2 INFORMATION TECHNOLOGY AND THE U.S. HEALTH CARE INDUSTRY: A NEW DIRECTION

Richard M. Scheffler

A rough estimate suggests that health information systems consume between 1.5 and 2 percent of the Gross National Product (GNP). The health care industry spends over 10 percent of the GNP. Hospitals, the major users of health information technology, account for about 40 percent of all expenditures. Estimates are available that indicate at least one quarter of a hospital's operating budget goes to some form of information collection and processing, which includes electronic data processing and manual information processing (Eralp and Rucker 1984). These costs include the personnel and equipment costs of collecting, recording, retrieving, and disseminating both financial and clinical data. In addition, health insurance companies as well as government payers such as Medicare and Medicaid spend heavily on information processing, as do nursing homes and physicians' offices. If these users spend half as much on health information systems (a conservative assumption), then our estimate that health care information costs consume 1.5 to 2 percent of the GNP is a fair one.

The author gratefully acknowledges the contribution of Randolph Hill to the research and writing of this paper and Allen Cheadle for assistance with the data analysis. The author also thanks Robert Turnage, Otto Stoll, John Nicholas, Jonathan Osgood, Caro Carpenter, and William Kine for providing helpful data and information.

In this chapter we will describe the development and growth of health information technology in the U.S. health system and will detail its uses. We will identify major developments in the health care field, including regulatory, environmental, and organizational changes that are affecting the use of technology. In the conclusion we will make some guesses of where the health care information industry is headed and why. Perhaps these conjectures will serve as the basis for further discussions of the new direction of information technology for the health care sector.

THE USE OF HEALTH INFORMATION SYSTEMS

Health information technology has had an impact on almost every aspect of the health care industry. The major areas are the following:

1. *Medical Education:* access to biomedical data for research and teaching
2. *Patient Care:* automated medical records
3. *Patient Education:* computerized instruments to measure health risks
4. *Business Management:* financial data and billing records.

The rapid advances in computer technology during the last two decades, particularly the increases and quality and reductions in cost of both hardware and software, have paved the way for many of the developments in health care computer use. Smaller stand-alone computers have replaced the large centralized computers that used high-speed batch systems (Waters and Murphy 1983). Today, mini- and microcomputers have permitted the development of in-house turnkey systems that are more flexible and can be tailored to the needs of the individual user.

One can define three distinct levels of health information systems. The first employs on-line, real time, communications-oriented systems with interdepartmental data integration. The user interacts with computers on-line and obtains immediate real-time responses. This level of medical computing is oriented towards the financial functions of the hospital. The second level uses on-line, real-time systems that have been designed to capture and process part or all of the patient's medical record. The third level is very similar to the second, but it combines patient data elements with the medical resources being used on the patient. This third level of medical computing is expanding rapidly because of regulatory changes in the health care industry (Waters and Murphy 1983).

The diffusion of health information systems in the United States has been rapid in some areas of the health care industry and surprisingly slow in others. Automated computer billing systems for accounting have spread rapidly with over 90 percent of hospitals having such a system. The use of automation for diagnosis and treatment such as the analysis of electrocardiographic signals by computer systems has expanded more slowly. Only 15 percent of EKG's used this procedure in 1979. Also, less than one percent of the hospitals made use of the automation of medical information systems with patient information (Lindberg 1982).

Within the hospital industry there are three major uses of computer technology in health information systems (HISs). The Patient Information System is used to insure proper treatment while the patient is in the hospital. The system follows the patient throughout his or her hospital stay. It notes when the patient is treated by a physician, and it keeps an on-going record of pharmaceutical and laboratory uses by the patient. The second type of HIS is used for financial management. It deals with typical business functions such as billing, payroll, and accounts receivable. The third use of an HIS is in the area of strategic management, which is the fastest and growing area in health information systems. The HIS provides information on financial planning and resource allocation, as well as information on the environment in which the hospital is located (Packer 1984b).

AN OVERVIEW OF THE HEALTH CARE INDUSTRY

This overview is intended to highlight several characteristics, especially those that have been affected by or impact upon information technology. As is the case with most overviews, there will be sweeping generalizations, and in some cases the exceptions will be of considerable interest.

The most casual observer of the health care industry is aware of its rapid rate of growth, which has accelerated over the past two decades. This growth is part of the overall increase in the service sector of the economy. Yet, the passage of federal and state programs that finance the delivery of health care to the elderly (Medicare) and to the poor (Medicaid) has stimulated the growth of the health care industry to an even greater degree. The fact that the purchase of health care is now dominated by third party payers such as government payers and private insurance carriers is of particular interest to economists. About 90 percent

of individuals are covered for hospital services and about 40 percent for physician services (Arnett et al. 1985). There is some cost-sharing in the form of copayments and deductibles.

Hospitals are the primary not-for-profit sector of the health care field. Community hospitals and university medical centers are set up on a not-for-profit basis. Today about 85 percent of all hospitals are considered nonprofit (Samors and Sullivan 1983). This feature, however, is changing rapidly. For-profit hospitals are growing in their number and influence.

The fastest growing component of health expenditures has consistently been hospital services. An important factor influencing the rate of growth of costs is medical technology. As noted earlier, a number of the technological innovations in hospitals have been geared to improve the state of medical information that is used for diagnosis and treatment. CAT scanners, fetal monitors, and computer-assisted EKGs are but a few examples.

The health care industry employs about six or seven million people, depending on how its scope is defined (Ginzberg 1978). Most significant has been the increase in health personnel, especially physicians. Aided by federal funds and to some extent state funds, the supply of physicians is expanding rapidly. The current supply of practicing physicians is about 400,000 and is expected to increase by about 600,000 in the next five to seven years (Scheffler et al. 1979).

Pressure on government budgets has led to recent developments in the health care industry. In many states, health care is the largest single item of the budget, and the fastest growing as well. In the federal budget following social security, health is the largest component of the social service budget. Within the private sector, health insurance consumes the largest share of the fringe benefit package. The annual rate of increase of health insurance premiums have averaged about 16 percent, and for some industries it has been as high as 30 percent in recent years (Fox, Goldbeck, and Spies 1984). It appeared to many health experts and health economists that the industry was growing out of control and some market discipline was required.

The pressure from government and the private sector has produced some significant trends:

1. Growth in the for-profit hospital sector
2. An increasing number of hospital mergers, including both horizontal and vertical integration

3. Increased concentration in the industry
4. New regulations for the financing of health services

The growth of the for-profit sector of the hospital industry is significant for health information technology. These hospitals tend to be run with more attention to production and cost decisions than nonprofit hospitals. They have a greater need for timely and useful information.

The large hospital industry, with over 7,000 hospitals nationwide, is operating with a great deal of unused capacity. Current bed occupancy rates are in the 65 to 70 percent range (Ermann and Gabel 1984, 1985). To cover fixed costs, hospitals are being pressured in general to expand their markets and to compete with other hospitals for patients. To compete in the market, hospitals are merging into chains and multihospital systems. Market power is increasingly becoming an important factor in the hospital industry.

Cost control is also becoming a real issue. Medicare uses a new prospective pricing system—a DRG system—that has changed the economic character of the hospital. Previously, hospitals were paid their costs and reimbursed retroactively. The diagnostic related groups system (DRG) pays hospitals a set price for treating a patient with a specific diagnosis. There are currently 470 diagnoses in which the patient can be placed for payment. Certain adjustments are currently possible to these prices, and there is a policy covering outliers. For the most part, however, hospitals face a given price for a given DRG. Private payers and states are using this type of payment policy with increasing frequency. Its major impact, however, is on federal payments under Medicare (Wennberg, McPherson, and Caper 1984).

The physician market is also changing. Large supplies of physicians are putting pressure on the market. Purchasers of care such as insurance companies and business firms are using their market share of patients to lower their costs. There is a new financing scheme that is gaining a fair amount of momentum in the health care industry: the development of so-called "preferred provider organizations" (PPOs). These are composed of groups of physicians, or hospitals and physicians, that agree to discount their fees in exchange for the patient base of the insurance company or a business firm (Gabel and Ermann 1985). Organizational forms of PPOs abound, with many hybrids, but the essential feature is discounting by physicians in exchange for guarantees of large patient populations. The small solo or candy store physician's practice is giving way to corporate medicine. Statewide and, in some instance, nationwide

PPOs are being developed. Competition for market shares and the growth of PPO systems is clearly a potentially large and new market for health information systems.

Although the rate of increased concentration of the health care industry is difficult to quantify, its direction is clear. Some believe that within a decade three or four hundred large firms or chains will control a major portion of the health care market. The rate of growth and improvement of health information systems will be an important factor in determining which portions of the system grow and which decline.

TODAY'S HEALTH INFORMATION INDUSTRY

There has been a considerable increase in the size of the health information industry. Much of this growth, as might be expected, is in the hospital industry. Data processing (DP) in hospitals is small in comparison with other service sector industries but is expected to increase at a rapid rate. Although about a quarter of the hospital's budget is used for information collection (about 25 billion dollars in 1984), only about 2.2 percent is spent on data processing (see Table 2–1). Table 2–1 suggests a projected increase of 20 percent per year. Even before the beginning of DRGs (prospective payments), DP as a percent of operating expenses was increasing.

It is interesting to note, as Table 2–2 shows, that expenditures on data processing increases with the size of the hospital. The DP expenses per bed increases from $1,035 for small (100 bed and less) hospitals to almost four times that amount for large (500-plus bed) hospitals. The

Table 2–1. DP Expenditures as Percentage of Total Hospital Expenses ($ millions).

Year	*Total Operating Expenditures*	*Total DP Expenditures*	*DP as % of Operating Expenses*
1980	76,851	1,610	2.1
1981	90,572	1,939	2.1
1982	104,876	2,305	2.2
1983	116,412	2,780	2.4
1984	130,964	3,405	2.6
1985	148,382	4,141	2.8

Source: Eralp and Rucker (1984).

Table 2–2. Electronic Data Processing Is Only a Fraction of Total Operating Expenses.

Size	Total U.S. Hospitals	Total DP Expenses	Avg. DP Expenditures Per Hospital	Avg. DP Expense Per Bed	DP as % of Total Hosp. Expenses
(Number of beds)		($ Mill.)	($ Thous.)	($)	(%)
500+	332	872	2,625	3,805	2.9
400–499	273	350	1,282	2,900	2.5
300–399	423	345	816	2,400	2.2
200–299	738	324	439	1,807	1.7
100–199	1,380	263	190	1,350	1.6
99 or less	2,655	151	57	1,035	1.6
Total	5,801	2,305	397	2,283	2.2

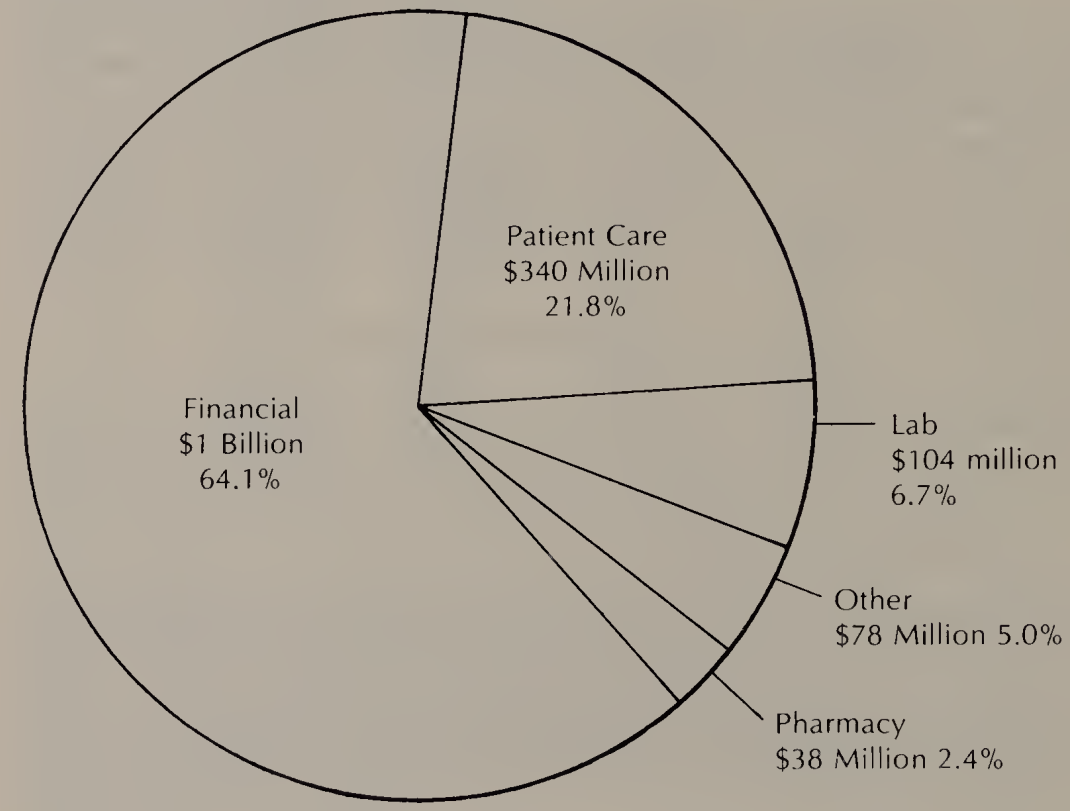
Source: Eralp and Rucker (1984).

Rate of increase appears somewhat less pronounced when DP expenses are viewed as a percentage of total hospital expenses. Small hospitals (less than 100 beds) use 1.6 percent of their revenues on data processing whereas large (more than 500 beds) use 2.9 percent of their revenues on data processing. Reasons for this are many: larger hospitals are more complex, and they provide more technical services; management planning needs are greater; and DP needs require more specific tailoring to the structure of the hospital.

In 1982, almost all hospitals had DP systems for financial billings. This one item accounts for almost two thirds (64.1 %) of the expenditures by hospitals on DP (see Figure 2–1). The other large item is patient care, which accounts for almost 22 percent. These separate areas are beginning to be merged as hospitals respond to DRGs. The market for purely financial services is saturated and little growth is seen in this area. The average data processing per patient for financial management and patient care generally rises as hospital size increases from a little over $5.00 per day to almost $8.00 per day for large hospitals (see Figure 2–2). These costs are small in comparison to the cost of a hospital bed per day, which is in the range of $500.

The hospital data processing market is quite competitive. There are almost two hundred firms—the three largest being IBM, SMS, and McDonnell Douglas Automation (see Table 2–3). Revenues in 1982 approached $1.5 billion and are expected to pass $5 billion by 1987

Figure 2–1. Hospital Information Systems Market (by type of application).



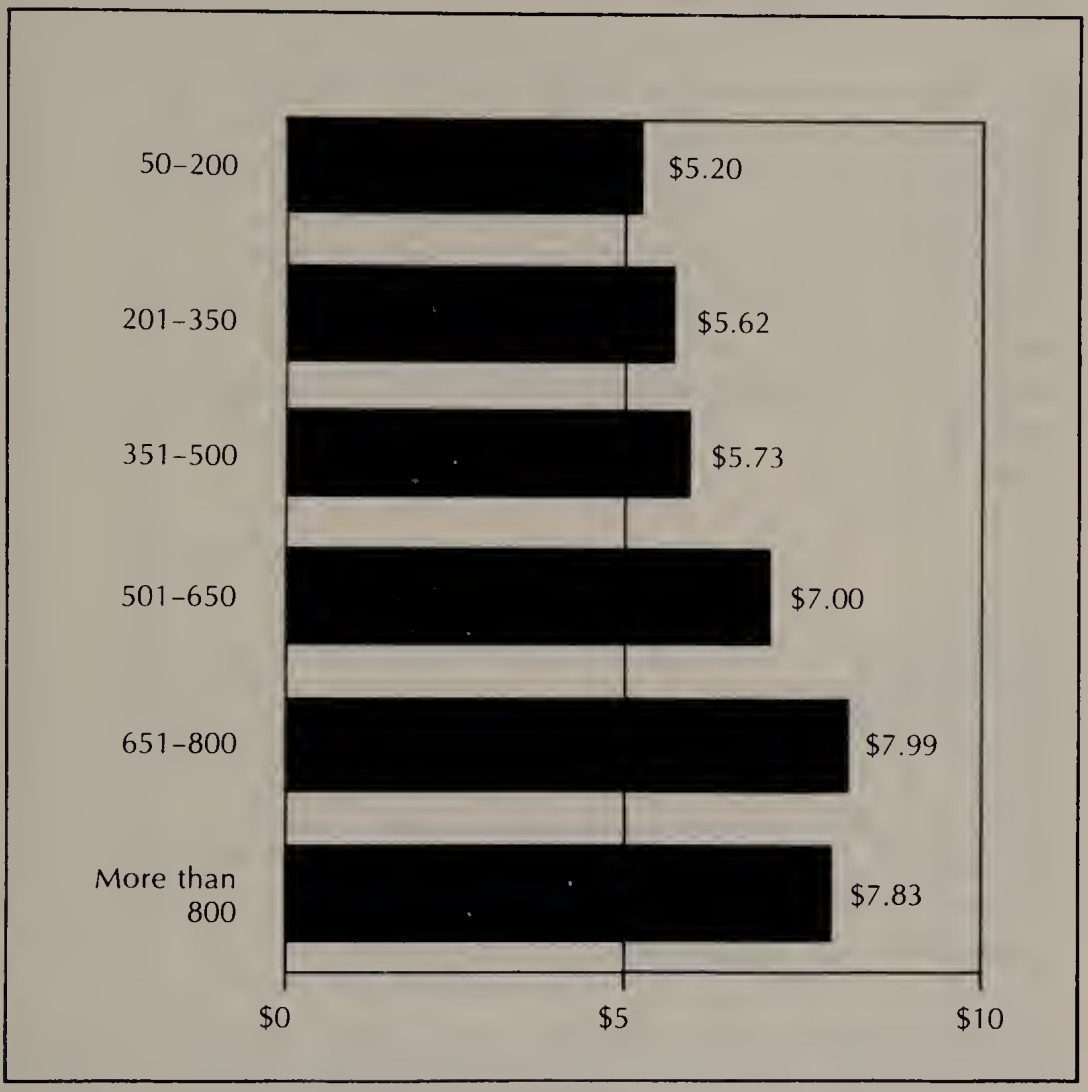
1982 Total: $1.6 Billion

Source: Eralp and Rucker (1984).

(Nicholas 1984). Hardware manufacturers account for the largest portion of sales; IBM has 40 percent of the market for hospitals over 300 beds, with vendors selling shared services accounting for the next 20 percent of the market (Carpenter 1984).

The growing companies, however, are those that can provide either turnkey or in-house systems that can be tailored to individual needs. Rapid turnover and on-line systems are replacing batch systems that were primarily used for billing. Hospitals now need to make timely resource allocation decisions and require data and data-based reports for financial planning. With the advent of DRGs, hospitals have become particularly interested in purchasing software to manage the case mix of the hospital and to help select the most profitable DRG for a given

Figure 2–2. Hospital DP Expenditures per Patient Day (by hospital size).



Source: Packer (1984).

admission. Those companies in the industry who sell software and turnkey systems are scrambling to develop effective hospital resource management packages. Furthermore, the market has tightened as prospective payment policies have forced hospitals to be more price conscious in the selection of a health information system.

Many of the companies in the market give IBM the hardware portion and develop other services that are compatible with IBM hardware. However, some companies such as HBO are in the process of developing and marketing new software products that are compatible with Data

Table 2–3. Hospital Information Systems—Estimated Sales Breakdown by Principal Vendor ($ millions).

Vendor	*1980*	*1981*	*1982*	*1983*	*1984*	*1985*
IBM Corp.	310	380	450	540	660	845
SMS	106	132	166	209	255	329
McAuto	95	126	156	198	250	308
Data General	24	32	40	60	90	135
HBO & Co.	23	37	53	66	85	111
Compucare	7	11	21	40	55	75
Technicon	25	31	38	44	63	78
AMI	3	8	12	25	37	55
DEC	64	71	78	92	105	111
Mediflex	10	13	18	24	32	43
Baxter Travenol	0	2	5	12	25	40
EDS	3	7	10	13	20	28
H-P	14	17	19	31	43	46
Amherst	4	7	10	13	17	23
Burroughs	50	54	57	55	63	60
Systems Assoc.	6	9	11	15	20	25
Community Health	7	9	11	14	18	22
Tandem	10	13	15	18	23	26
CDC	14	18	22	26	31	33
NCR Corp.	55	58	60	55	51	47
Four Phase Sys.	48	51	54	60	48	25

Source: Eralp and Rucker (1984).

General equipment. Many industry analysts feel these new products will greatly increase HBO's dominant market share. For example, HBO recently released a system, *Galaxy,* that integrates accounting, patient care, and case mix applications in a single turnkey system for hospitals with less than 150 beds.[1]

Another popular competitive strategy followed by SMS, HBO's most direct competitor, is to purchase licensing rights to software developed by a single hospital or academic institution for its own use and then to sell the product under an SMS name and label. SMS is also attempting to meet the new price sensitive environment through the repackaging of its old systems in smaller and cheaper units.[2]

Also of interest is the increase in mergers among leading companies. Recently, HBO, a fast-rising vendor of hospital computer systems, purchased

two of its major competitors, Mediflex and Amherst Associates (Benway 1984). Mergers will have a significant impact on the direction and growth of information technology in the health sector, but the nature of that impact is quite uncertain.

Although health information systems are less well documented in the physician's practice, the increased attractiveness of micros has led to the availability of data systems for individual physician practices. Moreover, the increase in group practices and health care delivery systems such as health maintenance organizations (HMOs) and PPOs has increased the need for all types of HISs and technology. Cost control pressures on physicians require attention to resource allocation and production. Corporate medicine and the trend towards large health systems will be a new and expanding market for HISs.

THE NEW DIRECTION

Information technology is a driving force in the delivery of health care in the United States. It is crucial to the field of medical research developing new medical tests and procedures. Information technology is at the forefront of medical knowledge. Pacemakers that monitor heartbeats, the computer-assisted health risk instruments that assess health needs are some examples. There is even talk of the "hospital on the wrist": a small microprocessor with electronic probes capable of monitoring changes in the body, measuring vital signs, analyzing blood and enzymes (Ruby 1984). The device would network with a hospital or a physician. "Lifeline," which is now operational, is linked to a hospital and will respond if the patient needs care.

The health care data processing market will continue to grow at a prodigious rate throughout the remainder of the decade. The trend is shifting back from decentralized departmental computing (a micro in every office) to more integrated, database oriented systems that can be used throughout a hospital or other major health facilities. The big hardware vendors such as IBM and Data General disappointed many hospitals in the early seventies because their systems, promised to handle all the hospital's data processing needs, proved unable to do so, causing large facilities to resort to using shared systems or purchasing small departmental in-house systems. But such leading companies such as HBO and Mediflex, selling integrated turnkey systems, have caused a reversal in the trend.[3] The wave of the future may be networking of the

already purchased smaller systems, especially in smaller health care facilities. For example, AT&T is expected to enter the health care industry aggressively with its new line of hardware and its networking software such as UNIX. Some predict that IBM will follow its age-old strategy of dominating the market by imitating popular software packages and entering the field through aggressive advertising. Thus, the market for information technology in the health care industry could be following the pattern of the health care industry itself: increasing centralization and concentration to meet growing competition and cost pressures, with extremely large firms dominating the industry.

Information technology is helping to change the face of the health care industry. The industry's response to cost control, excess capacity, and the changing regulatory environment will undoubtedly increase the need for information technology. Hospitals are effectively integrating health information systems that link patient data with financial and resource use data. In addition, information technology is being used increasingly to improve financial management and the strategic planning of hospitals and health care systems. There appears to be an ever stronger demand for HISs and information technology in the health care system. We are just at the beginning of an era of expansion.

NOTES

1. Information regarding recent products of health care technology companies came from the author's personal discussions with industry representatives.
2. See note 1.
3. See note 1.

REFERENCES

Arnett, R.H.; C.S. Cowell; L.M. Davidoff; and M.S. Freeland. 1985. "Health Spending Trends in the 1980's: Adjusting to Financial Incentives." *Health Care Financing Review* 6, no. 3:1–26.

Benway, S.D. 1984. "More Feverish Growth?" *Barrons* 44 (December 24): 11, 20.

Carpenter, C.J. 1984. *Company Update: Mediflex Systems Corporation.* Baltimore, MD: Alex Brown & Sons Research.

Eralp, O., and B.B. Rucker. 1984. *The Hospital Information Systems Industry.* San Francisco: Hambrecht and Quist.

Ermann, D., and J. Gabel. 1984. "Multihospital Systems: Issues and Empirical Findings." *Health Affairs* 3, no. 1:50–64.

——— . 1985. "The Changing Face of American Health Care: Multihospital Systems, Emergency Centers and Surgery Centers." *Medical Care* 23, no. 5:401–20.

Fox, P.D.; W.B. Goldbeck; and J.J. Spies. 1984. *Health Care Cost Management.* Ann Arbor, MI: Health Administration Press.

Gabel, J., and D. Ermann. 1985. "Preferred Provider Organizations: Performance, Problems, and Promise." *Health Affairs* 4, no. 1:24–40.

Ginzberg, E. 1978. *Health Manpower and Health Policy.* New York: Universe Books.

Lindberg, D.A.B. 1982. "Diffusion of Medical Information Systems Technology in the United States." *Journal of Medical Systems* 6:219–228.

Nicholas, J.P. 1984. *Hospital Information Systems Update.* Chicago: William Blair & Co.

Packer, C.L. 1984a. "A Comparison of Hospital Data Processing Costs." *Hospitals* 58, no. 15:83–86.

——— . 1984b. "Major Data Processing Systems and Applications." *Hospitals* 58, no. 17:66–72.

Ruby, G. 1984. "Information Technology and the Health of an Aging Population." (Background chapter for paper presented at the Symposium on Computer Applications in Medical Care, Washington, D.C.).

Samors, P.W., and S. Sullivan. 1983. "Health Care Cost Containment Through Private Sector Initiatives." In *Market Reforms in Health Care: Current Issues, New Directions, and Strategic Decisions,* edited by J.A. Meyer, Washington, D.C.: American Enterprise Institute for Public Policy Research.

Scheffler, R.M.; S.G. Yoder; N. Weisfeld; and G. Ruby. 1979. "Physician and New Health Practitioners: Issues for the 1980s." *Inquiry* 16:195–229.

Waters, K.A. and G.F. Murphy. 1983. *Systems Analysis in Health Information Management.* Rockville, MD: Aspen Systems Corporation.

Wennberg, J.E.; K. McPherson; and P. Caper. 1984. "Will Payment Based on Diagnosis Related Groups Control Hospital Costs?" *New England Journal of Medicine* 311, no. 5:295–300.

OTHER REFERENCES

Austin, C.J. 1979. *Information Systems for Hospital Administration.* Ann Arbor, MI: Health Administration Press.

Austin, C.H., and H.S. Carter. 1981. "National Hospital Information Resource Center: A Model." *Inquiry* 18:291–299.

Ball, M.J., and T.M. Boyle, Jr. 1980. "Hospital Information Systems: Past, Present and Future." *Hospital Financial Management* 34, no. 2:12–24.

Dorenfest, S.I. 1981. *A Comprehensive Review of Hospital Computer Use.* Highland Park, IL: Sheldon I. Dorenfest and Associates.

Dorenfest, S.I. 1983. *A Guide to Better Hospital Computer Decisions.* Highland Park, IL: Sheldon I. Dorenfest and Associates.

Fedorowicz, J. 1983. "Hospital Information Systems: Are We Ready For Case Mix Applications?" *Health Care Management Review* 8, no. 4:33–41.

Hospital Financial Management Association. 1981. *Data Processing Information Survey.* Chicago, IL: HFMA.

Menning, W.R.; R.W. Bolek; and D. Mon. 1984. "Microcomputer Use Comes of Age in Hospitals." *Healthcare Financial Management* 14, no. 8:32–37.

Packer, C.L. 1984. "The Four Principal Approaches to Data Processing and the Satisfaction They Provide." *Hospitals* 58, no. 11:88–93.

Packer, C.L. 1984. "Management Information Systems: Key Tools for CEOs." *Hospitals* 58, no. 22:107–109.

"Trends: Computer Review." *Hospitals* 58, no. 7:39–78.

Wiederhold, G. 1982. "Databases for Ambulatory Care." In *Computer Applications in Medical Care,* edited by D.A.B. Lindberg, pp. 79–85. New York: Masson Publishing.

DISCUSSION OF CHAPTER 2

Mark V. Pauly

Richard Scheffler has provided an interesting look at the present and the future of information technology in the U.S. health care system. It is surprising that so little change has actually occurred in medical care as a result of the technological revolution in information. The kinds of structural changes we see in banking and telecommunications are ones that we just do not see in health care. Although there have been some changes, and even more are in the works, the industry structure is not all that dissimilar today from what it was ten or even thirty years ago; information technology has thus far been neither an important cause nor an effect of those changes.

Scheffler provides ample documentation for this sweeping generalization. Data processing expenditures have increased only modestly over the decade as a percentage of hospital expenses—surely at a lower rate than for many other industries. What is more important, even the computerization that has occurred has virtually all been directed at substituting machines for old tasks; there have been few successful attempts at using the new technology to define new products or new markets.

In my comments, I will respond to three questions Scheffler raises:

1. What impacts are current changes in the industry likely to have on the use of information technology?

2. Why hasn't information technology had more of an impact on the structure of the industry?
3. Is technology likely to make much of a difference in the future?

It is especially important to note that the medical market has become more marketlike, and at a fairly rapid pace. Third party payers—beginning with Medicare and continuing through preferred provider organizations (PPOs), Medicaid, and some Blue Cross plans—are moving toward prospective payment and away from cost-based reimbursement, while both for-profit and not-for-profit firms are paying more attention to the financial bottom line.

These changes have had four kinds of effects on the demand for information technology. First, the mere fact of change requires new expenditure, as the old systems become inappropriate to the new (and often perplexing) environment. This surge, however, will obviously be temporary. Second, incentives for efficiency, quality, and avoidance of errors have changed. Third, prospective payment makes information provided to external agents less necessary. For example, one of the advantages of the diagnosis related groups (DRG) system is that it has greatly reduced the need for Medicare to become involved in the hospital's business. Cost reporting and creative accounting, certification of length of stay and the need to prepare excuses, and similar activities are now no longer necessary. All of this data—the two sets of books—are no longer needed, so the technical machinery to gather, aggregate, and launder or massage such hospital data is no longer necessary. There still remains a need to make sure that the output or volume measures, which are monitored by Medicare, are in the hospital's favor.

Finally, in contrast, there is now an increased need for accurate and useful internal data, for the hardware systems to generate and collect that data in a timely way, and for the software to analyze it in terms of its financial consequences. The result, as Scheffler has noted, is a burgeoning market in financial planning and resource allocation systems; the market in software to cope with (or at least justify one's actions in connection with) the DRG system approaches perfect competition.

There has been no corresponding change in the environment with regard to basic financial records—billing, payroll, and the like—although there has been a continuation of a long-running trend to substitute capital for labor in these functions. Information transfer within the process of care itself—medical records, orders for tests, and so forth—has not been

subject to a massive change, although it has been growing. Finally, in an effort to control costs—a new motivation as far as many hospitals were concerned—there has been renewed interest in monitoring and controlling the process of care itself, and the people—largely physicians who are not hospital employees—who direct it.

Almost surely the increasing demand for technology for internal control offsets the falling demand for external justification, and so I must agree with Scheffler's conclusion—justified by the data on data processing expenditures—that such expenditures will continue to grow at a rapid clip. But how rapid, and what will determine the speed? I do not know how fast a "prodigious rate" is; the approximately 18 percent annual rate exhibited in Table 2–1 falls a little short of prodigiosity, in my opinion, especially since total hospital expenditures were also increasing at a double digit rate.

Moreover, and more importantly, there are some factors that could slow this rate down. I have no question that there is intensely strong industry demand for technology to control and monitor professional behavior in hospitals and to calculate the marginal cost and marginal revenue of alternative outputs. I also do not question that many hospitals, and especially not-for-profit ones, will buy virtually any such technology just to prove that they are doing something and to protect themselves from criticism should things go wrong. What I have a hard time convincing myself is that, either now or in the near future, *effective* and *productive* technology to perform these tasks will be available for sale. It is not true that information itself is useful and self-evident.

For professional behavior, I have yet to see the system that can effectively second guess or control the doctor, and really control his behavior if he is not in the mood to be controlled.

As far as accounting for revenue and costs is concerned, I am skeptical of the DRG cost figures that many of the software packages pump out. They allocate overhead costs, ignore economies and diseconomies of scope, make unsupported assumptions, and base costs on revenues—all sins in the economist's catechism. The figures for these software packages are nice and neat, and they can be used to justify actions; but do they work? I do not think we know yet, and I have to believe that a day of reckoning will come. Whether large hospitals have relatively higher expenditures on data processing than do small hospitals is in itself an interesting research question. Nursing homes, long-term care (LTC), and home care so far have not been major buyers of information technology. So I would be more comfortable predicting growth a little

short of prodigious—perhaps 15 percent per year once the DRG changeover bulge works its ways through.

For physician services, let me also sound a somewhat pessimistic note. Physicians were always paid prospectively. The biggest change over the years has been the linking of insurance payment levels to other physician fees—the "reasonable and customary" approach. There followed what health care consultants felicitiously call "procinflation"—the explosion in the number of levels of differentiated services and procedures for which differentiated billing can and does occur. There are rumblings at the federal level to do something about this—to cut, to simplify, and to set prices. The largest growth in activity will occur outside the hospital. The solo physician—kindly GP or otherwise—is fast disappearing and being replaced by group practices large and small that ought to present a strong demand for information technology.

The next question looks not at the demand for information technology but its effects, past and future, on industry structure. In the past its effects have been minimal. Any cost reductions due to DP substitution were engulfed by the roaring inflation that characterized the hospital industry since the early sixties. The automated computerized medical record as a diagnostic aid (the subject of a number of ballyhooed demonstrations in the seventies) turned out, according to the oral tradition, to be a bust—it did not improve results because physicians did not use it much; and when they did, it did not affect outcomes much. In addition, there was no pressure to do much about costs when revenues rose when costs rose.

Will things be different in the late eighties and nineties? Will, in Scheffler's words, "information technology help to change the face of the health care industry"? Maybe, but only if it gets some help.

For one thing, providers will need to be offered incentives and knowledge on how to use data to make decisions—how to substitute the monitor screen for the seat of the pants. There is work going on here (literally, here at Penn), and new physicians are somewhat better trained in systematic medical decisionmaking—but it remains to be seen whether they will have the incentive to use that training.

Next, it may be that information technology could assist and encourage increasing debundling and reorganization in the medical care sector. Will the corporations formed to run the new magnetic resonance imager (Hillman and Schwartz 1986)—itself a product of computerization—find the information technology to transmit what it finds in a way consistent with (and perhaps even superior to) the same function organized in a more traditional way as a hospital department?

Scheffler mentions a number of systems that allow monitoring from home. Will these systems work? Can we computerize home care, especially for the increasing fraction of the population that is both elderly and affluent? Finally, can information technology aid and abet the fundamental revolution in medical culture—instead of asking why this patient should go home, asking why this patient should stay here? It will be interesting to see.

REFERENCE

Hillman, A.L., and J.S. Schwartz. 1986. "The Diffusion of Magnetic Resonance Imaging: Patterns of Siting and Ownership in an Era of Changing Incentives." *American Journal of Roentgenology* 146, no. 5 (May):963–69.

DISCUSSION OF CHAPTER 2

Kenneth E. Thorpe

In "Information Technology and the U.S. Health Care Industry: A New Direction," Richard Scheffler provides a useful overview of information technology in the health care sector. His work is especially noteworthy because it represents a pioneering effort to document and assess the growing role of information technologies in this industry.

According to Scheffler, the growth in health information technology has affected four aspects of the health care industry including medical training, patient care, patient education, and management. He observes that dramatic changes in hospital reimbursement methodologies, combined with the rapid diffusion of microcomputers, are largely responsible for the expanded use of information technologies in the health care industry.

The only omission in the chapter is that there is no discussion of the implications of the increased use of information technology on health and health care. Therefore, I will offer such a discussion.

The advent of the diagnosis related grouping (DRG) system used by Medicare is a revolutionary change in hospital finance. Prior to this system, hospitals submitted their bills to fiscal intermediaries when providing care to Medicare patients and were paid an amount deemed "reasonable and necessary." In contrast, under the DRG methodology, hospitals receive fixed prices set in advance depending on the patient's discharge diagnosis. Two critical changes have occurred in this

reimbursement transition. First, payment levels for Medicare patients are now set before rather than after treatment. Second, the unit of payment changed from a per-diem to a discharge basis. The importance of this second change is that it has altered dramatically the information requirements of hospital administrators. Under the retrospective system, higher reported costs resulted in larger Medicare payments. Thus, it was not necessary to know the "true" marginal costs of treating individual patients. With the new fixed price payment system, a hospital administrator needs to know the resource costs of providing specific services. The requirement to have patient level cost data has led to changes in hospital cost accounting systems as well as changes in the information requirements of hospital administrators.

How hospital administrators and physicians use the newly generated patient level data has (at least) four important implications for health and health care. These following implications will be discussed below:

1. Increased efficiency
2. Restructuring the relationship between hospital administrators and physicians
3. Movement toward "product line" analysis and its implications for the scope of services provided
4. Confidentiality issues.

Administrators now have at their disposal an enormous volume of information regarding physicians and their patients. Detailed profiles of physician practice patterns, including their use of ancillary procedures and the length of time they keep patients in the hospital, can be created by the DRG system, which provides the incentive, and the new microcomputers and software technology, which provide the means. This information allows the administrator to review an individual physician's performance relative to other physicians. Of course, the actual impact of the new information technology on health and health care depends largely on how the information is used within the hospital.

One desirable use of the information is to increase hospital efficiency. Since hospital profits now occur when the fixed DRG payments exceed marginal treatment costs, there is an incentive to provide medical services of a given quality at least cost. Greater efficiency is achieved when hospital administrators are able to eliminate "unnecessary" hospital

days and ancillary procedures and produce the same health outcomes. On the other hand, the mounting financial incentives for early discharge and reduced ancillary procedures may generate undesirable outcomes if the health status of the elderly is adversely affected. At this time, it is still too early to assess the impact of cost saving efforts by hospital administrators on health outcomes (Carter and Ginsburg 1985; Lohr et al. 1985).

The new information systems also have the potential to restructure the traditional relationship between administrator and physician. The advent of DRGs provides administrators an incentive to find methods of encouraging efficient practice patterns and discouraging costly ones. This incentive could change dramatically the traditional role of the hospital administrator vis-à-vis the physician. For example, detailed knowledge of physician behavior within the hospital could provide a device for administrators to challenge a physician's autonomy and practices. This would represent a substantial shift in the locus of power within the hospital away from the physician toward the administrator. At the very least, normative decisions by administrators regarding desirable physician practice patterns based on some measure of central tendency increases the likelihood of creating tremendous conflict between administrators and physicians (Stern and Epstein 1985).

Although the DRG payment system provides an incentive to reduce costs for all Medicare patients and services, it also provides incentives for administrators to commit resources to profitable services and to shed unprofitable ones. The DRG system has created a virtual gold rush for management consultants to streamline and optimize the distribution of cases within a hospital.[1] This "product line" analysis provides an incentive to use patient level data to specialize in services (e.g., obstetrics, surgery, burn care) where the Medicare payments exceed marginal treatment costs. Reducing the scope of services offered may be socially desirable if economies of scale are exploited, especially in areas that have too many beds. Yet, service reduction has the potential to negatively impact social welfare if local health care needs are no longer met. The potential reduction in the availability and scope of hospital services should be balanced against cost savings and streamlined operations.

The availability of patient level discharge data, treatment costs, and health outcomes has created a large demand by cost conscious third party payers and employers for access to this information. Such information would facilitate comparison shopping by examining treatment costs and health outcomes across hospitals. Patients could then be directed

by third party payers or employers interested in reducing health care outlays to hospitals providing quality health care at relatively low costs. To some, access to this information is a critical component of creating competition within the health care industry.

The availability of patient level data may foster competition in the industry, but it may also violate traditional norms of confidentiality between physicians and their patients. This latter possibility has led some hospitals, physicians, and patients to oppose the demands by outside parties to disseminate patient level data outside the hospital. The battle over the public's right-to-know and the traditional relationship between physician and patient has recently escalated. In the center of this controversy is the type of information that Medicare's peer review organizations (PROs) may release.

Both hospitals and physicians have resisted the dissemination of "quality" of care data identifying individual patients, physicians, and hospitals. Some of the resistance may be traced to concern that the public would not have the sophistication or expertise to assess the data accurately.

Hospitals have been concerned about the potential impact the detailed cost and quality of care information would have on patient utilization patterns. The final disclosure rules, however, permit the PROs to release data identifying costs and quality of care information at the hospital, but not at the individual patient or physician level. Moreover, when hospital data are released, hospitals will have a thirty-day period to issue comments that must be included with the data. Thus, the battle over the "appropriate" distribution of medical care information has already begun and will certainly rage as a policy issue in the future.

The ultimate impact of information generated by hospital management information systems on society depends on how (and by whom) it is used. Clearly, the growing sophistication of these information systems will provide an opportunity to stem the growth in health care costs and promote efficiency in the delivery system. If such information is used to the detriment of other social goals—such as providing quality health care to the elderly—then its use should be monitored closely by government's physicians and their patients.

NOTE

1. Even a cursory examination of trade journals such as *Healthcare Financial Management* reveals the proliferation of management consulting and software available to "maximize" Medicare payments.

REFERENCES

Carter, Grace, and Paul B. Ginsburg. 1985. *The Medicare Case Mix Index Increase, Medical Practice Changes, Aging, and DRG Creep*. Santa Monica: The Rand Corporation.

Lohr, K.; R. Brook; G. Goldberg; M. Chassin; and T. Glennan. 1985. *Impact of Medicare Prospective Payment on the Quality of Medical Care. A Research Agenda*. Santa Monica: The Rand Corporation.

Stern, R.S., and A.M. Epstein. 1985. "Institutional Responses to Prospective Payments Based on Diagnosis-related Groups. Implications for Cost, Quality, and Access." *New England Journal of Medicine* 139:621–27.