A framework for analyzing prospective payment system rate-increase factors

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Editor's Note—*An earlier version of this framework appeared as Appendix B, "Medicare Program; Changes to the Inpatient Prospective Payment System for Fiscal year 1986 rates; Proposed Rule," in the June 10, 1985, Federal Register. This proposed rule and the forthcoming final rule provide valuable supplemental reading for understanding the context of this framework.*

Overview

Section 1886(e)(4) of the Social Security Act requires the Secretary of the Department of Health and Human Services to update the rates of individual diagnosis-related groups under the prospective payment system beginning in fiscal year 1986, taking into account the recommendations of the Prospective Payment Assessment Commission (1985a and b). Section 1886(e)(4) of the Act reads as follows:

"(4) Taking into consideration the recommendations of the Commission [that is, the Prospective Payment Assessment Commission, or ProPAC] the Secretary shall determine for each fiscal year [beginning with fiscal year 1986] the percentage change which will apply for the purposes of this section as the applicable percentage increase (otherwise described in subsection (b)(3)(B)) for discharges in that fiscal year, and which will take into account amounts necessary for the efficient and effective delivery of medically appropriate and necessary care of high quality."

As prescribed by Section 1886(e)(2) of the Act, the Commission, in making its recommendations to the Secretary, "shall take into account changes in the hospital market-basket described in subsection (b)(3)(B), hospital productivity, technological and scientific advances, the quality of health care provided in hospitals (including the quality and skill level of professional nursing required to maintain quality care), and long-term cost effectiveness in the provision of inpatient hospital services."

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Four of the above factors (market basket, productivity, new technological and scientific advances, and long-term cost effectiveness) are related to inputs and outputs in the process of hospital inpatient care. Quality and intensity of all factors (including the quality and intensity, or skill level, of professional nursing services) are reflected in these four input-output factors.

For purposes of this conceptual framework, we have defined another set of variables as outcomes. Outcomes are a result of the four input-ouput factors. Outcome factors include quality of health care, access to care, financial viability of the hospital industry, and Medicare Part A Trust Fund viability.

The diagnosis-related group (DRG) rate percent-increase factor should be set so that it provides incentives for desired outcomes under the prospective payment system (PPS). A management information system has been designed to monitor outcomes under PPS. Data generated by this monitoring system will be used to improve the overall design of PPS; including the setting of rate-increase factors.

Analytical framework

We have developed factors that are necessary to insure the cost-effective delivery of care. These factors relate to productivity, new technology, scientific advances, and the elimination of ineffective practice patterns. Each factor interacts with the others to some extent and has an impact on the quality of care. We have determined an aggregate percent-increase value for each factor, making conservative assumptions with regard to its potential effect on the quality of inputs and attendant impact on quality of care as an outcome. We have combined these values into a proposed, composite, policy-target adjustment factor.

In this section, we attempt to translate the intent of the PPS rate-increase regulations into an algebraic accounting identity for the four input-output factors. As previously stated, quality of hospital care is considered to be an outcome variable that results from the four input-output factors.

In the accounting identity:

Term A is the average cost per discharge for a typical DRG.

Term B (cost/real input) is current dollar cost divided by real (inflation-adjusted) input. The hospital market basket is a weighted average of the prices of inputs used to produce a constant quantity and quality of hospital care. It is used to adjust for input price inflation specific to the hospital industry. Term B is an expression of the hospital market-basket index; that is,

$$\frac{cost}{real\ input} = market\text{-}basket\ index$$

Accounting identity

$$\underset{A}{\frac{Cost}{Number\ of\ discharges}} \equiv \underset{B}{\left(\frac{Cost}{Real\ input}\right)} \underset{C}{\left(\frac{Real\ input}{Real\ output}\right)} \underset{D}{\left(\frac{Real\ output}{Number\ of\ discharges}\right)}$$

It can also be described as:

$$\underset{A}{Average\ cost\ per\ discharge} \equiv \underset{B}{\left(\begin{array}{l}Average\\cost\ per\\unit\ of\\input\end{array}\right)} \underset{C}{\left(\begin{array}{l}Average\\relationship\\between\\inputs\ and\\outputs;\ that\\is,\ the\ inverse\\of\ productivity\end{array}\right)} \underset{D}{\left(\begin{array}{l}Average\\real\ output\\per\ discharge\end{array}\right)}$$

or, with algebraic manipulation,

$$\frac{cost}{market\text{-}basket\ index} = real\ input$$

Alternatively, cost is the product of quantity of inputs times their respective factor prices. Thus, when cost is divided by the quantity of inputs, the result is price (because the inputs cancel) or the Health Care Financing Administration (HCFA) market basket.

Term C (real input/real output), an expression of the average relationship between the quantity of input and the quantity of output, reflects productivity. The inverse of the standard productivity relationship (output per unit of input) is used because productivity is an offset factor; that is, gains in productivity should be associated with reductions in the rate of increase in the DRG rate. The term productivity is used interchangeably with the term efficiency.

Term D (real output/number of discharges) is inflation-adjusted output per discharge or output intensity per discharge.

In this framework, the intent of the regulation is interpreted as a need to classify hospital outputs per discharge into two categories: cost-effective outputs and cost-ineffective outputs. Cost-effective outputs per discharge are effective in two senses: (1) the outputs are appropriate to hospital inpatient settings rather than to some lower cost setting such as ambulatory care (for example, preadmission testing), skilled nursing home care, or home health care; and (2) value for the money expended exists in terms of enhanced health status compared with cost. Outputs per discharge associated with cost-effective new technologies and scientific advances are expected to add to the current base of cost-effective outputs per discharge. Thus, cost-effective outputs per discharge are an add-on factor.

Cost-ineffective outputs per discharge are ineffective in two senses: (1) the outputs are more appropriate to cost settings less expensive than inpatient hospital, and/or (2) value for money expended does not exist in terms of enhanced health status compared with cost. Cost-ineffective outputs per discharge are an offset factor, because hospitals are reducing the use of ineffective outputs incorporated in base-period practice patterns. Thus, real output per discharge (Term D) needs to be partitioned into two categories: cost-effective and cost-ineffective outputs per discharge.

$$\left[\underset{D1}{(a)\left(\frac{Real\ output}{Number\ of\ discharges}\right)} + \underset{D2}{(1\text{-}a)\left(\frac{Real\ output}{Number\ of\ discharges}\right)}\right]$$

The cost-effective proportion of real output per discharge in the base DRG rate (value for money expended) is reflected by the term (a). Likewise, the cost-ineffective proportion of real output in the base DRG rate is reflected by the term (1-a). Together, (a) plus (1-a) totals 100 percent of real output per discharge.

It is important to understand the difference between the concepts of effectiveness and productivity (efficiency) and how they relate to prospective payment system incentives and the DRG percent-increase factor.

Productivity is a measure of output per unit of input and gets at the question, "Could the same output have been accomplished with fewer resources or with a different mix of resources?" (Suver and Neumann, 1981; and Mundel, 1983). Effectiveness measures are a comparison of a hospital's objectives, such as improving health status, with its accomplishments. Effectiveness gets at the question, "Are we doing the right things?" Two examples of changes in practice patterns to improve effectiveness are the elimination of selected diagnostic tests, because their use does not improve health status, and reductions in length of stay with no decrease in health status.

Four combinations of productivity and effectiveness are possible (Figure 1). Some outputs per discharge are cost-ineffective (more appropriately provided in lower cost settings and/or without value for money

expended) and produced inefficiently (excessive inputs per unit of output), as reflected in quadrant D. Quadrant C combines cost-effective outputs with inefficiency in production (that is, the right care is delivered inefficiently). In quadrant B, there is ineffectiveness, but the production is efficient (that is, less effective care is delivered, but efficiently). In quadrant A, outputs are cost-effective (appropriate to hospital inpatient setting and with value for money expended), and the outputs are produced efficiently (low ratio of inputs to outputs).

Figure 1
Typology for efficiency and effectiveness

	Cost-effective outputs	Cost-ineffective outputs
Efficiently produced outputs per discharge	A Cost-effective and efficient	B Cost-ineffective but efficient
Inefficiently produced outputs per discharge	C Cost-effective but inefficient	D Cost-ineffective and inefficient

A major objective of PPS is to provide incentives for hospitals to move a higher proportion of outputs per discharge from quadrants B, C, and especially D to quadrant A. Positive incentives are given by the add-on for effective new technology and science. Normative standards or policy goals are used to determine the offsets for inefficiency and cost-ineffective practice patterns. When shifts to efficient and effective care are made judiciously, enhanced quality of care should result, with concurrent reduction in the rate of increase in hospital costs (Adam, Hershauer, and Ruch, 1981; Deming, 1982; Donabedian, 1985, 1981, and 1980; Gray and Steffy, 1983; Williamson, 1978; and Williamson, Hudson, and Nevins, 1982).

Increasing productivity and eliminating cost-ineffective practice patterns allow hospitals to shift the mix of services provided to enhance quality of care and/or to increase profit margins. The latter improves hospital financial viability, improving access to and lowering the cost of capital (Cohodes and Kinkead, 1984).

The framework for analyzing the DRG rate percent-increase factor can be summarized as:

$$\text{Percent change in DRG rate} = f(+MB, -P, +CEO, -CIO).$$

where

$+MB$ = Market basket, a weighted average of the prices of inputs used to produce a constant quantity and quality of hospital care (holding all other factors constant). It is an add-on factor.

$-P$ = Productivity (efficiency), a measure of output per unit of input. It is an offset factor.

$+CEO$ = Cost-effective outputs per discharge associated with new technologies and scientific advances. It is an add-on factor and is associated with enhanced quality of care.

$-CIO$ = Cost-ineffective outputs per discharge. This is an offset factor, because hospitals are expected to reduce the use of ineffective outputs.

Outcome variables such as quality of care, access to care, financial viability of the hospital industry, and Medicare Part A Trust Fund viability are monitored under the prospective payment management information system. Peer review organizations represent one example of such monitoring because they set policy targets for reducing risk and improving quality of hospital care. In addition, distributional impacts by hospital type and geographical location are monitored.

Cost-increasing dynamics

Cost-increasing dynamics were built into the retrospective, cost-based method of Medicare reimbursement, which was in effect during fiscal years 1967-83. Under cost-based reimbursement, Medicare costs per discharge rose substantially in excess of economywide inflation. This result could be expected from the incentives inherent in cost-based reimbursement.

The market basket rose faster than economywide prices and wages did. There was no strong incentive to be a prudent buyer of labor or other inputs. The higher the wages or prices paid by the hospital, the more Medicare paid the individual hospital. Also, the more expensive the skill mix of employees, the more Medicare paid the hospital. There were incentives for negative productivity: the more efficient the hospital, the less HCFA would reimburse.

Cost-based reimbursement provided no incentives to specifically encourage cost-effective outputs per discharge or to discourage cost-ineffective outputs per discharge. The incentive under cost-based reimbursement was to increase all outputs per discharge regardless of effectiveness, as long as no harm was done to the patient. Consequently, because of generous cost-based inpatient reimbursement, ineffective outputs are believed to have proliferated. Service outputs that could have been provided in other, more cost-effective settings were often provided in an inpatient setting. Outputs whose costs exceeded benefits in enhanced health status were also encouraged, because Medicare cost-based reimbursement formulas provided "open-ended" spending. In this regard, the Medicare reimbursement system was similar to that of private health insurers.

Cost-decreasing dynamics

The prospective payment system tends to reverse the incentives of retrospective, cost-based reimbursement. During the 3-year cumulative period fiscal years 1984-86, there should be a tendency to reduce the rate of increase of costs per discharge.

Under PPS, hospitals are provided an incentive to be prudent buyers of labor and nonlabor inputs, to pay labor at the "going" wage, and to have an efficient skill mix. Revenues not spent for labor costs can be used to purchase other goods and services that

generate profits, increase competitive position, and enhance quality of care.

Hospitals are rewarded for productivity increases, because they receive a fixed price per DRG. If a hospital is efficient and produces care at costs below the DRG rate, it retains the resulting profits. Likewise, inefficiency is penalized, because costs above the DRG rate are not reimbursed. Productivity improvements for fiscal years 1984-86 could be substantial, following many years of no incentives for productivity improvements under the cost-based system.

Under PPS, with fixed prices by DRG, there is an incentive to search out cost-effective outputs. Hospitals are likely to be more careful in adopting new cost-increasing technologies under PPS. However, if such technologies have a proven value in terms of increased health status compared with money expended, they will probably be adopted. Peer review and peer pressure, competition, threats of potential malpractice suits, and professional ethics will likely provide incentives for hospitals to add certain new cost-increasing, health-enhancing technologies, even with decreases in costs per discharge. Both can occur if productivity is increased and cost-ineffective outputs reduced. By reallocating inputs and outputs toward the more cost-effective practice patterns, cost per quality of care can be improved. When cost-ineffective outputs are eliminated, the inputs associated with these outputs must also be eliminated. Otherwise, costs will not decline proportionately and negative productivity will result.

Policy target adjustment factors

Policy target adjustment factors include the effects of productivity, technology, and cost effectiveness on the DRG rate per discharge. They are termed policy target adjustment factors for two reasons: (1) they are extremely difficult, or perhaps impossible, to quantify individually with existing data sources, and (2) they are likely to be policy-determined variables reflecting targets rather than historical experience. The use of adjustments such as the policy target adjustment factor or the discretionary adjustment factor proposed by the Prospective Payment Assessment Commission has a long historical precedence in State and Federal payment systems (Prospective Payment Assessment Commission, 1985b).

Quantifying aggregate inputs and outputs in a conceptually meaningful way is extremely difficult, perhaps impossible. Therefore, we believe it is not currently possible to make precise empirical estimates for the individual factors of productivity, technology, and ineffective practice patterns. Existing studies are sometimes reported to have a measure or indicator for one of these three concepts, but inadvertently have some unknown mixture of all three. Interaction relationships inherent among the three factors make individually set target values for the three components suggestive, at best, given current data limitations. Each individual hospital can best determine the mix of productivity increases, cost-effective technology add-ons, and ineffective practice pattern offsets to reach the desired target for the sum of the three factors. With this caveat in mind, we will now discuss the individual factors.

The use of the framework for the fiscal year 1986 DRG rate percent change is shown in Figure 2. The annual increase factors are added and subtracted to get the composite percent increase. The algebraic framework previously discussed is multiplicative rather than additive. The difference (resulting from interaction terms) is small. The additive framework is easier to understand for percent changes, so it is suggested for use in this framework. The algebraic framework is presented in terms of costs per DRG. Figure 2 shows percent changes for the various factors relative to the fiscal year 1985 DRG rate levels. The basic concepts inherent in the algebraic framework apply to these percent-change factors.

Productivity offset

Productivity improvements result in increases in output prices that are less than increases in the price of inputs (assuming constant profit margins and no change in the nature of outputs). In competitive industries, consumers benefit from increases in productivity by paying lower prices. Likewise, under PPS, increases in productivity should be reflected in lower DRG prices than would otherwise be the case. Sharing the cost savings from increased productivity provides desirable incentives for hospitals under PPS.

A review of the literature on historical and potential hospital productivity, recommendations of the Prospective Payment Assessment Commission (1985a and b), and numerous reports of hospital industry experiences in recent trade journals such as *Health Care Financial Management, Hospitals*, and *Modern Health Care* indicates that, in aggregate, a 1.0 percent productivity offset is both reasonable and conservative (Altman and Eichenholz, 1974; Applied Management Sciences, Inc., 1980a and b; Cromwell, 1974; Grimaldi and Micheletti, 1985; Gray and Steffy, 1983; and Sherman, 1984). This policy target adjustment factor for fiscal year 1986 takes into account that productivity increases may occur with a lag after reductions in the ineffective practice pattern outputs observed in fiscal year 1984. The 1.0-percent offset allows most of the potential productivity gains to accrue to the hospital industry. No duplication is caused by offsets for both productivity and ineffective practice patterns, because the latter are for observed changes in fiscal 1984 and the productivity offset is for prospectives changes during fiscal years 1985 and 1986. Although ineffective practice patterns were observed to be reduced in fiscal year 1984, the offset factor will not be operative until fiscal year 1986.

Process-innovative technologies, which are associated with increased productivity and decreased operating costs, are included with the productivity offset factor, not with the technology add-on factor. Capital costs associated with the purchase of cost-decreasing technologies continue to be reimbursed on a pass through or retrospective cost basis.

Decreased operating costs associated with the use of such cost-decreasing technologies can be used to

Figure 2
Use of the framework for the fiscal year 1986 DRG rate percent change

Annual DRG increase factors	Percent change	Brief rationale
Hospital market basket	+4.85	This is the percent increase forecast for fiscal year 1986. It reflects a complete passthrough for hospital input price inflation. Because hospital industry wage rates are used in calculating the market basket, shifts in occupational mix and skill mix are automatically included in the market basket.
Policy target adjustment factors	- 1.5	
Productivity (efficiency) offset	- 1.0	Valid productivity indexes are not currently available for the aggregate hospital industry (Prospective Payment Assessment Commission, 1985b). Various Bureau of Labor Statistics economywide productivity indexes indicate productivity increases of approximately 3 percent annually for the last 2 historical years (1983 and 1984). However, long-term average rates of increase vary substantially depending on the time period covered, the industries included, and the type of productivity measure used—multifactor productivity or labor productivity (Prospective Payment Assessment Commission, 1985b). A 1.0 percent productivity offset is conservative. It allows for most of productivity gains to accrue to the hospital industry.
Cost-effective technologies add-on	+1.5	This is a target rate of increase that allows significant growth over time in cost-increasing, health-enhancing new technologies and scientific advances, as they affect operating expenses (Prospective Payment Assessment Commission, 1985a and b). This target rate of increase recognizes that long-run, historical intensity increases are not compatible with the viability of the Medicare Hospital Insurance Trust Fund. By increasing productivity and eliminating ineffective practice patterns at rates higher than shown here, hospitals free additional revenues. These revenues can be used to purchase additional technologies at a rate in excess of the 1.5-percent target rate of increase and/or to increase profit margins. Capital costs associated with new technologies continue to be reimbursed on a retrospective cost basis.
Ineffective practice patterns offset	- 2.0	Ineffective practice patterns include services that are more appropriately provided in lower cost settings or services that do not give value for money expended. The average length of stay for Medicare patients decreased 11.0 percent for hospitals in States with prospective payment in fiscal year 1984. Physicians reduced outputs associated with this decline in length of stay. Presumably, physicians deemed that such outputs would not give value for the money expended and/or could be provided more effectively in a lower cost setting. If marginal cost is assumed to be 40 percent of average cost, then costs would be reduced 4.4 percent. A 2.0-percent offset has been chosen. This allows for more than one-half of the fiscal year 1984 estimated savings to accrue to the hospital industry and does not take any additional amounts for potential gains in fiscal years 1985 and 1986.
Composite increase	+3.35	

finance quality-enhancing services. In addition, reductions in length of stay do not necessarily translate into increases in productivity when using conventional definitions of productivity (real output per unit of input). Also, measures of both outputs and inputs are necessary to quantify productivity.

Cost-effective technologies add-on

Certain product-innovative technologies and scientific advances (with accompanying labor and nonlabor inputs) are believed to increase the operating cost of treating illness, but they result in a favorable ratio of benefits (improved health status) to operating costs. Such cost effectiveness can be subjective and difficult (or, perhaps, impossible) to quantify in the aggregate (Warren and Luce, 1982). It is the intent of Federal regulations to include an add-on factor for such technologies and scientific advances. Inclusion of this cost-increasing, health-enhancing technology factor recognizes that, within bounds, HCFA should continue to provide positive incentives for technological and scientific excellence.

The impact of new technologies and scientific advances on operating cost and health status is hard to isolate (Prospective Payment Assessment Commission, 1985b). Typically, some uses of a specific new technology increase operating costs, and other uses decrease them. Use of new technologies may increase costs in the short run, but decrease costs in the long run, with attendant increases in productivity. Concurrently, in some situations, their use may substantially improve health status; in others, it may have no effect or worsen health status. Isolating the relative importance of each of these effects in the aggregate has proven to be elusive from a statistical point of view (Altman and Blendon, 1979; Office of Technology Assessment, 1983 and 1984).

Ineffective practice patterns offset

Some outputs per discharge are cost-ineffective. Effectiveness compares a hospital's objective of improving health status with cost-effective use of resources. Selected diagnostic tests may be eliminated because their use does not improve health status. Lengths of stay may be reduced providing no decrease in health status results. Based on articles in a recent issue of *Health Affairs* journal (1984), the experience under PPS, and studies on this subject, it appears that retrospective, cost-based reimbursement encouraged the growth of ineffective practice patterns. Substantial savings can be achieved by changing practice patterns to ensure more effective use of resources.

Average length of stay for hospitals in States subject to PPS (excluding hospitals in Maryland, Massachusetts, New Jersey, and New York, which are paid under specially approved State systems) declined 11 percent in fiscal year 1984 (Bureau of Data Management and Strategy, 1985). A reduction in operating costs occurs when length of stay is reduced. For purposes of determining additional payments for day outlier cases, HCFA assumes the marginal cost of an additional day of stay to be equal to 60 percent of the average per diem payment for the applicable DRG, excluding payment for pass-through costs that are not included in the prospective payment rate. If this represents the ratio of marginal cost to average cost, the 11-percent reduction in length of stay results in about a 6.6-percent reduction in cost per case. Of course, it can be argued that the marginal cost of an additional day of care may be significantly less than 60 percent of the average per diem cost. If marginal costs are assumed to be 40 percent of the average per diem cost, the fiscal year 1984 reduction in length of stay results in about a 4.4-percent reduction in cost per case. However, these probable reductions in costs do not reflect other changes in utilization of ancillary services, which have probably generated further reductions in the average cost per case under prospective payment.

Conclusion

Reasonable target rates of increase and decrease have been used for each of three factors: productivity, cost-effective outputs associated with new technologies and scientific advances, and cost-ineffective practice patterns. These target rates of change reflect a need to obtain a composite increase for the sum of all three components. The composite increase should be reasonable and should provide incentives for desirable outcomes relating to quality of care, access to care, and financial viability of both the hospital industry and the Medicare Part A Trust Fund. Target rates of increase are intended to reflect judicious policy goals rather than historical patterns.

The prospective payment system was intended to produce significant changes in the hospital industry. These changes need not be in conflict with each other. Productivity and cost-effectiveness need not compete with quality; usually they are best pursued together. For example, practice patterns that minimize the potential for iatrogenic diseases result in reduction of ineffectiveness, eliminate unnecessary costs, and directly contribute to improved health status. Also, under PPS, a hospital that improves productivity and reduces its costs per case has an opportunity for an improved margin of revenue over cost. Depending on individual hospital choice, this margin may be shared many ways. A portion of it could be expended in ways that would improve quality.

As the concepts in our framework are modified to reflect improved understanding of the factors contributing to the DRG percent increase, and as relevant data become available, the DRG percent-increase methodology will evolve to incorporate such changes.

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