

Chapter 1

The Role and Function of Quantitative Methods in Health Services Management

LEARNING OBJECTIVES

After studying this chapter, you should be able to:

1. Describe how health services managers analyze, design, and implement in a systems context.
 2. Differentiate between efficiency and effectiveness as vital managerial interests.
 3. Describe how quantitative methods fit into the repertoire of the health services manager.
 4. Describe the general systems model in relation to health services.
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LEARNING OBJECTIVE 1: EXAMINE HOW HEALTH SERVICES MANAGERS ANALYZE, DESIGN, AND IMPLEMENT IN A SYSTEMS CONTEXT

Health administration, as a profession, deals with the management of human, fiscal, physical, and information resources to meet the goals and objectives of healthcare organizations. Survival of the healthcare organization in a competitive environment, as well as characteristics of this survival, involve multiple factors, including the abilities of managers. The challenge is to provide healthcare organizations, and the communities, patients, and clients they serve, with competent managers able to perform the robust and challenging role of manager.

Being a competent manager in a healthcare organization means fundamentally different things depending upon specific role expectations, perspective, and circumstance. Within a healthcare organization, managers are assigned very different functions, each with potentially different definitions of core competency. Managers in the human resources department of a hospital face different management challenges than the managers in the hospital's planning and marketing department or the financial services department. Different types of healthcare organizations

may require different types of managers. Nursing homes may require managers with different skills and values than public health clinics. Healthcare organizations also may shift their definition of desired or needed management competency because of a shift in their objectives, in characteristics in their environment, or in both. A hospital in the process of affiliating with a regional healthcare system may require different management talents than the hospital intending to remain a solo institution. Definitions of management competency also may change based upon perceived or real changes in the field of management. The competencies expected of professional health services managers encompass a very wide breadth and depth of potential responsibilities, values, interests, and abilities. Health administrators need a broad repertoire of skills to function in this dynamic situation. More specifically, multiple perspectives also exist concerning the role and function of the health manager in a contemporary healthcare organization. Being able to use quantitative methods designed to assist managers make decisions is one essential part of this repertoire, regardless of the role and function of any health services manager. Figure 1-1 is one framework able to integrate many of these perspectives and is based upon the simple recognition that managers need the ability to analyze, design, and implement.

Analyzing, as a core managerial competency, is the ability to discover what is. It involves, for example, discovering the current market share of an organization. It involves discovering the actual total cost of a specific service rendered by the organization. It involves discovering who does what with what resources to provide a specific service. It involves using forecasting to discover the logical or reasonable future of the organization. The key and defining aspect of analysis is discovery. Sometimes discoveries shift the organization's goals and objectives. Other times discovery is used to determine whether the organization is meeting and how it is meeting its goals and objectives. To facilitate discovery, quantitative methods provide the manager an analytical road map. Each quantitative method has a unique analytical ability. For example, a method such as queuing theory can only be used to analyze specific types of waiting lines. When incorporated into the manager's repertoire, quantitative methods provide the manager with useful and robust tools.

Designing, as a core management competency, is the ability to identify and arrange resources in a manner commensurate with goals and objectives. If the goal is to provide a specific service, managers need to be able to design (or redesign) the mix of resources needed to provide the service. The goal of operating a short-stay surgical unit in a hospital requires that a manager identify and arrange the

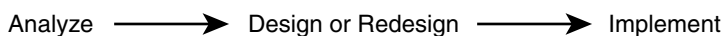


Figure 1-1 General Management Competencies

resources needed to realize the goal, such as specialized equipment and staff. If the goal is for the organization to retain specific information, then managers must be able to design work processes to capture, report, and store the desired information. Design as a managerial competency often involves engineering because it encompasses the ability to break down desired capabilities, such as an organization's goals and objectives, into requisite components or parts. If the organization desires a new service, it is a manager's responsibility to design the service by first determining the different mix of human, fiscal, physical, and information resources needed to provide the service, and then specifying exactly how much of each will be needed to provide the service. Design of new work processes, or the redesign of existing ones, involves developing detailed plans so that when the plans are executed the desired capability has been incorporated into the organization. Design also involves developing these detailed plans as to what is needed as well as how the needed resources should be used. Design is performance oriented; the new or revised design must establish the desired performance capability.

Implementing, as a core management competency, is the ability to change the organization. The process of implementation may require the manager to change the behavior of specific employees. It may also involve the ability of the manager to accumulate and operationalize the resources necessary to achieve desired goals and objectives. Whereas design may be the management competency that determines what is needed, implementation is the management competency that installs new or revised elements in the organization. The manager's repertoire needs to include quantitative methods to assist implementing change within the organization. These methods include, for example, Program Evaluation Review Technique (PERT). The Program Evaluation Review Technique is a formal method used by managers to plan and control projects. It informs managers of the desired order and schedule of activities needed to be accomplished to realize the overall completion of a project or change within the organization, such as the opening of a new short stay surgical unit in a hospital.

LEARNING OBJECTIVE 2: TO DIFFERENTIATE BETWEEN EFFICIENCY AND EFFECTIVENESS AS KEY MANAGERIAL INTERESTS

Managing in the Health Services Organization

A healthcare organization is any organization that provides health and medical services to patients, residents, and clients, such as an acute care or specialty hospital, a nursing home, an ambulatory care organization, such as a university health services, public health clinic, and a home health agency. The defining characteristic in this definition of a healthcare organization is patient care; care provided by

physicians, nurses and therapists to prevent and treat disease or infirmity. The mission of these organizations serves to distinguish them as healthcare organizations.

Services provided to patients could include a surgical procedure, diagnostic examination, specialized treatment, or disease prevention or screening program. These services also could be an appropriate meal, a safe and comfortable environment, or an accurate and timely bill for service. All healthcare organizations provide a range of services and specialize in providing individual patients a particularized array of services based upon a patient's needs or diagnosis. The central and defining element of all healthcare organizations is the provision of a personal and personalized experience, and high quality health or medical service. As such, a central expectation shared by all health administrators is the expectation that management practice will lead to the *efficient* provision of *effective* services to people in need of service.

The interests of managers and the interests of the healthcare organizations that employ health administrators as managers are difficult to distinguish. Both interests emphasize that patients receive needed services and that services are provided in an *efficient* manner. Healthcare organizations and health administrators rely upon physicians, nurses, and therapists to determine or diagnosis the needs of a patient accurately and to plan and execute an intervention or treatment that has some probability of success in maintaining or improving the health status of the patient. Clinical interests stress the needs of individual patients and the identification of appropriate service interventions. Decisions made by clinicians are based upon what they consider to be *effective* approaches, interventions that have some probability of clinical or medical success. The physician, nurse, or therapist has been educated and trained to select and apply current knowledge to assist patients. Clinical interests and perspectives are focused on the *effectiveness* of a service—the ability of a service to accomplish its predetermined objective. Although clinicians are not necessarily oblivious or insensitive to *efficiency*, their unique role and function stem from their commitment to provide effective service to patients. They alone have the expertise to determine a patient's needs (i.e., diagnosis) and to meet them (i.e., treatment) and are judged by their peers, specific systems, and patients based upon their ability to provide an *effective*, but not necessarily an *efficient*, service.

Efficiency as a Management Interest

Efficiency is the ratio measure of output over input. High efficiency is achieved when a service is rendered using the least amount of resources. Inefficient clinical practice, such as requiring more clinical tests than necessary to make an accurate diagnosis can lead to a highly inefficient healthcare organization. Using more medical supplies than needed or even stocking more medical supplies than needed are other examples of operational inefficiency. Using an excess number of people

to prepare a meal or render a bill is inefficient; an excess amount of input resources are being used to produce a specific output. Unlike operational effectiveness which is primarily in the province of the clinician, operational efficiency lies within the dual province of both clinicians and managers. Health administrators are retained to analyze, design, and implement work processes in the healthcare organization that lead to desired levels of operational efficiency.

Inefficient work processes waste scarce resources. Efficient work processes provide services that maximize the opportunities created by the mix of resources used to produce the service. Managers are employed by organizations to ensure that desired levels of efficiency are attained, not by accident, but by design. Being interested in efficiency differentiates the health services manager from the health service clinician. Striving for maximum appropriate efficiency is a management value that requires a specific repertoire of skills—the ability to analyze current levels of efficiency, the ability to design and redesign services to achieve desired levels of efficient, and the ability to implement new or revised services.

Effectiveness as a Management Interest

Effectiveness means the ability to accomplish a defined task. For example, if a specific drug is able to cure a specific infection, then that drug can be considered effective. If a specific medical procedure or therapy is able to cure or alleviate a specific disease or infirmity, then the procedure is effective. To be effective, the procedure or drug must accomplish its intended purpose. Multiple factors may influence the effectiveness of planned intervention or treatment. For example, some patients may respond differently to the same drug. Sometimes the effectiveness of a procedure or treatment is influenced by the behavior of the patient, something not totally controllable by the clinician. Effective treatments are those treatments that have a probability of success; sometimes these probabilities may be 5%, 50%, or 95% depending upon the state of clinical and scientific knowledge and/or the existing health status of the patient.

Healthcare organizations rely upon clinically trained professionals to select the appropriate clinical services or treatments for specific patients from the array of services offered by the organization. Clinical professionals are expected to select appropriate services and, if not available in the healthcare organization, to refer the patient to another organization. In the healthcare organization, managers are not empowered to override or veto clinical judgments involving a patient's diagnosis or treatment. Clinical protocols are established by clinical professionals, not managers. At the operational level, the clinical staff determine how effective the organization will be in accomplishing its mission to provide a high-quality personal and personalized health or medical service to specific patients (to treat disease or infirmity).

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At the strategic or macro level of organizational decision making and action; however, managerial interests involving organizational effectiveness emerge. For example, the costs and benefits of investing in new technology must be identified and examined from both a clinical and organizational perspective before the decision is made by the organization to acquire and implement it. Even though a new technology may enhance the effectiveness of the clinicians affiliated with the organization and thereby increase the organization's effectiveness, its acquisition and/or operational cost to the organization may prevent the organization from acquiring it. Managerial involvement in these types of strategic decisions is one example of how managers influence the effectiveness of the healthcare organization. Health administrators also are trained to use epidemiology and are expected to use epidemiology to analyze the health and medical needs of the communities and groups of individuals served or potentially serviced by the healthcare organization.

Efficiency and Managerial Competence

Just as clinical operational *effectiveness* is the responsibility of the clinical professional, operational and organizational *efficiency* is the primary responsibility of the health administrator as manager. As stated, efficiency means providing a needed service using no more resources than necessary; it is a ratio measure of output and input. Health administrators are employed in part to ensure that any service provided by the healthcare organization is supplied in an efficient manner. Being able to determine current levels of efficiency is an example of analysis as a managerial competency. Being able to design or redesign how the organization does something to enhance efficiency is an example of design as a managerial competency. Being able to change how the organization provides a service to enhance operational efficiency is an example of implementation as a managerial competency.

Striving to make the healthcare organization efficient is a dominating, unique, and defining value associated with management and managers and the field of health administration. Whereas the credit for effective clinical practice must be given to the clinical sciences and professions and the technologies they use, credit for efficient operations and the efficient use of resources must be given to health administrators and their ability to analyze, design, and implement.

LEARNING OBJECTIVE 3: DESCRIBE HOW QUANTITATIVE METHODS FIT INTO THE REPERTOIRE OF THE HEALTH SERVICES MANAGER

Theoretical designs to describe or illustrate the role and function of management abound. Models such as the Shewhart or Deming cycle (also known as the "Plan-Do-

Check-Act;” the PDCA approach), systems theory, chaos theory, management by objectives, and many more have been developed to organize management thinking and action. Indeed, the level of acceptance or “popularity” of these models has varied over time, as models come into and fall out of favor. One constant remains, however. It is clear that effective managers need to be able to do many things well.

Managers must be able to:

- Articulate organizational objectives.
- Assess opportunities and threats in the internal and external environments.
- Design effective and distinctive organizational strategies.
- Make decisions regarding the allocation of human, fiscal, physical, and information resources to implement these strategies.
- Motivate staff and colleagues to work collaboratively on accomplishing the strategies.
- Evaluate the effectiveness of the strategies.
- Modify the strategies and resource allocation decisions, as necessary.

Management should be viewed as both an art and a science; the principal focus of this book is on the latter aspect, specifically developing skills and tools in quantitative analysis. We do not wish to suggest that quantitative data should be the sole driver for management decision making; we are not advocating a cookie-cutter approach to management or a slavish dependency on numbers. However, effective managers use a variety of quantitative tools, skills, and techniques to complement their intuitive, subjective, and qualitative analysis.

Managers remain very interested in formal methods that can assist them to enhance the operational and organizational efficiency of the healthcare organization. Given their professional concern involving *efficiency*, managers are expected to know how to use specific methods to enhance the efficiency of healthcare organizations. Formal methods expand the ability of health administrators to analyze, design, and implement and constitute an essential element of the manager’s unique and defining repertoire of skills. These methods, many of which are quantitative, and come from operations research, applied statistics, and industrial engineering, provide managers with specific protocols to analyze current levels of efficiency, design new services or redesign existing services to enhance efficiency, and implement change efficiency.

Most of the quantitative methods used by health services managers are based upon the fundamental ability of healthcare organizations and health administrators to count. For example, to determine service efficiency, healthcare organizations count or account for their resources and services. Healthcare organizations count:

- The number of laboratory tests performed
- The number of patient visits to an emergency room

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- The number of meals served to nursing home residents
- The number and type of surgical operations
- The number of immunizations
- The number and type of employees used to provide specific services
- The costs associated with each service

Management actions designed to assess and improve the efficiency and effectiveness of a healthcare organization always begin by counting what is currently being done.

Although basic, counting may not be simple. Every healthcare organization provides a broad array of services. Not everything done in the healthcare organization can or should be counted. Healthcare organizations count those aspects of their operation necessary to assess service effectiveness and/or efficiency. For example, hospitals count the number of patients discharged and the number of days that patients spend in a hospital to calculate the average length of stay (ALOS) of their patients. Average length of stay is a traditional measure of hospital activity. Some hospitals compare themselves with other similar institutions to determine whether they are adhering to similar patterns of utilization. All hospitals generally compare their ALOS with national trends and take national trends into consideration when forecasting service utilization. When ALOS is calculated for a specific medical diagnosis, comparing results by attending physicians also may yield important information concerning the effectiveness and efficiency of clinical practice. Calculating the ALOS of a hospital, like so many similar calculations, begins with counting.

Ambulatory care clinics also count. For example, they count the number of patient visits per day, usually by time of day. This information can assist in determining whether the staffing in the clinic is appropriate for the demand for service. This information can also be used to design efficient staffing levels based upon demand levels that change based upon hour of the day, day of the week, and month of the year.

Other examples of counting include dietary departments in hospitals and nursing homes counting the number of meals prepared and served. Custodial services in all types of healthcare organizations usually count the number of square feet cleaned and the number of staff hours used to clean. Because efficiency is a ratio measure of output (e.g., square feet cleaned) and input (e.g., staff hours used to clean), counting enables the manager to analyze current levels of efficiency, design new approaches to enhance efficiency and implement any needed changes. Being more efficient requires knowing the amount of work accomplished as a measure of output and the amount of resources used to accomplish the work as a measure of input. Knowing input and output levels is a prerequisite for analysis and design or redesign.

Still other examples can be found throughout healthcare organizations. For example, medical laboratories count the number and type of medical test

processed. This provides a statement of the laboratory's output. It also provides a statement of the tests physicians ordered to accomplish their diagnoses. Both can be used to assess efficiency and effectiveness. This list of examples also can include business offices in hospitals counting the number and type of health insurance claims processed, pharmacies counting the number and type of prescriptions filled, and hospitals counting the number of live births. Counting is the common attribute of each of these activities and a prerequisite to assess and improve service efficiency and effectiveness.

To count appropriately often requires using a unique classification or counting system. Diagnosis related groups (DRGs) help hospitals count appropriately the number and type of patients discharged. The classification system objectively assigns each discharged patient to a specific category. The number of patients in each category can then be counted by day, week, or year to yield an accurate listing of hospital actions by discharge diagnosis. Although used as a basis for reimbursement, DRGs were developed as an output measurement system for hospitals.

Healthcare organizations also count mistakes; in fact, this aspect of trying to assess and measure clinical errors has taken on considerable currency in the healthcare system. Examples of such mistakes include errors made in administering medications and blood transfusions, and mistakes made in surgery. Surgical deaths are counted. Postoperative infections are counted. Pathology reports that indicate unnecessary surgical resections are counted. Patient complaints are counted. Inaccurate patient bills are counted. Meals served cold are counted. Patients inappropriately transported to another healthcare organization are counted. Stock out conditions in inventory are counted. Single mistakes and/or patterns of mistakes can be used to determine where change (i.e., redesign) may be needed in the healthcare organization.

Similar to footprints on a sandy beach, the services provided by the healthcare organizations create a trail that can be counted. Once counted, the information expands the manager's ability to analyze the effectiveness and efficiency of the organization or a part of the organization. Service counts are a product of what services were offered by the organization (i.e., capacity) as well as the frequency these services were used (i.e., utilization). The difference between capacity and utilization is an important distinction.

Every healthcare organization offers a unique array of services and has a finite or limited service capacity. For example, a 100-bed hospital has the capacity to generate no more than 36,500 patient days in a typical year (i.e., 365 days \times 100 beds). Some healthcare organizations have the capacity to perform surgery, others do not. These types of expressions indicate the capacity of the healthcare organization. For example, not all hospitals have the capacity to perform neurosurgery, and as such, would not create any service counts involving this type of surgical operation. Not all hospitals have the capacity to offer patients certain cancer treatments.

To assess efficiency requires knowing the capacity of the healthcare organization as well as how the capacity is used.

Utilization is the amount of capacity actually used and is usually reported for a specific period of time, such as an hour, shift, day, week, month, or year. The frequency of a service being rendered, aside from being dependent upon its availability, also reflects the need (and demand) for the available service. Often this need is a decision made by a clinician. A count of laboratory tests by type of test indicates the contribution a medical laboratory makes to the effective operation of the healthcare organization and effective medical care. This same count also can be used to assess service efficiency when combined with counts of the number and type of supplies used and the number and type of staff used in the laboratory as input measures. Counts that indicate utilization when combined with measures of capacity provide the ability to determine the amount and percent of capacity being used. A more complete identification of what is counted in health services organizations, as well as a discussion of how these counts are used, is found in Chapter 2.

As stated, improving the operation of any healthcare organization through the application of quantitative methods begins with the ability to count, often an ability delegated to an information system. What is counted and how it is counted is important, as it establishes the data library managers rely upon as they analyze and design. Formal analytical methods, techniques, and models designed to assess efficiency and effectiveness can only be used in conjunction with an adequate data library. Some quantitative methods have very specialized demands in terms of what needs to be counted to then use the specific method. As such, what is placed in a data library will influence the manager's ability to perform expected functions; namely, the improvement of the efficiency of the healthcare organization using an appropriate method, technique, or model.

LEARNING OBJECTIVE 4: DESCRIBE THE GENERAL SYSTEMS MODEL IN RELATION TO HEALTH SERVICES

Quantitative Methods and the Systems Model

Management, as a profession and field, has long searched for specific methods to assist managers analyze, design, and implement change as organizations strive to enhance their efficiency and effectiveness. Some methods, still in use today, trace their birth to the era of scientific management and the needs of large-scale production lines designed to efficiently produce physical products such as automobiles. In this era, the complex organization was conceptualized as a machine with the pieces of the organization thought of as cogs in the greater machine. Workers were considered cogs. Equipment was considered cogs. Managers were retained to design organizations

as machines and ensure that cogs did what they were supposed to do in the most efficient way possible. Managers wrote procedures to tell human cogs how to do their specific job. Specific methods also were developed to determine the efficiency of individual cogs and assist managers design or redesign cogs and machines. Organizations that produced the best for least were considered survivors.

In this earlier era, division of labor was a new concept because workers were retained to perform one set of tasks necessary for the finished product, not as craftsman held individually responsible for an entire product. The need for people as managers also was new. Coordinating the cogs in the greater machine was a task expected of the manager to ensure efficiency. The thinking in this era emphasized that more efficient machines were more desirable than less efficient machines, that workers were merely extensions of the machine, and that science or engineering could be used to analyze operations and design or redesign work processes. Some of the quantitative methods used today by health administrators trace their conceptual roots to this era. Techniques drawn from industrial engineering, operations research, and operations management emphasize the production characteristics of the organization. Although the era of managers looking to classical bureaucratic theory and the principles of scientific management is over, many quantitative techniques remain available for health administrators to use to analyze, design, and implement within the healthcare organization.

Today, managers in general, and health administrators in particular, are more likely to rely upon general systems theory (Figure 1-2) for concept and direction. This theory suggests that healthcare organizations are one example of goal-directed systems with identifiable inputs, work processes that convert inputs into outputs, identifiable outputs, and feedback loops that serve to direct and control the system. To understand the complexity of activity within any organization, the general systems model provides the ability to assign activities or features of the organization to one of four categories: inputs or resources, conversion processes (i.e., what is done with the inputs), outcomes (what is desired), and feedback.

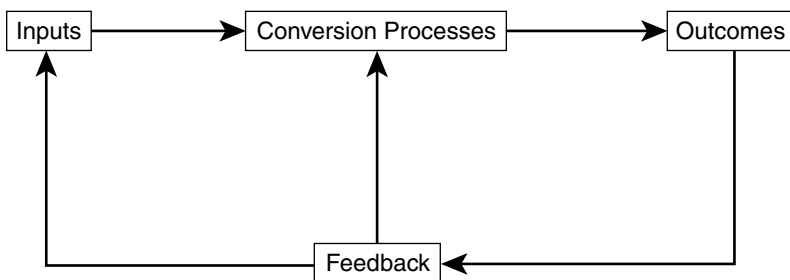


Figure 1-2 The General Systems Model

Organizations are considered open systems that are influenced by events and circumstances external to the organization. As open systems, organizations draw resources from their dynamic environment and provide back to their environment some valued product or service. In spite of this fundamental change in the way managers think about organizations and management, quantitative methods originally developed during the era of scientific manager are still used and considered central in the repertoire of methods that defines the unique abilities of the manager.

Elements of the General Systems Model

Using the systems model to improve the efficiency and effectiveness of the healthcare organization requires appreciation of the defining elements of the systems model.

Organizational Goals

Any system strives to attain its goals by accumulating sufficient resources and converting these resources into desired products or services. Goals express the intent of the system. Organizations, however, have multiple and sometimes conflicting goals. For example, maximizing organizational profit and providing services to anyone regardless of their ability to pay are potentially conflicting goals for any private healthcare corporation. Therefore, the use of the general systems model may be limited by the type and amount of goal ambiguity or conflict that exists in the healthcare organization. The first and most important analytical challenge faced in our quest for improved efficiency and effectiveness is to identify system goals.

Inputs Are Resources

Inputs are the resources needed to achieve a desired goal often expressed as a desired output or outcome. Inputs are needed to accomplish the desired goal of the system. Examples include:

- People, each with a skill deemed needed by the organization
- Time
- Supplies and materials
- Capital assets, such as buildings and equipment

Based on this definition it is reasonable to expect that different types of healthcare organizations, because of their different goals, have different input resources. For example, the input resources needed by a nursing home are different from the input resources needed by an acute care hospital or by a clinic. An organization's wealth may also determine its inputs. As many inputs can be purchased, the

amount and type of input resources held by the organization may be a product of the financial position of the organization.

As they are used, most inputs resources are counted. Financial accounting counts expenses and revenues by category. Other processes count the number and type of workers employed and the numbers of hours worked. Still other systems count the supplies used.

Conversion Processes Add Value

Conversion processes convert inputs into outcomes. A surgical procedure is a conversion process. It takes a specific array of inputs (e.g., people such as a surgeon and nurses plus capital assets and equipment) and converts them into a desired outcome, such as the removal of a diseased gall bladder. Conversion adds value. A conversion process takes inputs and produces an outcome. In the process that transforms inputs into outcomes, value is added. Working with clinicians, health administrators strive for efficient as well as effective conversion processes.

System Modifiers Influence the System

System modifiers influence inputs and conversion processes. Examples of modifiers include need, demand, want, social values, and physical climate. A system modifier is something that influences a conversion process but is outside the direct control of the system. For example, how a hospital converts resources into patient days is influenced by the “need” for medical care. As “need” changes, such as with the advent of HIV infections, conversion processes are changed (e.g., blood is transfused using different procedures/universal precautions). Laws and regulation modify and influence conversion processes.

System modifiers can be as bold as a fundamental change in reimbursement policies or as subtle as a specific health profession striving for the autonomy, status, and income historically reserved for the physician. A system modifier also can be the cultural attributes of the specific organization when these attributes either cannot or will not be changed.

Outcomes and Outputs

Outcomes or outputs are the results created by the system. It is hoped that these results are the desired, intended, or expected goals of the system (or subsystem) under study. If results match expectations, the system is accomplishing its goals. If results do not match expectations, change may be required. Examples of outcomes include the improved health status of the population, the organization’s financial position, the number and type of hospital patient days or discharges, the number

and type of clinic visits, or the number of meals served. Outcomes or outputs are the units of service produced by the organization. Many outcomes or outputs are counted by the organizations. Outcomes involving the worth of an organization are counted using financial accounting. Statistics are generated by organizations that report their outputs and outcomes.

Subsystems and Suboptimization

For purposes of analysis, design, and implementation, large complex systems are usually conceptualized as having multiple layers or subsystems. For example, a human body as a system has one subsystem for circulation and another to control its nerve function. Subsystems serve systems. For example, dietary, imaging, medical information, and patient process subsystems in a hospital serve the acute care system, called a hospital, created by the interplay of numerous subsystems.

Within the hierarchical and interdependent arrangement created by subsystems within a system, suboptimization is expected. Suboptimization is the recognition that the ultimate goal of any subsystem is to meet the requirements of its larger system and that meeting these large and more important system requirements may mean that any individual subsystem may need to operate at less than its highest level of efficiency.

Managers analyze, design, and implement to maximize the performance of the organization as a system. Efficiency and effectiveness are measures of performance. To achieve the goals and objectives of the organization, subsystems are analyzed, designed, and implemented. Expectations placed on subsystems come from system goals and objectives. In some instances, managers expect to have inefficient subsystems so that the organization as systems can be efficient. Suboptimization occurs when subsystems perform below their potential so that the overall organization as a system meets its goals and objectives. In some instances, managers design subsystems to perform below their potential. In other words, suboptimization can be a design parameter used in designing subsystems.

A classic example of suboptimization is a hospital's emergency room. Service is expected to be available, and not necessarily used, 24 hour per day, 7 days per week. By definition, the emergency room is intended to be very inefficient. Staff are retained to be available and provide services when they are needed. The utilization of an emergency room typically is only a small percentage of its capacity. In most emergency rooms, input levels are high and output levels relatively low.

Feedback

Feedback is typically information the organization generates to adjust inputs and/or conversion processes to change the desired outcome or make the actual outcome

more closely resemble its goals. Healthcare organizations produce multiple forms of feedback. Patient outcomes are feedback. Patient opinions about their service encounters are feedback. Market share is feedback. The Balance Sheet and Statement of Income and Expense are feedback, just as conversation between employees is a form of feedback. Generally, feedback is system or subsystem output information that is used to monitor, evaluate, adjust, or change the system or subsystem so that the organization is better able to achieve its stated goals and objectives.

PUTTING IT TOGETHER: QUANTITATIVE METHODS AND THE GENERAL SYSTEMS MODEL

The general systems model provides the framework for our examination of specific quantitative methods. This model focuses our attention on inputs, conversion process, outputs, feedback loops, and modifiers. It is sufficiently robust to capture the essence of all types of healthcare organizations and tells managers to analyze and design healthcare organizations as systems and subsystems. Efficiency and effectiveness are the two primary performance measures used in healthcare organizations. To be an effective healthcare manager requires the ability to view the healthcare organization as a system and to make the organization perform better on both performance measures. Quantitative methods exist to assist managers to analyze and design systems and facilitate implementation of change within the organization not as ends, but as means to enhance organizational effectiveness and efficiency.

A quantitative method is a specific tool, technique, or model that can be used by managers to help address specific situations or problems. Frequently, quantitative methods involve collecting information (or using information collected by others) and manipulating the information using mathematics and statistics. Examples include economic analysis, queuing theory, Program Evaluation Review Technique (PERT), and general system flow charting. Many quantitative methods involve using specific mathematical models to analyze systems. Some methods have very specific applications and specific rules governing their application. Methods included in this work have been drawn from many fields, including industrial engineering, operations research, and general management analysis. Selected methods have the ability to assist managers analyze systems, design, or redesign systems and implement desired change in systems.

Another way to explain quantitative methods for health services managers involves application. To be considered a quantitative method in this context, the tool, technique, or model must have broad application in the healthcare organization and serve the needs of managers. The method must be something that the health administrator working in the hospital, nursing home, or ambulatory clinic needs to use or know about.

Not all quantitative methods have applications in health services management. All statistics are not quantitative methods used by health services managers. Also, some quantitative methods are not purely mathematical. For example, in statistics students learn the rudiments of testing a hypothesis using a *t* and *f* test. These tests are statistical methods used under specific conditions to test a hypothesis based upon a sample. In contrast, often in a same statistics course, students learn basic linear regression. As taught in statistics, the *t* or *f* test is not a quantitative method for health service management; it is a statistical method. Its use in health services management situations is rather limited. In contrast, linear regression is a professionally recognized technique used often by health services managers in forecasting. General system flow charting is a specific method to analyze systems. It is not mathematical or statistical; however, it meets the criterion of being used in certain situations by health services managers.

A REPERTOIRE OF QUANTITATIVE METHODS: AN OVERVIEW OF THE REMAINDER OF THE BOOK

Health administrators as managers have unique repertoires. Health service managers know how to do things other people do not. Health services management is a profession based upon a unique body of knowledge, values, and skills. Managers employed by a healthcare organization need to know (as part of their defining repertoire) how to design efficient systems of health and medical care and how to improve the efficiency of existing systems of care. In other words, efficiency is important to health service managers. Tools, techniques, and models used to improve the efficiency of health and medical care systems are essential elements in the repertoire of health services managers. Most methods are related to “efficiency.” However, this should not be misinterpreted to mean that health services management is only interested in or trained to improve is “efficiency.” Efficiency as well as effectiveness are central values for the professional manager of health services.

Management, like many other fields, can be thought of as reasoned judgment. In applying reasoned judgment, managers need formal methods to assist them to define and resolve problems. Just as master chefs need and create recipes to govern their culinary creations, health services managers need formal methods to analyze and improve complex systems. Using quantitative methods, however, does not absolve the manager from the broader responsibility of being a manager; quantitative methods and tools merely aid the manager in making reasoned judgment.

This book expands a health services manager’s abilities to analyze, design, and implement. It provides methods to analyze systems and complex work processes. It also provides methods to design and implement new or revised work processes or subsystems in healthcare organizations. Frequently, the tools, models, and

techniques involve using mathematical approaches. This book is organized by area of application.

Section I, Foundation Competencies, provides basic skills needed to use the quantitative methods included in subsequent sections. For some, it will be well-known material. For others, it provides a needed review. The foundation competencies include: Chapter 2, Working with Numbers; Chapter 3, Flow Charting; and Chapter 4, Time Value of Money.

Section II, Forecasting Competencies, addresses many approaches that can be used to forecast. Chapter 5, The Art and Science of Forecasting, points out that although many aspects of forecasting are quantitative in nature, subjective and qualitative factors are also critical to the process. Chapter 6, Trend Forecasting Techniques, covers specific mathematical models to detect and extend trends for purposes of forecasting. Chapter 7, Regression Forecasting, covers the application of this statistical model to forecasting. Overall, this section establishes the health services manager's ability to understand and use basic analytical forecasting to construct logical and reasoned forecasts. Forecasting is presented as a core competency associated with the role of the health services manager. Basic algebraic and statistical competencies are needed to complete this section of the book.

Section III, Designing and Analyzing Systems, provides health services managers with the ability to apply specific quantitative methods to specific types of service systems. Chapter 8, Analyzing Capacity and Resources, includes methods to estimate the capacity of service systems. Chapter 9, Managing Waiting Lines, addresses the application of single and multiple channel queuing theory as a method to describe waiting lines. These chapters require basic abilities involving algebra and statistics.

Section IV, Project Analysis, covers five types of applied quantitative methods related to projects. A project is defined as a one-time activity or significant modification to an existing service. Chapter 10, Decision Analysis, formalizes the decision-making process regarding a choice among projects. Chapter 11, Economic Analysis, presents approaches to cost-benefit, cost-effectiveness, and cost-utility analysis used by managers to select among different projects or different project approaches to achieve similar results. Chapter 12, Program Evaluation Review Technique (PERT), is a technique to define a new project and to establish an appropriate time schedule and project implementation control system. Chapter 13, Financial Evaluation of Projects, covers methods used to assess the financial implication of projects and includes specific methods related to the cost of capital, and project risk. Chapter 14, Quality Analysis, addresses quantitative aspects related to evaluating the quality level of a project or program. Overall, this section establishes the manager's ability to analyze, design, and implement projects within the healthcare organization. A basic understanding of economic concepts, financial accounting, statistics, and algebra are needed to complete this section.

Section V, An Application of Quantitative Methods, Chapter 15, Quantitative Analysis in Strategic Planning, provides an extended example of an application of quantitative analysis, including elements of database creation for use in strategic planning. The chapter presents a framework for organizing and evaluating the external environment of a healthcare organization.

This book expands the repertoire of the health services manager to analyze complex systems, and to be able to design and implement changes in systems. Applications are drawn from hospitals, nursing homes, and ambulatory care clinics. Traditional quantitative methods with limited management applications in these settings have been reserved for more advanced presentations. Application is of paramount importance. Throughout the book, repeated reference is made to the importance associated with the ability to effectively communicate results. No matter how perfect or insightful the analysis or design, if it cannot or is not effectively communicated to decision makers in the healthcare organization, the health services manager has failed. Quantitative methods are a robust tool in the skill repertoire of the health services manager and must be used skillfully.