Information Technology and the U.S. Health Care Industry: A New Direction

by Richard M. Scheffler

Columbia Institute for Tele-Information
Graduate School of Business
Columbia University
809 Uris Hall
New York, NY 10027
(212)854-4222

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

by

Richard M. Scheffler

Professor of Health Economics
University of California, Berkeley

1985

This is a draft copy of a working paper which will be published in final version in a volume entitled The Impact of Information Technologies on the Service Sector, G. Faulhaber, E. Noam, and R. Tasley, eds.

#73

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

I. Introduction

A rough estimate suggests that health information systems consume between 1 1/2 and 2 percent of the Gross National Product. 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 payors 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 1/2 to 2 percent of the GNP is a fair one.

In this chapter we will describe the development and growth of health information technology in the US 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.

II. 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 standalone computers have replaced the large centralized computers that used high-speed batch systems (Waters and Murphy 1983). Today, mini and micro computers have permitted the development of in-house turnkey systems which 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 system system. 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).

III. 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 which 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 payors such as government payors 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 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 65% of all hospitals are considered non-profit (Samors 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 are used for diagnosis and treatment. CAT scanners, fetal monitors, and computer-assisted EKG's are but a few examples.

The health care industry employs about 6-7 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 5 to 7 years (Scheffler 1979).

Pressure on government budgets has lead 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 has averaged about 16 percent, and for some industries it has been as high as 30 percent in recent years (Fox 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 non-profit 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 & 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 multi-hospital systems. Market power is increasingly becoming an important factor in the hospital industry.

In the hospital industry, cost control is now becoming a real issue. Medicare uses a new prospective pricing system (DRGs) that has changed the economic character of

the hospital. Previously, hospitals were paid their costs and reimbursed retroactively. The DRG system (diagnostic related groups) 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. But for the most part, 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 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 which is gaining a fair amount of momentum in the health care industry. It is 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 & 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 instances 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.

IV. 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% is spent on data processing (see Table _-1) (Eralp & Rucker 1984). Table _-1 suggests a projected increase of 20 percent per year. Even before the beginning of DRG's (prospective payments), DP as a percent of operating expenses was increasing.

It is interesting to note, as Table _-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 below) hospitals to almost four times that amount for large (500 plus bed) hospitals. The rate of increase appears somewhat less pronounced when DP expenses are viewed as a percent of total hospital expenses. Small hospitals (<100 beds) use 1.6% of their revenues on data processing whereas large (>500 beds) use 2.9% 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 _-1) (Eralp and Rucker 1984). The other large item is patient care, which accounts for almost 22%. These separate areas are beginning to be merged as hospitals respond to DRG's. 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) (Packer

TABLE _-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, O. and Rucker, B.B. 1984. "The hospital information systems industry." Hambrecht & Quist Incorporated, San Francisco.

TABLE 2

ELECTRONIC DATA PROCESSING IS ONLY A FRACTION

OF TOTAL OPERATING EXPENSES

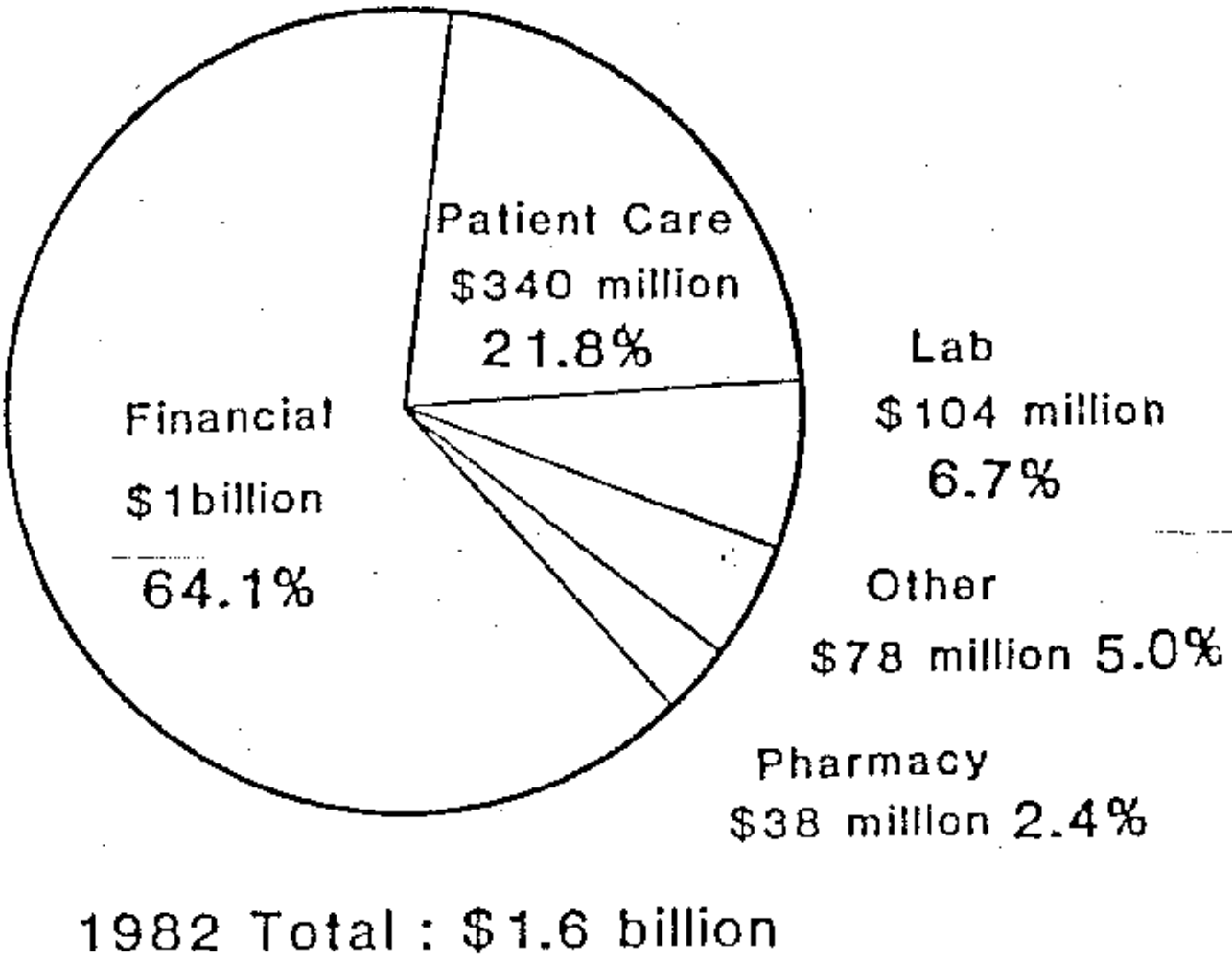
Size	Total U.S. Hospitals	Total DP Expenses ($ Mill.)	Avg. DP Expenditures Per Hospital ($ Thous.)	Avg. DP Expense Per Bed ($)	DP as % of Total Hosp. Expenses (%)
500 & Over	332	872	2,625	3,805	2.9%
400-499	273	350	1,282	2,900	2.5%
300-399	423	345	816	2,400	2.2%
200-299	708	324	439	1,807	1.7%
100-199	1,380	263	190	1,350	1.6%
100 & Below	2,655	151	57	1,035	1.6%
Total	5,801	2,305	397	2,283	2.2%

SOURCE:

Eralp, O. and Rucker, B.B. 1984. "The hospital information systems industry." Hambrecht & Quist Incorporated, San Francisco.

FIGURE _-1

HOSPITAL INFORMATION SYSTEMS MARKET
by type of application

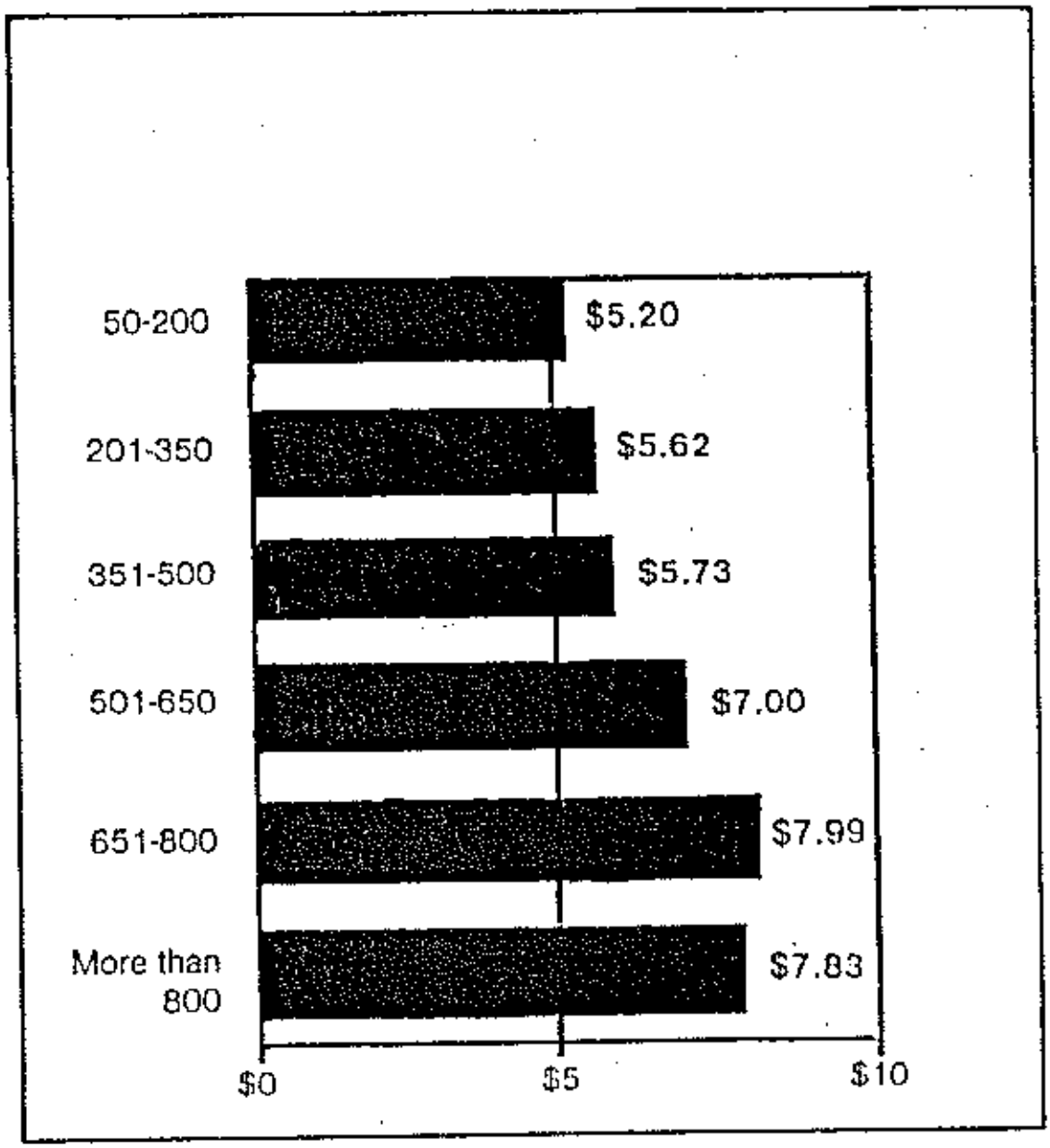


1982 Total : $1.6 billion

SOURCE: Eralp, O., and Rucker, B.B. (1984). "Hospital Information Systems Industry." Hambrecht and Quist, San Francisco, CA.

FIGURE _-2

HOSPITAL DP EXPENDITURES PER PATIENT DAY
by hospital size



SOURCE: Packer, C.L. (1984). A comparison of hospital data processing costs. Hospitals 58 (no. 15), 83-86.

1984a). These costs are small in comparison to the cost of a hospital bed/day, which is in the range of $500.

The hospital data processing market is quite competitive. There are almost two hundred firms with the three largest being IBM, SMS, and McDonnell Douglas Automation (See Table _-3). Revenues in 1982 approached $1.5 billion, and are expected to pass $5 billion by 1987 (Nicholas 1983). 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% of the market (Carpenter 1984).

But the growing companies are those that can provide either turnkey or in-house systems that can be tailored to individual hospital 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 DRG's, hospitals have become very interested in purchasing software to manage the case mix of the hospital and to help select the most profitable DRG for a given admission. Those companies in the industry who sell software and turnkey systems are scrambling to develop effective hospital resource mangement 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 is in the process of developing and marketing new software products that are compatible with Data 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*, which integrates accounting, patient care, and case mix applications in a single turnkey system for hospitals with less than 150 beds.[1]

[1] Information regarding recent products of Health Care Technology companies came from the author's personal discussions with industry representatives. Contact the author

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, Medifiex 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 micro's has lead 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.

V. 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

for details.

[2] See footnote 1.

TABLE _-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	28	31	33
NCR Corp.	55	58	60	55	51	47
Four Phase Sys.	48	51	54	60	48	25

SOURCE:

Eralp, O. and Rucker, B.B. 1984. "The hospital information systems industry." Hambrecht & Quist Incorporated, San Francisco. The figures for 1984 and 1985 are estimates.

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 70's, 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

[3] See footnote 1.

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.

REFERENCES

Arnett, R.H, Cowell, C.S., Davidoff, L.M., & Freeland, M.S. 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), pp. 11, 20.

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

Eralp, O. and Rucker, B.B. 1984. "The Hospital Information Systems Industry." Hambrecht and Quist, Inc., San Francisco, CA.

Ermann, D. & Gabel, J. 1984. Multihospital systems: Issues and empirical findings. *Health Affairs 3* (no. 1), 50-64.

Ermann, D. & Gabel, J. 1985. The changing face of american health care: Multihospital systems, emergency centers and surgery centers. *Medical Care 23* (no. 5), 401-420.

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

Gabel, J. & Ermann, D. 1985. Preferred Provider Organizations: Performance, problems, and promise. *Health Affairs 4* (no. 1), 24-40.

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

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." William Blair & Co., Chicago, IL.

Packer, C.L. 1984. A comparison of hospital data processing costs. *Hospitals 58* (no. 15), 83-86.

Packer, C.L. 1984. 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, DC).

Scheffler, R.M., Yoder, S.G., Weisfeld, N., and Ruby, G. 1979. Physician and new health practitioners: Issues for the 1980s. *Inquiry 16*, 195-229.

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

Wennberg, J.E., McPherson, K., & Caper, P. 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." Health Administration Press, Ann Arbor, MI.

Austin, C.H. and Carter, H.S. 1981. National hospital information resource center: A model. *Inquiry 18*, 291-299.

Ball, M.J. and Boyle, T.M. 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." Sheldon I. Dorenfest and Associates, Highland Park, IL.

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

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." HFMA, Chicago, IL.

Menning, W.R., Bolek, R.W., and Mon, D. 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), pp. 39-78.

Wiederhold, G. 1982. Databases for ambulatory care. *In* "Computer Applications in Medical Care" (D.A.B. Lindberg ed.), pp. 79-85. Masson Publishing, New York.