing Administration (HCFA) grant to the New Jersey Department of Health.) In May 1980, 26 hospitals began billing patients on a DRG-specific rate per case. By October 1982, all New Jersey hospitals had been brought into the DRG system (22).

The DRG payment system works as follows: each patient is assigned to a specific DRG on discharge, and the hospital is paid a previously specified rate for that DRG. All classes of payers must pay the assigned rate to the hospital regardless of the actual amount of resources consumed in treating the patient, with the exception of these "outlier" cases: patients for whom the length of stay is unusually short or long relative to the mean stay in the DRG; cases where the hospital stay ends with death; when the DRG is a low-volume category; or when discharge is against medical advice. These outlier cases are paid according to the hospital's charges, which are themselves controlled under a preexisting ratesetting approach.**

The DRG rate assigned to a hospital is constructed from data on the hospital's own costs as well as those of all other similar hospitals in the State.*** A hospital-specific preliminary cost base (PCB) is first established by taking the hospital's actual expenditures in a base year (2 years before the rate year). This PCB includes direct patient care costs, indirect (overhead) costs, allowances for the replacement of capital facilities, bad debt and charity care, and working capital. Only the

*The State of New York currently uses a DRG case-mix index in its ratesetting program, but there the unit of payment is the inpatient day, not the case. Payment of per-diem rates creates incentives that are quite different from per-case payment. Consequently, the use of DRGs in New York is not discussed here.

● A detailed description of the New Jersey DRG payment system is provided in a separate working paper, 'Using Diagnosis Related Groups (DRGs) in Hospital Payment: The New Jersey Experience, " by Joanne E. Finley (22).

● *Even these cases would not be reimbursed on a cost-reimbursement basis. They would be paid the DRG rate plus a perdiem rate for each day beyond the "trim point."

● **Hospitals are classified in three categories: major teaching, minor teaching, and nonteaching.

direct care component of the PCB is assumed to vary with the DRG. The direct care costs are allocated among DRGs using formulas that presumably reflect actual resource use by patients in various DRGs. For example, nursing costs are allocated among the hospital's DRGs according to the percentage of total patient days in each DRG, while ancillary department costs are allocated among DRGs on the basis of the percentage of total department charges in each DRG.

Each hospital's DRG-specific average direct patient care cost computed as above is the basis for calculation of a statewide average cost per DRG, which becomes a standard DRG rate. The hospital's rate becomes a blend of the hospital's own average direct care cost per DRG and the peer group average (or standard) DRG cost. The portion of each cost average that is used (i. e., the hospital's own or the standard) varies across DRGs depending on the amount of statewide variance in the costs of treating patients within a given DRG. If there is substantial variation in the costs of treating a DRG, greater reliance is placed on the hospital's own cost experience. The percentage of the statewide standard cost used in setting rates ranges from a low of zero percent to a high of 100 percent, with most DRGs falling into the 40- to 75-percent range (62).

After DRG-specific direct care costs are estimated, hospital-based physician costs and overhead costs are added, and the total is inflated to the rate year. Other allowable costs (e.g., allowances for capital facilities and equipment and charity care) are calculated and allocated among DRGs on a percentage basis. Hospitals are then paid these final DRG-specific rates throughout the rate year.

Under this system, hospitals may keep any surplus achieved by reducing per-case costs, but beginning in the 1982 rate year, a part of any surplus resulting from increasing admissions is taken back in the final reconciliation. Similarly, increases in costs per case must be absorbed by the hospitals, but revenue losses due to decreases in admissions are moderated by a formula at reconciliation.

In theory, this method of DRG price construction contains built-in annual adjustments to DRG rates through changes in the base-year costs to reflect changing levels of resource use. The hospital's rate for a particular DRG could change as a result of either changes in its own costs of providing services or statewide peer group changes in the costs of treating the DRG. The rate facing a particular hospital can change even if its own and the statewide peer-group average costs do not change. For example, if the variance among patients in the cost of treating cases in a particular DRG were to decrease due to greater standardization of treatment across the State, the rate in subsequent years would be based more heavily on the statewide average cost and less on the hospital's own costs than in the previous year. In practice, staff and budget limitations have precluded timely updating of the base year. The 1983 DRG rates are still based on 1979 costs, with only inflation factors changing in recent years (65). The Commission expects to update the base year to 1982 for the 1984 rate year (96).

Changes in specific DRG rates are also possible through an appeals process in which any interested party, be it a hospital, a payer, a patient, or the Commission itself, may request a review of a rate in one or more DRG category if it believes it is offering services using new, more costly technology. As of February 1983, however, only a few DRG appeals had been filed, and none had been completed (96).

Per-Case Payment With a DRG Case-Mix Index: TEFRA

In August 1982, Congress passed landmark legislation, the Tax Equity and Fiscal Responsibility Act of 1982 (TEFRA) (Public Law 97-248), which moved the entire Medicare system toward DRG payment beginning in October 1982. TEFRA made major revisions in traditional cost-based reimbursement with the imposition of a hospital-specific maximum limit on the amount of reimbursable inpatient operating costs.

The new Medicare approach, which went into effect in October 1982, has two key elements:

- For 3 years starting in October 1982, a hospital's inpatient operating costs per case will have a "target" rate of growth determined by the general rate of wage and price inflation in the hospital's region. If its operating costs per case are below this target rate it may keep 50 percent of the savings, up to 5 percent of the target rate. If the hospital's costs exceed the target rate, it will receive only 25 percent of its excess costs in the first 2 years, and none in the third.
- In no case can the hospital's reimbursement exceed a per-case limit on operating costs established by DHHS. The hospital's new limit is 120 percent* of the mean cost per case for hospitals of the same type. (Each hospital is categorized according to its bedsize and location.) The limit is adjusted up or down by a DRG-based index of case mix for each hospital.

Neither of these provisions puts any limit on capital costs (depreciation and interest), direct teaching ex-

● This limit will be reduced over the 3 years to 110 percent.

penses, or outpatient services. These remain "pass-through" items.

The DRG case-mix index for a particular hospital has been computed as the sum over all DRGs of the number of cases in the DRG times its national relative cost weight. The relative cost weights were constructed from a 1979 20-percent sample of Medicare inpatient claims (the "MedPar" file) which contains data on hospitals' charges and clinical information. The weight assigned to a particular DRG is the ratio of the average charge (adjusted and standardized) per case in that DRG to the average charge per case across all DRGs (18). Although the amounts that hospitals charge patients do not necessarily correspond to the cost of treating patients (69), a study of the relationship between hospitals' overall 1979 DRG index value and their total 1979 inpatient operating costs revealed a simple correlation coefficient of 0.60 between the two (69). Further analysis has shown that a given percentage difference in the case-mix index is met with roughly the same percentage difference in operating costs among hospitals (69).

TEFRA did not represent a wholesale abandonment of cost-based reimbursement. For those hospitals whose costs are below both the per-case limit and the target rate, reimbursement will be on the basis of cost, with a small incentive payment added. Over time, however, as the limit becomes tighter, a greater proportion of hospitals will find themselves with the per-case limits as real price constraints.

It was not clearly specified in the law how often HCFA was to update the hospital's case-mix index. There appeared to be no plans to update the index throughout the life of TEFRA. Annual changes in the case-mix index value to reflect changing case loads are considered unnecessary on the assumption that in the short run, a hospital's case mix is relatively stable and not easily manipulated (see ref. 2). This decision underscores the temporary nature of TEFRA provisions, which will be phased out after 3 years as the new Medicare law is implemented.

DRG-Specific Rates Per Case: The Medicare Law

In April 1983, the President signed into law a sweeping revision of Medicare's inpatient hospital payment system (Public Law 98-21). Begining in October 1983, the new payment method will evolve over a 3-year transition into a national set of DRG-specific prices adjusted only for the hospital's area wage rate and its urban or rural location. DRG prices will apply to virtually all short-term acute-care general hospitals in the United States.

The new system will gradually supercede TEFRA, which moved the entire Medicare system from retrospective cost-based reimbursement toward DRG payment. The provisions of TEFRA (summarized above) did not represent complete abandonment of cost-based reimbursement, but after the 3-year transition period, the new Medicare system will virtually replace retrospective cost-based reimbursement with a prospective payment system based on DRG prices.

During the 3-year phase-in period, only part of the hospital's payment will be on the basis of a DRG price; the remainder (a percentage decreasing each year) will be made on the basis of its own reasonable costs (with maximum limits as designated by TEFRA). Capital costs will continue to be paid for totally on a retrospective cost basis* until the end of the transition period, at which time the law contemplates, but does not specify the method for, the incorporation of payment for capital into the DRG pricing system.

The pricing system will apply to all inpatient admissions except for a small number of cases (set as a percentage of the total by statute) with unusually long lengths of stay. The rate of payment for these cases will be increased by the estimated incremental marginal costs of care during the extended stay.

The initial national set of DRG prices will be based on the 1980 average inpatient operating cost per case for each DRG in a 20-percent sample of Medicare inpatient claims. The law requires that DRG prices be updated regularly in two ways. First, an overall annual rate of increase is applied to every DRG to keep pace with the general level of inflation and rate of technological change in the economy. Second, the relative prices (i.e., the ratio of one price to another) must be assessed and recalibrated at least once every 4 years, with the first recalibration scheduled for October 1985. The recalibration process must reflect changes in treatment patterns, technology, and other factors that alter the relative use of hospital resources among DRGs. The Prospective Payment Assessment Commission established by the law will be responsible both for making recommendations regarding recalibration and for evaluating any such adjustments made by the Secretary of DHHS.

Certain kinds of hospitals, such as long-term, psychiatric, and children's hospitals, will be exempted from DRG payment. Teaching hospitals are included, but for the present the direct costs of teaching (e.g., residents' and interns' stipends) will be retrospectively reimbursed on the basis of cost, and a further adjustment will be made for the indirect costs associated with teaching. In addition, the law requires the Med-

*For-profit hospitals will be paid a return on equity as part of the capital cost reimbursement.

icare program to participate in any State-legislated alternative prospective payment program that covers at least 75 percent of the State's population, makes provisions for competitive health plans, assures the Federal Government that access to hospital care for Medicare and Medicaid beneficiaries will not decline, and assures the Federal Government that hospital costs in the aggregate will be no higher under the State program. If the State system leads to hospital costs that are higher than would be expected under DRG payment, Medicare is empowered to recoup such overpayments from hospitals in subsequent years. Thus, States will probably move cautiously to adopt alternative all-payer prospective payment systems.

The law also puts into place a mechanism for quality assurance and utilization review by requiring hospitals to contract with regional peer review organizations at a fixed price per review as a condition of payment. The payments for such reviews will come out of the Medicare Hospital Insurance Trust Fund and are guaranteed by statute.

DRG Case-Mix Adjustment: Maryland's Guaranteed Inpatient Revenue System

The State of Maryland has been regulating hospital rates since 1974, when hospitals' charges were frozen pending the implementation of a new ratesetting approach. From its inception until 1977, the Health Services Cost Review Commission was empowered to set rates for all payers except Medicare and Medicaid. In 1977, a waiver from Medicare and Medicaid regulations was granted by HCFA; since then, the system has included all payers.

The ratesetting program has evolved over time with different methods applied to different hospitals. The Guaranteed Inpatient Revenue (GIR) method, which uses DRGs, was first employed in 1976 in 14 hospitals (53). Today, approximately 30 of Maryland's 51 hospitals are paid by this method, including all hospitals with 400 beds or more.

Maryland's GIR method is essentially a revenue control system, where the allowed amount of revenue per case in each DRG is based on the hospital's actual revenue per case in the DRG in a selected base year. Hospitals do not bill the payer directly by the case; they bill on the basis of approved charges for each service provided. At the end of the year, the actual revenue per case in each DRG is compared to the allowed revenue for that DRG. If actual revenue received per case exceeds the previously set allowed revenue per case in a DRG, implying that the intensity of services and/or length of stay have increased from the base year, the hospital's revenue per case for the following year is reduced by the amount of the difference. If actual revenues per DRG case fall short of approved revenues for the DRG, then the hospital receives the difference in an increase in the following year's approved revenues (8). Hospitals may keep all savings from reductions in per-case costs, but a part of the revenue obtained from increases in admissions is recaptured by the Commission. The hospital is also partly protected from losses due to decreases in admissions.

The GIR system was modified in 1980 to bring interhospital comparisons into the computation of approved revenues per case. Currently, all hospitals in the State are classified by geographic area. For each DRG for each payer category (i.e., Medicare, Medicaid, Blue Cross, and others), an average charge for the group is established. Each hospital's actual charge per DRG in each payer category is then compared to this standard in the group. If, on the average, the hospital's charge is higher than the group standard by more than twice the allowable inflation rate, the hospital's approved revenue is adjusted downward. For example, if the allowable rate of inflation is 6 percent, and the hospital's DRG-specific charges are 15 percent above the group standard, then the hospital is allowed an inflation rate of only 3 percent (15 percent - [2 x 6 percent]) in its computation of allowed revenue for that DRG.

A second modification is also under consideration. For all GIR hospitals, the Commission is moving toward DRG-based reimbursement at the level of the group standard, as opposed to the hospitals' own base-year revenue levels. If, for example, the hospital's DRG revenues are 10 percent higher than the standard across all DRGs, but are well above the standard, say by 40 percent or so, for one or two DRGs, the Commission will move the hospital's rate toward the 10 percent figure on all DRGs. This may have the effect of providing disincentives to the hospital to increase the volume of cases in the more profitable DRGs.

Per-Case Payment With DRGs: Georgia's Medicaid Program

Georgia used DRGs as part of its hospital grouping system in a 1981-82 Medicaid reimbursement experimerit. ' As in any grouping scheme, the underlying assumption was that similar hospitals with similar case mixes and service characteristics should consume similar amounts of resources per admission (80). The grouping was accomplished by using two data sets, one containing the number of patients in each of the

● Since Jan. 1, 1983, Georgia's Medicaid program has been operating on a cost-based reimbursement system using 1980 costs plus an inflation factor.

original 383 DRGs and the other containing data on 20 service characteristics (e.g., bed size, surgical facilities, diagnostic radiology, etc.). The case-mix and service characteristics data sets yielded over 400 bits of descriptive information which were then used to group similar hospitals via a cluster analysis. In 1981, 12 groups were formed ranging in size from 7 to 20 hospitals. When the process was repeated for 1982, there were 11 groups, one with 5 hospitals and the others with 10 to 20 (101). ●

After grouping the hospitals, the Medicaid program compared the operating costs, excluding certain costs such as malpractice premiums, depreciation on capital, and education. A group limit on costs for the next year was set based on 130 percent of the mean. It had been estimated that 10 to 12 percent of the hospitals would be outside their group limits.

Approximately 160 hospitals participated in this project. In the first year, 19 were outside the limit, and in the second year, 22 were higher than the limit. The penalty for being outside the group limit depended on how the hospital's base-year costs had compared to the mean. Hospitals would lose the difference between the allowable inflation rate and the percentage above the base-year mean, with the maximum penalty being the allowable inflation rate. For example, if a hospital were 8 percent over the group limit and if the overall allowable inflation rate were 10 percent, that hospital would have an allowable inflation rate of 2 percent (101).

Per-=Case Payment Without DRGs: California Medicaid

From 1980 to the present, California's Medicaid program (Medi-Cal) has operated under a per-case hospital payment system without an explicit adjustment for case mix. ** For each patient, hospitals have been reimbursed the lowest of: 1) customary charges, 2) Medicare reasonable costs, or 3) a maximum cost per discharge (CPD) calculated in a fixed base year (generally fiscal year 1980). The CPD comprised the hospital's own base period costs adjusted by an inflation index, growth in service intensity, and pass-through costs (including items such as depreciation, interest, utility costs, and malpractice premiums). Changes in the number of discharges from the base year were reflected in adjustments to the CPD limit. Beginning in October 1981, the program began to reduce allowable fixed costs in hospitals with very low occupancy (below 55 percent), thus reducing the cost per discharge limit in those hospitals as a penalty.

Hospitals have the right to appeal their CPD limit to the Department of Health. For example, if a hospital were to find that its Medicaid patient load shifted from more routine cases to a high-cost load of, say, cardiac surgery, the hospital would have recourse to the appeals process. Otherwise, such case-mix changes from the base year to any rate year would not be reflected in the CPD limit.

Per-Case Payment Without DRGs: The AI-1A April 1982 Proposal

AHA proposed a Medicare payment system for inpatient care based on a prospective fixed rate per discharge. Although beneficiary liabilities for deductibles and copayment would remain, hospitals would be permitted to charge up to $1,000 per discharge in addition to the rate received from Medicare if they do not agree to accept the Medicare fixed price as payment in full. Each hospital's rate would be based on its own allowable costs in a base year with adjustments for capital expenditures, compliance expenditures, return on equity, high Medicare and Medicaid volume, and self-insurance against professional liability suits. These costs, with adjustments in a given year, would be divided by the number of Medicare discharges to obtain the initial rate. An inflation factor set by an independent panel of economists would be a forecast intended to reflect input price inflation, medical technology advances, and regional differences. The Medicare fixed rate would be computed by multiplying the base rate by the inflation factor. Hospitals would be paid this fixed rate per Medicare discharge.

In its proposal, AHA asserted that hospitals' case mixes would not change in the short term, for which this program was intended, because of long-standing admitting patterns, medical staff relationships, and hospital policies and procedures. The proposal called for an appeals process, however, which would have allowed hospitals to appeal their rates because of increases in the complexity of their case mixes.

Per-Case Reimbursement Without DRGs: Idaho's Medicaid Program

Since 1979, Idaho's Medicaid program has had a per-case maximum limit on payment for Medicaid hospital

● If the system had continued after Dec. 31, 1982, it was anticipated that the grouping would be an annual exercise until the groups stabilized. The Georgia Medicaid program staff had discussed changes in the procedure that might have led to stabilization (e.g., using the original 83 Major Diagnostic Categories with some partitioning based on whether or not surgery was performed) (101).

● *This method is gradually being phased out in favor of a new "Selected Provider Contracting Program, " under which hospitals will be awarded contracts on the basis of competitive bidding to provide inpatient care for Medi-Cal recipients. Except for emergency admissions, Medi-Cal will pay for care delivered to its enrollees only at contract hospitals.

stays. The limit in any year is calculated on the basis of the hospital's previous year's audited costs per case with an adjustment for inflation. Hospitals are reimbursed the lower of billed charges, allowable costs, or the per-case limit (92). The per-case limit is implicitly adjusted for changes in case mix over time by the use of the previous year's costs in calculating each year's rate. At present, one-third of Idaho's 47 hospitals are subject to the per-case limit (81). However, since Medicaid represents only about 5 percent of hospital expenditures in Idaho, the program is not likely to have had much impact on hospitals' fiscal positions or rehavior.

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