Study of the Financing of Graduate Medical Education

Report I
Study Objectives, Design and Data

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STUDY OF THE FINANCING OF GRADUATE MEDICAL EDUCATION

REPORT NUMBER I

STUDY OBJECTIVES, DESIGN AND DATA

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Preface

The Study of the Financing of Graduate Medical Education was conducted by Arthur Young and Company, prime contractor, and was sponsored by the Office of the Assistant Secretary for Planning and Evaluation in the Department of Health and Human Services. The project was initiated in 1980. Most data collection occurred during 1983 and 1984. Data processing and analysis continued through 1985.

The study was designed to address policy issues in the area of graduate medical education. The data base produced by the study, because of its detail and scope, should be a productive resource for years to come, and, as such, represents a primary achievement of the study. Analyses conducted by study participants are the other tangible product of the study. These analyses are documented in the series of reports listed below.

I. STUDY OBJECTIVES, DESIGN, AND DATA

Overview of the project -- issues, objectives; study design; description of sampling methodology; emphasis on description of data collected by the study.

II. AN ANALYSIS OF COSTS OF GRADUATE MEDICAL EDUCATION

Cost function analysis relating operating costs to teaching intensity as measured by resident-to-bed ratio, controlling for variations in various case-mix variables, including severity of illness.

III. SUBSTITUTION: ACTIVITY AND PRODUCTION FUNCTION ANALYSIS

Analysis of substitution and substitutability among residents, attending physicians, nurses, and other health professionals.

IV. CASE MIX AND QUALITY OF CARE: MEASUREMENT AND ANALYSIS

Detailed analysis of reliability and validity of alternative case mix and quality of care indicators collected by the study. (A Rand Corporation study.)

V. Part 1. FLOW OF FUNDS: CASE STUDIES

Examination of financing arrangements among entities in the hospital complex.

Part 2. EFFECT OF REIMBURSEMENT

Investigation of links between performance variables and mode of physician reimbursement (salary versus fee-for-service).

Public Use File

A large selection of the data collected and processed in the course of the project and described in Report I, will be made available for independent research in early 1987. For further information, write GME Project Officer, Office of Health Policy, Room 432E Humphrey Building, 200 Independence Avenue, Washington, D.C. 20203

PROJECT PARTICIPANTS

Arthur Young and Company, (AY) the prime contractor for the Study, maintained overall management control during the entire course of the project. The company has been involved directly in on-site data collection, data processing, and analysis. Stephen Varholy, AY partner-in-charge, was project director during the largest part of the effort. Other Arthur Young & Company staff that made a significant contribution to the completion of the study or the preparation of the report included:

Robert J. Rourke
Susan Cosgrove
Katherine Douglass
Richard Frey
Dorne Hawxhurst
Alice Katz
Kevin Murphy
Teresa Roda
Nancy Southers

Policy Analysis Incorporated (PAI), with company president Ralph Berry, Ph.D., assumed major responsibility for developing the study's analytic approach. PAI has also participated in on-site data collection and had responsibility for cost analysis. Other PAI personnel that were major contributors to the study include:

Mason Russell
Nancy Kelly, D.Sc.
Daniel Huse
Stacy Hubbard

The Rand Corporation, working under a separate grant, conducted case-mix and quality of care analyses beginning in 1984. The effort is under the overall direction of Robert Brook. Other Rand Corporation staff involved in the study include:

Toni Richards
Nicole Lurie
William Rogers

Others who were associated with the project in the early and middle stages include: Susan Horn, Ph.D., Johns Hopkins University; Dr. Dale Schumacher, Rockburn Institute; Mr. Stanley Jones, Health Policy Alternatives; Lewin and Associates and Steven Eastaugh, D.Sc.

Technical Advisory Panel

The study was shaped and guided by a panel of experts. Members who remained in an active status through the project were:

Gerard Anderson, Ph.D., Associate Director
Center for Hospital Financing and Management
Johns Hopkins University

Thomas Delbanco, M.D., Director
Division of General Medicine and Primary Care
Beth Israel Hospital

Mr. Richard Knapp
Director, Department of Teaching Hospitals
Association of American Medical Colleges

Isidore Levine, M.D.
Deputy Director of Professional Affairs
Montefiore Hospital and Medical Center

Mr. Mark Levitan, President
Albert Einstein Health Care Foundation

Mr. Lawrence E. Martin
Associate General Director
Massachusetts General Hospital

Mr. Bruce Steinwald
Prospective Payment Commission

PROJECT OFFICERS

The first Project Officer and principal author of the concept and initial design of the study was Gerald Anderson, Ph.D. The final phase of the study and these reports were prepared under the direction of Stuart Schmid, Ph.D. Arthur Young & Company and Policy Analysis, Inc. would like to express their appreciation for the assistance that was provided by Drs. Schmid and Anderson and to acknowledge the contribution that both have made to the study.

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STUDY OF THE FINANCING OF GRADUATE MEDICAL EDUCATION

REPORT I

STUDY OBJECTIVES, DESIGN, AND DATA

I. Issues and Objectives

The Study of the Financing of Graduate Medical Education was designed to answer a range of policy questions about graduate medical education. This report describes the study, with emphasis given to reviewing the data collected in the course of the project. The report should be useful as a background for other reports in the series (See Preface).

ISSUES

Graduate Medical Education

Graduate medical education (GME) refers to the training of residents and interns in teaching hospitals. Approximately three-quarters of the over 74,000 residents in U.S. hospitals are distributed among 400 major teaching hospitals. The remainder are scattered among another 800 hospitals.

The graduate education process occurs largely in combination with the treatment of patients. Residents and interns learn by caring for

patients under varying degrees of supervision and with varying degrees of conscious teaching effort being exerted by teaching physicians, nurses, and senior residents. Residency programs defined for specific specialty fields may continue for up to four years.

During their training, residents are paid a salary (stipend). Salaries now average on the order of $20,000 per annum, varying with seniority and specialty.

Financing and Cost of GME

GME produces important benefits for society, for the physicians who are trained, and for hospitals. At the same time, care delivered by teaching hospitals is substantially more expensive per case. How the higher costs are--or should be--financed is one of several major GME issues that motivated the present study.

Consistent with the nature of GME as a product produced jointly with patient care, GME is supported financially largely from patient-care revenue accruing to the teaching hospital. Such revenue accounts for about 90 percent of total funding for the typical teaching hospital. The rest comes mostly from state government grants and appropriations. As a first approximation, then, the costs of GME, whatever they are, are financed by the major payers--Medicare, Medicaid, Blue Cross, the commercial health insurance companies, and private pay patients--through subsidies implicit in the rates paid for patient care.

The idea that GME is a costly activity originates from simple comparisons: per diem and per admission costs in teaching hospitals are generally one and one-half to two times the costs of non-teaching hospital costs. A simple comparison can be misleading, however, since cases treated in teaching hospitals tend to be more complex on the average. But even after taking this into account, there remains to be explained a significant cost differential.

Until recently, those third-party payers who in effect financed the higher costs of teaching hospitals had no particular reason to be concerned about the situation. Physicians largely determined where a patient would be hospitalized, and payers paid the bills. Recent high rates of growth of health care expenditures plus fundamental changes in reimbursement methodologies have changed the situation drastically.

The most conspicuous change has been the shift to a prospective payment system (PPS) for Medicare reimbursement to hospitals. In contrast to a traditional system of reimbursing costs, Medicare pays a fixed rate per patient according to diagnosis-related categories. Payments to teaching hospitals are supplemented by a direct pass-through of resident salaries (as before) plus payment of a special percentage add-on to PPS revenues. The add-on, referred to as the "indirect cost of teaching payment," is calculated by a formula geared to the number of residents relative to number of beds in each hospital.

These changes have raised new issues and spurred questions about the justification for the level of the higher costs at teaching hospitals and the distribution of the financing burden associated with current payment formulas. Some observers have proposed drastic revisions in financing arrangements. For example, it has been suggested that GME costs be shifted from Medicare and other third-party payers to taxpayers of states where residency programs are located. While changes this drastic are unlikely, other suggested departures from the status quo continue to emerge. At the most basic level, controversy surrounds the current formula under which Medicare supports the higher costs of teaching hospitals. While all parties agree that such formulae should be "fair" and "scientific," there is disagreement concerning the relevance or relative importance of various payment factors.

Informed discussion of these issues, let alone their resolution, has been hindered by inadequate information about cost relationships in

teaching hospitals and about the many financial, activity, and performance factors around which those relationships exist. The objectives of the present study all stem from the desire to close these gaps in our knowledge of teaching hospitals.

Study Questions

The study was designed to address several specific questions.

Cost relationships. The underlying theme of the study has to do with questions about GME cost relationships: How do costs vary from hospital to hospital? What effect does teaching have on costs?

This theme pointed to several related issues:

> Substitution of interns and residents with other personnel. To what extent do interns and residents substitute for other physicians and nurses?
>
> Case-mix. How well do conventional case-mix indices measure the types of cases being treated in teaching hospitals? Can a measure of severity be included in the development of a case-mix index?
>
> Teaching status: What criteria should be used to differentiate hospitals with respect to teaching activity?

The remaining issues addressed were:

> Physician reimbursement effects. How do physician reimbursement methods in teaching hospitals affect the quality of patient care, the quality of graduate medical education, and total reimbursement?

Flow of funds. To what extent do fees paid for physicians' professional services finance medical education in the hospital and medical school? What effects might restrictions in fee reimbursement to teaching physicians have on the teaching functions?

II. STUDY DESIGN

Project Plan and History

The study was planned as a series of developmental steps, beginning with a feasibility and design phase. The study progressed through the planned phases beginning in 1980. Each phase was originally planned for one year's duration.

Phase I: Feasibility study. The winning proposal submitted by Arthur Young and Company and its collaborators was selected in the summer of 1980. The design phase began in September, 1980 and continued through 1981.

Study objectives (stated in terms of the questions listed above) were translated into hypotheses, an analytic framework was developed, and a general set of data requirements described. With the assistance of a technical advisory panel, detailed data specifications, the sample design, and a collection methodology were set forth.

An analysis of teaching hospital typology (with respect to concentration of teaching activity) was undertaken to provide a basis for measuring degrees of "teaching status."

Phase II: Pre-test of data collection methodology. Five prototype hospitals were selected and visited in 1982 in order to pretest the data collection methodology. Necessary revisions in data set and collection techniques were made following evaluation of results.

Phase III: Data collection, data entry, and data processing. Hospitals were selected according to the sampling criteria. Collection teams spent two weeks at each hospital in accordance

with a detailed collection plan. Site visits began in November, 1982. Solicitation for participation continued until the requisite number in each sample category--45 in all--were brought into the study. The final hospital site visit occured in January, 1985. Data collection consumed much more time than expected, primarily due to difficulty in soliciting participation by the desired number of hospitals with minor teaching involvement.

Data was processed and entered into computer files as it was collected. Development of analytic files from the raw data occurred in parallel with later phases of site visits and continued for a period following completion of the collection effort.

Phase IV: Analysis. Data was analyzed in accordance with a predetermined plan based on the study questions listed above. Programs for analysis of the GME data were developed and tested on partial sets of the hospital data during early and mid-1985. The major part of analysis presented in the study reports was completed by the end of 1985.

Design Overview

The study collected data from a sample of 45 hospitals--36 teaching hospitals and 9 non-teaching hospitals. The data pertain to three levels of observation: individual patient cases, standardized departments within the hospital, and the entire hospital. Within each hospital, a sample of 75 random cases for each of five departments was obtained together with a sample of 200 "tracer cases," 25 in each of 8 selected diagnoses.

The data fall into the following four categories:

- Finance/Cost. Revenue and cost information was collected at the hospital, department, and patient level. Detailed expense data at department and hospital level was obtained. Non-salaried physician costs were im-

puted. Patient case charges and hospital accounting data are combined to estimate costs at the case level.

- Activity analysis. Data pertaining to routine activities of residents, other physicians, and nurses were collected via diary logs filled out by a sample of personnel in each sampled hospital.

- Case mix. Information contained in each hospital's discharge abstract tape plus a systematic review of the sampled medical records (575 per hospital) were the basis for development of various case descriptors and case mix measures. Conventional indices include the Medicare case mix index, the ICD-9-CMDRG index, and the New Jersey DRG index. Other descriptors in the data include measures related to stage of illness, severity of illness, and quality of care.

- General Hospital Data. A variety of data elements describing each hospital and its economic environment were collected.

Hospital Sampling Plan

Sample size. Data was collected from 45 hospitals. Of these, 36 were teaching hospitals and 9 were nonteaching. The size of the sample was based on a major strategic trade-off between number of hospitals and depth of detail of data collected from each, all subject to resource constraints posed by the scope of the study effort. Although the absolute number of hospitals included in the sample was small by most standards, it was intended that careful stratification of the sample would assure that the hospitals were sufficiently representative.

Stratification plan. The proportional distribution of the 45 hospital sample into teaching and nonteaching was a compromise

based on the competing requirements of a focus on teaching hospitals and the need to make comparisons between teaching and nonteaching. (Interestingly, the 80-20 split settled upon turned out to be the opposite of the distribution of teaching-nonteaching hospitals in the U.S.)

Teaching hospital stratification occurred along dimensions of teaching type and by geographic region. Hospital type was derived from a four-category typology measuring degree of involvement of the hospital in teaching. At one extreme were hospitals with very small teaching programs. At the other were the major teaching centers with large numbers of GME programs. (A significant effort was made by the Study to discern the important features that differentiate types in order to assure that the sample would be representative and to assure that comparisons among types were meaningful. The methodology by which the types were identified is explained in detail in the appendix to this report.)

Teaching hospital geographic stratification was by four Census regions. The distribution of the sample among 16 cells (4 locations for each of 4 types) was guided by the distribution of teaching hospitals in the U.S., but was adjusted according to judgements reflecting relative focus of interest in the larger teaching hospitals. In addition, it was deemed necessary to include at least a minimum number of hospitals in each cell. In the final sample design, 9 hospitals from each of the four Census regions were included. By type, only 4 hospitals each were assigned to Types 1 and 2 (the lower end of the teaching spectrum), while 16 from Type 3 and 12 from Type 4 (the largest teaching hospitals) were included. Exhibit I shows the distribution of sample hospitals by type.

Nonteaching hospitals were substratified only by bed size. To allow for use of the sample in comparisons with teaching hospitals, the bed size distribution of the nonteaching hospitals was selected to as to match that of the expected sample of teaching

DISTRIBUTION OF SAMPLE HOSPITALS BY TYPE

	Geographic Region				
	NE	NC	S	W	Total
HOSPITAL CATEGORY					
1	1	1	1	1	4
2	1	1	1	1	4
3	4	4	4	4	16
4	3	3	3	3	12
TOTAL	9	9	9	9	36

hospitals. Consequently, the nonteaching hospital sample excluded all hospitals with fewer than 100 beds. The nonteaching hospital sample was comprised of one each in the 100-199 and the 200-299 bed size categories and the remaining 7 in the 300+ size category.

Once the sampling plan was established, hospitals were selected at random within each cell. The 1980 American Hospital Association survey was used to select candidate hospitals. Multiple back-up candidates were selected to allow for non-participation decisions by selected hospitals.

Actual sample; implications for analysis. As it turned out, for hospitals with minor teaching involvement, considerable difficulty was encountered in obtaining the required sample size. A substantial number of hospitals had to be contacted to fill the sample for this category, raising the prospect of selection bias. However, analysis failed to reveal any apparent bias.

The nonteaching hospital sample turned out to be somewhat smaller on average in terms of bedsize than anticipated as a result of difficulty in soliciting participation among these hospitals. The mean bed size of the sample hospitals was 33 percent smaller than target size and average costs per admission were 40 percent lower than expected. These differences shift the average sizes of nonteaching hospitals relative to teaching hospitals in such a way as to suggest caution in some applications of the data, in particular, simple cross-type comparisons.

The teaching hospital sample was designed to include hospitals that were larger and more involved in GME than teaching hospitals in general. This resulted in an oversampling of the generally larger Type 3 and 4 institutions. Correspondence between the actual sample values and the expected values for this type of teaching hospital was quite close. Within each of the four regions, particularly the North Central region, the sample values exceeded those of the population as a result of the oversampling

of the larger institutions. None of the deviations, however, were large enough to jeopardize the validity of the sample.

The design of the sample and the characteristics of the teaching and nonteaching hospitals in the final 45 hospitals included in the study had two implications for analysis. First, as noted above, the nonteaching hospitals were smaller than expected, and the possibility that comparisons of sample teaching and nonteaching hospitals will overstate actual differences must be recognized.

Second, the oversampling strategy used for the teaching hospitals provided more observations from hospitals that are more heavily involved in GME than average. This would be an advantage for analyses of teaching hospitals of this size, but it meant that the teaching hospital sample was not representative of teaching hospitals in general, and even with differential weighting of the data in the analysis, there were not enough hospitals in the sample from the lower end of the teaching spectrum to support reliable conclusions about teaching effects in the institutions with less GME involvement. Consequently, inferences made on the basis of the data should be formulated with care. The strongest conclusions are those bearing on the major teaching hospitals.

Sample of Cases Within the Hospital

The sample design called for obtaining patient billing and detailed medical records information on a total of 575 cases within each hospital. Of the total, 375 cases were selected on a random basis, and 200 cases, consisting of 25 in each of 8 common DRGs, were selected in accordance with specific criteria related to principal and secondary diagnoses and age. The latter category of cases are referred to as tracers throughout the remainder of this report. The cases were selected from the information contained on the discharge abstract tape provided by the hospital using software developed specifically for the purposes of select-

ing the sample cases. A sample approximately twice as large as was required was drawn to provide for cases that might not be available for one reason or another at the hospital. A matching patient bill was obtained from the hospital for each sample case from the list of record numbers provided by the study team.

III. DATA

Introduction

Although the GME Study was conceived originally to address a set of specific questions, the study design that evolved has produced a mass of data of extraordinary scope and detail. The database is, without doubt, a major product of the study and should provide grist for a wide variety of research for many years to come.

This section of the report offers a description of the data in moderate detail. Survey instruments used in the study are reproduced in a separate appendix which may be requested from the GME Project Officer at the address given in the preface to this report.

Organization of the Data

The data can be described along several dimensions. The data are divided first into four major categories labeled as follows:

(1) financial,
(2) medical record,
(3) activity,
(4) general.

Data elements pertain to various levels of detail, allowing analysis to carried on at three levels of observation:

(1) case level,
(2) department level,
(3) hospital level.

Data collected at the case or department level can be and generally is aggregated or otherwise consolidated to allow for appli-

cation at the broader levels. For example, average case-level costs can be computed for applicable departments and for the entire sample hospitals. Department-level performance and expense elements can be averaged to produce hospital-level variables.

Exhibit II offers an overview of selected, illustrative data elements arranged by categories and levels. It should be noted that the list is not exhaustive and the names of the items are generic for the most part rather than labels of individual elements.

Organization of case-level data. Case-level data has been collected from the sample of patient records accessed in each of the 45 hospitals included in the study. The case-level information now residing in the study database represents an amalgam of elementary data copied from records, data reflecting technical evaluation of patient medical records, and measures derived through complex procedures of adjustment and construction.

As indicated in the exhibit, case-level data fall into two of the categories: some are of the medical record type, some are financial. (All medical record data elements are case-specific.)

Cases entered the study sample by one of two routes. They were selected as "random" cases from a universe comprised of the hospitals entire list of discharges for the year, or they were selected (randomly) from a narrower universe of cases falling into one of eight "tracer" diagnoses. (These distinctions are explained in more detail in the previous section on sampling procedure.) Some medical record information was obtained only for the "tracer" cases and not the "random" cases.

The "random" or general sample of cases have been sorted into one of five standardized departments using a computerized sorting algorithm. (The five departments are medicine, surgery, obstetrics/gynecology, pediatric and "other.") The tracer cases fall into

EXHIBIT II

ORGANIZATION OF GME STUDY DATA

LEVEL	MEDICAL RECORD	FINANCIAL	ACTIVITY	GENERAL
CASE	Discharge Data: Patient sex, age pay source LOS Diagnoses Procedures, consults Abstracted Data: Severity of illness Stages of illness Adverse occurrence Process, outcome	Units, charges, costs by service type		
DEPARTMENT		Payroll, expense data Labor inputs, by type	Time/task logs Residents Other physicians Nurses Other	
HOSPITAL		Expenses by cost center Balance sheet Combined operating revenue and expense		Activity measures: Admissions, days Capacity measures Programs, organization Typology, funds flow

one of eight diagnostic categories.[1] The eight diagnoses, arranged by department, are listed below.

Department	Tracer Disease
Medicine	Acute myocardial infarction
	Upper Gastrointestinal hemorrhage
Surgery	Gallbladder disease with cholecystectomy
	Benign prostatic hypertrophy
Obstetrics/ Gynecology	Complicated delivery
	Hysterectomy
Pediatrics	Acute gastroenteritis
	Asthma

The case-level data was generated from (1) abstracts of medical records prepared on site by medical records technicians on the data collection team, (2) discharge data, and (3) patient bills. The medical record information and matching bill constituted the basic information at the case level. From that information plus hospital accounting data, other case-level variables have been constructed.

Department-level Data. As noted above, many variables available for department-level analysis are produced by aggregation of case-level data (either between departments within hospitals or between identical departments at different hospitals in the sample). Some departmental data was constructed from hospital expense data

[1]The categories were established by a panel of medical experts in the early stages of the study. The diagnoses were distributed two from each of four departments. Selection was based partly on their being representative of cases in those departments, and also for being relatively homogenous in terms of the course and treatment of the disease.

through allocations from cost centers to departments. A few items collected were organized specifically by hospital departments. These included information related to (a) capital and labor costs, (b) quality of education measures, and (c) certain information on hospital physician staff payment arrangements.

Hospital-level data. The specifically hospital-level data describes the entire hospital in terms of annual activity levels, size and capacity measures, types of patients served, annual revenue, expense, and balance sheet data, teaching status, and indicators of the local economic environment. In addition, hospital-level measures constructed from case-level data are provided, including, for example, a variety of case-mix indices.

In the following sections, data are discussed in more detail under headings corresponding to the four categories: financial, medical record, activity, and general.

FINANCIAL DATA

Objectives

Detailed financial data were required at several levels of aggregation. A strategic decision was made at the outset to develop GME cost data from elementary hospital accounts rather than rely on the information submitted by hospitals in the Medicare Cost Report. Moreover, the conceptual design of the study called for determining the cost of procedures performed by hospitals using relative value units (RVUs) as the measure of the resources applied to patient care, to the maximum extent possible, rather than the more traditional but less accurate method of using the ratio of costs to charges (RCCs) as a basis for determining the cost of procedures. The latter procedure relies essentially on the relationship between total revenue and the revenue derived from a specific procedure to estimate the cost of administering

that procedure. Because charges for procedures often are set somewhat arbitrarily, the RCC costing methodology can result in significant distortions of true costs. The RVU methodology relies on estimates that have been developed through work measurement and related studies of the inputs required to perform various procedures.

The Medicare Cost Report, a traditional source of cost data for many previous studies, uses the RCC costing methodology to estimate hospital costs. In addition to the potential distortions introduced through reliance on this methodology, the Medicare regulations provide a degree of flexibility in the allocation of costs to various categories. This generally resulted, prior to the introduction of Prospective Payment System, in a maximizing of the reimbursement to hospitals by Medicare. While this was standard operating procedure under prevailing regulations, it meant the Medicare Cost Report could not be used as a reliable source of cost detail for comparative cost analysis.

The decision to develop costs from elementary data rather than depend on the Medicare Cost Report led to an effort involving collection of:

- Itemized patient billing information
- 20 categories of expenses at the information cost center level of detail
- Revenue and expense and balance sheet information at the general ledger level of detail.

Various "off-the-books" expenditures and revenues also had to be obtained for analysis of the flow of funds among entities within medical complexes to determine if the in-kind services that are frequently exchanged between the hospital and the medical school or the university constituted a subsidy that might affect the cost of patient care.

Collection and Processing

Preparation of financial data included in the GME data base involved both a very labor intensive effort and considerable manipulation of the data using machine processing. Most of the manual processing of data involved transcribing hard copy of individual patient bills, many of which consisted of 10 pages or more, into a form that was suitable for key entry. An additional step was required if the hospital provided patient bills on microfiche, in that it was necessary to make a full-sized hard copy from the fiche using a special copy machine.

Cost and revenue data for each hospital were collected for each of 26 cost centers and over 20 expense categories using a series of data instruments developed specifically for that purpose. Before the data could be used in the study, it was necessary to conduct a comprehensive audit and reconciliation to be sure that the data tied to the hospital's accounting information. Because hospitals typically include over 100 cost centers in their cost accounting systems, a "crosswalk" was prepared to consolidate these centers into the uniform set of 26 selected for the GME study. The audit process removed any errors that might have been introduced in the process of combining the cost and revenue data, by assuring that the individual cost center totals reconciled to the revenue and expense totals on the hospital financial statements.

At the completion of the audit, the data were key entered for machine processing and submitted, after editing, to a computerized allocation process called the Expense Assignment System (EAS) which had been developed specifically for the GME project. The EAS allocated various expense and overhead cost items to the benefiting cost centers using statistical bases accepted by the industry and a step-down method of allocation.

The next step in the processing of financial data involved assigning relative value units (RVUs) to most procedures performed by the hospital. (The number of procedures analyzed in this way was determined as the number needed to account for at least 80% of the revenue generated by the hospital.) The process began with analysis of the revenue and usage report maintained by the hospital to record the frequency with which individual procedures were administered, and the revenue that was generated by each procedure. Price changes during the year were accounted for by using the mean price.

Once the procedures that were of interest were identified, which typically accounted for approximately 1,000 of the 3,000 different procedures provided by most hospitals, RVUs were assigned using published industry sources such as the California Workman's Compensation Manual. In some instances, notably in the case of the pharmacy and medical supplies cost centers a ratio of cost to charges (RCC) weighting of procedures was used because hospital records did not provide adequate detail on these procedures. The result of this process, which was initially performed manually and later automated, was the total relative value units, i.e., the total number of resource inputs consumed by each cost center in administering the procedures for which it was responsible for the year under study.

Preparation of the financial data also included editing and entering general financial and performance data. These data included total revenue and cost from the financial statements, total patient days, and total productive and non-productive staff time as reported by the hospital. In addition, the narrative information relevant to the flow of funds and other "off the books" cost and revenue was compiled and organized for use in the discussion of the effects of these practices on costs. The quantitative data that was collected from hospitals in which the in-kind and other services were material was also transcribed for data entry.

Non-salaried physician charges. Surrogate charges were developed for the non-salaried physician component of costs, (not otherwise available since these costs did not flow through the hospital.) An inventory of physician-administered procedures was prepared for each patient using ICD-9-CM coding and the medical record. Physician charges for these procedures were obtained from Blue Cross/Blue Shield of Pennsylvania and adjusted for location using the Medicare Directory of Prevailing Charges published by HCFA. The data was validated by comparing the results with the charges recorded by two hospitals in the sample that prepared physician bills as a service to the practice plan.

MEDICAL RECORD DATA

This category refers to data collected from sampled patient medical records. Medical data pertaining to the admission and medical history of a hospital visit in terms of the status of the patient and procedures and treatments given. Exhibit II provides a concise overview of this category in context with other classes of data.

Objectives

Medical record data were collected in the first place to support inter-hospital cost comparisons. For the cost analyses (described in Report II of the series), it was necessary to control for variations in case mix. It was also considered important to provide a basis for controlling for variations among hospitals with respect to various measures of quality of care. In the second place, case mix and quality of care measures were of interest in themselves. At the time the study was designed, severity of illness and stage of illness measures were in the experimental stage. Further experience was desired regarding the ability to obtain reliable, and consistent readings of these variables. (The sampling methodology, by providing for blind double abstracting of randomly selected subgroups of the case records, allowed for testing of

reliability of instruments and abstracting techniques and offered a means for checking quality of the particular records abstracting effort developed for the study.)

Case-Mix Information

Information allowing the classification of cases in medical terms was collected in several forms. Three general types of data -- DRG, severity of illness, and disease staging -- were collected from the Uniform Hospital Discharge Data Set (UHDDS) and from the patient medical record.

DRG data. The basic classification of cases was by diagnosis-related group (DRG). DRGs assigned by the computer-based algorithm (DRG Grouper) were used to channel cases into random and tracer samples for medical records abstraction.

Each hospital provided a copy of the discharge abstract tape for the fiscal year under study. The tapes were used primarily for the selection of the sample of random and tracer cases, however, selected data available from the discharge tapes was included in the database for later use. These data included UHDDS, weights for patients in the case level sample, case-mix index for the random sample by department, and overall case-mix index for the hospital.

Disease staging. The disease staging measure developed by Syste-Metrics (Gonnella, 1983, 1984) was assessed for all cases in the random sample for which staging criteria were available. Cases that were evaluated for stage of illness were assigned to one of four disease stages. In addition, for each of the 200 tracer cases per hospital, stage of disease information was recorded for admission, peak and discharge according to specific criteria established for each of the eight tracer diseases.

Severity of illness. Severity of illness data based on the measure developed by Susan Horn (Horn and Sharkey, 1983) was collected using the Patient Severity Index instrument prepared by Susan Horn and Dale Schumacher. All 575 cases at each hospital were evaluated by the study abstractors using this instrument. Severity levels from 1 to 4 were determined for each of several disease characteristics including stage of principle diagnosis, interactions, complications, dependency, procedures, and response to therapy. In addition to providing a rating for each characteristic, raters assigned an overall rating on a scale of one to four.

Quality of Care Data

Information necessary to measure quality of care for each of the departments was obtained at the case level from the medical records of each of the 575 cases. We estimated quality of care with two separate measures. For each of the 575 cases a record of adverse occurrences before and during hospitalization was prepared, using the Adverse Patient Occurrence Inventory that had been developed. The information was obtained from physician and nursing progress notes as well as from laboratory and other data on the medical record.

The second measure relied on process outcome and quality assurance instruments completed for the 200 tracer cases at each hospital, using a separate instrument for each of the diagnoses. The objective was to compare the course of hospitalization to that of a standard, or typically managed, case. For each of three stages of hospitalization, admission, peak, and discharge, a dummy variable (1,0) was indicated for the presence or absence of standard diagnostic tests, treatments and responses.

ACTIVITY DATA

Objectives

The study design recognized the need to account for the contribution that residents make to patient care in serving in the role of the attending physician, and the effects that this common practice might have on the cost of patient care in teaching hospitals. Of related interest was the extent to which physicians and other members of the medical team substituted for each other in providing patient care services.

Two types of analysis were anticipated. The first was based on direct measurement of the division of time of physicians and nurses into categories that could be identified with patient care, teaching, learning, and combinations of those functions. The second approach applied the more indirect analyis of labor inputs of these different types in association with hospital output measures to estimate economic production functions.

The time allocation methodology was undertaken because it was believed to be the most straightforward way to address the substitution issue. As it turned out, collecting the data needed for this component of the study posed the most difficult of all the data collection requirements. (This component also proved to be a major deterrent to participation by hospitals.)

Collection and Content

The activity study required that a log of daily activities of health professionals be maintained for a ten-day period in each hospital. The goal for participation was 100% of residents in the teaching hospitals, 50% of the nurses at all 45 hospitals, 100% of other health professionals (physician assistants, nurse practitioners, nurse anesthetists, etc.), and 100% of the attending staff responsible for the majority of admissions during the preceding year.

Participants made entries in a passport-sized logging book that divided each day into half hour increments. Coded entries provided a means of capturing four items of information on staff activities in half-hour time increments:

Activity - distinguished by 20 different types of activity. Major categories were patient care, education, research, administration, and personal;

Role - indicated primarily whether individual was performing activity under supervision, or alone;

Location - where in the hospital the activity was performed; and

Education weight - numerical value indicating percent of half hour, if any, spent in resident education.

The combination of the 20 activity codes and 6 role codes (8 for residents) provided 120 possible descriptions of activity in any one half-hour period among each of the four labor classes. The 120 combinations were combined into 6 discrete activity descriptions, using the respondents' estimates of the percent of resident education as the allocation basis for separating joint activities. This was done by calculating an average estimate of percent resident education for each labor class at each hospital and allocating to education a proportionate amount of all joint time for the labor class.

GENERAL DATA

General data collected at the hospital level ranged from local economic data that was used in standardizing salary and other costs through information on the characteristics of the residency programs including the number enrolled in each specialty and the

number of foreign medical graduates (FMGs) to occupancy rates for each of the major departments.

A class of data that could be included under this heading pertains to physician reimbursement and funds flow. Some of this was financial in nature, but much was qualitative information on method of physician reimbursement and on financial arrangements and exchange of services between hospitals and affiliated entities.

Data about physician reimbursement was obtained at all three levels. At the basic level, the department, we interviewed department chairmen and/or chiefs of clinical services. The chairmen were asked to identify the sources of reimbursement for each member of the staff -- fee for service, hospital, practice plan, and other.

Information bearing on the quality of medical education at each hospital was also obtained by interview. For each residency program in the hospital, an estimation of the success of the hospital or sponsoring medical school in filling available first year residency spaces through the National Resident Matching Program was recorded in terms of the percentage of available spaces filled. In addition, accreditation status of resident programs was indicated for several prior years.

At a more subjective level, informal financial arrangements among institutions were probed by interviewing officials of the institutions. Findings were recorded in three forms:

Discussion paper. An outline of issues identified, the officials contacted, and estimating procedures used for calculating net flows;

Flow chart. Diagram of revenue and service flows between affiliated institutions; and,

Spreadsheets. Flows of net dollar amounts and sources. These amounts were later entered into the EAS system to calculate total costs, at the case level, including unbooked costs.

The most common form of unrecorded service cost was attributable to attending physicians' voluntary teaching. Estimating the dollar value of these services was handled as part of the funds flow process, but the information was recorded separately. The value of this teaching was calculated by estimating, through interviews with department chairmen, the approximate number of hours per week each department attending staff member spent with residents. Salary level was estimated on the basis of university faculty rankings. An average hourly salary for staff was estimated using mean salary by faculty rank for the hospital's affiliated medical school. Multiplying the average salary by the number of hours spent in resident contact and totaling the departments provided an estimated total imputed voluntary teaching cost for each of the five departments.

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APPENDIX: MEASUREMENT OF TEACHING STATUS

Introduction

The Study of the Financing of Graduate Medical Education included an extensive effort aimed at creating a useful categorization of teaching hospitals for analysis and to use in sample design. The result of this effort was a four category classification noted in the text discussion on sampling.

The typology utilized readily-available (secondary) data to distinguish among all nonfederal short term general hospitals that are approved to participate in residency training. Eleven measures of educational output derived from the following three categories were used in constructing the typology:

- amount and scope of GME provided;
- extent of medical school affiliation; and
- participation in other training program aside from GME.

Cluster analysis was used to form the hospital groups from the 11 separate measures. Using a combination of subjective judgment and statistical analysis, a total of four hospital groups was identified from the 11 variables.

Exhibit A-1 shows how the universe of 1,102 teaching hospitals was divided into four groups and presents a brief description of each group. As shown on the exhibit, about two fifths of the total, which we labeled the Type 1 institutions, consisted of those that had limited involvement in teaching relative to the other hospitals included in the analysis (typically, only a single small residency program). The next group, which we labeled the Type 2 hospitals, chiefly consisted of those offering residency programs

Descriptive of Teaching Hospital Groups

Group	Number of Hospitals in Group	Percent of Total	Description of Group
1	425	42.0	Hospitals relative limited teaching involvement
2	182	18.0	Hospitals with primary care teaching programs and medical student training
3	304	30.0	Hospitals with significant teaching activities in conjunction with other hospitals and affiliated with medical schools
4	101	10.0	Major teaching centers

in the largest specialities, such as internal medicine and family practice. In addition, most of these institutions, in contrast to the Type 1 hospitals, were involved in medical student training.

The final two groups consisted of the major teaching hospitals. Type 3 institutions offered a considerably broader range of speciality training than those in either of the two previous groups. Also in contrast to Types 1 and 2, Type 3 hospitals typically provided GME in conjunction with other hospitals and affiliation with medical schools. Finally, Type 4 hospitals constituted the major teaching centers. In nearly all respects, the 10 percent of the hospitals that were assigned to this group stood apart from the others. Specifically, they were involved in training considerably more residents in more specialities, and they provided significantly more other professional training than other teaching institutions.

Validation of the Typology

Validity of the classification was tested by analyzing the intergroup differences in measures that had not been used to form the classification, but which should have been related systematically to the grouping structure. The four groups of teaching hospitals exhibited significant differences in the expected direction in both scope of services and case mix. For instance, the value of the Medicare case mix index was lowest in Type 1 and highest in Type 4 institutions. Similarly, average costs per case were lowest in Type 1 hospitals and highest in Type 4 hospitals, consistent with the patterns in scope of service and case mix as well as teaching activity.

Once the data from the 45 sample hospitals was available, it was possible to re-evaluate the original typology in light of the new data, which included some of the same measures that had been obtained from the secondary sources as well as additional descriptors of educational activity not available elsewhere. Our

review of the input data for the sample of hospitals and the primary-secondary data comparisons revealed several findings that had implications for the structure of the original typology.

Closer inspection of the sample hospitals revealed several differences between the original classification for sample stratification purposes and the actual classification. One hospital classified as a minor teaching hospital was found to have no teaching activity. Several hospitals in the teaching group were found to be misclassified by type.

Medical school affiliation, role in undergraduate training, and participation in other professional training appeared to be the most unreliable of the 11 measures used to form the hospital groups. While participation in other professional training does not appear to have played a major role in distinguishing one group of hospitals from another, affiliation and undergraduate training were important in distinguishing Types 1 and 2 from Types 3 and 4. Development of more reliable measures for these characteristics would probably change the original configuration significantly. We could not accurately test the effects of such changes on grouping structure without data for the entire population of teaching hospitals.

Findings

Sample data confirmed that the existing configuration did not distinguish groups of hospitals that have clearly distinct roles in the provision of GME. Perhaps as a result, the groups as a whole did not differ significantly with respect to case mix or costs. Comparison of data on faculty composition, provision of undergraduate and other professional training, case mix, and costs did reveal, however, a consistent difference between the Type 4 hospitals and all of the others. The former hospitals were the most involved in both GME and undergraduate training, and had substantially more residents, salaried faculty, and other

While the continuous measure of teaching intensity (residents-to-bed ratio) was used in statistical analyses, the apparent validity of the classification scheme for the larger population of teaching hospitals and for intergroup differences observed in the field allows the typology to be used in presentation of descriptive data in the study. The version used for this purpose, however, was slightly modified in accordance with the patterns revealed by the primary data.