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Peer Review Information Systems

by

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Medical peer review starts with the management control system of the health service deliverer. A health care management control system enables health care managers

- To make better plans — plans that relate to organizational goals and objectives based on the relative benefits and cost of alternative courses of action
- To have better control — control that assures efficient and effective action in pursuing the organization's objectives.

But plans and controls require four generic types of information — *planning information* about

- What services the organization will render and to whom
- What resources the organization will use to provide these services

and *performance information* about

- How effectively the organization is doing its job
- How efficiently the organization is using its resources.

Developing the capacity to provide planning and performance information requires a management information system, or more simply, an MIS. The MIS must be dominated by what information is needed in decision making. The MIS must produce information that

- Defines how current resources are required and being consumed (e.g., how are professional staff deployed?)

This article is a working paper which will be published in modified form elsewhere.

- Assesses the pattern of service delivery (e.g., who receives what types and amounts of services?)
- Provides monitoring aids for various health care providers and managers (e.g., were particular admissions inappropriate?)
- Develops data for multiple reporting requirements (e.g., reporting to funding agencies or payment agents such as Social Security Administration or PSRO review)
- Creates a data base for planning (e.g., identifying changing patterns of utilization)
- Assesses outcomes of rendered services (e.g., level of functioning of client, changes in symptoms).

As varying forms of medical peer review emerge (e.g., PSRO, PSRO hospital delegated review, hospital-based and self-initiated reviews), both service deliverers and service monitors will sense the vital role of and the demands placed upon an MIS in their respective organizations. While this paper focuses initially on the information system of a hospital deliverer, a service monitor (e.g., PSRO) can benefit from and use the same analysis since it, too, must implement systems to develop planning and control information.

But information systems are not free. The management of information costs. The balance between "enough information to make adequate planning and control decisions" and the "cost of developing and maintaining an information system" is a constant cost-benefit struggle. Whenever any organization expands its information system beyond the satisfaction of minimal legal requirements and routine problem solving, the continuing question becomes: "Are the benefits worth the investment?"

The themes of this paper are simple:

- Effective medical peer review *starts* with the development of a management information system at the level of service delivery. The requirements and characteristics of management information vary by level of decision making and type of organizational function. The physician, the nurse, the skilled attendant, and their immediate managers collectively require considerably *more* detailed information to perform their tasks than higher level superiors or reviewers. Quality assessment and utilization review, for example, *extract* and/or *aggregate* specific key items for analysis and comparison by drawing information from patient records or clinical files and management records. Without an adequate information system, quality or use reviews are stymied and diminished in effectiveness. Organizations who may review deliverers of services are dependent on the service deliverer's information systems—input to the reviewer is the output of the deliverer.
- An understanding of the content of and underlying concepts of information systems is required to build and operate an effective, yet efficient, medical peer review system. Not all information that health care managers or reviewers receive, need, or use comes from the information system. A phone call from a close friend or a casual comment by a medical colleague in a group discussion may have a large impact

and can change the whole course of an organization. This "informal" information system is acknowledged as important but this paper focuses on the formal, structured information system *planned* for managing the organization and the medical peer review.

- Information costs. Information is not free or even inexpensive. Information
  - should be viewed as a valuable, but expensive resource
  - should be used in improving and in managing the delivery of health care services
  - should be evaluated for its own cost-effectiveness.

A highly specific but timely look at emerging PSRO requirements highlights inadequate concern for the costs of information systems and medical peer review.

REQUIREMENTS AND CHARACTERISTICS OF MANAGEMENT INFORMATION

Information Requirements Depend on Level of Managerial Activity

The information needs of a health care manager vary by levels of managerial activity. Because the *level* of the management activity influences the *characteristics* of the information used, information systems must be designed to provide different types of information at different levels. Four general managerial levels may be identified within health care organizations:

- Strategic planning
  - Setting organizational goals
  - Outlining policies and objectives
  - Identifying general range of appropriate organizational activities
  - Long-range planning
- Tactical or managerial control
  - Short-range activities for acquiring and allocating resources
  - Identifying new services or locations of services
  - Deciding on service location layout and personnel requirements
  - Analysis of budgets and variances from budget
- Operational control
  - Ensuring specific tasks are implemented in an effective and efficient manner
  - Accepting or rejecting specific clients
  - Insuring quality of service at point of delivery
  - Allocating personnel to predetermined programmatic plans
  - Determining reasons for variations of expenditures from budgeted amounts

- Clerical inputs

  Completing data capture forms according to prescribed procedures

  Performing assigned functional tasks.

Clerical systems feed information into the decision-oriented information systems at higher levels of the organization. Moving from the lower levels of the organization to higher levels, the decision emphasis turns from operations to control to planning and policy making (Hoffman, Chervany, Dickson, and Schroeder, 1973, p. 12), while planning and control operate throughout the entire organization. The emphasis is decidely different at the varying activity levels. Data are condensed and filtered until they become information for decision making (Hoffman *et al.*, 1973, p. 10). Conceptualization of the data-to-information process through varying levels of managerial activity is presented in Figure 1.

Medical peer review has its beginning in the clerical inputs since the primary review team is focusing on the day-to-day operations such as surveying new patient admissions and assessing patient progress and readiness for new interventions. Often pre-established procedures and decision rules are used and specific data capture forms are utilized in order to encourage consistent, efficient, and effective health services to clients.

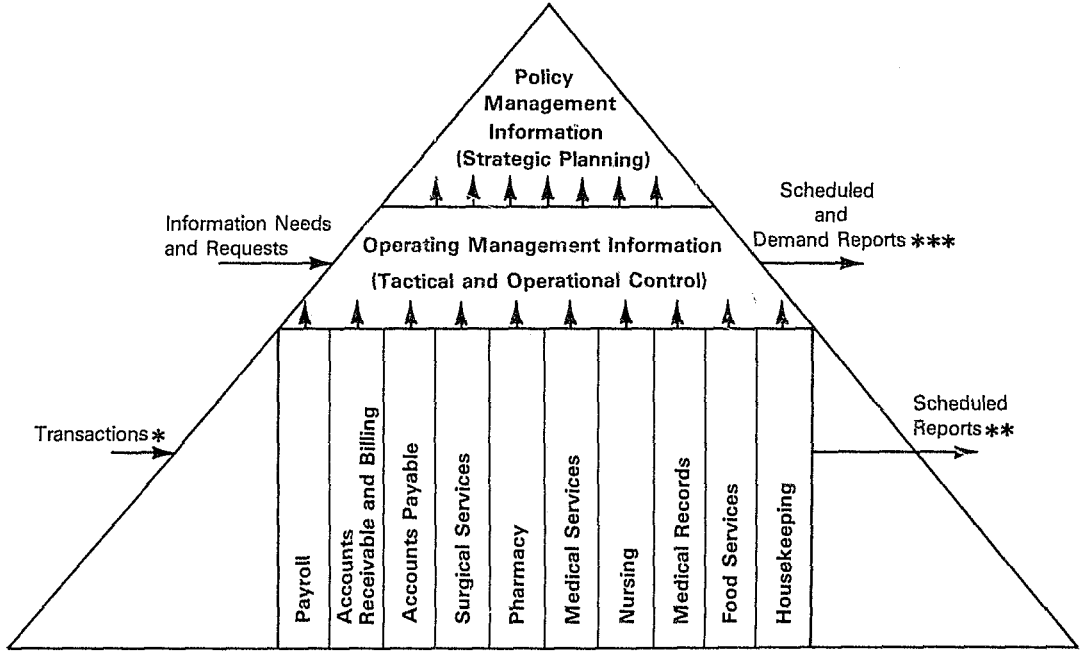
Utilization review is basically another form of operational control. Only at a level two review—a peer review committee focused on utilization, medical unit, evaluation, continuing education—are higher levels of control activated. Level two review (and level three—appeal) incorporate both strategic planning through the setting and reviewing of objectives as well as managerial (or tactical) control by assessing deviations from objectives.

The characteristics of information needed for planning and management vary by level of managerial activity. Strategic decision making -- especially long-range planning -- requires greater amounts of external information, lower levels of accuracy, and higher levels of summarization. Tactical decisions require more accurate, precise, current, and more repetitive information. Operational decisions, however, require the most detailed information. Specific, accurate, frequent, and current data are required for health care deliverers and managers to evaluate the immediate response required for short-range changes in day-to-day operation. Table 1 summarizes the interaction of characteristics of information and level of decision making.

Information Requirements Depend on Organizational Function

Another source of variation in the characteristics of information stems from organizational function such as the service delivery, personnel, and finance/accounting or evaluation function. Often each functional area of organization requires specific types of information and this frequently leads to functional information subsystems that merge, ideally, as an integrated management information system. This "federation" of functional subsystems, while processing functionally specific informational needs, may often use a common data base (but maintaining some unique files) while sharing common computer programs. A matrix of functional subsystems *and* managerial

FIGURE 1



Source: Adapted from Robert Head, "Management Information Systems: A Critical Appraisal," *Datamation*, May 1967

* Transactions refer to interactions with the system in connection with its operation, e.g. patients using services, purchases from outside vendors, paying the medical and nursing staff, etc.

** Scheduled reports refer to outputs from the processing system in a fixed format at a fixed time, e.g., census reports , drug inventory status, payroll summaries, budget variances, balance sheets and income statements, etc.

*** Demand reports refer to outputs based on special requests, e.g., explanation of admission, cost of a certain service, explanations why costs exceed budget, etc.

TABLE 1

Information Characteristics by Decision Category

Characteristics of Information	Decision Making		
	Operational	Tactical	Strategic
Source	Largely internal		Largely external
Scope	Well-defined, narrow		Very wide
Level of aggregation	Detailed		Aggregate
Time horizon	Historical		Future
Currency	Highly current		Older
Required accuracy	Higher		Lower
Frequency of use	Very frequent		Infrequent

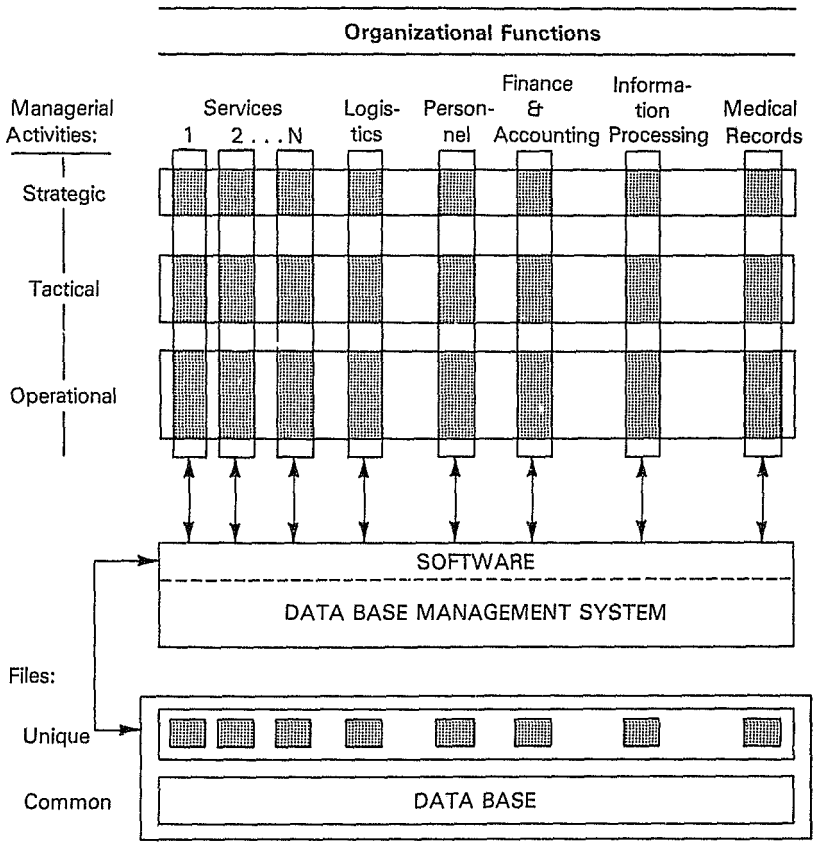
Source: Adapted from G. A. Gorry and M. S. Scott Morton, "Framework for Management Information Systems," Sloan Management Review, Fall 1971, p. 59.

activities is summarized in Figure 2. The *size* of the subsystem is usually inverse to the level of the managerial activities and is pictorially represented by varying sized rectangles with more of the subsystem being devoted to lower level managerial activities and comparatively smaller portions being devoted to higher level activities.

Characteristics of information change as the managerial function changes. The service delivery function needs data, for example, on population at risk, clients, historic and current utilization of services, and progress on treatment plans. The personnel management function, however, needs data on employees' professional training, experience, years of service, and pay grade. Some data will be associated with only one fuction while other data will be used by several functions. Years of service may only be used by the personnel department but hours of rendered service may be used by managers in service delivery function as well as by payroll, cost-finding, and billing in the accounting/finance function. Managers in the service delivery function could use hours of rendered service to evaluate the level of effort by various professional staff while accounting/finance may use the same information for billing a specific client, insurance agency, or reimbursing agency for services received by the client.

FIGURE 2

Conceptualization of Health Care Information Systems



Source: Adapted from James E. Sorensen and Richard Elpers, "Developing Information Systems for Human Service Organizations, "in Evaluation of Human Service Programs, Academic Press, in Press.

Information characteristics (Adams and Schroeder, 1972) such as accuracy or precision (less to more accurate), age of data (younger to older), repetitiveness (less to more repetitive), summarization (less to more summarized), descriptive contents (less to more descriptive), and source (less to more outside) also seemed to vary by the particular managerial function. The accounting function, for example, requires precise, older, repetitive, and summarized data at one extreme where a service delivery function (e.g., medical nursing station) requires accurate, up-to-date, detailed and often descriptive data.

Summary

The characteristics of information vary both by level of decision making *and* by organizational function. The information system that is created as a health care organization grows must be correspondingly varied and complex. If it is created in an unsystematic, piecemeal fashion, as is often the case, it can be excessively redundant and ineffective. The MIS designer attempts to integrate existing and needed information fuctions to best serve the organization at its current size and stage of development. Now the discussion focuses on the *content* of the information system.

CONCEPTUAL CONTENT OF HEALTH CARE INFORMATION SYSTEMS

Within a health care organization, information is needed for a variety of purposes. Information is required for

- Clinical monitoring

  Supervision and review of medical and surgical treatment interventions

  Communication of background and instructions to those who deal with the patient

- Research
- Management

  Planning and controlling the acquisition and use of the organization's resources

  Assessing the efficiency and effectiveness of the organization's performance.

Weinstein (1975, p. 397) has commented on the changing role of information in health care organizations:

> Traditionally in medicine, individual physicians and other therapists have assessed for themselves how well individual patients responded to particular treatment procedures. . . . Much of the information needed to evaluate the treatment of individual patients is the same information needed to treat these patients . . . and is [the] information . . . assembled for statistical analyses of groups of patients. . . . With imaginative use of modern information handling . . . a given piece of information [is] recorded only once and used any number of times for a variety of purposes.

Overlapping Systems

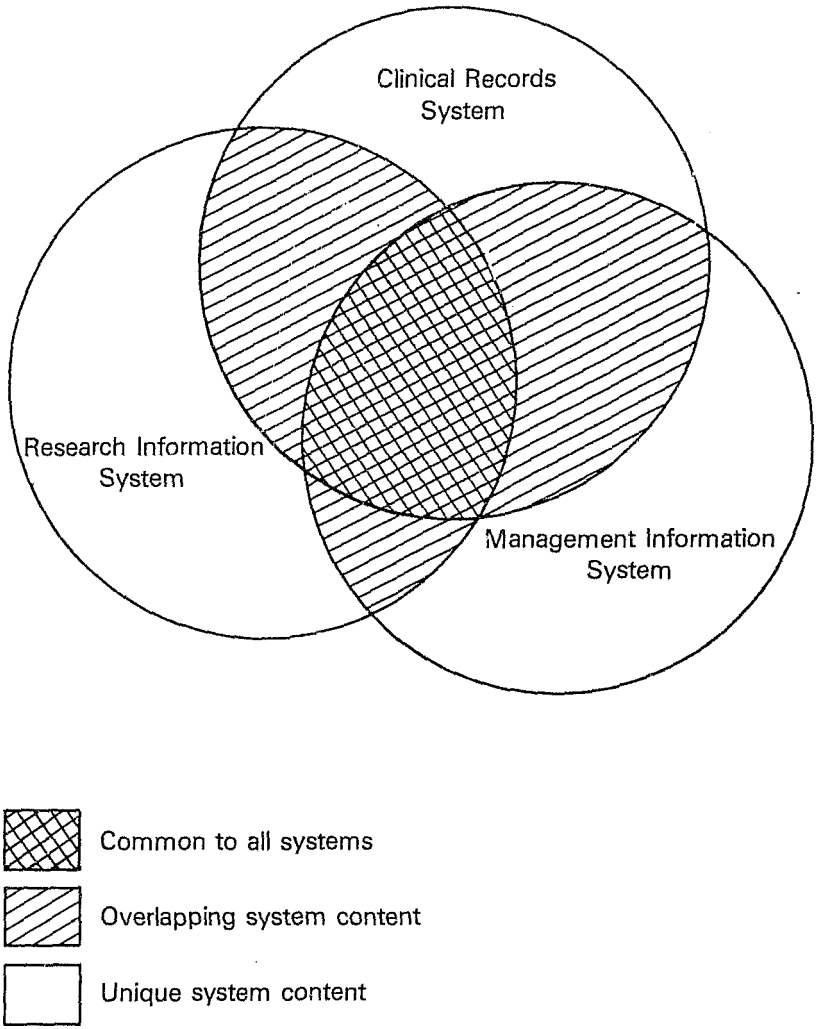
Clinical monitoring, research, and management information requirements overlap but an intensive examination reveals that the kinds and extent of data needed for each system vary considerably. The commonalities and differences are conceptualized in Figure 3.

CLINICAL RECORDS SYSTEMS

Clinical record data for monitoring a patient's treatment needs and progress must be explicit and as objective as possible. Historically, these files

FIGURE 3

Commonality Among Clinical Records, Research Information and Management Information Systems



were developed manually and often could not be manipulated statistically because of inconsistencies in recording and difficulties of retrieval from hand prepared records. With the advent of peer and utilization review, *specific* elements of the *clinical* record system must be extracted, summarized, and/or compared to specific criteria for operational and managerial control. Length of stay (LOS), types of service, admitting diagnosis, for example, are elements which serve both the clinical records and management information systems. While an inappropriate LOS for a given diagnosis may be flagged for possible review by a physician advisor or a peer review committee for inappropriate treatment, a hospital administrator may desire profiles of the LOS by diagnosis and service to assess the need for modifying the types of services offered or adding additional staff because of changing admission patterns.

RESEARCH INFORMATION SYSTEMS

Research on medical problems requires extensive, often expensive to obtain, information on samples of (or, in some cases, on total) patient populations. The distinction between complex research approaches and simpler managerially oriented program operations evaluation should be drawn clearly. A long-term prospective controlled study examining the clinical cost-effectiveness of short-term hospitalization as an alternative to long-term hospitalization for schizophrenic patients (where either type of case is clinically feasible such as in the study by Glick, Hargreaves, and Goldfield, 1974) requires an elaborate design using classical evaluation procedures. On the other hand, less complicated approaches may be used in ascertaining that a given Community Mental Health Center (CMHC) target group received services that achieved a treatment plan objective and at what cost during the past three months or ascertaining which of two modalities used by a CMHC treating manic depressives was most effective for the costs incurred. The first example of evaluation is more clearly in a research area where the second and third type have a greater management flavor.

> There should be a clear-cut separation between studies designed to determine relationships between treatment modes and effects and evaluation studies. The former studies should be undertaken within a pure science context. . . . For evaluation purposes, it is necessary to monitor treatment programs to see that any given approach does not fall below some experimentally determined lower limit of production (Levine and Levine, 1975).

MANAGEMENT INFORMATION SYSTEMS

As quality and utilization reviews develop, more elements of the clinical record systems will become part of the required inputs of the management information system. Initially, the process may be done by manual extractions from manually prepared records done by humans. Eventually, the overlaps will be automated, and computers (ranging from mini to midi to maxi) will perform routine processing and report preparation for key manager/decision makers within (and outside of) the delivering organization. Medical audit teams may want to be alerted to possible cases of poor health care while administrators may be interested in the overall incidence and resolution of

the same cases. The medical audit team may be expected to press for more detail while hospital administrators are likely to press for greater summarization.

Management requires select data on all clientele (usually less detailed) and on the resources acquired and devoted to providing various services (Cooper, 1973, pp. 10-11). Managers at varying levels usually require report information focused around five broad classes of questions:

- Questions assessing patterns of patient or client care and services. Illustrative reports would include

  Disposition of intakes by organizational service

  Ethnic/racial background by sex and type of service received

  Residence of patients admitted by organizational service

  Patients added by major presenting health problem

  Patients discharged by major and minor discharge diagnosis

  Number and proportion of admissions (apparently) eligible for third-party reimbursement

  Volume of services by type of service and organizational unit

  Patient load by individual staff or staffing units

- Questions defining how various types of resources are acquired and consumed. Typical reports include statistical and financial data.

  Statistical

  - Distribution of staff time by discipline and service
  - Volume of services provided by staff or staffing units

  Financial

  - Cost per unit of service
  - Comparison of program costs and fee revenue by type of service
  - Comparison of budgets and expenses by organization components

- Questions that create monitoring aids for health care managers for medical peer review and utilization review. Reports might include

  Statistical/Medical

  - Concurrent review aids
    - Admissions not meeting admissions justification profile criteria by type of admitting diagnosis or problem

      Listing of admissions exceeding average LOS criteria (local norms)

      Extended length of stay by service and complications
  - Retrospective review aids
    - Admitting diagnoses not validated by physician

      Admission justifications not confirmed

Case listings of diagnoses not accompanied by critical diagnostic or therapeutic services

Case listings of diagnoses accompanied by potentially harmful medical services

Financial

- Concurrent review aids
  - Admission without determination of third-party payment source

    Cumulative charges in excess of Medicaid or medicine allowances
- Retrospective review aids
  - Cases where cost per spell of illness exceeds average cost criteria (mean ± 1 standard deviation)

- Questions identifying patient outcomes

  Discharge status by diagnosis and LOS

  Specific complications by diagnosis and LOS

  Specific complications by service and attending physician

- Questions responding to external reporting requirements. Usually, these reports should be completed from existing internally generated reports or by a search of an external source (e.g., census data).

Areas of managerial overlap between clinical and, to a much lesser extent, research information systems should be clear. Whether these three kinds of data can be easily and economically integrated into a *single* data system is problematic because of the variations in the depth, nature, and manipulations of their respective systems data bases. Information systems for each major system pose challenging but differing design and reporting requirements. Selected medical information about a patient's allergies, for example, must be immediately accessible for the physician prescribing medications, while the length of stay may need to be accessed only periodically. Readings on an experimental group may be analyzed long after the patient has been discharged but the information may have to meet exacting measures of calibration and time of administration.

Distinction between these three systems add clarity to the design (or redesign) of an information system to serve medical peer review. While drawing heavily on medical records systems, the medical peer review process is likely to cause more records to become part of the management information system. Medical peer review is a management control process that depends on two interlocking information systems for its success and adds another demand on the provider of care's often inadequate and overburdened information system. To be economical, yet effective, requires an *integrated* approach to information system design — an approach seldom considered in most health care organizations.

INTEGRATING THE INFORMATION SYSTEM IN A HEALTH CARE ORGANIZATION[1]

Two overriding considerations of how the information system is integrated flow from:

- Top management's view of how they want to manage the organization
- The level of diversity within the organization — the level of separateness or interdependencies within the functions and operating units.

Management comes in many forms and so do approaches to information systems. Information systems may be

- Hierarchically oriented with either centralized data processing or decentralized data processing

or

- Systems oriented with either integrated processing or distributed processing.

While these distinctions are not easy to differentiate, this rough classificatory scheme provides an organizing framework for probing optional approaches to designing organizational information systems. The hierarchical approach reflects what has been achieved historically while the systems approach offers an alternative basis for conceptualizing logical rather than practical issues.

Hierarchical Approach

Superordinate and subordinate relationships channel the flow and processing of information. Hierarchial organizational units — functional, departmental, or divisional — provide the lines through which information flows upward or downward. The data bases are segregated along functional or other specialized lines. For example, the service delivery function may be separate from personnel which may be separate from the accounting/finance function. Often communications between the functions are problematic since the data processing activities of each function or organizational units are unrelated to each other. The *solid* line relationships in Figure 4 reveal this approach.

Actual data processing may be done with centralized or decentralized facilities. Centralized processing may be done by a separate electronic data processing department, service bureaus, time sharing computer facilities, or facilities under contract. The general condition is that the separate data bases of different functions, for example, are processed by a common unit such as an electronic data processing (EDP) department. Decentralized data processing still retains vertical (e.g., hierarchical) information processing but the EDP department is separated from the other areas. The essential characteristic of the hierarchical approach is that the data processing is geared to specialized interests — functions, departments, services — and results in separate data bases for each of the functions, departments, or divisions and is controlled by the area to whom the information is reported.

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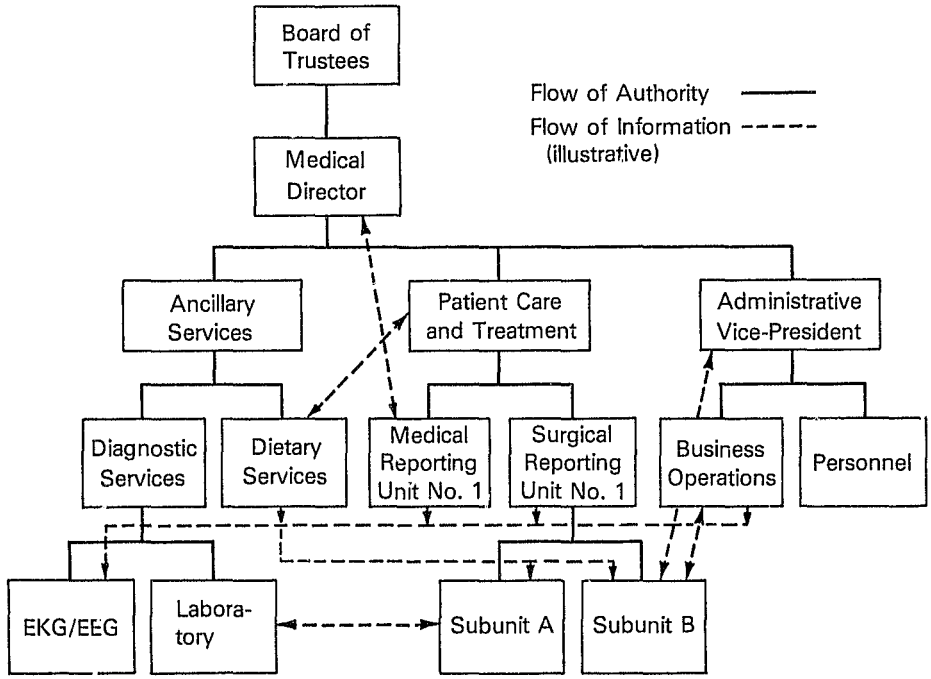
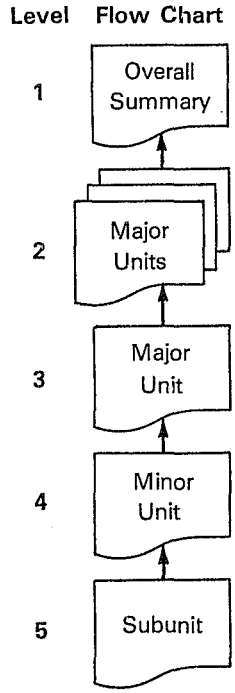
[1]This section draws on discussion developed in James E. Sorensen and J. Richard Elpers, "Developing Information Systems for Human Service Organizations," in *Evaluation of Human Service Programs,* Academic Press (in press).

FIGURE 4

Simplified Sample Organizational Chart



Reporting Level



Systems Approach

An alternative approach focuses on the systems perspective – one which makes available a broad base of comprehensive information on a timely basis to internal and external users for observations, reaction, and decision making. Strategic, tactical, and operational levels of decision making are incorporated as well as planning and controlling activities into an interlocking network of subsystems (rather than a vertical organizational hierarchy). *Information flows directly to users who need and are supposed to receive it.* The super-ordinate-subordinate "reprocessing" of data is reduced thus permitting lateral and vertical flows of information. The dotted lines in Figure 4 illustratively portray this perspective. Two general systems approaches exist:

- Integrated system (analogous to the centralized data processing used in the hierarchical approach)
- Distributed system (analogous to the decentralized data processing method in the hierarchical approach).

INTEGRATED SYSTEM

The integrated system channels all organizational data into a common data base and services all data processing and information functions for the entire organization. Traditional methods of handling data and information are changed since

- Data collection
- Data processing
- Production of information (e.g., reports)
- Communication of information

are *integrated.* Client records systems (e.g., medical and demographic data), financial data (e.g., accounting, cost-finding, budgeting) and managerial data (e.g., personnel, outpatient services, patient days, intakes) are largely consolidated. For example, when a service is rendered, patient and professional staff data are captured and used to update patient and professional personnel files for purposes of summarizing services

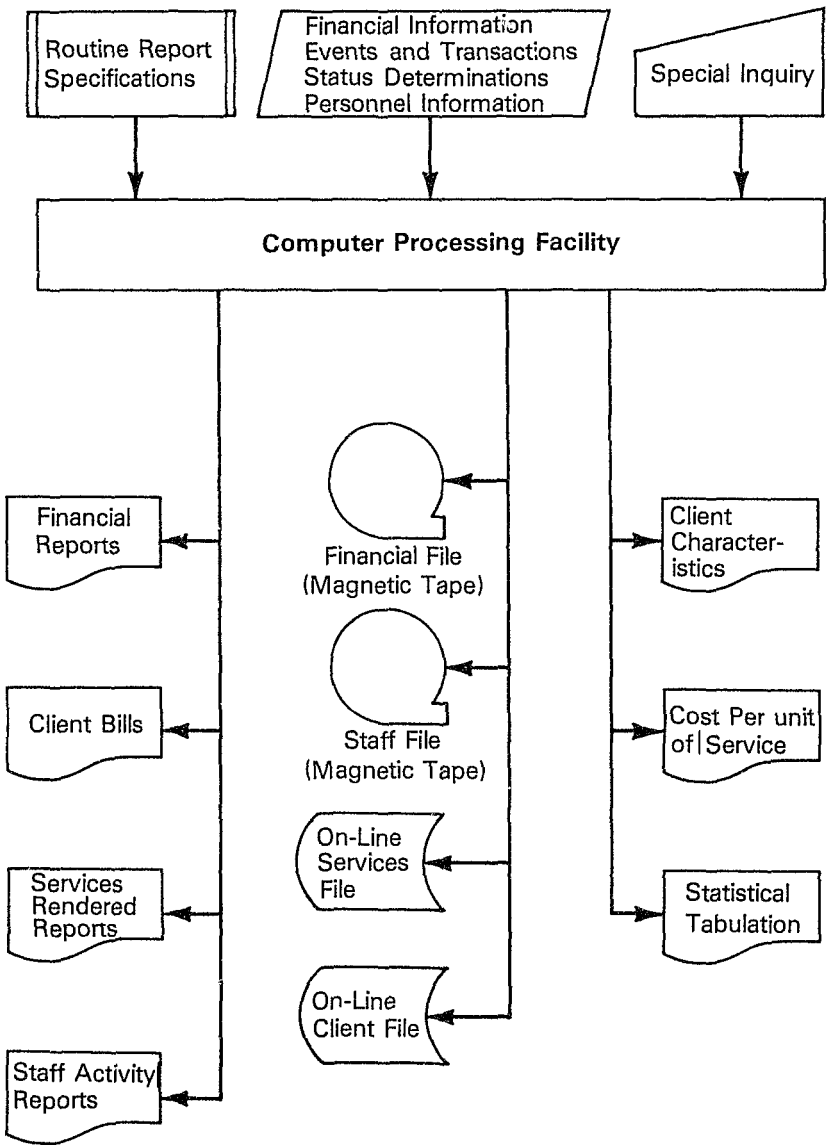
- Received by specific client including billing of client or third-party
- Rendered by type of service and specific individual professional as well as by classes of varied professionals
- Accumulated by delivered units of service by program and geographic location
- Compared against time, size, or appropriateness criteria (e.g., when last medication was given, dosage, inappropriateness because of allergic reactions).

Figure 5 reveals major components of an integrated information system with a *common* data base. Characteristics of this system are (Burch and Strater, 1974; Murdick and Ross, 1975; Davis, 1974):

- Instantaneous and simultaneous updating of files
- High-speed response to inquiries via remote terminals
- Massive on-line storage
- Both centralized batch data processing and on-line processing (although on-line processing is not always necessary).

FIGURE 5

Partial Outline of an Integrated System



The advantages of the integrated system include (Burch and Strater, 1974; Murdick and Ross, 1975; Davis, 1971):

- Reduction of duplication and redundancy of files and programming
- Increased standardization
- Reduction of clerical work and involvement in input, processing, and output thereby reducing errors
- Instantaneous and simultaneous updating of files
- Concurrently retrieve, update, or delete data from the common data base by multiple users
- Greater security, controls, and protection of common data base against unauthorized users
- Retrieval of data on an economical basis since economics of scale can lead to lower overall costs, fewer errors, and more timely reports.

On the other hand, integrated systems have the following possible disadvantages (Burch and Strater, 1974; Murdick and Ross, 1975; Davis, 1971):

- A high level of financial and personnel resource and management commitment are required to make the system successful; cost of development is high
- Withheld cooperation at any level of management can destroy the potential benefits of the system
- Downtime can be catastrophic; if the central processing unit (e.g., computer) is down, the system is completely degraded and backup facilities can be costly and redundant
- Modifications are difficult because of the interdependencies within the programs
- Threats to client confidentiality may be increased.

DISTRIBUTED SYSTEM

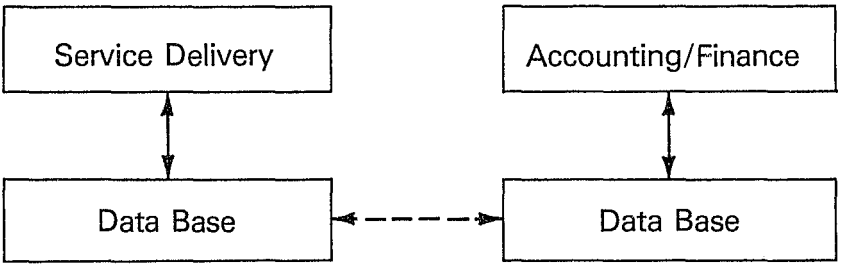
The distributed system, recognizing the disadvantages of the integrated system, uses a group of information systems to provide a "system of subsystems" with relatively independent subsystems which are tied together via varying communication interfaces. Large files are broken down into several files with "need to know" access criteria. An example of a distributed system is presented in Figure 6.

Advantages accruing from the use of the distributed information system include (Burch and Strater, 1974; Murdick and Ross, 1975; Davis, 1974):

- Greater cost-effectiveness of distributed systems and their interaction with individual data bases by using minicomputers and telecommunications
- Reduced central facility costs (but may be offset by costs of interaction between data bases)
- Ease of modification to meet user requirements
- The level of resources (personnel and financial) and level of coordination among levels of management is not as great (when compared to an integrated system)
- Less sophisticated and less expensive technology is required with lower costs

FIGURE 6

Two Functions in a Distributed System



- Organizational demands for volume, timing, complexity, and processing may be easier to meet
- Breakdown of one subsystem does not degrade the entire system
- New subsystems can be added more easily and without upsetting other subsystems.

The distributed system, however, is not without its disadvantages. Some of these include (Burch and Strater, 1974; Murdick and Ross, 1975; Davis, 1974):

- Difficulty in extracting corresponding data from different files or in making inquiries into different files
- Increased possibility of inconsistencies in different systems leading to errors (e.g., mismatches of data files on the same client)
- Duplication of data capture and storage
- Difficulty in maintaining coordination and communications.

Summary

Distributed systems possess some integration while integrated systems possess some distribution. In brief, the varieties of combinations are endless. *The basic decision is whether to favor a highly integrated system or a distributed system with some integration.* Conditions such as the following flavor the choice:

- Type of activity of the organization — how diverse are the activities of the organization?
- Type of management style — does management want to operate as an integrated unit or to decentralize so that each unit makes important decisions about its own activities?

- Extent of geographic dispersion — are the organizational units geographically dispersed?

Commercial airlines, for example, favor integrated systems because of their similarity in operations and the central role of reservations in determining requirements for personnel (e.g., pilots, stewardesses, maintenance) and other resources (e.g., airplanes). Large manufacturing operations where the diversity among functional areas is great lean toward distributed systems. Health care information systems can be successfully developed with both approaches but should lean toward integrated systems. The degree of integration occurs by integrating

- Data into a data base (e.g., eliminating numbers of files and providing for planned retrievals)
- Data processing functions (e.g., single and general programs process data at common facilities regardless of sources)
- Data flows (e.g., developing flow around natural mainstream and collecting all information needed downstream at appropriate sources)
- The outputs (by integrating networks, copying individual files, or using general retrieval programs, the report response capability can be similar to an integrated system).

INFORMATION SYSTEMS FOR MEDICAL PEER REVIEW

Integration of health care information systems begins with the design process by asking questions about *how could* the system be designed. While systems *analysis* focuses on what a system is doing or what it should be doing to meet user needs, systems *design* seeks answers to how could the system best meet user requirements. System *implementation* focuses on the installation, development, testing, and evaluation of a detailed system design. In Table 2 Murdick and Ross, through a suggested standard task list for project control, provide a convenient but highly condensed overview of the entire systems development process. (While the table suggests the use of a computer, manual or keysort or other data processing approaches may be appropriate.)

STUDY AND GROSS DESIGN PHASE

During the study phase, varying organizational constraints and requirements will be weighted differently by different health care organizations. For example, weighting on

- Cost of acquisition
- Cost of maintenance
- Reliability
- Life expectancy
- Level of performance
- Flexibility
- Potential for growth
- Ease of installation
- Accuracy

will vary widely among health care organizations but each variable must be considered in arriving at a preliminary design.

TABLE 2

Standard Task List of the Work Breakdown Structure for Project Control

I. Study Phase
- Task 1 Study organization goals and problems.
  - Subtask 1.1 Interview managers and study internal documents.
  - Subtask 1.2 Survey operating problems.
  - Subtask 1.3 Study informational problems.
- Task 2 Study company resources and opportunities.
  - Subtask 2.1 Evaluate company resources.
  - Subtask 2.2 Study needs of the market and environmental trends.
  - Subtask 2.3 Evaluate competitive position.
- Task 3 Study computer capabilities — equipment and manpower skills.
- Task 4 Prepare proposal for MIS design study.

II. Gross Design Phase
- Task 1 Identify required subsystems.
  - Subtask 1.1 Study work flow and natural boundaries of skill groupings and information needs.
  - Subtask 1.2 Develop alternative lists of subsystems.
  - Subtask 1.3 Develop conceptual total-system alternatives based upon the lists of subsystems.
  - Subtask 1.4 Develop scope of work to be undertaken based on need of the company and estimated resources to be allocated to the MIS.
  - Subtask 1.5 Prepare a reference design showing key aspects of the system, organizational changes, and computer equipment and software required.

III. Detailed Design Phase
- Task 1 Disseminate to the organization the nature of the prospective project.
- Task 2 Identify dominant and principal trade-off criteria for the MIS.
- Task 3 Redefine the subsystems in greater detail.
  - Subtask 3.1 Flowchart the operating systems.
  - Subtask 3.2 Interview managers and key operating personnel.
  - Subtask 3.3 Flowchart the information flows.
- Task 4 Determine the degree of automation possible for each activity or transaction.
- Task 5 Design the data base or master file.
  - Subtask 5.1 Determine routine decisions and the nature of nonroutine decisions.
  - Subtask 5.2 Determine internal and external data required.
  - Subtask 5.3 Determine optimum data to be stored in terms of cost, time, cross-functional needs, and storage capacity.
- Task 6 Model the system quantitatively.
- Task 7 Develop computer support.
  - Subtask 7.1 Develop computer hardware requirements.
  - Subtask 7.2 Develop software requirements.
- Task 8 Establish input and output formats.
  - Subtask 8.1 Develop input formats (design forms).
  - Subtask 8.2 Develop output formats for decision-makers.
- Task 9 Test the system.
  - Subtask 9.1 Test the system by using the model previously developed.
  - Subtask 9.2 Test the system by simulation, using extreme value inputs.
- Task 10 Propose formal organization structure to operate the system.
- Task 11 Document the detailed design.

TABLE 2 (cont.)

IV. Implementation Phase
- Task 1 Plan the implementation sequence.
  - Subtask 1.1 Identify implementation tasks.
  - Subtask 1.2 Establish interrelationships among tasks and subtasks.
  - Subtask 1.3 Establish the performance/cost/time program.
- Task 2 Organize for implementation.
- Task 3 Develop procedures for the installation process.
- Task 4 Train operating personnel.
- Task 5 Obtain hardware.
- Task 6 Develop software.
- Task 7 Obtain forms specified in detail design or develop forms as necessary.
- Task 8 Obtain data and construct the master files.
- Task 9 Test the system by parts.
- Task 10 Test the complete system.
- Task 11 Cut over to the new MIS.
- Task 12 Debug the system.
- Task 13 Document the operational MIS.
- Task 14 Evaluate the system in operation.

Source: Robert G. Murdick and Joel E. Ross, *Information Systems for Modern Management*, Second Edition, Prentice-Hall, 1975, pp. 260-261.

The sequence of events in these two phases is also crucial:

1. Formulation of organizational goals and objectives
2. Determination of questions (or hypotheses) to be addressed by information systems for assessing achievement of goals/objectives in #1
3. Formulation of reports that address the question in #2
4. Determination of data elements to be used in formulating reports in #3
5. Creation of data capture instruments to accumulate data for report in #4
6. Identification of most cost-effective approaches to error control
7. Estimation of volumes of data processing and storage requirements
8. Simplification of report requirements, document requirements, and error control mechanisms
9. Derivation of data processing recommendation
10. Review of design by management and staff for decision to
    - Move to detailed design
    - Modify design (e.g., use a manual system by reducing reporting requirements)
    - Abandon the project entirely.

A common fault is to plunge into the creation of data capture instruments (step 5) with little regard for the crucial role of the first four steps. Inefficient and ineffective systems often result and create frustrated and disappointed users. "Add-on" or redesigned information requirements to accommodate medical audit review and utilization review are not exempt from the requirement to be developed using sound systems design methodology. The temptation to pass off the requirements as too time-consuming or too rigorous is

great. Only good system *design* can produce good clinical and managerial information.

DETAILED SYSTEM DESIGN

This phase of system design (or redesign) usually involves (Chapman, 1976, pp. 4-1 to 4-52):

- A design of improved record flow that integrates required MIS documents with existing forms. Most systems grow like Topsy and addition of medical peer review is added, old forms are patched and new ones added. Data gathering becomes inefficient and accuracy drops and staff resistance grows. An easy way to counteract opposition is to simplify through record-keeping integration – the sequential step of charting current record flows, integrating MIS documents with current flow, and simplification of record flow
- The design of input documents or forms design. Use of demonstrated techniques on item coding, item format, and form layout reduce the burden of recording data (written document or CRT input) and enhance accuracy and completeness
- Prepare data processing specification including

  Criteria for editing data inputs for documents and internal processing (e.g., merge edits)

  Procedures for selected computations (e.g., age, units of services, indices, exception listings)

  Formats and guides for reports

  Performance criteria for data processing including programming deadlines, confidentiality, and financial arrangements
- Determination of firm cost estimates
- Design review which leads to final approval for implementing the information system.

IMPLEMENTATION OF THE DESIGN

Installing the information system requires (Chapman, 1976, pp. 5-1 to 5-18):

- Preparation of detailed plan of implements (using Program Evaluation and Review Techniques or PERT)
- Pretest of forms
- Preparation of procedures manuals and conducting orientation and training sessions
- Decisions about inclusion of current case load and historical data in data base. (A good way to start is with *current* case load and to be sure that all of the data loaded into the base have been *thoroughly edited*.) This approach ignores most "historical data" captured under different systems since the accuracy *and* completeness are nearly always seriously deficient

- Develop and test computer programs (if used)
- Initiate collection of essential data for data base for existing case load
- Initiate collection of current data and delivery system operation.

Guidelines for Design

The level of integration of conceptual content in managerial decision levels and functions hinges on the approach outlined in the discussion in the systems approach — integrated or distributed. While adhering in varying degrees, health care information systems should observe some of the key guidelines of good systems design (Burch and Slater, 1974; Murdick and Ross, 1975; Davis, 1974):

1. Source data should be collected only once even if used several times by the system (to reduce redundancy and error)
2. The number of steps in data capture should be at a minimum (to increase accuracy)
3. Subsystems should produce data that are compatible with other subsystems; one subsystem should not have to re-enter data received from another subsystem
4. Timing of reports should be geared to timing and processing of supporting data; data should not be captured any sooner than required for reports
5. Changes or innovations should be cost-effective from an overall system perspective (e.g., cost of capturing data, correcting errors)
6. Source data should be thoroughly edited so only valid data will be input into the information system
7. Audit trails and record reproduction should be available upon demand
8. Back-up and security procedures should be maintained for all files.

In summarizing a technical approach to system design and the context in which the approach can be used, Chapman (1976) observes that a MIS for any organization

- Can be helpful only to the extent that a climate prevails that welcomes the assistance that can be provided by a management tool
- Must provide information about resource expenditures that can be compared to objectives, intuitive or structured, that can influence decisions about future resource allocations
- Must determine information collection requirements primarily in terms of the structuring of data for decisions
- Must be designed by an iterative process in which the broad outlines of organizational structure, as it implies feedback needs, report requirements, data collection needs, and of maintaining data integrity are determined in sequence
- Must determine the details of record-keeping integration, data processing specifications, and input document contents and format only after a total system concept has been conceived so that implications of cost-effectiveness tradeoffs can be traced throughout the system
- Must be implemented according to the carefully prepared plan that

minimizes the consternation of organizational change and gets the system operational without delay and loss of credibility in the eyes of the agency staff.

ECONOMICS OF INFORMATION SYSTEMS FOR QUALITY ASSESSMENT AND UTILIZATION REVIEW

Developing integrated information systems for medical peer and utilization review consumes resources. The outlays should be cost-effective. Another way to state the question is: "What costs and in what amount will be different *because* of medical peer review information requirements?" Many people, often well intended observers, make the mistake of thinking that incremental information requirements can be added to an existing system with little or no inconvenience or expense. Wrong! Others misguidedly believe that the major cost of a system is the computer configuration. Wrong again! Costs of information systems are extensive and pervasive. A partial list follows:

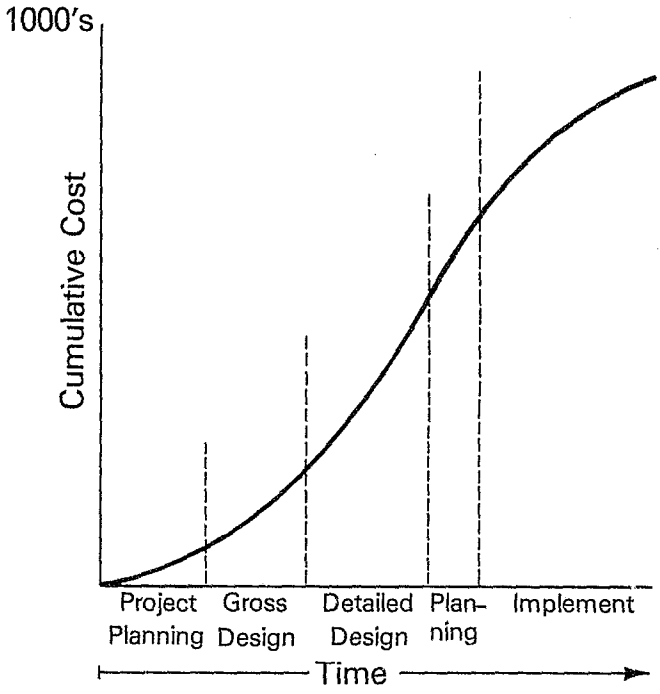
- Costs of computer configuration
- Costs of renovation (e.g., facilities, air conditioning)
- Costs of training (e.g., including users and preparers of input)
- Costs of programs and program testing
- Costs of conversion (e.g., preparing and editing records for completeness and accuracy, setting up file library procedures, preparing and running parallel operations)
- Costs of operations (e.g., staff, supplies, maintenance, insurance, light and power, computer rental [or amortization])
- Costs of professional staff and support personnel time complying with data capture requirements
- Costs of error detection and correction process; costs of tracking specific cases emerging in various appeal processes
- Costs of information system changes or modifications excited by changing external reporting requirements or controls
- Costs of preparation of new materials to accommodate changing external requirements.

Information systems costs start with project planning and grow into an operational state. Figure 7 is an integrated performance/cost/time (PCT) chart used for controlling the three key variables in a system development and clearly reveals the pattern of growth of costs over time.

The Information Economics of PSROs

To explore the financial impact of peer review information systems within a contemporary frame of reference, the current and announced PSRO information requirements are examined for their impact on direct and indirect care provider expenditures. Unless the discussion is circumscribed, an inclusive catalog of all costs and related economic determinants associated with all forms of peer review could consume the entire book. The discussion also provides a clearer look at the impact of PSRO directives on hospital information systems.

FIGURE 7



Planned Actual	Man-hours	
Planned Actual	$Labor	
Planned Actual	$Materials	
Planned Actual	$Computer Charges	
Planned Actual	Total	

Source: Adapted from Robert G. Murdick and Joel E. Ross, Information Systems for Modern Management, Second Edition, Prentice-Hall, 1975, p. 264.

A prime concern of hospitals is the urgent need to implement (and to pay for) the unfolding data handling requirements of the PSRO program. If PSRO either succeeds or fails at the local hospital level, then the economic impact of PSRO upon hospitals could become a major determinant in the survival of either the PSRO program or the hospital or both. Any overall economic impact can be roughly divided into those factors which affect total revenues (hospital income) and those which divert portions of that income to non-reimbursable expenses. An *effective* PSRO program will reduce hospital admissions, shorten patient stays and curtail "unauthorized" services — the expressed hope of Congress and the Federal establishment — and could pose a potential long-range threat to the survival of many hospitals. But, PSRO participation has more immediate but still threatening economic consequences to hospitals. Stated simply, "What will it cost hospitals to comply with informational requirements and what reimbursement will they receive?" Costs (both direct and indirect) likely to be encountered are tentatively identified for PSRO-delegated hospitals irrespective of the specific type of information system employed. While a pragmatic oversimplification, is the proposed 75¢ per case a rational level of compensation which will enable a delegated hospital to meet its PSRO information requirements? Or will the cost be so much greater that the hospital will be forced to divert revenues from patient care or to raise its charges to cover unreimbursed expenses of PSRO informational requirements?

CATALOG OF PSRO REQUIREMENTS

The first step in addressing these questions is to enumerate all of the various PSRO informational requirements which have been officially promulgated or formally announced to be in the planning stage. These requirements, though published, are scattered among a number of "Transmittals" and other HEW documents. Table 3 presents an overview of the kinds of information system costs recognized and unrecognized in current PSRO pronouncements. Only by examining each in the context of all the others can one obtain some appreciation of their cumulative demand for resources. A precise calculation of the actual costs at the hospital level could only be ascertained in the context of a given institution. But the absence of a specific organization does not preclude an identification of the announced data handling functions which are likely to generate some kind of expense to the hospital regardless of how much these functions cost. Seen in the aggregate, one can begin to appreciate the magnitude of present and anticipated demands required by PSRO participation — demands leading to expenses which hospitals must budget and fund from one source or another.

TABLE 3
Summary of PSRO Data Requirement Costs

Recognized Costs	Unrecognized Costs
Uniform Hospital Discharge Data Set	PSRO Document Control System
Medical Care Evaluation (MCE) Abstract (PMIS)	Data Base Layout/Programs for Data Interchange
MCE Re-Study Report (PMIS)	Charges/Costs per Episode of Care
Concurrent Review Data	Reporting PSRO Decisions to Payors
Patient Profiles	Data Processing Control Data
Practitioner Profiles	Patient/Provider File Access Records
Provider (Hospital) Profiles	File Access Notification System
Diagnoses	Accuracy Verification Procedures (Files)
Procedures	Compartmentized Access
Dificiency Analysis (PMIS)	Identification Purge System
PSRO Review Activity Reports	Data Removal Records
Non-PSRO Review Activity Reports	Claims Appeal Disclosures
Educational Activities	Sanction Report Disclosures
Corrective Procedures	Data Quality Control Procedures
Hospital Administrative costs	Studies of Diagnostic Validity
	Recommended PSRO Accounting System
	Current Review Activities (Manual)
	Cost Reporting

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