



CHAPTER ONE

INTRODUCTION TO QUANTITATIVE DECISION-MAKING METHODS IN HEALTH CARE MANAGEMENT

In today's highly complicated, technological, and competitive health care arena, the public's outcry is for administrators, physicians, and other health care professionals to provide high quality care at a lower cost. Health care managers must therefore find ways to get excellent results from more limited resources. The goal of this book is to introduce aspiring health care managers to operations research models that allow decision makers to sort out complex issues and to make the best possible use of available resources. Such models are used, for example, to forecast patient demand, and to guide capital acquisition and capacity decisions, facility planning, personnel and patient scheduling, supply chain, and quality control. They use mathematical and statistical techniques: multivariate statistical analysis, decision analysis, linear programming, project evaluation and review technique (PERT), queuing analysis, and simulation, to name a few.

This book presents all these techniques from the perspective of health care organizations' delivery of care, rather than their traditional manufacturing applications. This chapter covers a brief historical background and the development of decision techniques and explains the importance of health care managers using these techniques. Finally, the scope, distinctive characteristics and current trends of health services are emphasized. After reading this chapter, you should

have a fair understanding of how important quantitative techniques are for decisions about delivering health care of high quality.

Historical Background and the Development of Decision Techniques

Beginning in the 1880s, the scientific management era brought about widespread changes in the management of the factories that had been created at an explosive rate during the Industrial Revolution. The movement was spearheaded by an efficiency engineer and inventor, Frederick Winslow Taylor, who is regarded as the father of modern scientific management. Taylor proposed a “science of management” based on observation, measurement, analysis, and improvement of work methods, along with economic incentives. He also believed that management’s tasks are to plan, carefully select and train workers, find the best way to perform each job, achieve cooperation between management and workers, and separate management activities from work activities. Taylor’s work was based on his idea that conflicts between labor and management occur because management has no idea how long jobs actually take. He therefore focused on time studies that evaluated work methods in great detail to identify the best way to do each job. Taylor’s classic 1911 book, *The Principles of Scientific Management*, explained these guiding principles: 1) development of science for each element of work; 2) scientific selection and training of workers; 3) cooperation between management and employees; and 4) responsibility shared equally between workers and management (Taylor, 1911). Other early contributors to scientific methods of management were Frank and Gillian Gilbreth, who worked on standardization, and Henry Gantt, who emphasized the psychological effects that work conditions have on employees—he developed a time-based display chart to schedule work. Quantitative inventory management was developed by F. W. Harris in 1915. In the 1930s, W. Shewhart and associates developed statistical sampling techniques for quality control (Stevenson, 2002; p. 23). World War II prompted the growth of operations research methods, and development of project management techniques; linear programming and queuing methods followed in the 1950s. After the 1970s, the development and wider use of computers and management information systems (MIS) reshaped all these techniques, since large amounts of data could be analyzed for decision making in organizations. Such tools for quality improvement as total quality management (TQM) and continuous quality improvement (CQI) became very popular in the 1980s and 1990s; then came supply chain management and productivity improvement techniques, in particular reengineering.

The Health Care Manager and Decision Making

A health care manager can be a chief executive officer (CEO) or chief operating officer (COO), or a middle-level manager to whom the duties are delegated. At the top management level, a health care manager's responsibilities include planning for capacity, location, services to be offered, and facility layout; those responsibilities are strategic. The health care manager also is ultimately responsible for overseeing service production through supply chain management, quality monitoring and improvement, and organizing health services to be either produced or outsourced. Finally, the health care manager is responsible for patient and personnel scheduling, and for optimally staffing the facility and directing job assignments and work orders. Regardless of whether the health care manager is directly involved or delegates these responsibilities, his or her ultimate responsibility remains. Generally, operational decisions are delegated to mid- and lower-level decision makers, while strategic decisions are evaluated at the organization's top levels. With the integrated delivery systems (IDS) movement, health care organizations are becoming larger and more complex, so health care managers are in dire need of the most recent, reliable information derived from quantitative data analysis in order to make informed decisions. Information technology (IT) has become integral to management decision processes.

Information Technology (IT) and Health Care Management

If they are to analyze their current situations and make appropriate changes to improve efficiency as well as the quality of care, health care managers need appropriate data. The data, from various sources, are collected by information technology embedded in systems either internal or external to the health care organization. For example, decisions about the location of a new health facility will require analysis of data on the communities under consideration (such as census, epidemiological data, and so on). Decisions about nurse staffing will require internal data on patient admissions and acuity that are collected routinely by the hospital. This book identifies the sources of the data for various decision-making tools and emphasizes the use of IT for informed decision making by health care managers.

The Scope of Health Care Services, and Recent Trends

According to the Organization for Economic Cooperation and Development (OECD) countries, its members' total expenditures on health services constituted from 5.7 to 14.6 percent of gross domestic product (GDP) in 2002, making that a very significant sector from a public policy perspective. Moreover, the statistics in Table 1.1 show an increasing trend in health care expenditures. The countries that spent about 3.4 percent of their budgets on health care in the mid-1990s are now spending almost twice that. The United States is the country spending the highest percentage of GDP on health care. Its percentage share of GDP was stabilized from 1995 to 2000, but has been increasing again during the last few years.

Health care, especially in the United States, is a labor-intensive industry with more than twelve million jobs, constituting 9.5 percent of the workforce in 2002. As shown in Table 1.2, the health care work force is expected to reach close to sixteen million in ten years. That constitutes over 28 percent growth and is the fastest job growth area, with nine out of twenty occupations in health care (U.S. Department of Labor, 2004). The aging population—as well as the proliferation of medical technology and new treatments—contributes to this growth.

The health care industry seeks to match varying medical needs in the population. Its 518,000 establishments vary in size, complexity, and organizational structure, ranging from small-town, private practice physicians with one medical assistant to urban hospitals that employ thousands of diverse health care professionals. About 2 percent of the health care establishments are hospitals, but they employ over 40 percent of all health care workers. While 59 percent of health care establishments are physicians' and dentists' offices, those employ 21.4 percent of the health care workforce (see Table 1.2).

Advances in medical technologies, new procedures and methods of diagnosis and treatment, less invasive surgical techniques, gene therapy—all these increase longevity and improve the quality of life. Similarly, advances in information technology can improve patient care. For example, handheld order entry systems (such as

TABLE 1.1. TOTAL EXPENDITURES ON HEALTH AS %GDP FOR 30 OECD COUNTRIES.

	1995	1996	1997	1998	1999	2000	2001	2002
Average	7.8	7.9	7.7	7.8	8.0	7.9	8.2	8.6
Minimum	3.4	3.9	4.2	4.8	5.0	5.1	5.6	5.7
Maximum	13.3	13.2	13.0	13.0	13.0	13.1	13.9	14.6

Source: OECD Health Data 2004.

TABLE 1.2. DISTRIBUTION OF HEALTH PROVIDERS AND HEALTH WORKERS IN HEALTH SERVICES IN 2002, AND EXPECTED GROWTH.

Provider Type	Percent of Providers	Percent of Employment	Employment (in 000)	Percent Change, 2002–2012
Hospitals, public and private	1.9	40.9	5,148	12.8
Nursing and residential care facilities	11.7	22.1	2,743	34.3
Offices of physicians	37.3	15.5	1,983	38.8
Offices of dentists	21.6	5.9	726	30.9
Home health care services	2.8	5.5	675	55.8
Offices of other health practitioners	18.2	3.9	482	48.8
Outpatient care centers	3.1	3.3	184	47.5
Other ambulatory health care services	1.5	1.5	174	37.6
Medical and diagnostic laboratories	1.9	1.4	5,148	12.8

Source: U.S. Department of Labor (2004).

personal digital assistants (PDAs) and bar code scanners at bedside make health workers more efficient, but also minimize errors and thus improve the quality of care.

These advances usually add to costs, so cost containment is a major goal in the health care industry. To accomplish it, the health care industry has shifted the care of patients from hospital care to outpatient and ambulatory care. At the same time, managed care programs have stressed preventive care to reduce the eventual costs of undiagnosed, untreated medical conditions. Enrollment has grown in prepaid managed care programs: health maintenance organizations (HMOs), preferred provider organizations (PPOs), and point-of-service (POS) programs.

The health care industry has turned to restructuring to improve financial and cost performance. Restructuring is accomplished by achieving an integrated delivery system (IDS). An IDS merges the segments of health care delivery, both vertically and horizontally, to increase efficiency by streamlining financial, managerial, and delivery functions. More than 50 percent of the hospitals expect to be part of IDS in 2005 (U.S. Department of Labor, 2004).

It is fair to conclude that the changes in the health care industry will continue and will affect the delivery of health services in terms of cost and efficiency as well as the quality of care.

Health Care Services Management

Given such complexity in both the nature and the environment of health care, managers of such establishments face challenging day-to-day decisions as well as long-term and strategic ones. Their discipline, the management and improvement of the systems and processes that provide health care, must rely on decision tools—namely, the specific methods that can help managers analyze, design, and implement organizational changes to achieve efficiency as well as high quality of care (effectiveness) for patients.

Clearly, then, management of health care establishments requires reasoned inquiry and judgment. Therefore, health care managers must use proven scientific methods drawn from such disciplines as industrial engineering, statistics, operations research, and management science. However, it must be remembered that such quantitative tools do not, alone, shape the final decision, which may have to include other, qualitative factors to arrive at the right course of action.

An increase in the number of manager positions in health care is expected during the next decade. According to the U.S. Department of Labor statistics shown in Table 1.3, the growth in health care management positions is projected to be slightly higher than that in all health care occupations. In 2002, there were 598,000 managers employed in the health care industry, a level expected to increase by 31.2 percent within ten years. More specifically, in the top and middle management levels, the three subsections shown in Table 1.3, approximately 284,000 health care managers are employed, constituting approximately 2 percent of the health care work force.

TABLE 1.3. HEALTH SERVICES BY OCCUPATION IN 2002, AND PROJECTED GROWTH.

Health Services Occupation	Employment (in 000)	Percent Change, 2002–2012
Management, business, and financial occupations	598	31.2
General and operations managers	81	34.1
Administrative services managers	32	28.4
Medical and health services managers	171	34.2
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All health service occupations	12,524	28.0

Source: U.S. Department of Labor (2004).

Future health care managers, whether in top administration or in administrative or clinical operations, will be making informed decisions using state-of-the-art decision-making techniques and the latest information from management information systems. To use those techniques successfully, however, they must also understand the distinctive characteristics of health care services.

Distinctive Characteristics of Health Care Services

Health care operations have five major distinctive characteristics: 1) patient participation in the service process; 2) simultaneity; 3) perishability; 4) intangibility; and 5) heterogeneity (Fitzsimmons and Fitzsimmons, 2004; pp. 21–25). Let us examine each of these characteristics, to better understand the decision platforms in health care.

Patient Participation

In health care, as in any service industry, to evaluate performance (efficiency and effectiveness) a distinction must be made between inputs and outputs. Patients (or their health conditions) who receive care are among the inputs into the service process. On the other hand, after diagnosis and treatment, the patient's condition constitutes the effectiveness of the health care organization—that is, output. Hence, the health care organization and the patient interact throughout the delivery of care—a profound distinction of health care as compared to manufacturing industries.

Simultaneous Production and Consumption

As a service industry, health care is produced and “consumed” simultaneously. This point reflects the fact that health is not a product, to be created, stored, and sold later (will science achieve that via gene therapy?). One of the drawbacks of that simultaneity of “production” and “consumption” is the challenge it presents for quality control—that is, ensuring the effectiveness of the service. In manufacturing, a product can be inspected and, if found defective, not be offered for sale; meanwhile the process that is producing bad outputs is corrected. However, in health care, due to simultaneity, an instance of poor quality care cannot be “recalled,” even though the process resulting in poor care can be corrected for future patients.

Perishable Capacity

Health care organizations design their services to serve with certain capacity over a given time. If the designed capacity is not used during that period, the opportunity to generate revenue from that capacity is lost. For example, consider a hospital with fifteen operating rooms that are staffed and open for twelve hours. If the surgeries are not scheduled appropriately to fill the open slots, or if a large amount of time is wasted by the turnover of the cases, a portion of the available capacity, and thus of potential revenues for that day perishes. Similarly, consider a physician's office with an available ten-hour schedule for patient visits. If the office does not receive appointments to fill all those time blocks, the practice's capacity for that day will be reduced, as will the revenues.

The Intangible Nature of Health Care Outputs

The output in health care does not comprise a tangible product on hand like food bought from your favorite fast-food restaurant, where you can judge the quality of the food as much as the promptness of the service. In health care, it is not so obvious what the patient has paid for. For one thing, since a healing process takes time, the opinions of patients about the service quality of their care are formed over time. Moreover, health care is not something that can be tested or handled before deciding on it. Although health care monitoring groups, as well as health care facilities in their marketing, may provide information about the quality of an organization's services, one patient's experience may nevertheless not equal that of another receiving the same service because patients' conditions and perceptions are never identical.

The High Levels of Judgment Called upon, and the Heterogeneous Nature of Health Care

Although some routine health care tasks can be automated (recording patient history via IT), there remain a wide range of tasks that require a high level of judgment, personal interaction, and individual adaptations, even in a given service category. For example, a surgeon and an anesthetist must make specific decisions before operating, to plan the surgery for the particular condition of patient. The heterogeneity of patients' conditions, already noted, often mandates considerable specialization in the delivery of care.

Even given these distinctive characteristics of health care, managers work together with clinicians to standardize health organizations' operations for both efficiency and effectiveness. Examples of such standardization are the diagnostic and treatment protocols developed for the care of various diseases.

Summary

Contemporary health care managers must understand the distinctive characteristics of the health care services and use state-of-the-art decision-making techniques with the latest information available to plan and organize their facilities for best quality patient care. The remaining chapters of this book will discuss and show the use of state-of-the-art decision-making techniques and their applications in health care.