



**PBGH**  
Pacific Business  
Group on Health

## **Hospital Cost Efficiency Measurement: Methodological Approaches**

J. William Thomas PhD, Institute for Health Policy, University of Southern Maine

Prepared for the Hospital Value Initiative sponsored by the California Public Employees Retirement System and Pacific Business Group on Health

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# Acknowledgements

## About the Author

**J. William Thomas, Ph.D., M.B.A.**, is Professor Emeritus of Health Management and Policy at the University of Michigan, as well as Professor of Health Policy and Management at the University of Southern Maine. His research has focused primarily on measuring performance of health care providers in terms of efficiency and quality of care. During the 1980s and early 1990s, his work focused on hospital inpatient care. More recently, Dr. Thomas has examined methodologies used in the economic profiling of physicians. In 2002, he completed an evaluation of risk adjustment methods used in the economic profiling of primary care physicians. In 2004, he finished a study that focused on methodological issues associated with economic profiling of specialist physicians, including minimum sample sizes needed for reliable profiles, rules for attributing responsibility for episodes of care to individual physicians, and methods for dealing with cost outlier episodes. Currently, he is working with the RAND Corporation on a study investigating relationships between measures of physicians' quality of care performance and practice efficiency performance. He also is working with colleagues at the University of Southern Maine on a Robert Wood Johnson Foundation grant examining issues associated with use of tiered provider networks by health plans.

Preparation of this report also reflects review, comments and technical input by individuals listed below.

Anne Castles, M.P.H. (Pacific Business Group on Health)  
Matthew Frankel (Mercer Human Resource Consulting)  
Ray Herschman, M.S. (Mercer Human Resource Consulting)  
David Hopkins, Ph.D. (Pacific Business Group on Health)  
Peter V. Lee, J.D. (Pacific Business Group on Health)  
Arnie Milstein, M.D., M.P.H. (Pacific Business Group on Health)  
Loren Suter (California Public Employees' Retirement System)  
Sarah Young (Mercer Human Resource Consulting)

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For further information regarding the PBGH-CalPERS Hospital Value Initiative, please contact Anne Castles at 626-564-0757 or [acastles@pbgh.org](mailto:acastles@pbgh.org).

# Hospital Cost Efficiency Measurement: Methodological Approaches

January 2006

The report that follows, *Hospital Cost Efficiency Measurement: Methodological Approaches*, was commissioned jointly by the Pacific Business Group on Health (PBGH) and the California Public Employees' Retirement System (CalPERS) in order to provide a framework for discussing and selecting measures of hospital efficiency. The report was authored by Bill Thomas, Professor Emeritus from the University of Michigan, and a noted authority in the field. It introduces the reader to the arena of cost-efficiency – defining terminology and summarizing the various approaches and challenges to sound measurement.

For more than 15 years, PBGH and its members, including CalPERS, have advocated for the increased availability of health care performance information at all levels of the delivery system. Performance information not only enables purchasers and consumers to make value-based choices, but also stimulates improvements in quality and efficiency of care through increased accountability on the part of health plans and providers. PBGH's and CalPERS' performance measurement efforts have rested on three principles: (1) measures should be valid and scientifically sound; (2) measures should present as little burden as possible on providers and be standardized across payers and providers; and (3) information on both quality and efficiency is necessary for consumers and purchasers to make true value-based buying decisions and for providers to use for quality improvement.

Building on these principles, PBGH and CalPERS recently launched a major initiative aimed at developing a consensus among California stakeholders – including purchasers, labor, consumers, plans, physicians, and hospitals – on a standard, scientifically-defensible set of cost efficiency metrics for hospitals. That standard will then be applied in measuring performance in our market and, we hope, will inform the development of a national standard. This *Hospital Value Initiative* is one element of the CalPERS-sponsored *Partnership for Change*, and is expected to complement the work of CMS, the national Hospital Quality Alliance, and the California Hospital Assessment and Reporting Task Force (CHART) by recommending cost-efficiency metrics that can be used in combination with clinical quality and patient experience measures to better inform health-care decision making. We further expect that establishing a statewide standard for measuring hospital cost efficiency will reduce the myriad of products currently being used to evaluate hospital costs and replace them with a single set of methodologically-sound metrics.

It is our hope that this report not only serves to facilitate the consensus-building process in California, but also assists standard-setters and health care industry stakeholders nationwide as efficiency metrics are considered for application by other payers and in other markets.



Peter V. Lee, J.D.  
Chief Executive Officer  
Pacific Business Group on Health  
San Francisco, CA



Deputy Executive Officer for Benefits Administration  
CalPERS  
Sacramento, CA

## **About the Pacific Business Group on Health**

The Pacific Business Group on Health (PBGH) is one of the nation's top business coalitions focused on health care. Our large purchaser members spend billions of dollars annually to provide health care coverage to more than 3 million employees, retirees and dependents. In addition, PBGH operates PacAdvantage, a small group purchasing pool providing health coverage to the employees of thousands of California's small businesses. PBGH is a respected voice in the state and national dialogue on how to improve the quality and effectiveness of health care while moderating costs. Partnering with the state's leading health plans, provider organizations, consumer groups and other stakeholders, PBGH works on many fronts to promote value-based purchasing in health care. Reflecting the vision of its member organizations, PBGH plays a leadership role in an array of health care quality initiatives that includes providing consumers with standardized comparative quality information and developing methods to assess and communicate the quality of care delivered by health plans, medical groups, physicians and hospitals. For additional information or an electronic copy of this report, visit [www.pbgh.org](http://www.pbgh.org).

## **About the California Public Employees' Retirement System**

CalPERS is the nation's third largest employer-purchaser of health benefits after the federal government and General Motors. The System provides benefits to 1.2 million State and public agency employees, retirees, and their families. The CalPERS Health Program seeks to: assure that affordable, quality health care is available to all members; develop strategies to take advantage of our purchasing power and position in the health care marketplace; and provide focus and leadership so that CalPERS can influence the evolution of changes in health care. The Partnership for Change: Promoting Value in Hospital Care is a CalPERS effort to increase hospital accountability and improve the quality and efficiency of hospital care. By acting together, purchasers of health care can bring about significant improvement in these areas. For more information about CalPERS or The Partnership for Change, visit [www.calpers.ca.gov](http://www.calpers.ca.gov).

# Hospital Cost Efficiency Measurement:

## Methodological Approaches

January 2006

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# Objectives of this Guide

In identifying six domains of performance for the health care system to target in measurement and improvement activities, the 2001 Institute of Medicine (IOM) report *Crossing the Quality Chasm* has been a central force in focusing efforts to standardize performance improvement activities. Since the publication of that report, tremendous strides have been made in developing consensus around standard sets of clinical effectiveness and patient experience measures through the efforts of organizations such as the Joint Commission on the Accreditation of Health Care Organizations (JCAHO), the National Quality Forum (NQF), the Centers for Medicare and Medicaid Services (CMS), and National Committee for Quality Assurance (NCQA).

However, the domain of efficiency – defined by the IOM as “avoiding waste” – has thus far not been central in these standard-setting activities. Although several commercial products are available, there currently exists no agreement on a standardized, methodologically-sound approach for evaluating the efficiency of health care providers. This lack of a standard is particularly problematic at the hospital level, given that hospital services make up the largest portion of health care spending.

Payers have increasingly realized that measuring efficiency is an essential component for developing the benefit design, rewards programs and network solutions that will direct patients to providers with demonstrated ability to efficiently deliver high-quality clinical services. One manifestation of this demand can be seen in the formation of the Hospital Value Initiative, a purchaser-led effort designed to build consensus among pertinent California stakeholders on a scientifically-defensible set of efficiency metrics that can better inform health care decision making.

This primer is intended to help California health care industry stakeholders and others communicate effectively about issues of hospital efficiency. In support of this objective, we propose terminology and present concepts that hopefully will reduce ambiguity and enhance understanding of different stakeholders’ perspectives and concerns. We present examples of indicators proposed as measures of hospital efficiency, and we talk about the assumptions underlying these indicators and issues involved in their use. For one comprehensive measure of hospital efficiency, we elaborate on steps required when transforming raw data into summary measures of hospital performance. And, finally, we discuss the methodological challenges that must be addressed if hospital efficiency is to be measured reliably and validly. Although our focus here is on hospital efficiency, many of the concepts apply equally to measuring the efficiency of physicians and other provider units.

# Terms and Concepts

## Efficiency and Cost Efficiency

The term *efficiency* has been used in several ways in health care. Health economists employ one definition, and insurers, employers and others concerned about relative cost and resource use among providers typically utilize a different definition. Health economists define *efficiency* as a measure of relative resources required to achieve a given *level of outcome* – e.g., absence of pain, restoration of mobility. However, when payers and purchasers speak of efficiency, they tend to focus on the costs of resources for a specified set of services, without explicit reference to outcomes or quality. Their concept is that such measures should be independent of measures of quality, but that they should be considered along with available clinical effectiveness and patient experience measures when evaluating provider performance.

Recognizing that economists, purchasers, payers, policy makers and others all have important interests in efficiency-related issues and that meanings are sometimes unclear, we would propose the following distinctions between closely related terms.

- **Cost efficiency** refers to relative total cost incurred by patients and their insurers for treatment of specific conditions, regardless of clinical outcomes. In this definition the term “relative” indicates that cost incurred are compared to a cost standard, such as average cost in peer hospitals for the conditions managed. This measure reflects the combination of quantity and mix of services rendered and unit prices of those services. It is typically adjusted for case mix differences and other factors that may affect total cost of care

beyond the practices of the provider being measured.

- **Efficiency** refers to the relative quantity, mix, and cost of clinical resources used to achieve a measured level of quality.

In this primer, we will adopt this terminology, and our focus will be on measurement of *cost efficiency* of hospitals, where we will use the term *cost* to refer to the amount **paid** to the hospital (or potentially other providers) for its services by the combination of insurer and patient, i.e., the **cost to payers**. This cost is the product of resource use times unit prices. This use is in contrast to the way the term is generally used by the hospital industry to refer to the **cost incurred by a hospital** to produce services.

## Measures and Indicators

Whether speaking of efficiency or cost efficiency, we are concerned with *relative* resources used; that is, our focus is the quantity or costs of resources employed by one or more providers compared to a standard or to the quantity or costs of resources employed by other providers. A key characteristic of both terms is that they are not measured in price per pound or feet per second or any other type of unit; they are ratios where both numerator and denominator have the same units – e.g., dollars, FTEs – and the resulting ratios have no units. Although a *measure* of cost efficiency must be unitless – e.g., 1.2 – the same is not true of an *indicator*. Any number that can be used in the numerator of a cost efficiency calculation can be used as an indicator of cost efficiency. For example, hospital FTEs per bed might be used as an indicator, as might average length-of-stay per adjusted

discharge. But these are not *measures*, since cost efficiency is unitless. Nevertheless, cost efficiency indicators can be as useful as cost efficiency measures when evaluating providers, but this requires that the standard of comparison – the denominator in the ratio calculations – be the same among all providers.

## Appropriateness of Care

*Inappropriate care* may be defined as care that a well-informed patient would not want, or care that violates applicable nationally-endorsed clinical guidelines, or that offers no probable net gain in health or in the patient’s satisfaction with health. Some potential indicators of hospital cost-efficiency, such as “preference-sensitive care” and “supply-sensitive care” proposed by John Wennberg and his colleagues at Dartmouth, address one or more of these inefficiencies. However, most cost efficiency indicators do not.

## Unit of Analysis

Hospital cost efficiency analyses involve comparisons across institutions, and the term *unit of analysis* refers to what is being compared. **Table 1** summarizes the potential units of analysis,

## Focus of Analysis

Cost efficiency analyses can encompass all services provided in hospitals, or they can be limited to specified service lines such as cardiology or obstetrics. Analyses might also focus on comparisons of patients admitted by specified physicians or physician groups. Validity of cost efficiency comparisons (see below) is enhanced when focus boundaries are specified explicitly. For example, comparisons of cardiac surgery costs across hospitals might be defined as focusing on episodes of specified types (e.g., “with surgery” ETGs in the range 0256 – 0311), or patients discharged in specified DRGs (e.g., DRGs 103-112), or patients undergoing specified ICD9-CM procedures.

## Resource Use and Unit Price as Subcomponents of Cost Efficiency

In managing a patient’s care, one provider might utilize exactly the same quantity and mix of resources – personnel hours, equipment time, supplies, etc. – as a second provider, and still be less cost efficient. This would occur if the first is paid higher prices than the second for the resources used in providing care. Alternatively, the two providers

**Table 1. Examples of Potential Units of Analysis**

Unit Type	Focus of Comparison
<b>Hospital inpatient stay</b>	<ul style="list-style-type: none"> <li>• Inpatient facility costs incurred during the period between hospital admission and discharge</li> <li>• Professional fees associated with the hospitalization are also considered in some cases.</li> </ul>
<b>Outpatient visit</b>	<ul style="list-style-type: none"> <li>• Outpatient facility costs incurred for specified services or procedures</li> <li>• Associated professional fees are also considered in some cases.</li> </ul>
<b>Hospital episode of care</b>	<ul style="list-style-type: none"> <li>• All costs associated with acute hospital episodes, e.g., <ul style="list-style-type: none"> <li>• Inpatient facility costs</li> <li>• Related medication costs, professional fees, facility costs for such services as laboratory tests and radiology examinations provided to patients prior to hospital admission.</li> <li>• Costs for services, such as physical therapy, that are provided after discharge</li> <li>• Costs associated with related hospital readmissions when they occur.</li> </ul> </li> </ul>
<b>Longitudinal episode of care</b>	<ul style="list-style-type: none"> <li>• All medical costs incurred during a specified period by members of a defined cohort of patients, such as all persons hospitalized with a diagnosis of hip fracture.</li> </ul>

might be paid exactly the same prices for resources used, and one might be considered more efficient than the other because that provider used a less costly mix or a smaller quantity of resources. When possible, it is useful to partition measured cost efficiency into resource use, or utilization, based cost efficiency, which concerns quantity and mix of resources consumed, and unit price based cost efficiency, which relates to relative prices paid for resources. Unfortunately, this is feasible only when the unit of analysis is episode of care, because outpatient analyses typically focus on a single service or resource and inpatient facility analyses typically are based on sources of data (see below) that do not provide the level of specificity needed.<sup>1</sup>

Episodes of care, on the other hand, are composed of bundles of outpatient, professional, and pharmaceutical services, in addition to inpatient facility services. With outpatient, professional, and pharmaceutical claims, all services of the same type in the data base (e.g., having the same CPT code for professional services, HCPCS code for outpatient facility services, or NDC code for medications) can be assigned the same standard unit price. For hospital inpatient services, prices can be standardized on the basis of DRG (or APR-DRG) and/or length of stay. Then, episode calculations based on these standard unit prices will reflect quantity and mix of resources utilized (i.e., utilization-based cost efficiency); and calculations based on actual costs listed on service-level claims will describe provider total cost efficiency. Differences between a hospital's total actual cost and its total standard cost reflect *unit pricing* for that institution.

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<sup>1</sup>Even hospital claims records generally do not provide the necessary level of detail. Line items on hospital claims typically include entries such as "Laboratory-Chemistry" and "Pharmacy-Generic Drugs" which identify only the general category of services received by patients and the cumulative charge for those services. However, where specific services can be quantified (number of days in different bed types), distinctions between unit price- and resource use-based cost efficiency for that service are possible.

## Validity of Indicators of Hospital Cost Efficiency

Cost efficiency indicators can be used in steering health plan members toward high performance hospitals or in other ways designed to reward hospitals for their superior performance. If cost efficiency indicators are valid, such uses can be expected to reduce or control increases in hospital expenditures. However, if the indicators are not valid, health plan members may be steered not to the more efficient hospitals, but rather to average or inefficient hospitals. And invalid measures are unlikely to encourage hospitals to improve efficiency, because inefficient hospitals could be rewarded as frequently as efficient hospitals. A valid indicator of hospital cost efficiency is one that consistently and accurately distinguishes among efficient, average, and inefficient hospitals. Such measures can be characterized in terms of degree of bias, reliability, scope and perspective.

***Degree of Bias.*** A biased indicator cannot measure cost efficiency performance accurately; it will suggest that a hospital's level of cost efficiency is higher or lower than is actually the case. What are the possible sources of bias in cost efficiency indicators? The most obvious source is inadequate risk adjustment, where differences in risk among patients are due to differences in clinical conditions, severity, and demographics. A hospital treating patients who are more severely ill than patients in other hospitals can be expected to consume more resources than the other hospitals. If appropriate adjustments are not made to cost efficiency indicators, then that hospital is likely to appear less efficient than the other hospitals, even if it is actually more efficient. In addition to case-mix and severity related sources of bias, other sources include systematic differences among hospitals in:

- (a) volumes of patient transfers, both into and out of hospitals;
- (b) geographic area wage rates and local input prices that influence hospital operating costs; and

- (c) patient characteristics, such as poverty status, that might influence quantity and mix of resources required for care.

If indicators are not properly adjusted to control for such differences when they exist, hospital cost efficiency indicators will be biased and measured performance will be inaccurate.

**Reliability.** Reliability refers to the likelihood that an indicator will yield the same value each time it is assessed. If an indicator is unreliable, it is likely to produce different views of hospital cost efficiency performance, even when performance is unchanged and even though the indicator's value, averaged over a long period of time, might provide an accurate picture. What can cause unreliability in cost efficiency indicators? The principal source of unreliability is the "small numbers problem."

Indicators that are averages, such as average cost per discharge, average length-of-stay, and early readmission rate, must be calculated from a large enough sample of cases to ensure that sampling variability (difference between sample mean and overall mean) is small. If average length of stay is calculated for a single diagnosis, using, for example, only 10 discharges, the calculated average can be quite different – smaller or larger – than the true long-term average length-of-stay for that diagnosis in the hospital. The larger the number of cases used when calculating averages, the more reliable the resulting indicators will be.

A second source of unreliability in cost efficiency indicators is the distorting effects of outlier cases. For example, in calculating average cost per discharge, if one patient's cost is \$200,000 and all other similar patients have costs less than \$20,000, the one high cost patient can greatly influence the

calculated mean. Various techniques, such as dropping outlier cases from analysis or truncating their values, exist for reducing the distorting effects of such cases.

**Scope.** Potential cost efficiency indicators such as average length-of-stay and readmission rate reflect hospital inpatient performance only. Ideally, hospital cost efficiency indicators should provide information on outpatient as well as inpatient aspects of hospital operations. In addition, as discussed below, in the case of episode-based cost-efficiency measures, it is crucial to include hospital-associated differences in non-hospital related costs. For example, average payable surgeons' fees may be higher at one hospital than another. This could be accomplished by including professional fees in the cost calculation and/or outpatient-specific indicators in the set of indicators used when assessing cost efficiency performance, and/or by focusing on indicators that simultaneously address both outpatient and inpatient performance. Outpatient specific indicators might include, for example, total cost per adjusted outpatient visit. Aggregate indicators addressing both outpatient and inpatient operations might include, for example, total cost per episode for types of episodes that include both inpatient stays and outpatient services.

**Perspective.** From whose perspective is hospital cost efficiency being viewed? Alternatives include (a) the hospital, in which case the focus of cost efficiency measurement is the relative cost incurred by the hospital in producing a specified set of services, or (b) the insurer or purchaser (same perspective), in which case the focus is the relative payment for a specified set of services. We take the latter perspective in this document.

# Potential Sources of Data for Cost Efficiency Measurement

While there are numerous potential indicators of hospital cost efficiency,<sup>2</sup> data that can be used for assessing these indicators of performance fall into only three categories. These are insurer paid claims databases, hospital discharge abstract databases, and Medicare Cost Report data.

## Paid Claims

Paid claims databases from commercial health insurers, such as Blue Cross of California and PacifiCare, and government health insurers, such as Medicare and Medi-Cal, represent the richest source of detailed data available for assessments of hospital cost efficiency performance. Claims databases maintained by health insurers, both commercial and government, include medical and, in many cases, pharmaceutical claims records for covered services provided to insured members during a specified period of time. Among the items listed on each medical claim are:

- (a) unique patient identifier;
- (b) unique provider identifier;
- (c) dates of service;
- (d) ICD9-CM codes for diagnoses present at time of service;
- (e) codes identifying procedures performed (ICD9-CM codes for inpatient services, CPT codes for professional services, and HCPCS

codes for outpatient services such as laboratory testing);

- (f) service charge (often called "billed amount");
- (g) allowed amount (the fee determined by the health plan as appropriate payment for the service); and
- (h) paid amount (the amount actually paid to the provider after patient deductibles, co-pays, and co-insurance).

Pharmaceutical claims include, among other things,:

- (a) unique patient identifier
- (b) unique pharmacist identifier;
- (c) NDC code and quantity of specific medicine dispensed;
- (d) prescribing physician identifier (although this is sometimes missing)
- (e) billed amount;
- (f) allowed amount; and
- (g) paid amount.

## Hospital Discharge Abstract Databases

Hospital discharge abstract databases, such as that maintained by California Office of Statewide Health Planning and Development (OSHPD), include a single summary record for each hospitalization occurring during a period of time. Each discharge record in the OSHPD database includes fields for:

- (a) hospital identifier;
- (b) patient demographics;

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<sup>2</sup>Note that the examples given here are indicators, as opposed to measures, of cost efficiency. If indicators, such as hospital risk-adjusted average length-of-stay, are divided by an appropriate reference value, such as regional community hospital risk-adjusted average length-of-stay, the resulting ratios are properly viewed as measures of cost efficiency.

- (c) ICD9-CM diagnosis codes;
- (d) ICD9-CM procedure codes;
- (e) assigned DRG and MDC (major diagnostic category)
- (f) admission source;
- (g) discharge status;
- (h) admission/discharge dates or length-of-stay;
- (i) type of insurance; and
- (j) total charges.

and indirect costs. The reports also provide statistics, again for the hospital as a whole and by hospital revenue code, on discharges, patient days of care, personnel utilization, and other operational characteristics of the hospital. Cost to payers (other than Medicare) cannot be determined from this data source.

In California's OSHPD discharge abstract database, the usual 5-digit ICD9-CM diagnosis code is augmented with a 6<sup>th</sup> digit that indicates whether or not the diagnosis was present at admission.

An advantage of discharge summaries over paid claims is that a single record, instead of dozens or hundreds of claims, characterizes the entire inpatient stay. Indeed, a discharge abstract is essentially an aggregation of detailed claims records. However, paid claims databases provide significantly greater amounts of information than discharge summaries on specific services received during hospitalization, and claims databases include records for outpatient as well as inpatient services. With hospital discharge abstracts, differences in cost efficiency across providers cannot be disaggregated by service line (e.g., cardiac admissions) or separated into utilization-based and unit price-based components, nor can the cost to payers be determined.

## **Medicare Cost Report Data**

Medicare cost reports are filed annually with the Center for Medicare and Medicaid Services (CMS) by all hospitals in the United States. These reports are audited to ensure that reported data are correct, and they are publicly available. Electronic copies can be purchased from numerous sources. Included in these reports are detailed data for the hospital as a whole and by hospital revenue code (e.g., emergency room, laboratory, room and board) showing total charges, aggregate revenues (amounts received from all sources), and total direct

# Examples of Hospital Cost Efficiency Indicators

The following are examples of hospital cost efficiency indicators; each of the indicators is based on one or more of the data sources listed above.

## Risk-Adjusted Average Length-of-Stay

Risk-adjusted average length of stay (ALOS) is calculated by adjusting hospitals' actual average lengths-of-stay upward or downward to account for case-mix (case type and severity) characteristics of patients treated. Hospitals having higher risk-adjusted ALOS values are considered less efficient than those with lower risk-adjusted ALOS values. Risk-adjusted average length-of-stay can be calculated from hospital discharge abstract databases using the following steps:

- (a) for each discharge, estimate an expected length-of-stay (e.g., as the CMS DRG or APR DRG category ALOS for similar hospitals in the area);
- (b) separately sum patients' actual lengths-of-stay and their expected lengths-of-stay; and
- (c) divide the hospital's actual length-of-stay sum by its expected length-of-stay sum, and multiply the result by the area-wide average length-of-stay.<sup>3</sup>

When risk-adjusted ALOS is used as a hospital cost efficiency indicator, a key assumption is that per-diem costs are approximately equal in all hospitals. This is certainly not true, for example, when comparing community hospitals to university teaching hospitals. It also will not be true when some hospitals utilize higher proportions of special care unit days than other hospitals. Thus, while some recommend that cost

efficiency comparisons should be made only among hospitals having similar missions (e.g., university teaching), this would be especially important for comparisons based on length-of-stay.

## Risk-Adjusted Early Readmission Rate

Early readmission is defined as readmission within a specified time frame (e.g., 14 days, 30 days) for the same condition or a related condition treated during an index stay at the hospital. The early readmission rate is the proportion of all hospital stays that are classified as early readmissions, and the risk-adjusted early readmission rate is the hospital specific rate after adjustment, as described above for average length-of-stay, to control for hospital case-mix. Risk-adjusted early readmission rate is sometimes proposed as a hospital cost efficiency indicator because it is presumed that patients who are discharged prematurely or who received poor quality care during their index admissions will be more likely to require re-hospitalization than other patients.

Since re-hospitalization consumes resources, higher rates of re-hospitalization will, it is assumed, be associated with lower levels of cost efficiency. However, this assumption is valid only when risk-adjustment is adequate, and it is not clear whether administrative data bases (claims data or hospital discharge summaries) include the information detail required for such adjustment. Clearly, if risk adjusted readmission rate is used as an indicator of hospital cost efficiency, it would be useful to supplement the indicator with other indicators that involve fewer, or different, assumptions.

## Risk-Adjusted Hospital Costs

There are several versions of this indicator, which differ in terms of how costs are defined or estimated

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<sup>3</sup>Other algebraically equivalent methodologies exist for doing these calculations.

for individual patients. However, all forms of the indicator utilize essentially the same risk adjustment process:

- (a) after each patient's actual hospital stay cost is determined, an expected cost is estimated (for example, as average costs of all patients in the same APR DRG category hospitalized in similar hospitals);
- (b) both patient actual costs and expected costs are summed; and
- (c) the ratio of actual to expected costs is multiplied times the area-wide average cost per hospitalized case.

When the perspective of hospital cost efficiency calculation is that of the insurer or the purchaser of care, a hospitalized patient's cost is typically calculated from claims data as the sum of allowed amounts on the detailed claims submitted for that hospitalization. Allowed amounts are preferred over paid amounts for these calculations because paid amounts can differ from transaction to transaction, because of differences in patient deductibles, and these differences will cause unreliability in cost efficiency estimates.

When the focus on hospital cost efficiency measurement is the hospital as a production system, patient costs are commonly estimated in either of two ways, depending on whether claims data or hospital discharge summaries are used. When claims data are used to estimate hospital costs for individual patients:

- (a) billed charges on the patient's individual claims are summed to the hospital revenue code level (e.g., emergency room, x-ray);
- (b) the patient's revenue code sums are multiplied by the appropriate revenue center (or department) level ratio of total costs to total charges (department-level RCC) obtained from the hospital's Medicare Cost Report, and the results are summed across all revenue centers.

When hospital discharges summaries (e.g., OSHPD data) are used to estimate hospital costs for individual

patients, the "total charges" field on each patient's summary record is multiplied by the hospital-level ratio of costs-to-charges (hospital-level RCC) from the hospital's Medicare Cost Report.

Although estimating patient costs from total charges shown in hospital discharge data summaries is a common practice, research has shown these estimates can be unreliable. Using hospital-level RCCs in patient cost calculations involves an implicit assumption that all patients utilize similar mixes of hospital resources, i.e., that all patients' charges are distributed similarly among hospital revenue codes. However, this is almost never true. As a consequence, when viewing cost efficiency from the hospital perspective, risk-adjusted hospital costs *should* be calculated from claims data bases. When viewed from the insurer's or purchaser's perspective, it *must* be calculated from claims data bases.

## Case-Mix Adjusted Episode Costs

Each of the three examples above utilizes hospital stay as the unit of analysis. To incorporate pre-hospital services (e.g., office visits, radiology examinations), post-hospital services (e.g., medications, physical therapy), and professional fees into cost efficiency calculations, episode of care is the appropriate unit of analysis. Episode-based analyses utilize health care claims, and generally focus on episode costs, as opposed to, say, days of care or other metrics, because services of different types and services provided in different settings can be combined easily and meaningfully along the single dimension of total costs.

Of the three financial fields typically present on health care claims, the one most commonly utilized in episode-based analyses of cost efficiency is "allowed amount." As noted above, "billed charges" are always unreliable, and "paid amount" is sometimes unreliable because it can differ from claim to claim for the same service and same provider because of differences in patient deductibles. In addition to, and in some cases instead of, allowed amount, a standard unit price for the service (see "Resource Use and Unit Price as

Subcomponents of Cost Efficiency” above) often is used in episode-based analyses of cost efficiency. If allowed amount and standard unit price are both used in calculations, it is possible to distinguish between utilization cost efficiency and unit price cost efficiency.

As an example, hospitals can be compared on the total costs of caring for patients hospitalized with stroke (Cerebral Vascular Accident or “CVA”) episodes of care. In the Episode Treatment Group™ (ETG) system from Symmetry Health Data Systems, currently the most commonly used episode grouper software, CVA patients are found in four ETGs, which differentiate between hemorrhagic and non-hemorrhagic strokes, and strokes with and without surgery.<sup>4</sup> Measuring cost efficiency for stroke care, using allowed costs, would require the following:

1. Process the claims database through the episode grouper software. The software will assign each claim to an episode. Each of these episodes is characterized by a unique identifier and an episode type.
2. For each defined episode (each unique identifier), sum allowed amounts on all claims included in the episode. Call this sum *allowed cost*.
3. Across all episodes of the same type (e.g., non-hemorrhagic CVA w/o surgery), calculate average allowed costs. The average becomes, for that episode type, *expected allowed cost*.
4. Separately sum allowed costs (AC) and expected allowed costs (EAC) across all episodes treated at each hospital. The sums are compared (e.g., divide AC / EAC) to yield a measure of cost efficiency for the hospital. Hospitals with larger ratios of AC to EAC will

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<sup>4</sup>It may be desirable to combine the with- and without-surgery episodes of each type to yield two episode types: hemorrhagic strokes and non-hemorrhagic strokes prior to step 2 below. This would allow inefficiencies due to disproportionately high rates of surgery to be identified.

be considered relatively inefficient compared to hospitals with smaller ratios.

The example here is limited to one condition group, CVA, and our cost efficiency indicator would be termed “costs of CVA episodes of care.” However, the calculations are easily extended to include other condition groups or the entire spectrum of conditions seen in hospitals. In that case, the indicator would represent “case-mix adjusted episode costs.”

## Cohort-Based, Longitudinal Patient-Level Indicators

With a methodology developed by Wennberg and colleagues at Dartmouth, the unit of analysis is the patient, and differences among cohorts of patients in outcomes occurring during an observation period are noted. Services received by patients are classified as follows:

- (a) effective care (care having proven clinical effectiveness, such as beta blockers for patients with coronary artery disease);
- (b) preference-sensitive care (care driven by patients’ own preferences, such as lumpectomy vs. mastectomy); and
- (c) supply-sensitive care (care which is of questionable effectiveness and which is strongly correlated with healthcare system resource capacity).

Key elements of the methodology, which utilizes paid claims databases to identify indicators of supply-sensitive care, include:

- A cohort is defined on the basis of one or more patient characteristics, such as being admitted to a hospital for a defined, usually chronic, condition.
- The period over which cohorts are monitored is defined by a sentinel event, such as patient death or hospitalization for a specified condition. The period can either begin or end with the sentinel event.

- Responsibility for each patient in a cohort is attributed to a specific hospital, such as the hospital to which the patient was admitted at the start of the period or the hospital to which the patient was most frequently admitted during the period. The patient's hospital and medical staff is assumed to be responsible for all care, inpatient and outpatient, that occurs during the observation period.
- Each patient's outcome risk is assessed using a patient-level risk adjuster such as ACGs, DCGs, ERGs, or the Charlson Comorbidity Index.
- Among indicators used to compare hospitals on cost efficiency are counts and associated total costs of: hospital admissions, physician visits, diagnostic tests, and minor procedures.

An example of a cohort-based, longitudinal patient level analysis might be:

**Cohort:** all patients hospitalized with a diagnosis of congestive heart failure;

**Observation period:** two years following date of index hospital admission;

**Responsible Hospital:** patient responsibility attributed to hospital where index admission occurred;

**Risk Adjustment:** ACGs;

**Cost efficiency indicators:** risk-adjusted hospital readmission rates, risk-adjusted total health care costs.

At the conclusion of the observation period, each hospital's cost efficiency indicators are summed and divided by the number of attributed patients to produce per-capita rates of readmission and per-capita total health care costs.

# Hospital Cost Efficiency Indicators: Validity and Comparability Concerns

As noted above, the characteristic *perspective* for hospital cost efficiency indicators refers to the question of whose resources are the focus of the indicator. For many indicators, e.g., risk-adjusted length-of-stay or risk-adjusted early readmission rate, this is not a meaningful distinction, because the indicators do not presume any particular perspective. However, for other indicators – chiefly financial indicators related to costs – perspective is important and must be defined, although it should be noted that either hospital perspective or insurer/purchaser perspective can be appropriate depending upon context. We also noted above that *scope* is an important attribute for indicators of hospital cost efficiency. While it is not essential that all indicators relate broadly to all aspects of hospitals' operations, both outpatient and inpatient, it is highly desirable that among the *set* of indicators used to compare hospitals on cost efficiency are at least some that relate to inpatient care and at least some that relate to outpatient care, or that included in the set are indicators that encompass both inpatient stays and related outpatient services such as pre-admission testing and post-discharge care.

Correct perspective and proper scope are important characteristics of indicators, but in practice they tend to be far less problematic than the other two desirable characteristics noted above, bias and reliability. Because much of the criticism concerning validity of hospital cost efficiency indicators relates to these two attributes, we note several methodological issues that can influence bias and reliability.

## Risk Adjustment Methodology

Analyses of length-of-stay as a cost efficiency indicator involve comparing patients' actual lengths-of-stay to

the lengths-of-stay that would be expected given the patients' demographic and clinical characteristics. Analyses of hospital cost as a cost efficiency indicator involve comparing patients' actual hospitalization costs to their expected costs, with expected costs estimates based principally on patients' diagnoses, severity, and demographics. In cost efficiency calculations, the function of risk adjustment is to estimate an expected value for each hospital stay, outpatient visit, episode of care, or other unit of service being analyzed, so that cost efficiency estimates can properly account for differences among hospitals in the case-mix, severity, and demographics of patients treated. In general, risk-adjustment methodologies are of two types: categorical risk-adjusters and regression-based risk-adjusters. With categorical risk adjustment methodologies, cases (inpatient stays, episodes of care, etc.) are classified into a limited set of homogeneous categories, and cases within each category are assigned the same expected value (e.g., expected cost). With regression-based risk adjustment, regression analysis is used to produce equations with which each individual case's risk score is calculated as a function of the case's risk characteristics (e.g., age, gender, diagnoses). Categorical risk-adjustment methodologies are used far more commonly than regression-based methodologies.

An early example of categorical risk-adjustment is the DRG case-mix classification system used in the 1980s with Medicare's Prospective Payment System. Because Medicare DRGs did not control for severity differences among patients, some hospitals believed that they were underpaid because they treated the sickest, and therefore the most expensive, patients in a DRG category, while being paid only the average amount for that DRG. The CMS DRG system has

changed substantially since the 1980s, but it remains primarily a case-mix classification, and its demographic focus is still the elderly (Medicare) population. However, 3M™ Health Information Systems now offers other risk adjustment products, Refined DRGs (RDRGs) for Medicare patients and All Payer Refined DRGs (APR DRGs) for all hospitalized patients, designed to incorporate severity, along with case-mix and demographics, into the classifications. In addition to these inpatient categorical risk-adjustment methodologies, 3M™ developed Ambulatory Patient Groups (APGs) for classifying outpatient services, and Clinical Risk Groups™ (CRGs) for estimating health plan capitation payments by classifying member annual costs. Other categorical risk adjustment systems include Adjusted Cost Groups (ACGs) from Johns Hopkins University, and Clinical Complexity Index™ (CCI) from Solucient, both of which are designed to predict member annual costs.

Regression-based risk adjustment methodologies include Diagnostic Cost Groups (DCGs) from DxCG, Inc., and Episode Risk Groups™ (ERGs) from Symmetry Health Data Systems. These methodologies, like ACGs and CCI, are designed to predict health plan member annual costs. Other regression-based methodologies include various outcome (complication rate, readmission rate, mortality rate) prediction models from Solucient, and condition-specific models from Care Science for

predicting hospitalized patient length-of-stay, total charges, total costs, and readmission risk.

In any given situation, should a categorical risk adjustment methodology or a regression-based methodology be chosen? This question cannot be answered, since neither approach is inherently superior to the other. The choice of the most appropriate risk adjustment methodology for a particular situation depends on several factors, as summarized in Table 2.

## Inclusion of Specialized Services

Cost efficiency indicators that neutralize, or assume approximately equal, per diem costs among hospitals will be biased in favor of hospitals that utilize intensive care, coronary care, or other special care units more frequently than these units are used in other hospitals. Hospitals that transfer inpatients to occupational therapy, physical therapy, or other post-acute care services prior to discharge are likely to appear less cost efficient than other hospitals that first discharge these patients and then separately admit them to the special therapy units. When using claims data bases for hospital cost efficiency analyses, it is possible to ensure that the types of services – routine care, specialty care, extended care – being compared across hospitals are approximately equivalent. However, with hospital discharge abstract data bases, it generally is not possible to identify the different service units

**Table 2. Selection of Risk Adjustment Methodology**

<b>Methodological Factor</b>	<b>Issues and Considerations</b>
<b>Predicted outcome</b>	Is the principal focus of the methodology costs, mortality risk, readmission risk, or some other outcome? Methodologies often are used to define expected values for related outcomes, such as length-of-stay and costs. But a methodology developed for cost risk-adjustment is unlikely to provide the best estimates for readmission risks.
<b>Analytical time frame</b>	Is the purpose of the methodology to define risks related to an inpatient stay, an outpatient visit, an episode of care, a complete year of care, or other unit of time?
<b>Relevant population</b>	Risk methodologies developed using only Medicare data are unlikely to provide the best risk estimates for commercially insured populations.
<b>Purpose</b>	If a risk methodology is to be used in hospital payment, it is preferable that the methodology not incorporate incentives that favor one kind of care (e.g., surgical care) over another (e.g., medical treatment).
<b>Performance</b>	Risk methodology “performance” is typically measured in terms of the R <sup>2</sup> statistic and refers to relative ability to account for variation among cases. For example, APR DRGs account for larger proportions of variation in costs and lengths-of-stay among commercially insured inpatients than CMS DRGs, and thus APR DRGs often are preferred over CMS DRGs for risk-adjusting costs and length-of-stay for this population.

involved in an individual patient's care within an inpatient stay.

## Geographic Differences

Wages, supplies, and other hospital input prices can vary widely across geographic areas. Costs used in efficiency calculations for hospitals should be adjusted to account for regional differences in input prices because these differences are largely beyond the control of hospitals, and they can account for up to one third of cost differences among providers. These adjustments are relatively straightforward and can take advantage of Medicare wage index tables.

## Payor Mix and Disproportionate Share Status

In setting up its hospital Prospective Payment System, the Centers for Medicare and Medicaid Services (then HCFA) recognized that hospitals that treat disproportionately large shares of low-income persons are likely, other things being equal, to incur both higher costs and higher rates of uncompensated care than other hospitals. CMS deals with this issue in its Prospective Payment System by making special adjustments called Disproportionate Share Hospital (DSH) payments for hospitals serving largely indigent populations.

When assessing hospital cost efficiency, it should be recognized that potential risk-adjusted indicators may not fully reflect the higher costs associated with caring for low-income individuals in disproportionate share hospitals, because commonly used risk adjusters, such as APR-DRGs, account for some, but not all, effects of poverty status on health care costs. Low income patients are likely to have poorer health status when admitted to a hospital than higher income patients, and thus they are likely to require higher levels of care and longer hospitalizations. Readmission rates for low-income patients may also be higher than for other patients, because of poorer health status or poorer access to needed post-discharge services. Hospitals with histories of serving disproportionately large shares of low income patients are likely to have higher unit prices (allowed amounts) than other hospitals, in

order to cover their higher uncompensated care costs. Some would argue that special offsets should be included in the cost-efficiency calculations to recognize these and other "community benefit" related factors, while others would maintain that the issue of uncompensated care should not be "masked" by adjustments and should be directly reflected in hospitals' comparative cost efficiency. In the latter view, addressing how to fairly apportion the burden of uncompensated care needs to be directly addressed rather than being hidden in financial modeling. In any event, with such hospitals, it may be especially desirable to disaggregate hospital cost efficiency into utilization and unit price components.

## Peer Group Comparison

When evaluating hospital cost efficiency performance, fundamental differences in hospital mission may be recognized through selection of comparison institutions, rather than through direct adjustment of cost efficiency indicators as suggested above for area input price differences. The mission of an academic medical center is broader than that of a community hospital, encompassing, in addition to patient care, teaching objectives and research objectives. Because of these mission differences, the mix and quantity of resources utilized in academic medical centers are different, and generally more costly, than those of community hospitals, even when the hospitals are serving essentially the same populations. Similarly, rural hospitals that serve as critical access facilities in their communities may be expected to have higher unit costs, and thus lower indicated cost efficiency, than community hospitals located in more urban areas and serving larger populations.

However, some health care purchasers and payers maintain that efficient patient care is the single most important responsibility of any hospital, and that other missions, while useful and desirable from an overall societal perspective, cannot be used to justify higher costs of basic hospital services. According to this view, hospitals should not be differentiated by mission for cost efficiency comparisons.

# A Final Comment on Quality and Efficiency of Care

We noted earlier that economists use the term efficiency to refer to relative resources required to achieve a given level of outcome. In this document, we have addressed cost efficiency, which we defined above as relative cost of care without regard to clinical outcome. Except in research studies, the focus of hospital performance evaluation is almost always on cost efficiency instead of on what economists regard as efficiency. This is because (a) outcomes are often not well defined, (b) relationships between resource consumption and outcomes are not well understood, and (c) sources of data used in cost efficiency analyses often do not support meaningful assessments of health care outcomes.

Thus, when we compare hospitals solely on the basis of cost efficiency indicators developed from claims data bases, hospital discharge summary data bases, and/or Medicare cost reports, we are assuming, implicitly in most situations, that similar levels of quality are being produced by the different hospitals. It is important to recognize that this assumption is being made, and when interpreting cost efficiency data it is important to acknowledge that in some cases the assumption may be incorrect. Cost-efficiency information should be used in concert with quality information – including process, outcome, patient experience and structural measures – when assessing hospital performance.

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**PBGH**  
**Pacific Business  
Group on Health**

221 Main Street, Suite 1500  
San Francisco, California 94105  
415.281.8660 ph  
415.281.0960 fax  
[www.pbgh.org](http://www.pbgh.org)