Market
Analysis
Program
(MAP)

Industry Sector Markets 1991-1996

Medical Sector

INPUT®

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DECEMBER 1991

INDUSTRY SECTOR MARKETS 1991-1996

MEDICAL SECTOR

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1280 Villa Street, Mountain View, California 94041-1194 (415) 961-3300

Published by
INPUT
1280 Villa Street
Mountain View, CA 94041-1194
U.S.A.

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MAPMD • 594 • 1991

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Introduction

A
Purpose and Methodology

1. Purpose

There are five basic objectives of this Market Analysis Program vertical market report:

- Introduce the reader to the medical industry's structure and demographics
- Identify the business issues and trends that are driving the use of information services within the medical industry
- Discuss the manner in which the medical industry uses information systems, and discuss the issues facing medical industry information systems organizations
- Discuss the information services market within the medical industry, including market sizing and the factors driving market demand for each delivery mode
- Discuss the competitive environment and profile the leading information services vendors in the medical industry

This 1991 assessment of the health services sector finds an industry in a similar status as in the 1990 assessment. The sector is challenged by spiraling costs and extreme pressure to improve the overall health care delivery process. There remain many opportunities for the effective application of information technology. In general the reader of this report will find most of the report re-emphasizes the issues and findings as reported by INPUT in 1990.

2. Methodology

Much of the data on which this report is based were gathered during 1991 as part of INPUT's ongoing market analysis programs. Trends, market size, and growth rates are based primarily on in-depth interviews with users within the medical industry and the IS vendors serving the medical industry. INPUT maintains ongoing relationships with, and a data base of, all users and vendors that it interviews.

In addition, extensive use was made of INPUT's corporate library in Mountain View, California. The resources in this library include several on-line periodical data bases, subscriptions to over 50 computer and general business periodicals, continually updated files on over 3,000 information services vendors, and the most up-to-date U.S. Department of Commerce publications on industry statistics.

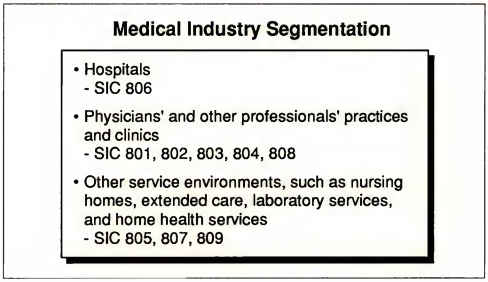
It must be noted that vendors may be unwilling to provide detailed revenue breakouts by delivery mode or industry. Also, vendors often use different categories of industries and industry segments, or view their services as falling into different delivery modes from those used by INPUT. Thus, INPUT must estimate revenues by these categories on a best-effort basis. The delivery mode and individual segment forecasts should be viewed as indicators of general patterns and trends rather than as specific, detailed estimates for individual years.

When the information is provided from vendors as requested, at times it is provided under an agreement of confidentiality. Therefore, vendor rankings based on these revenue figures should be considered indicative rather than definitive, and the revenues themselves should be viewed as approximations only.

B
Industry Structure

For purposes of this report, the U.S. medical industry (SIC 80) will be segmented as shown in Exhibit I-1.

EXHIBIT I-1



1. Descriptions

Hospital-based medical services in the U.S. are provided in one of four major organizational settings. Investor-owned (or proprietary) hospitals generally are affiliated with a major national chain or a regional chain of hospitals, operate as businesses on a profit-and-loss basis, and show widely ranging levels of central or decentralized control of operations. Secular not-for-profit hospitals most often are independent and local nonprofit community service institutions. Catholic and other religious hospitals are also nonprofit institutions and operate with church affiliations that may impact services offered, as in the case of Catholic hospitals that refuse to offer abortion or birth control services. Public hospitals are most often city- or county-based and generally operate as nonprofit institutions within the city or county governmental structure. About half of the nation's 7,000 hospitals are nongovernmental nonprofits, over 15% are proprietary, and the rest are public hospitals, many in rural locations.

Although many physicians, dentists, and other professionals continue to maintain private practices as individuals, the trend is for medical professionals to practice jointly in small- or large-group clinic settings. In clinics they provide mutual backup and case consulting, as well as share the costs of administration—including computer services. Although small clinics generally offer specialized medical services, larger clinics may handle a wide range of patient needs, as in the case of larger family-practice clinics that serve newborns, young children, adolescents, and their parents. The *clinics* category also includes specialized facilities, such as those dedicated to outpatient surgery or physical therapy.

The other medical service environments listed in Exhibit I-1 fall outside any neat categories, and only collectively account for levels of health care expenditures approaching the other two segments, as outlined in the next section.

2. Financials

As shown in Exhibit I-2, estimated U.S. health care expenditures in 1991 are relatively evenly divided among the hospital, professional/clinic, and Other (including nursing home) segments. Of interest is the consistent percentage change from 1990 to 1991 (11.1% to 13.5%) across all segments of the medical sector, indicating that, individually and collectively, expenditure growth was relatively constant.

EXHIBIT I-2

Estimated U.S. Health Care Expenditures

Expenditure	1991 ($ Billions)	Percent Change 1990-1991
Hospital Care	286	11.1
Physician, Dentists, and Other Professional Services	220	11.9
Nursing Home Care	61	13.5
Other Expenditures	189	12.5
Total	756	11.9

Total employment in the medical industry was over 7.5 million in 1989, with almost half (3.5 million) in hospitals and approximately 1.4 million in nursing homes and personal care facilities. As of 1987, there were approximately 612,000 physicians, over 161,000 dentists, and more than 1.6 million nurses.

As some measure of the growing importance and size of the medical sector of the economy, Exhibit I-3 identifies the ten largest U. S. health care services, and notes their 1990 revenues. It is immediately obvious that health care, at the provider level, is now big business, with five of the noted entities earning annual revenues in excess of $1 billion. Eighteen health care business were listed in the Business Week 1000, and the largest, Humana, was 138th (in terms of its market value) among all businesses listed.

EXHIBIT I-3

Ten Largest Health Care Services

Rank/Service	1990 Revenues ($ Billions)
1. Humana	5.1
2. National Medical Enterprises	3.7
3. Beverly Enterprises	2.1
4. U.S. Healthcare	1.3
5. FHP International	1.2
6. Manor Care	0.8
7. United Healthcare	0.6
8. National Health Laboratories	0.5
9. Community Psychiatric Centers	0.4
10. Medical Care International	0.2

C

Organization and Contents of Report

The remainder of this report is organized as follows:

Chapter II—Trends, Events, and Issues— provides background information on business and social issues and trends that are driving the use of information services within the medical industry.

The section on trends and events focuses on two areas:

- The impact of general business and social trends—such as increased pace of change, organizational fragmentation, the aging population, and the continuing use of technology to improve basic operational practices.
- Medical-industry-specific trends and events—including the pressures of medical cost containment, new competitive pressures, the AIDS care crisis, and the outlook for major changes in the current system of paying for health care.

The section on issues identifies specific questions that should be asked and situations that should be addressed in developing a business strategy to provide information services to one or more segments of the medical industry.

Chapter III—Information Systems Environment—provides an overview of the basic business processes in the medical industry and their supporting information systems applications. For example, a discussion of how the medical industry uses information systems to operate and manage its business activities is included. Networks and data communications are part of this analysis.

The impacts of new and emerging technologies on applications and the IS organization are addressed, as are organizational and budgetary considerations.

Chapter IV—Market Assessment—looks at the medical industry from two viewpoints:

- By delivery mode—how are these services delivered? INPUT's major categories of delivery modes are:
  - Processing services
  - Network services
  - Software products
  - Professional services
  - Systems integration
  - Turnkey systems
  - Systems operations
- By industry segment—who is buying information services? In other words, what segments within the medical industry are buying services in which delivery modes?

Overall market forecasts are provided by delivery mode and industry segment.

Chapter V—Competitive Environment—identifies leading IS vendors in the industry, discusses some of the factors that affect the competitive dynamics of the industry, and profiles representative vendors.

Chapter VI—Conclusions and Recommendations—reviews the trends and opportunities in the report and provides recommendations for vendors as well as users.

In addition, there are two appendixes:

Appendix A presents industry-specific definitions used throughout the report.

Appendix B presents the forecast data base and the forecast reconciliation. The forecast data base contains a yearly (1991–1996) forecast of user expenditures by delivery mode for the medical industry as a whole and for each industry segment. The forecast reconciliation compares this report's forecast with the forecast in INPUT's previous medical industry report and explains the reasons for differences.

II

Trends, Events, and Issues

This chapter discusses trends, events, and issues in the medical industry.

Section A, Trends and Events, highlights the business and social forces driving the medical industry, key technology trends, and how the industry is responding to these forces.

Section B, Business Issues, identifies specific questions that should be asked and situations that should be addressed by IS vendors in developing a business strategy that is responsive to the industry trends in Section A.

A
Trends and Events

1. General Business and Social Trends

Several national business and social trends impact the medical industry, as listed in Exhibit II-1.

EXHIBIT II-1

Impacts of Business and Social Trends

- Rising percentage of uninsured
- Urban poverty and service needs
- Growing ranks of elderly
- Drives to control medical costs

a. Rising Percentage of Uninsured

For a number of reasons, the number of Americans without health insurance doubled between 1980 and 1990 to reach 37 million. An additional 21 million were underinsured, with some coverage (for example, for certain types of outpatient procedures) but facing other medical costs that are not affordable (such as a hospital stay).

A major reason for both conditions is corporate restructuring and layoffs during the late 1980s, resulting (for many) in losses of union-negotiated health benefits and switches to lower-paid service jobs with partial or no benefits. In fact, a reported 75% of the 37 million uninsured are employed, usually by small firms or in low-wage or part-time employment where health insurance is not provided. Statistics indicate that only 46% of businesses with fewer than ten employees offer health coverage.

Also, many individuals are denied coverage because they cannot pass newly permitted blood tests for drugs and HIV/AIDS infection, or due to high risk based on membership in a minority group with a high infection rate or a stereotyped occupation.

Using a somewhat different standard, the Census Bureau estimates that 63 million Americans lacked health insurance coverage for at least one month in the 1985 to 1987 period, often during a job change.

b. Urban Poverty and Service Needs

Under any of these uninsured conditions, certain sectors of the medical industry are impacted more than others. Urban locations, for example, include many unemployed or low-wage persons with no or inadequate health insurance. Medical services are provided by urban public hospitals without payment. Urban poverty today means social ills that directly increase medical service needs, such as AIDS infection and addiction to crack cocaine. One estimate, for example, is that crack babies will consume some $20 billion in medical services. As many as 1.5 million Americans may be infected with the HIV virus that causes AIDS, and lifetime medical expenditures for an AIDS victim are estimated at $80,000.

c. Growing Ranks of Elderly

Health care costs will keep rising well into the 21st century as the baby boom generation ages. By 2030, an estimated 66 million Americans will be over age 65, versus 26 million in 1980. Nursing homes alone will house an estimated 6 million elderly by 2040, versus 1.6 million in nursing homes and extended-care facilities today. Yet the upcoming "baby bust" generation will have ever-fewer wage earners to fund care for the swelling ranks of the elderly, who increasingly will be the older elderly—over 75

or 85. Exhibit II-2 offers a deceptively simplistic summation of the growth in the ranks of the elderly. The 129% growth (more than doubling in 61 years) in those age 65 or older is significant. A five-fold growth in those over 85 is *very* significant. And perhaps most significant of all: in 1989, people over 85 were less than 10% of the elderly; in 2050, they will be more 20% .

EXHIBIT II-2

Growth of Over-65 Population (Millions)

Age Range	Year				Percent Change 1989-2050
	1989	2000*	2025*	2050*	
65 and Older	31	36	60	71	129
75 and Older	13	17	25	38	192
85 and Older	3	5	7	15	400

*Projected Source: Social Security Administration

d. Drives to Control Medical Costs

By far the most significant factor affecting today's medical industry overall is the multifront drive to control the spiraling costs of medical care. The major drivers of rising medical costs are the increasing use of sophisticated and expensive medical technologies (such as CAT scanning and Magnetic Resonance Imaging machines) and innovative, high-cost treatments of heart disease, AIDS, and cancer—as well as costly procedures such as organ transplants.

The one-year increase in medical expenditures from 1990 to 1991 will be 11.9%, far outstripping general inflation and almost identical to the 11.8% rate from 1989 to 1990. Total health care spending that approaches two-thirds of a trillion dollars today represents about 12% of U.S. gross national product; according to the U.S. government's Health Care Financing Administration, this spending could rise to a full trillion dollars, or over 13% of GNP, as soon as 1995, and $1.5 trillion—15% of GNP—by 2000.

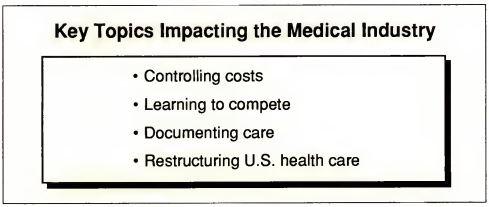
The public sector—mostly through the federal Medicare system for the elderly, with 33 million persons enrolled, and the state Medicaid programs for the poor—today funds 41% of health care costs, with the private sector covering 59%. Thus, businesses that fund employees' health insurance are absorbing the bulk of the increases in medical expenditures. Employer-sponsored medical plan costs were up 20% in 1989 and businesses now spend an estimated $140 billion per year on health care.

Surprisingly, some observers believe that as much as 30% of all medical care in the U.S. is unneeded. This percentage explains the observation that the most effective action that employers can take to control medical costs for their employees—and thus health insurance rates—is to require precertification (preapproval by the insurer's staff) for nonemergency hospital treatment. In addition, there is a growing trend toward medical cost management, whereby the insurer works with the hospital to manage the employee's treatment, shorten the stay, and minimize tests and treatments.

2. Medical Industry Trends and Events

The mix of key trends and events affecting the U.S. medical industry in the late 1980s and early 1990s can best be addressed in terms of the four major topics in Exhibit II-3.

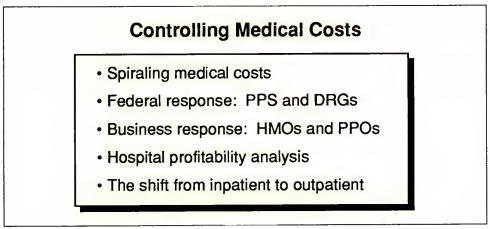
EXHIBIT II-3



a. Controlling Costs

Exhibit II-4 summarizes the key medical cost patterns, trends, and issues impacting the industry.

EXHIBIT II-4



Spiraling Medical Costs - A strong motivator for the medical industry's drive to control costs is the year-to-year spiral in medical costs discussed earlier in this chapter. Although hard figures are not available, it is, however, clear that the rising cost of expensive new treatment technologies is not the only problem. An ongoing shortage of professional nurses throughout the 1980s has steadily driven up salaries for this major employee group in the medical industry (1.5 million of 7 million employees). (One nonsalary means for attracting and holding nurses is the addition of technology that aids nurses—but, unfortunately, that strategy shifts salary costs to technology costs.) With no relief in sight to ease local salary bidding wars for nurses and the resulting cost pressure, experts are now also seeing looming shortages of other nonphysician medical professionals, especially those who operate the sophisticated new medical technology.

Federal Response - The federal response to the medical cost spiral began in 1983, with the introduction of PPS (Prospective Payment System) and DRGs (Diagnosis-Related Groups). Starting with Medicare-paid hospital inpatient treatment, in 1983 the U.S. government specified a major change in Medicare payment for hospital treatment. Medical conditions requiring treatment were grouped into DRGs, and hospitals were told that under the new PPS each DRG would be paid at a fixed rate per patient. Hospitals would no longer bill or be reimbursed for whatever treatments the doctor ordered; instead, hospitals would receive a preset amount per patient based on the diagnosis. Efficient hospitals could profit by providing service for a lower cost than the DRG-based payment. Inefficient hospitals would lose money on treatments that exceeded the DRG amount.

PPS and DRGs changed the business of hospital care overnight and sent the medical industry reeling. Hospitals had to start handling financial accounting on the basis of diagnosis-related treatments, and physicians were suddenly held accountable for costs they scarcely paid attention to before. Some critics complained of premature hospital discharges of Medicare patients whose DRG-based time was up, whether or not treatment was complete. With Medicare and Medicaid reimbursements averaging about half of the hospital segment's operating revenue, hospitals clearly could not ignore the new system.

Business Response - One response by the hospitals was to begin shifting costs to patients covered by private insurance, through increases in non-Medicare charge rates. Businesses, in turn, responded by moving toward HMOs and PPOs-Health Maintenance Organizations, and Preferred Provider Organizations.

HMOs work on a dual set of assumptions. First, HMOs charge little or nothing for the employees of a subscribing business to schedule routine examinations and treatments, on the theory that healthier employees will

result from such prevention-oriented services, and thus expensive acute-care procedures will often be avoided. Second, HMOs contract with participating physicians and other professionals to work on a steady salary basis at regularly scheduled times and without the administrative overhead of operating their own practices—the HMO administration schedules health professionals to be busy for the contracted hours. This scheduling helps the HMO to manage the professional-costs side on a predictable basis: enrolled employees consult only the HMO's doctors (or pay some or all costs for consulting an independent physician) and often have to wait days or weeks for noncritical appointments. Organizationally, HMOs are often associated with a local hospital; an insurance company may also be involved administratively if not financially.

PPOs address, in part, the major reluctance of many employees to enroll in an employer-paid HMO: the freedom to choose the medical professionals they will consult. PPOs organize physicians and other medical professionals (the preferred providers of medical treatment) by securing agreement that subscribing employees choosing to consult those providers will be charged at lower rates than the providers' customary rates. The physician or professional presumably benefits by being placed on the PPO's preferred-provider list that is distributed to all subscribing employees, and thus winning more business. Employees are encouraged to use the preferred list by some benefit that is not provided if they choose a provider not on the list. Such incentives include low fixed charges, waiving of deductibles, lower-percentage copayment by the patient, and coverage of more services. Overall, the PPO theory is that lower costs to employers will result from such an alternative to traditional free-choice health insurance plans. Organizationally, PPOs are often administered by insurance companies, with or without strong involvement by the management of one or more major local businesses whose employees are enrolled in the PPO.

Although some 25% of the U.S. population is served by HMOs or PPOs (collectively called *managed-care* plans), to date the plans are experiencing uneven encounters with medical business realities. To take one example, Exhibit II-5 shows a clear trend of slowing enrollment in HMOs.

Some observers see in this HMO enrollment data a plateau effect—the portion of the population inclined to HMO-style managed care has already signed up, and further gains will be minimal. The plateau theory conflicts with the end-of-1989 enrollment of 26 million employees (with an additional 60 million eligible family members) in PPOs and the continuing strong PPO enrollment growth that suggests a much higher plateau, perhaps one and one-half times the 1989 number.

EXHIBIT II-5

HMO Enrollment Growth (Millions)

Year	Total Enrollment	One-Year Growth	One-Year Growth Rate (Percent)
1985	21.1	-	-
1986	25.8	4.7	22
1987	29.3	3.5	14
1988	31.9	2.6	9
1989	33.1	1.2	4
1990*	35.5	2.4	7
1991*	37.4	1.9	5

*Estimated. Source: U.S. Department of Commerce

Several factors are at work. To date, the profitability of HMOs is still uncertain. One survey of hospital-based HMOs and PPOs found that in 1989, 29% of the HMOs surveyed lost money, and 19% of the PPOs. Aggregate HMO losses were $500 million in 1989, down from $900 million in 1988. A number of HMOs have shut down in recent years, and there have been a number of mergers and consolidations. These numbers become more significant when one notes that two-thirds of the HMOs are for profit and, obviously, not achieving their goals.

One reason for HMO profitability problems is the discounting of rates that took place in the mid-1980s to bring enrollments up to the levels needed for efficient operation. Most HMOs are now substantially raising charges to the enrolling corporations—thus the decrease in losses reported in 1989.

At the same time, however, HMO price increases almost certainly are contributing to the enrollment plateau, especially as employers set up PPOs instead of HMOs—or offer employees a choice. PPOs have other advantages over HMOs in that they are less complex (because an entire HMO organization need not be assembled) and more secure financially (since care is still fee-for-service on a demand basis, rather than prepaid services subject to underenrollment). For example, an executive at a MetLife subsidiary in Colorado that shifted from an HMO to a PPO structure commented that the PPO was more profitable and easier to administer than the HMO displaced.

As the medical industry struggles to control health care costs, HMOs and PPOs are not alone in profitability concerns. In general, hospital revenues average about 2% over costs.

Hospital Profitability Analysis - Prior to the imposition of Medicare's PPS/DRGs in 1983, profitability analysis for most hospitals was little more sophisticated than regular comparisons of total expenses and total revenues, perhaps supplemented by expense breakdowns by hospital department (surgery versus laboratory versus maternity, for example) or revenue subtotals by payor. Under PPS and DRGs, however, hospitals quickly scrambled to itemize costs centrally (across all departments serving a patient), by patient, by diagnosis, and by treatment procedures—and compare these with Medicare revenues for the patient. For the first time, physicians caring for Medicare patients found themselves accountable for cost-efficient as well as medically effective treatments.

As if the initial shock of Medicare PPS was not enough, the U.S. government has revised DRG-based payment schedules yearly, most often reducing payments to reflect federal budget reductions for the overall Medicare program. For fiscal year 1991, for example, the Bush Administration requested over $5 billion in Medicare cuts. In a year-to-year adaptation to the new DRG schedules, hospitals have encountered another challenge to effective profitability analysis most of the hospitals' department heads (who are expected to implement the cost-control measures to achieve operating surpluses) come from clinical backgrounds and have been promoted primarily for clinical expertise. Few are trained or experienced in business management. Departmental reorganization to achieve business-oriented expense control has already begun at some hospitals and likely will become a condition for survival, given the large Medicare/Medicaid percentage of the hospitals' revenues.

Shift from Inpatient to Outpatient - One major effect on hospital services from PPS has been a profound shift from inpatient to outpatient services because Medicare outpatient charges to date have not been subject to PPS. Hospitals have found that many Medicare services that are unprofitable if the patient is admitted (under DRG-based cost control) can be performed profitably (and presumably safely) on an outpatient basis. For example, about half of all surgery is currently done on an outpatient basis—and often in doctors' offices or surgical outpatient clinics, not in hospitals. In fact, a recent survey of hospital executives indicated that they expect that the current growth in ambulatory care will continue through the 1990s; by the year 2000, net outpatient revenues will be more than half of all hospital patient revenues.

b. Learning to Compete

Exhibit II-6 outlines the key issues faced by hospitals in the newly competitive environment.

EXHIBIT II-6

Competitive Issues for Hospitals

- Increasing operational efficiency
- Marketing hospital services
- Winning physician referrals

Increasing Operational Efficiency - Before 1983, the ability of hospitals to bill Medicare, Medicaid, and private insurers at standard service rates with few questions asked provided little incentive for improving operational efficiency. Even duplicate charges often would be overlooked and reimbursed by the payor. The DRG-based PPS for Medicare suddenly alerted hospitals to the need for business efficiency in choices among more- or less-expensive service alternatives and in days and staff hours required to handle patients' needs.

As many industries (such as automobile manufacturers) have learned over time, costs and efficiencies are only part of the competitive picture. Quality is also becoming increasingly important as an adjunct to efficient hospital operations.

Marketing Hospital Services - The post-1983 PPS-motivated shift to outpatient services also had another competitive impact: it provided a strong motivation to market hospital services. This new concern for marketing occurred for two reasons. First, with fewer inpatient admissions, hospital overhead cost structures, weighted toward a high proportion of inpatients, keep fixed costs high while inpatient revenues decrease. Marketing in this case means publicizing hospital services in hopes of filling more inpatient beds. Second, the increasing emphasis on outpatient services means that patients and doctors can choose doctors' offices or outpatient clinics for services—including surgery—formerly handled primarily in hospitals. Hospitals now are forced to market their outpatient services in competition with alternative care sites, or risk losing outpatients.

An interesting note on inpatient/outpatient revenues: a 1991 survey by the American Hospital Association indicated that as the number of beds in the hospital increases (from fewer than 50 to over 400), the inpatient/outpatient proportion of total revenues rises from 54%/43% to 78%/19%. The hospital progression from lower bed size categories to higher is matched (not surprisingly) by a steady increase in the inpatient portion of revenues.

Many hospitals are just now learning how to market their services, in some cases sending hospital executives and senior staffers (or directly hiring sales staffs) to educate the community, publicize the hospital, and

forge relationships with local businesses, often in PPO arrangements. One impact of the need to begin active marketing is the newfound willingness of hospitals to recruit chief executive officers and chief information officers from other industries where businesslike operations and ongoing marketing are accepted practices. In the past, the hospital administrator with the longest tenure often captured the CEO position. Now it is more likely to be the administrator with the most business experience and demonstrated business credentials.

Winning Physician Referrals - Much of the hospital marketing activity focuses on winning patient referrals from physicians, the primary caregivers on whom patients depend for professional guidance as to the best environment for required medical services. Exhibit II-7 lists the wide range of practices that hospitals use to establish closer working relations with physicians and win more patient referrals.

EXHIBIT II-7

Hospital Marketing Efforts to Physicians

- Income guarantees
- Joint ventures
- Low-interest loans
- Relocation reimbursement
- Practice-startup assistance
- Free office space
- Sign-up bonuses
- Physician referral services
- Acquisition of physician practices

The first and last items listed deserve further comment.

On the first item, one survey of 114 hospitals reveals that virtually all 95% provide some form of income guarantees to physicians.

Regarding physician practices, a clear recent trend is toward more than one-way acquisitions. Rather, the trend is toward mergers of hospitals and local physicians' clinics that can be an acquisition of the clinic by the hospital to tie physicians closely to the hospital, or an acquisition of the hospital by physicians to achieve operating control (and perhaps more-

favorable and -profitable working conditions) and/or to invest in sharing the hospital's profits. (Actually, the trend is broader still: hospitals, clinics, nursing homes, extended-care facilities, and managed-care companies are also merging in combinations that meet local needs.) Whatever the motivation, the resulting organizations are then marketed as local (or integrated) medical delivery systems that provide a wide range of medical services at multiple locations within a single administrative and billing structure.

c. Documenting Care

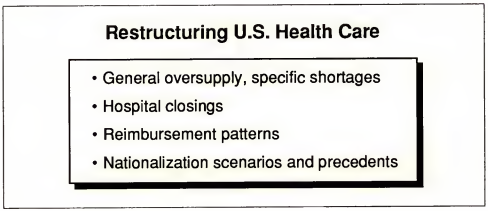
At one level, a new emphasis on documenting care began with Medicare DRGs after 1983, when basic documentation of the diagnosed condition became the standard for federal government payments. More recently, however, Medicare has implemented a formal system of peer review challenges: review by Medicare-contracted physicians of the treatment plan implemented by the patient's own physician. This has led specifically to some practitioners finding their fees rejected by Medicare as inappropriate treatments. More generally, however, it means that Medicare-reimbursed physicians and their hospitals are increasingly under pressure to formally document the care they provide—diagnosis, treatment plan, implementation, plan revisions, and results.

Similar pressure is emerging on the private-payor side, with insurance companies that initially hired nurses to check for double billing now adding physician-level reviews similar to those for Medicare. The general terms *outcome analysis* and *service appropriateness* are being applied to such review-of-care processes.

d. Restructuring U.S. Health Care

Exhibit II-8 outlines the key issues in current discussions of whether—or many would say, *how*, given the looming crisis—to restructure the U.S. health care system.

EXHIBIT II-8



Generic Oversupply - Some recent surveys report that over one-third of U.S. hospital beds are unoccupied (implying a general oversupply of hospital resources), but even if that number is correct, areas with specific shortages clearly do exist. In New York City, for example, only 10% of hospital beds reportedly are unoccupied. New York is typical of urban centers beset by poverty, crime, and drugs—and the attendant high level of medical needs. Such areas generally lack sufficient hospitals and physicians to meet those needs, while multiple centers for open-heart surgery are underutilized in affluent suburbs. Perhaps the most unfortunate are the rural areas that can no longer afford to keep a local hospital open—thus forcing long, often-dangerous drives for critical medical services.

Hospital Closings - Given these circumstances, it is scarcely surprising to find a pattern of hospital closings nationwide. The closings often reflect acquisitions of unprofitable institutions by profitable ones. From 1980 to 1987, for example, 231 of the nation's hospitals merged into a total of just 111 institutions (with some maintaining multiple campuses for services under a single organizational structure).

In terms of hospital closures, there were just under 700 from 1980 to 1989. Hardest hit were the community (generally public) hospitals, which represented over 500 of the nearly 700 institutions. The pace of closures accelerated in the latter portion of the decade, with the four years from 1986 through 1989 accounting for just over 50% of the ten-year total. Observers expect hospital mergers and closures to accelerate in the 1990s—one projection is that 70% of all health care services will be delivered outside hospitals by the year 2000.

Reimbursement Patterns - Distorted national patterns of health care reimbursement are clearly part of the reason for hospital closures, as in New York City where 80% of all voluntary (nonprofit) hospitals were losing money as of mid-1989. With 37 million uninsured Americans—many in the inner cities—the total amount absorbed by hospitals for uncompensated care rose from $3 billion in 1980 to $8 billion in 1988. In Washington, D.C., for example, the 1990 layoff of 400 hospital employees was blamed directly on rising levels of uncompensated care.

Nationalization Scenarios - Given such problems, a national health insurance program of some sort appears a natural outcome of the many uninsured, AIDS costs, and aging of the baby boom group. Some proponents note that only the U.S. and South Africa, among major industrialized nations, lack such a program.

The current Medicare (for the elderly) and Medicaid (for the poor) programs, of course, represent a first thrust at health care nationalization. Some leaders propose simply broadening these programs to make them more generally or universally available to the uninsured who do not now qualify.

Others propose legislating the broadening of employer-funded health insurance. One way would be to force most employers to provide mandated levels of health care insurance or pay a fee into a government insurance pool. Participation in this pool is available for a fee to all those without insurance, including the medically uninsurable, such as those with AIDS, and will provide some level of health care for those who remain uninsured. The New York state legislature is considering a similar proposal, as well as an alternative under which the state would be the sole payor for all health care services. In March 1990, the so-called Pepper Commission (the U.S. Bipartisan Commission on Comprehensive Health Care) recommended a national plan similar to that established by Massachusetts, with expanded Medicare and Medicaid programs covering those uninsured even under a national pool. An estimated $66 billion price tag was associated with that plan, and Republicans on the Commission voted against it (in the minority) under last-minute pressure from the Bush Administration.

Several federal proposals have been introduced in Congress for national health insurance, generally mandating minimum health care benefits for all citizens, with no exclusions and with a low limit (to be paid by the individual) on catastrophic care coverage. Some level of health care resource rationing, as is being pioneered now by the state of Oregon in its Medicaid program, might be included under such proposals, or might evolve over time. Most of these plans call for a phasing-in over a ten-year period.

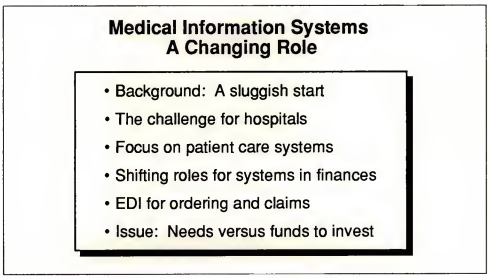
Yet key inhibitors to universal health care coverage loom as well. Those proposing single national insurance programs often suggest eliminating most employer and private insurance company participation in health-care funding. Such proposals call for a single national (or multiple regional) public insurer(s), mainly to cut claims administration costs especially by reducing or eliminating costs for eligibility verification. Clearly, the powerful private insurance industry will oppose such proposals. Also, some argue that any national health care program goes against the grain of independence-minded Americans. A further inhibitor is that most Americans who vote are covered by employer-funded health insurance, and thus are largely insulated from direct contact with the problems of lack of coverage or cost increases.

All in all, though, observers seem to agree that national health insurance in some form is possible but unlikely before 1995, and more likely but not certain after 1995. With many different proposals under consideration, impacts on the medical industry (assuming eventual implementation of some system, which is also unsure) remain unclear.

3. Technology Trends Impacting the Medical Industry

Exhibit II-9 outlines the information technology issues facing the medical industry in the 1990s.

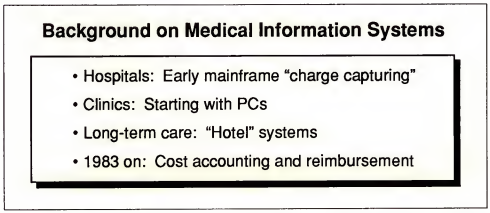
EXHIBIT II-9



a. Background: A Sluggish Start

In contrast to many other industries—such as insurance, banking, and financial services—the medical services industry has been relatively slow in its movement toward information systems, as noted in Exhibit II-10.

EXHIBIT II-10



Hospitals - In the early days of hospital computerization, the requirement was reasonably simple: use the mainframe (sometimes on-site but often timeshared on a remote-processing basis) to capture and bill patient charges. This requirement changed little until 1983.

Clinics - The rapid growth of clinics for physicians and other professionals, on the other hand, began recently enough that clinics could start many computer operations on the fast-evolving PC platform, or within a mini-

computer architecture. (Few individual physicians made significant use of computers until costs dropped significantly during the 1980s and fewer physicians practiced individually.) Many whose clinics now need second-generation systems are choosing networked PCs over minicomputers.

Long-Term Care - Nursing homes and other long-term-care institutions, in contrast, have always had accounting and computing needs more akin to those of a resort hotel (where guests stay for a week or a month at a time) than those of a hospital (where stays are shorter and many services are provided). Excluding transfers to a hospital, nursing home residents mainly incur bills for room, board, and relatively stable medications, with invoicing at regular weekly or monthly intervals. Computer systems may or may not be used, and system complexity can be kept to a minimum.

1983 On - Hospitals' information systems needs began to change radically after Medicare's 1983 imposition of PPS and DRGs. As discussed earlier, the new Medicare reimbursement requirements quickly began driving a shift from procedure-oriented to patient-oriented/diagnosis-based cost accounting. Hospital information systems in most cases are barely meeting this new set of needs now, and the 1990s should be a decade for hospital administrators to invest in such systems to survive financially and administratively.

b. The Challenge for Hospitals

A wide range of challenges faces hospitals in this systems evolution, as outlined in Exhibit II-11.

EXHIBIT II-11

Evolving Hospital Systems in the 1990s

- Decentralized departments and applications
- Centralized hospital information systems
- The integration challenge
- From financial to patient care systems
- The efficiency drive

Decentralized Departments and Applications - Historically, hospitals have functioned as very decentralized organizations. In a sense, the independent physician seems to have served as a model for the hospital's decentralized departmental operations, with centralization evident primarily in the billing function, where physicians' and departments' charges eventually came together into patients' bills. Although the information

systems implemented for such billing were technically central, they were also decentralized in the sense that they were purchased and administered by the finance department (including finance clerks' keypunching of charges from paper records), as were the laboratory, pharmacy, and other departmental systems that followed. Often, in fact, departmental information systems were independent, incompatible turnkey systems.

As noted earlier, Medicare PPS and DRGs demanded that hospitals shift rapidly to patient- and diagnosis-based analysis of the cost-effectiveness of alternate treatments in order to stay as far as possible under the DRG-based cost ceiling. Somewhat frantic and only partially effective efforts were made by both hospitals and vendors to patch such capabilities into installed finance and billing systems, with mixed results. Just as important, hospitals suddenly realized that independent departmental information systems no longer provided the level of central control now required. Beyond information systems, of course, the wider effect has been a push for more-central control of departmental operations in general, a significant feat for an environment where the independent-physician culture has permeated departments for years.

Centralized Hospital IS - Almost as a historical anecdote, it should be noted that throughout the 1980s (before and after PPS and DRGs) both hospital systems commentators and vendors heralded the coming era of the integrated hospital information system or HIS. The HIS model acknowledged the long-term inadequacy of department-based systems and the need for either a single hospital information system or integration among multiple systems. Such systems for the most part, however, have yet to see the light of day. Development costs have proven high, delays and complications abound, and implementation costs would be daunting to most hospital administrators.

Integration - Still, the integration challenge for hospital information systems has not disappeared. Rather, analysts today see the challenge in terms of using communications and networking standards to connect multiple systems. One standard—Health Level 7, or HL7—has been defined sufficiently to be useful today in achieving multivendor systems connections within the hospital. Longer term, the IEEE is defining MEDIX, an ISO-based standard with global potential. An industrywide federation—the Health Information Standards Coordinating Committee, or HISCC—was formed in 1988 to coordinate these efforts so that those implementing HL7 now can migrate to MEDIX when it is defined. Note also that many users now are evaluating the role of UNIX with its built-in capabilities for networking and interconnections as a possible future operating system of choice to facilitate system-to-system connections.

Standards, however, can be confusing, especially in the early stages. In 1991, at the Chicago-based American Hospital Association's Healthcare Information and Management Systems Society's annual meeting, Hewlett-Packard surveyed over 400 IS executives and learned that more than 75% didn't feel that they understood computing standards well enough to intelligently make a decision regarding implemention in hospitals.

Patient Care - In addition to the need to integrate information systems and analyze costs centrally on a patient/diagnosis basis, hospitals now realize that computer power can also be harnessed to assist in patient care as well as handle financial functions. Electromechanical medical devices to record heart and other bodily functions generally incorporate microelectronics, and in many cases the resulting charts can be recorded and examined more efficiently in digitized form (displayed and recalled from memory onto a screen) than on long paper tapes with pen-plots. It is only a small step further to connect multiple electronic sensors (and even electronic controls for intravenous infusion of liquids and medications) to a bedside computer. Whether at the bedside or at the nursing station, however, computerized patient care systems can assist doctors and nurses in care planning, plotting of vital signs, recording of drug administration, and other treatment and administrative processes.

Efficiency - Efficiency, in fact, is one driving factor in hospital systems for the 1990s. As a result of the nursing shortage, for example, not only are pay scales rising faster than desirable, but shortages often mean overtime pay at still higher rates. Computerization of the nursing function—whether at the nursing station or the bedside—will be justified by reduced nursing overtime, such as less need to stay beyound the end of a shift to document patient care, because such documentation has already been entered on-line throughout the shift and can be printed (or stored electronically on tape or disk) in little or no extra time.

c. Focus on Patient Care Systems

Respondents to INPUT's user interviews noted that the implementation and refinement of effective and efficient patient care systems was a key issue and challenge facing most of today's hospitals. The components of this challenge are noted in Exhibit II-12.

EXHIBIT II-12

Opportunities and Challenges in Patient Care Systems

- Electronic charting
- Systems use by medical professionals
- Flexible electronic records access
- Networking multiple systems
- Mixing data, plots, and images
- Longitudinal electronic medical records

Electronic Charting - Charting—recording on papers (usually kept at the foot of the hospital bed) of a patient's vital signs, care plan, and treatment records—has always been a sore point for many nurses and physicians. Problems are illegible writing, lapses in charting, and the time and attention required to write records when other duties call or when fast, crisis-based medical action is taking place.

Some see electronic, computer-based charting (also referred to as bedside terminals or bedside information systems) as part of the solution. As mentioned earlier, many sensors today can provide electronic input for a computerized chart. Advanced display systems can permit viewing of several such records in time-synchronized displays from memory (or in real time), potentially aiding in diagnosis or treatment decisions. (Variations of such systems are used in many hospital intensive-care units now, but otherwise are not yet common.) Equally important, touch-screen-based display, inquiry, and recording systems that minimize or eliminate keyboard entry, generally a barrier to information systems use by non-typing professionals, are now coming on the market.

In 1989, Medicare started requiring full documentation of physician-provided care, ideally an automatic output from a well-designed electronic charting system. In fact, already the prevailing wisdom in the DRG era is, "If it's not charted (on paper or electronically), don't bother to bill it. It will be challenged or rejected out of hand by Medicare."

Systems Use by Medical Professionals - As in many industries, there is a reluctance by professionals (doctors) to accept the use of some types of information systems. Though physicians in clinics readily accept the computer-based accounting and billing performed by administrative

staffers, for years doctors resisted attempts to apply expert systems software to the diagnosis or treatment-planning process. Because physicians are used to scribbling on paper charts (and getting away with it, at least until the recent Medicare documentation clampdown), it is unclear what it will take to motivate electronic charting systems. Perhaps if nurses or paraprofessionals can be enlisted to aid physicians in entering patient care information initially on the electronic charting system, there will be less resistance to entering treatment data or care plan changes directly, especially with a touch-screen interface. Nurses, on the other hand, can be expected to derive major efficiency benefits from such a system and should take quickly to any means that makes their jobs easier, especially the tedious task of end-of-shift documentation.

Flexible Access - Properly networked, bedside charting records could be available electronically at any time from virtually any location. At minimum, a physician should be able to stop at one hospital location and view electronic charts for all his or her patients before deciding which to visit or in which order to make the rounds. At best, physicians could monitor charting from their remote, networked clinic (or private) offices (with networking costs possibly paid by the hospital(s) that want the physicians' referrals of patients) to determine progress or problems, and to change care instructions directly into the bedside system, rather than through a phone call from or to the nursing station. Expert systems could, by accepting instructions to monitor changes in a patient's condition, alert the physician and/or nurse automatically (even automatically paging the physician, if necessary) if circumstances require.

Networking - As discussed earlier, networking is, in one sense, the challenge of connecting multiple, independently developed systems. Patient care systems will be most effective when they connect with local sensors and control devices, and can accept connections from departmental systems such as in pharmacy and radiology. Pharmacists, for example, could modify medications sent down for the next mealtime based on electronic access to the patient's vital signs and either standard-practice or physician-set standards for status-based dosages or alternative medications. The physician at the bedside could read the radiologist's typed entry of findings from an X-ray or CAT scan instantaneously, without needing to have the film or analysis physically sent, or without having to go to the radiology department.

Mixing Data, Plots, Images - The next logical step in such networking, of course, is bedside or remote-location access to the radiologist's images (latest and/or historical) as well as character-based or numerical data. The same goes for viewing one or more continuous graphic plots—not just periodic data—from recording devices that monitor patient functions. Mixing waveform, image, and text/data records as standard-form, transportable documents is indeed one of the objectives and promises of the MEDIX standard now under development.

Lifetime Records - Ultimately, such networking and standardization will make possible, for each individual, a longitudinal (or lifetime) electronic medical record. In theory, for each person, there can be an instantly transmittable or accessible electronic record of health statistics and medical treatments for as far back as records are captured, either in real time or entered after the fact. Privacy, legal, ethical, and related questions obviously will have to be addressed before such records become a reality.

d. Shifting Roles for Systems in Finances

With all this attention to patient care systems, however, it is important not to lose sight of ongoing changes in how information systems are used for hospital finances, as outlined in Exhibit II-13.

EXHIBIT II-13

Hospital Financial Information Systems

- Documenting services
- Profitability analysis and marketing planning
- Tracking outcomes; evaluating treatments

Documenting - As discussed earlier, it is no longer an option for hospitals to carefully document medical services provided and the associated patient-/diagnosis-based charges. Increasingly in the 1990s, financial information systems will have to evolve to handle this documentation efficiently.

Analysis and Planning - Both within and outside the Medicare-treatment arena, hospitals are starting to use the information resulting from such documentation of services for other purposes. Grouping patients by diagnosis, residence, age, and/or other factors, for example, can help a hospital administrator judge the relative profitability of services offered and then direct community-based and physician-oriented marketing efforts to win more high-profit patients.

Outcomes - Similarly, such data can be used to track and analyze outcomes (sometimes referred to by the more value-loaded term, quality of care analysis), and provide guidance to professional care givers as to the most effective treatments (where alternatives exist) and relative cost-efficiency, either where alternatives are known or where care-givers can exchange ideas about less-costly alternatives. Though this data is required to some extent by Medicare (and subject to often-distasteful peer review,

and possible rejection of charges), it is not clear to what extent physicians willingly will accept such feedback.

e. EDI for Ordering and Claims

EDI - Electronic data interchange, or direct computer-to-computer communication for routine exchanges of formatted data for specific functions, is already well accepted for ordering hospital supplies. To a lesser extent, EDI is in use now for electronic filing and/or payment of claims. Both subjects will be covered in more detail under "Impacts of New Technologies" in Chapter III.

f. Issue: Needs versus Funds to Invest

One observer summed up the issue of hospitals' information systems needs versus funding by noting that hospitals today have greater needs for new information systems than do most other industries ... hospitals simply lack the funds over the short term. Actually, the problem is somewhat more complex. Since many hospitals' financial information systems are 10 to 15 years old, clearly their need to update information systems is great, yet many other medical technologies call for major capital investments as well, and hospitals for the most part are operating on shoestring profitability ratios, at best. No short-term resolution is apparent.

B
Business Issues

In an overview of the business, social, industry, and technology trends and events discussed throughout this chapter, Exhibits II-14 through II-17 summarize the problems, challenges, and opportunities facing the medical industry as business issues for the 1990s.

EXHIBIT II-14

Social Issues

- Reining in spiraling medical costs
- Caring for more and more elderly
- Funding medical care for the poor and uninsured
- Balancing general oversupply and specific shortages
- Dealing with impacts of hospital closings

EXHIBIT II-15

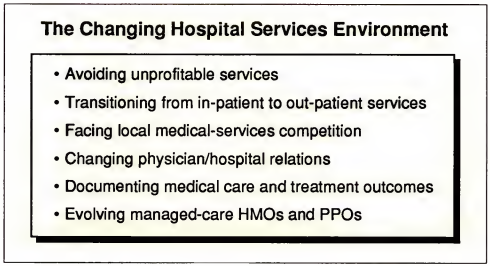


EXHIBIT II-16

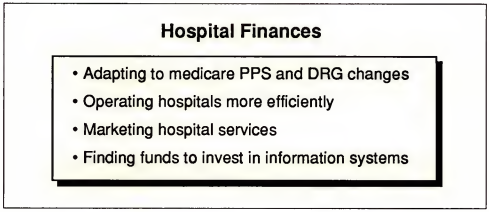
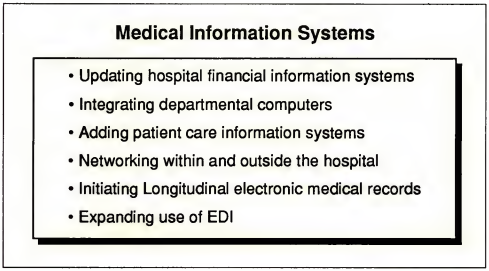


EXHIBIT II-17



Information Systems Environment

Based largely on primary research and interviews with selected medical institutions and insurers, plus secondary research using other industry sources, this chapter first outlines how the medical industry uses information systems, then details the key business and technical issues facing information systems management and the impacts of key new technologies. Finally, a review of organizational control of and budgeting for information systems frames a discussion of key objectives and plans for information systems departments within the medical industry.

A
Applications

Though some applications in the medical industry are common to other industries, many of the systems categories in Exhibit III-1 are unique to the medical industry.

EXHIBIT III-1

Categories of Medical Information Systems

- Billing and financial accounting
- Cost and profitability analysis
- Patient business information
- Clinical records and care delivery
- Services and patients/resources scheduling
- Departmental systems

Billing and financial accounting systems include the specialized hospital billing systems that represented hospitals' first major use of information systems, as well as utility systems such as general-ledger and payroll/personnel.

Cost and profitability analysis systems, in particular, have been implemented since the 1983 Medicare PPS and DRGs were established. These systems represent hospitals' attempts to track costs by patients and by diagnoses/treatments, in order to identify the relative profitability of services offered and populations served.

Patient business information systems relate primarily to the admission, registration, and discharge functions, including records of financial responsibility for billing purposes.

Clinical records and care delivery systems are an emerging category that attempts to create an electronic analogue to the classic paper records of vital signs, care plans, and treatments.

Services and patients/resources scheduling systems cover logistical planning areas such as materials management, patient/facilities scheduling, equipment use, and appointment scheduling.

Departmental systems have developed in decentralized fashion over the years to handle specialized functions for departments such as laboratories, radiology, pharmacy, pathology, and purchasing.

B
IS Issues

1. Business Issues

A wide range of business issues faces information systems managers in the medical industry, as outlined in Exhibit III-2.

EXHIBIT III-2

Costs and Revenues - In the era of Medicare PPS and DRGs, virtually all medical services administrators are under constant pressure to track and contain costs, and they transfer this pressure to information systems managers in the form of requests and requirements for computer functions to assist in the battle with costs. In a recent poll of hospital CEOs sponsored by Hospitals journal, the data-based reports shown in Exhibit III-3 were ranked in order of importance. The business management reports—accounts receivable/collections and P&L—were ranked most important by 9 out of 10 respondents. Following closely were reports tracking physicians' activities, a recognition of the impact that this group has on a hospital's bottom line.

One specific recent trend is finding new applications for systems to serve physicians' and nurses' clinical needs—especially care planning, treatment administration, and record keeping—in ways that boost efficiency and thus cut costs, especially nursing costs that can vary substantially when overtime is required or can be avoided with help from systems.

EXHIBIT III-3

Top 10 Data-Based Reports Ranked by Importance by 370 Hospital CEOs

Report	Percent Indicating Importance
Accounts receivable/collection	90.8
Monthly P & L (gross and net revenue)	88.6
Monitoring physician quality	85.1
Employee productivity	82.7
Physician admission patterns	82.1
Departmental utilization	81.6
Payer performance	78.3
Cost accounting (cost per case, product line, physician)	75.8
Effect of physician practice patterns on resources	75.8
Use of hospital resources in relation to patient outcomes	73.7

On the revenue side, documenting care is a closely related pressure, since Medicare now requires care to be documented in order to be reimbursed, and private payors now review and challenge charges regularly. New systems will play a productive role in meeting this need. Similarly, when electronic billing (based on EDI or Electronic Data Interchange) can reduce rejection rates and speed reimbursement, the increased revenue is important to hospital or clinic business operations.

Services - As medical service providers implement new systems to track costs and document care, a logical extension is to use the same system-captured information to identify—and improve or minimize—unprofitable services. On the other side of the coin, such information can help hospital or clinic administrators zero in on the more profitable services and populations.

A key services issue is an increase in the professional support provided by information systems—in terms of service efficiency and in terms of providing information at the point of care to improve professionals' treatment decisions. One source of such information for care givers—which can also be important to administrators tracking costs and evaluating service profitability—is the multiple departmental computer systems installed in the laboratory, radiology division, pharmacy, and other departments.

Unfortunately, most such systems have been purchased on a decentralized basis by departments and often operate in incompatible minicomputer environments. Emerging communications standards such as HL7 and MEDIX (see the Chapter II section, "The Challenge for Hospitals") promise to make networking of such systems feasible and to potentially bring data, text, waveform records, and even radiology images to the bedside. Beyond speeding bedside record access, such systems integration and networking can be expanded to include doctors' offices and clinics, permitting computer-based access to up-to-date charts and other records without a trip to the hospital. Systems can also provide on-line updating of care plans and treatment instructions for nurses and other professionals working directly with the patient.

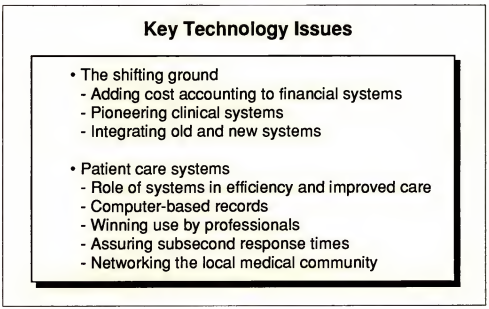
Implementation - In terms of complex information systems implementation, hospitals generally have more experience than clinics and other medical facilities such as nursing homes, which often have found minicomputer- or PC-based packaged software sufficient for their needs, perhaps with initial help from a consultant for system evaluation and setup. Historically, hospitals have more often purchased information systems and services outside than developed them in-house. At first, given high costs for mainframes, this purchase was often of an outside processing service with functions tailored specifically to the medical industry. More recently, lower-cost minicomputers and even networked PCs and workstations increasingly have proven practical for meeting hospitals' information systems needs in-house, with systems integrators and other consultants helping with implementation and more in-house staffing for systems operation.

One of the top implementation business issues today is the trade-off choice for capital funds. Investment in information systems must compete with investment in expensive medical technologies that can help attract leading physicians and physicians' referrals of patients for high-cost treatments. Although these alternate technologies are really an "apples and oranges" question, to hospital executives and boards of directors, such funds probably come from a single capital budget.

2. Technology Issues

In parallel, a number of key technology issues face medical industry systems managers, as outlined in Exhibit III-4.

EXHIBIT III-4



Shifting Ground - Arising, for the most part, from the business issues just reviewed, the worries of hospital information systems managers represent shifting ground technologically. The new world of billing and cost control business requirements calls for entirely new subsystems for cost-accounting—incorporated into or grafted onto existing financial and billing systems that emphasize charge capturing. Integration of such new functions is difficult at best, and in many cases some systems will have to be replaced to bring the functions together effectively. Similarly, the use of information systems to boost professionals' clinical efficiency and effectiveness is just beginning, and requires systems managers to serve users and functions largely untouched in the past. Given financial constraints, however, in the short term few medical institutions will have the luxury of wholesale replacement of systems. Rather, for most hospital professionals, integration of old and new systems will be a real-world technological challenge for the foreseeable future.

Patient Care Systems - One initial efficiency benefit of professional patient care information systems is relatively clear: decreased time to record vital signs and document care. Still to be more fully defined, however, is the role of clinical systems in improving patient care. One likely contribution from technology is fast, flexible access to medical records—preferably at the bedside—to raise the quality of medical decisions. In addition to patient records, appropriately designed systems could permit access to documentation such as information on drug interactions

or records of outcomes of alternative treatments that may be appropriate to changes in a patient's condition.

One key technology issue here, as with most such technology introductions, is the acceptance and use of such systems by professionals, in this case nurses and doctors. As discussed earlier, nurses may be expected to take readily to a technical support that speeds routine responsibilities such as charting, but physicians may take a show-me attitude. Factors likely to be key to physicians' acceptance of new patient care information systems include the access to medical records and other information just discussed, and consistent demonstration that the technology provides fast system response times, so doctors do not feel the system is wasting time or delaying treatment in a critical situation.

Finally, the need of hospitals increasingly to actively market to win patient references by physicians underscores a new technological reality and challenge—to effectively serve the marketing mission, systems networking can no longer consider only the needs within the hospital's walls. Rather, doctors' offices, clinics, and other professional-care settings must be regarded as a local medical community that requires networking with the hospital's systems to provide similar—if not identical—access to the network-based systems available when the physician is at the hospital.

Summary - Based on this analysis of the business and technological issues, Exhibit III-5 summarizes the information-systems business requirements that result and, from the standpoint of hospitals, have the most complex requirements.

EXHIBIT III-5

Hospitals: Business Requirements for Information Systems

- Handle complex billing requirements
  - Government payors
  - Private insurers
  - Electronic billing
- Track HMO/PPO service contracts
- Improve clinical efficiency and effectiveness
- Integrate financial and clinical information and provide useful business management data
- Analyze service profitability
- Support hospital marketing

C
Impact of New Technologies

A wide range of new technologies, listed in Exhibit III-6, is affecting the way the medical industry designs and implements information systems.

EXHIBIT III-6

Outlooks for New Technologies

- Patient-care information systems
- Mainframe-power networked workstations
- Physician information systems
- Touch-screen/light-pen technology
- Expert systems
- Image storage and access
- Voice recognition
- LAN-based intrafacility networking
- Non-LAN medical community networking
- Executive information systems
- RDBMSs
- EDI

As detailed in Chapter II, a broad spectrum of medical service needs is served by an upcoming generation of information systems designed for patient care functions. Benefits range from reduced nursing overtime on the quantitative side, to qualitative improvements in the usability of information charted, to mixed quantitative/qualitative benefits in the form of faster and more complete access to patient records at the time and location required. Given such benefits, a 1989 survey indicated that over seventy-seven percent of hospitals surveyed were evaluating the feasibility of such systems or were actively considering implementing a patient care information system.

Patient Care Information Systems - To meet this need, in the first quarter of 1990 IBM and Spectrum Healthcare Solutions (a shared venture between IBM and the information systems division of medical vendor Baxter Healthcare) introducted Clinical Workstation. Based internally on the IBM PS/2, the system features a small-sized display/entry unit, a washable surface designed to accommodate medical wipedown standards, a fold-up keyboard, a touch-sensitive screen, and an optional bar code reader. Spectrum's nursing-oriented software modules for the workstation are based on IBM's AIX version of UNIX. An option to the standalone configuration is a networked information system with a file server accessible from the nursing station as well as the bedside. In addition to the IBM/Spectrum venture, other vendors have announced or plan to intro-

duce patient care systems with competitive prices ranging from $1,500 to $5,000 per unit.

Mainframe-Like Networked Workstations - Given IBM's and Spectrum's announcement of UNIX-based networking and file-server options for patient care system, it is easy to visualize application of the new mainframe-like workstations to the patient care network. IBM's RISC System/6000 workstations, for example, which operate on IBM's AIX version of UNIX, include workstation functions and, at the high end of the line, offer processing power comparable to mainframes. Even with PS/2-level functionality at the bedside, network-based programming could easily make the capabilities of one or more powerful workstations available to connected PS/2s, thus providing virtual mainframe-power workstation functions through the less-expensive bedside system.

Physician Information Systems - Although many physicians as well as nurses and other care-giving professionals likely will make complete use of the new generation of patient care systems, there should also emerge logical subsets and extensions of such systems that are specific to the special information systems needs of some physicians. For example, some physicians will (at least initially) express a preference to access such systems very simply and only for information retrieval, not entry. Also, some may wish access not only to patient-specific information, but also to electronically accessible reference information otherwise contained in handbooks (as in the case of medications) and journals (for recent research and treatment reports), as well as to hospital-specific analyses and guidelines about cost-efficient and effective treatment options.

Touch-Screen/Light-Pen - Touch-screen and/or light-pen (or mouse-based, for nonclinical settings) interaction options to the keyboard will be important comfort factors for many nontyping, non-computer-literate physicians, as well as useful or necessary in clinical settings without a desktop or where typing or keyboard access would be too slow or awkward.

Expert Systems - An open question is whether expert systems technology will finally break into acceptance by medical professionals through such physician information systems. Throughout the 1980s, expert systems were prototyped for assistance to physicians in knowledge-based functions such as diagnosis or treatment recommendations, but the professionals targeted have generally spurned such systems, presumably because the systems represent a threat to professional stature (or perhaps to the monopoly on medical authority). It is unclear what it will take to win physicians' acceptance of expert systems, although a medication-oriented expert system to provide complete and up-to-date information (perhaps updated monthly on optical disc) on effectiveness, side-effects, and dangerous interactions of medications certainly seems to be a valuable way of handling information that even the most knowledgeable physician should

acknowledge as impractical to keep in one's head and as inefficiently (if not dangerously) time-consuming to look up in hard-copy references.

Images - Another question for the future of patient care information systems is the extent to which they will support bedside access to images such as radiology X-rays or CAT scans, waveform records of vital signs, and scanned images of records or other documents not entered directly into the system. Although radiology technologies that record, store, and display images digitally (generally with a film output option) are becoming more common, it is unclear how soon the networking and bedside image display standards, technology, and costs will make noncentral access to such images practical. The benefit for efficiency and the potential for improved effectiveness (at the bedside and through image access by remote experts for consultative purposes), however, are obvious, and most observers and interviewees for this report believe image storage and access information systems are very important.

Voice Recognition - Similarly, voice recognition technology is already winning important supporters in the medical community. Journals are now documenting (and vendors are actively promoting) a series of medically specialized voice recognition systems that overcome the key limitation of the current state of the art—recognition generally limited to words and voices trained into the system through two to five repetitions of each word for each user's voice—by restricting use to designated individuals using limited-vocabulary applications with high value. For example, skilled laboratory and radiology technicians can use voice recognition with an accepted and limited set of diagnosis terms to record (for automatic typing) analyses of specimens or images without taking their eyes from the microscope or image display. Reports suggest that accuracy, speed, and lack of fatigue are all benefits, not to mention overcoming a lack of keyboard skills and avoiding transcription time and errors from handwritten records. Untrained, speaker- and vocabulary-independent systems, however, remain in the uncertain future, as they have for a decade. Shorter-term, voice-based access may become an added workstation option to supplement touch-screen and light-pen technologies, given speaker-independent technologies that are already reasonably effective at recognizing a very limited set of commands such as numbers, letters, or simple directional commands.

LANs - Medical-industry information systems networking requirements have been discussed extensively in this chapter and in Chapter II. INPUT believes that LAN-based (local-area) networking within the hospital or clinic will become standard in the 1990s. There is even the opportunity, given the relatively limited use of such networking to date, to use new fiber-optic LAN technologies from the start, taking advantage of fiber's great advantages of compactness and capacity, especially for new high-bandwidth applications such as image transfer and downloading to workstations of extensive medical records or reference information.

The hospitals' desire to closely tie physicians to hospitals and the physicians' evolution to a new working style of flexible information access will drive the (non-LAN) networking of the local medical community beyond the walls of a hospital or clinic. Already, telecommunications vendors such as GTE and the regional telephone companies have announced pilots for such community networking.

Executive IS/RDBMs - With such patient care information (including so-called *outcome documentation* that reports the results of specific treatments for particular patients/diagnoses, presumably for aggregation and reporting) recorded and network-accessible, supplemented by financial information from systems already evolving beyond mere charge capture, hospital administrators will have a wealth of data to access. Increasingly important will be the use of executive information systems programmed to sift through and report, regularly or on demand, bottom-line impacts, patterns, trends, and points of variance of concern to administrators, especially for the ongoing cost-control mission. As noted in Exhibit III-3, top hospital executives want this type of data and analyses to better manage resources in an increasingly complex medical services environment.

In many cases, executive IS systems (as well as, perhaps, the patient care systems or certain subsystems themselves) will require relational data base management systems (RDBMSs) for the power to organize and easily access volumes of information.

EDI - A sleeper technology for the medical industry is EDI—electronic data interchange, or direct computer-to-computer communication for routine exchanges of formatted data for specific functions. EDI is already in extensive use by medical supplies vendors to speed ordering, delivery, and billing of routinely ordered supplies. Though only 20% of hospitals surveyed by a leading medical journal used some form of electronic order entry, the potential is much greater. One estimate is that two-thirds of hospital supplies can be ordered electronically today; fax is a practical option for virtually all other supplies.

The largely untapped potential for medical industry use of EDI, however, is for electronic claims submission and payment of reimbursements. One major benefit is faster claims payment, with paper-based hospital claims now reportedly taking an average of over 80 days from billing to payment. One EDI service vendor reports that typical paper-based reimbursement times of seven to eight weeks can be cut to two to three weeks using electronic claims. Not only are EDI-based claims received more quickly, but formatting (and therefore error-checking) requirements are said to result in the rejection of as few as 1% of electronic claims, versus 33% of paper claims on initial submission (and therefore requiring revision costs and resubmission delays). Claims preparation also can be cheaper (over $3 per paper claim, versus under $2 per electronic claim) and as a result of computer assistance, and perhaps future expert system functions will improve this performance.

According to the NEIC (Clearinghouse), approximately 10% of the yearly volume of 4 billion health claims are now filed electronically, although certain classes of claims far exceed this average. In-patient hospital claims by EDI reportedly are increasingly common, especially for Medicare, where clear government data standards and established processing services have generated far higher volumes. Broadly defining medical claims EDI as the nonpaper submission of claims by disc or tape delivery or by direct transmission, the federal Health Care Financing Administration that administers Medicare reports that almost 10 million Medicare Part A (hospital charges) and over 40 million Medicare Part B (primarily physician charges) claims were filed electronically in 1989.

The experience of one large Blue Cross/Blue Shield insurer underscores an obstacle to wider use of EDI for claims: although the insurer submits 95% of Medicare claims electronically (through the processing service that provides all information services), only 27% of insurer's commercial claims use EDI. Several problems block wider commercial use. First, despite so-called standards for claims forms, each private payor may actually require somewhat different claims information. The ANSI standards group is working on this problem (in conjunction with the federal Health Care Financing Administration) and hopes to have new standards by the end of 1991. Second, early in the 1980s, as many as 95% of all commercial claims required only summary claims forms that were very EDI compatible. Today, however, tighter claims review procedures have driven this percentage down to 30% of commercial claims, mainly because payors routinely are requiring supplemental information such as X-rays and physician notes that today cannot be sent electronically via EDI.

In the end, the entrepreneurial spirit may do the most to boost EDI use. One electronic claims vendor, in conjunction with a major insurer in the state of Utah, will pay for the hardware and software required by any Utah hospital, clinic, or physician to submit claims electronically, in exchange for a 3% to 5% service fee on all claims paid. The software provided includes extensive formatting and error-checking, presumably leading to a higher acceptance rate and fewer rejected claims.

INPUT believes that electronic commerce (EDI) is a major new information services marketplace and offers an ongoing subscription service that monitors and analyzes this new capability. Of special interest to readers of this document will be INPUT's 1991 report, *Electronic Commerce in U.S. Health Care*.

D
Organization and Budget

Exhibit III-7 presents general patterns from interviews and from secondary sources about information systems budgets in the medical industry.

EXHIBIT III-7

Organizational Control and Budgets

- Increasing central budget control
- Budget range: 1% to 2.5% of total expenses
- Annual budget increases average 9%

Increasing Control - Especially among hospitals (where decentralized turnkey information systems purchases were the pattern in the past), today there is a trend toward more-centralized control of the systems budget. Centralization is driven by the necessity to manage information more carefully to meet payors' accountability requirements and by strategic thrusts toward systems integration for improved service throughout the hospital.

Budget Range - Medical industry information systems budgets (including hardware, salaries, and all other products and services) range widely, from 1% or less to 2.5% or more of all expenses, based on the segment of the medical industry and the particular situation of each institution. Nursing homes and similar residence institutions, for example, generally have the least complex and costly requirements; IS budgets average just 1%. Group clinics of professionals (and, to a lesser extent, individual physicians' offices) are spending relatively more, both for early computerization (or for upgrades from turnkey minicomputer systems to networked PC/workstation/file server systems) and for integration with one or more local hospital systems; their average IS budget is 2%. Hospitals' needs are the most complex, but even hospital information systems spending varies widely, depending on budget constraints, the state of systems, and significant variables such as transitions from processing service to in-house operations or from mainframe (or minicomputer) processing to networked systems. A 1991 survey showed that, on the average, IS budgets, as a percentage of total hospital budgets, varied little by hospital size (measured by the number of beds) and ranged from 2.5% (for institutions with 251-500 beds) to 2.7% (for those with 250 beds fewer, or more than 500 beds). The results are in Exhibit III-8.

EXHIBIT III-8

Hospital IS Budgets
As a Function of Hospital Size

Size	Average IS Budget ($ Millions)	IS Budget As a Percent of Hospital Budget
250 Beds or fewer	1.3	2.7
251-500 Beds	2.2	2.5
501 Beds or more	6.0	2.7

Average Budget Increases - The average annual information systems budget increase of 9% is somewhat less than the 12.6% growth rate for the industry itself, due to strong competing pressures from other budget categories. Prices for medical supplies and equipment continue to rise significantly faster than the economy's overall inflation rate, yet are considered essential to a medical institution's operations, and frequently take precedence at budgeting time. Also, shortages of nurses and other professionals continue to drive up salaries, further squeezing information systems budgets.

Moreover, this average growth rate for all of the medical industry masks several important patterns. For example, Medicare-based cost constraints for hospitals keep that segment's average lower than the overall average. Fast-growing nursing home chains, in contrast, report much higher increases in spending (but from lower percentage-of-budget totals) to meet new systems needs. Finally, in each segment (and especially in hospitals, with generally older installed systems) there are many instances of big one-year increases or decreases based on current, planned, or recent major system upgrades.

Exhibit III-9 summarizes how hospitals, on average, have allocated their information systems budgets. Variations among individual institutions, of course, are substantial—for example, between individual hospitals and chains, or between hospitals that still use older processing services versus those that operate systems in-house.

EXHIBIT III-9

Hospital Information Systems Budgets

- 40% Salaries
- 26% Hardware
- 21% Software (Purchased)
  - 18% Applications
  - 3% Systems
- 6% Communications
- 4% External Information Services
  - 3% Processing Services
  - 1% Consulting Services
- 3% Other

E
IS Department Objectives

Based on background and findings presented throughout this report, Exhibit III-10 summarizes (by category) the objectives and plans of the medical industry's information systems managers. This summary is offered for general guidance to vendors planning products and services for this industry.

EXHIBIT III-10

Information Systems Objectives and Plans

- Billing and claims
  - Adapt to billing/service contract complexities
  - Incorporate cost accounting in financial systems
  - Expand EDI use, especially for claims
- Systems evolution
  - Integrate financial and clinical information
  - Provide new management/executive reporting and analysis capabilities
  - Fulfill new care documentation requirements
  - Introduce and evolve patient care systems
  - Improve scheduling support
  - Offer flexible access to electronic medical records
  - Provide advanced image processing
- Architecture and delivery modes
  - Decrease use of turnkey minicomputer systems
  - Move from processing services to in-house systems
  - Emphasize networked PCs over mainframes
  - Continue purchasing software over building systems
- Networking
  - Network and integrate departmental systems
  - Network multiple institutions and locations

Information Services Market

This chapter discusses the markets for information services in the medical sector. Information in this chapter draws on the statistics presented in Chapter I and the trends and issues discussed in Chapters II and III to outline the anticipated future directions of the markets for information services.

One of the key items is the trade-off between prepackaged solutions—such as processing services, applications software, and turnkey systems—and custom solutions that involve consulting or internal systems development and systems integration support.

User expenditure forecasts are provided for the medical sector, both by industry segment and by delivery mode. Assumptions driving the forecasts are presented. Note that these forecasts do not include functional general-purpose information services, such as for human resources or generic planning and analysis. The markets for these types of information services are presented in other cross-industry MAP reports rather than the vertical or industry-specific reports.

Section A, Overview, discusses the overall size and growth rate of the medical sector's expenditures for information services.

Section B, Delivery Mode Analysis, breaks the overall data into INPUT's seven standard delivery modes.

Section C, Industry Segment Analysis, provides a breakout of this same forecast in terms of the major market segments within the medical sector. These segments are:

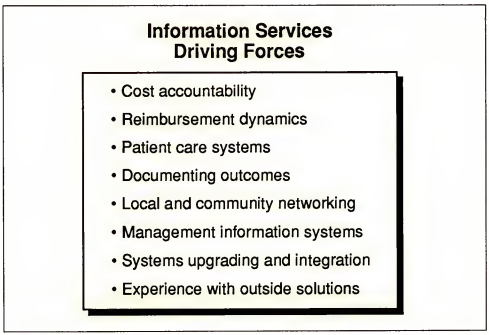
- Hospitals
- Physicians' and other professionals' practices and clinics
- Other service environments

A
Overview

1. Information Services—Driving Forces

As shown in Exhibit IV-1, a number of business, social, and technical driving forces are impacting the medical sector's use of information services in the 1990s.

EXHIBIT IV-1



Cost Accountability - With the requirement of the Medicare PPS to account for and bill services according to diagnosis, hospitals in particular are under continuing pressure to refine their ability to track costs. Medical information systems today and tomorrow must provide far more sophisticated financial capabilities than yesterday's charge-capture and billing systems.

Reimbursement - One side effect of Medicare's (and private payors') stricter charge-accounting requirements is ongoing cash-flow problems resulting from reimbursement delays and problems. Not only is reimbursement often delayed by payors' reviews of charges for care, but an increasing portion of charges are challenged or rejected. One information-services-related approach to solving this problem is to increasingly rely on EDI-based electronic billing. Electronic billing not only transfers information faster, it also can be structured to include computer-based error checking (perhaps incorporating expert systems functionality) that permits the charging institution to find and correct errors before transmission and thus lower challenge/rejection ratios. Direct electronic payment on the return route, of course, can also help cash flow.

Patient Care Systems - Beyond finances, a new generation of patient care systems is being developed and implemented to assist care planning, charting, and treatment record keeping—in many cases right at the patient's bedside. These new information systems promise greater efficiency for the professionals serving the patient, and improved effectiveness of treatment.

Documentation of Outcomes - Closely related to patient care systems, computer-based documentation of treatment outcomes is easier with such systems and increasingly required for cost-accounting and reimbursement functions.

Networking - Financial and patient care systems will depend on new systems-networking capabilities. First and foremost, networking must be established within hospital and clinic settings to maximize information accessibility regardless of the user's location. One especially interesting technological option is to use state-of-the-art new capabilities for fiber-optic local-area networking, so as to accommodate high-bandwidth communications applications such as image processing and high-volume records transfer that are emerging as critical to future medical information systems. As important, perhaps, in the mid-term (if not the short term) is to permit flexible networking outside the physical borders of an institution, especially to physicians' and therapists' offices. Such professionals could benefit from flexible access to medical records and patient care systems independent of physical location at the moment, and hospitals likely would enjoy higher patient referral rates from well-networked physicians.

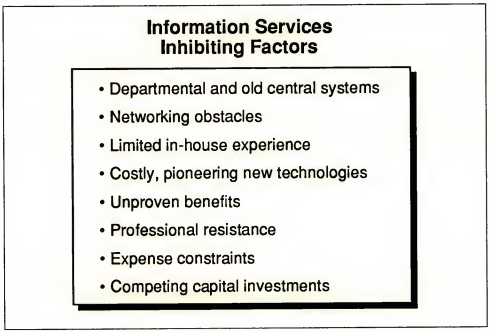
MIS - Once the types of systems discussed here are further implemented and networked, medical management—especially hospital administrators—increasingly can benefit from a new generation of management information systems. These systems can be designed to capture, analyze, and flexibly present to management the summary- and trend-level information needed to chart changing courses in matters such as response to Medicare DRG charge schedule revisions or plans for community-based marketing and outreach to profitable patient groups.

Upgrading, Implementation, Outside Solutions - Almost all the driving forces outlined here will require significant upgrading and integration of existing medical information systems. Information services vendors positioned to help with such systems evolution should benefit in particular from a medical-sector environment that is generally experienced with and receptive to outside solutions, because of earlier reliance on outside processing services and more-recent use of outside application software packages and consulting services.

2. Information Services—Inhibiting Factors

In contrast, a number of forces are simultaneously inhibiting insurers' use of information services, as shown in Exhibit IV-2.

EXHIBIT IV-2



Departmental Systems - There is also a negative side to the requirement for major information systems upgrades and integration. It will not be easy to bring separate departmental systems into cooperative, networked integration or to upgrade old central—usually financially based—mainframe systems to meet the new financial and clinical needs outlined earlier. Many hospitals' installed departmental systems, for example, are based on proprietary minicomputer architectures and were bought for specific departmental requirements. Even with emerging systems networking standards like HL7 and MEDIX, it will be challenging to link such systems. Replacement with up-to-date, standard-architecture departmental systems clearly raises many financial problems.

Old Central Systems - On the mainframe side, many central software systems are as much as 10 or 15 years old. As a result, significant system upgrades based on old architectures and languages may be impractical. Again, replacement raises financial problems, as well as invites major reexamination of system requirements and functions that could prove costly and disruptive to ongoing operations and busy managers.

Networking - Beyond the challenges of local networking (including the logistical challenge of cabling hospitals without overly disrupting patient care), only the earliest pioneering steps have been taken so far in flexible networking for the larger medical community beyond a hospital's walls.

Limited In-House Experience - Similarly, there is a negative aspect to the medical industry's extensive use of outside solutions. In many cases there is only limited in-house experience with information systems. For example, vendors and consultants have modified software applications to meet specific needs and have handled system implementation, leaving daily operations to the in-house staff. With limited in-house experience, hospital management may be reluctant to make the financial and organizational commitments required to meet necessary integration and upgrading needs.

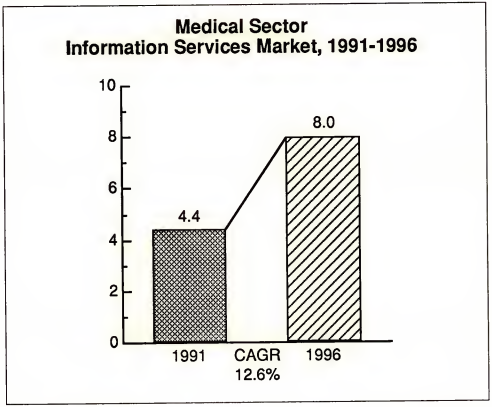
Unproven Benefits - Management also may look askance at investing in innovative and pioneering new technologies such as image processing and bedside patient care systems—technologies with very limited track records to date. Although the projected benefits are attractive and promising, new technologies may fall victim to the "let's see what happens when others try that" obstacle. This obstacle may be especially tough when the benefits offered are softer or qualitative—and thus not subject to traditional cost-benefit justifications—as well as generally unproven, to date.

Professional Resistance - Although not strictly managers (in most cases) of hospitals and other medical institutions, physicians have demonstrated that their professional resistance to a new practice or technology can limit (if not block) its acceptance or implementation. The testing and implementation of expert systems to assist in medical diagnosis, for example, has been severely constrained by most physicians' perception of the technology as a threat to their professional stature or authority. Patient care systems may meet the same type of resistance if physicians do not see at least efficiency benefits. These benefits should, however, quickly prove obvious to nurses in routine functions such as charting and recording medical treatments.

Expense/Capital Investment - In medical service environments where Medicare payments are a major revenue source, there is simply little extra money in the expense or capital budgets for new information systems. This limitation is especially true to the extent that, medically necessary costs (such as supplies and nursing salaries) continue to grow faster than the tightening reimbursement stream. On the capital side, in particular, competition for investment dollars from expensive non-information-system medical equipment may be hard for administrators to resist, especially in cases where lucrative physician referrals and costly treatments may result from investment in exotica such as the latest heart treatment technology.

Based on these driving and inhibiting forces, INPUT projects the medical sector information services market to grow as shown in Exhibit IV-3.

EXHIBIT IV-3

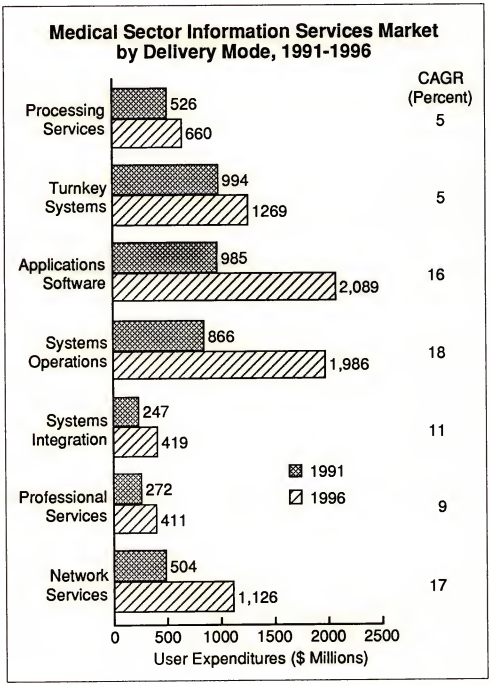


During 1991-1993, overall growth in medical sector information services will be restrained, mainly because of the combination of continued economic slowdown and (more importantly) the impact of short-term budget balancing on Medicare allocations and thus DRG-based reimbursements. Growth will increase somewhat through 1995 and more into 1996, in part as the new technologies on the horizon for medical information services begin to demonstrate their value to a relatively skeptical and cost-conscious audience. In each case, as well, delivery-mode-specific factors also play a part, as detailed in the next section.

B
Delivery Mode Analysis

As shown in Exhibit IV-4, there are significant projected differences in five-year growth rates for the information services delivery modes in the medical sector.

EXHIBIT IV-4



For reasons detailed in the individual delivery mode discussions that follow, three modes—applications software, systems operations, and network services—are expected to show five-year growth rates in excess of the industry-wide information systems CAGR of 12%.

1. Processing Services

For many experienced users in the medical industry, the use of processing services on a remote, time-sharing basis—for example, to capture and bill hospital charges—was the introduction to medical information systems. In recent years, however, the medical sector has joined the general exodus from this method of meeting information services needs, in favor of bringing computing power into the medical institution itself, in the form of more-cost-effective mainframe central processing units or as distributed, minicomputer-based departmental systems.

During 1991 to 1996, use of processing services in the medical sector will continue with a modest growth of 5% (CAGR), responding to the mounting pressure from increasingly powerful networks of PCs, workstations, and file servers.

2. Turnkey Systems

Turnkey systems provide an easy-to-implement solution by bundling the required hardware and software into a single package, but at the price of generally providing the least flexibility for the user—e.g., turnkey systems place the user most strongly at the mercy of the vendor. Historically, turnkey systems generally have been based on minicomputer hardware platforms and have been most frequently used by smaller firms with simpler operational needs, such as medical institutions that cannot afford the overhead of their own mainframe-based-data processing capabilities and do not need the power of mainframe-based processing services. Most turnkey systems sold to the medical industry have been for specialized departmental applications such as laboratory or radiology.

Today the turnkey market's growth rate has diminished to a conservative 5%, for two reasons. First, IBM-standard PC platforms increasingly offer minicomputer-level, networked functionality in a system based on a standard operating system, as opposed to minicomputer vendors' incompatible proprietary operating systems. Therefore, more and more medical industry application software vendors today write code for the generic PC platform at the level of processing power the software requires, leaving it to the buyer to purchase compatible hardware from one or more of the PC hardware vendors.

Second, even in the minicomputer market where turnkey systems vendors grew rapidly in the past, IBM—as a strong medical industry hardware vendor—in recent years has established a new hardware/software sales model. Typically, IBM now sponsors software vendors as business partners with solutions for IBM hardware, but increasingly IBM also sells (and services) the required hardware directly to the purchaser of the business partner's software, rather than selling the hardware at wholesale for the partner to resell at a profit. A small commission-like payment is

made to the participating business partner. As a new generation of powerful distributed workstations enters the market, the same nonturnkey approach will likely take hold as well, especially as UNIX-based open-systems workstation architectures provide a stable platform for software developers.

As with processing services, INPUT forecasts the continuation of a modest 5% annual growth for turnkey systems during the period 1991-1996, with expenditures going from almost $1 billion in 1991 to $1.3 billion in 1996.

3. Applications Software Products

Prior to 1990, medical application software products vendors enjoyed the benefits of an industry that was:

- In transition from reliance on processing services
- Caught in a period of rapid change requiring high-value new information systems capabilities
- Lacking strong in-house software development capabilities
- Not particularly interested in strengthening whatever capabilities there were

As a result, the previous five years have seen a steady 16% annual growth in the market for medical application software. This trend is expected to continue for the next five years as well, providing vendors with continuing growth from a solid revenue base, and taking user expenditures from almost $1 billion in 1991 to $2 billion in 1996. One important marketing tool for medical industry software vendors during this period will be the ability to offer customers rapid applications updates (under maintenance contracts) when significant industry changes occur, such as publication by Medicare of new DRG reimbursement schedules.

4. Systems Operations

The medical industry has been one of the more significant users of systems operations. Other major users are banking and finance, insurance, the federal government, and state and local government. Steady expansion in the use of systems operations is expected during the period as systems stabilize somewhat and user management presses for further economy in information systems operations.

In the past few years, hospital executives have steadily become more receptive to the use of contract management for resources that support the medical function, but are not necessarily part of it in the sense that the

function of a hospital is to provide medical services, not data processing services. A 1991 study showed that hospitals' use of contract management services is approaching 50% (of the hospital population), and that more than 61% will retain their current vendors when contracts end. Considering the three major categories of contract services (hotel, clinical, and business services), business services, of which systems operations is a major part, is the smallest (in terms of today's market) and the fastest growing. The transitional nature of the medical services market will cause perturbations in the implementation of any major data processing function, but the mandated need for comprehensive and efficient computer operations will continue to fuel the growth of systems operations in the medical sector at a rate in excess of most other industries. INPUT forecasts an 18% CAGR for this delivery mode, with revenues growing from $870 million in 1991 to almost $2 billion in 1996.

5. Systems Integration

Closely related to professional services is the market for systems integration. The key distinction between professional services consulting and systems integration is dependent upon who bears the ultimate responsibility for planning and managing a systems installation project. Consulting firms typically provide analytical or technical support as professional services to their clients, seldom bearing responsibility for the result of an implementation project. Systems integrators, in contrast, act as the general contractor on a systems project, assuming project management responsibility and generally bearing financial risk for the success of the project.

The complexity of today's information services technology and the accelerating pace of technical change make it increasingly difficult for a user to manage large new-systems projects, especially those requiring a combination of in-house and outside resources. As a result, firms are continuing to transfer the risk and responsibility to systems integration firms. Although relatively late in joining this trend, the medical industry as well is continuing to move in this direction.

Significant expansion of the systems integration market is not projected until late in the 1991-1996 period, when the implications of the need to fully integrate financial and patient care systems become clear to the medical industry. Until that time, expenditures will be modest, at $247 million in 1991. The compound annual growth rate (CAGR) will be 11%—to $419 million in 1996.

6. Professional Services

Though high-level information systems consulting to the medical industry has a small and steady place today, the delivery mode has never benefited from a broad pattern of sizable contracts to develop large custom systems for in-house implementation. Rather, the industry has tended to rely more on packaged software and, where necessary, contracted modifications of such software to the vendor, a third-party consultant, or some combination of the two. Since the 1983 changes in the Medicare reimbursement system, professional services firms serving the medical industry have, however, benefited from institutions' needs to modify in-house systems relatively quickly, whether the systems were purchased outside or developed in-house.

Only a modest 9% growth rate for professional services is projected during 1991-1996, mainly as more-complex patient care application packages come to market and require modification to fit particular institutional environments.

7. Network Services

Other than the processing of electronic claims for Medicare (much of which is included in 1990 figures under processing services because such processing is an offshoot of the continuing use of generalized processing services), interconnections between multihospital systems such as Kaiser and Humana, and some limited local access from the extended medical community, there is little other use of network services by the medical sector. Where long-distance networking occurs, it is generally on dial-up or leased lines, and there is little use of remote data base access.

INPUT's forecast shows a strong acceleration of network services growth during the 1991-1996 period, based almost entirely on the coming of age of EDI-based electronic claims. First, many firms now using processing services that include Medicare electronic claims capabilities will tran fer systems in-house, but will still want to maintain the benefits of elec ronic claims and reimbursements by signing up for such network serv ces with one or more vendors.

Second, institutions increasingly will learn that the timeliness and efficiency benefits they already enjoy (even when transferring claims information by magnetic tape or disk) can be significantly augmented by direct EDI computer-to-computer connections.

Third, private payors during this period will come together on EDI-based electronic claims standards, and thus will make large-scale transition to EDI for claims more practical and desirable. For dealing with Medicare and private payors, many institutions will choose to communicate electronically (at least initially) through third-party translation services, which

will still be necessary in this period of incomplete standards agreement and implementation.

Based upon this analysis, INPUT forecasts that network services will continue its 17% CAGR—from $504 million in expenditures in 1991, to more than double, $1.1 billion, in 1996.

C
Industry Segment Analysis

Exhibit IV-5 shows INPUT's segment-by-segment forecast for the medical sector. Exhibit IV-6 shows how the growth rate of these expenditures changes yearly.

EXHIBIT IV-5

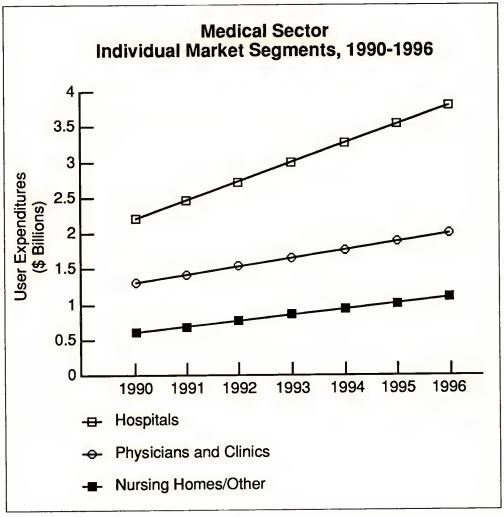
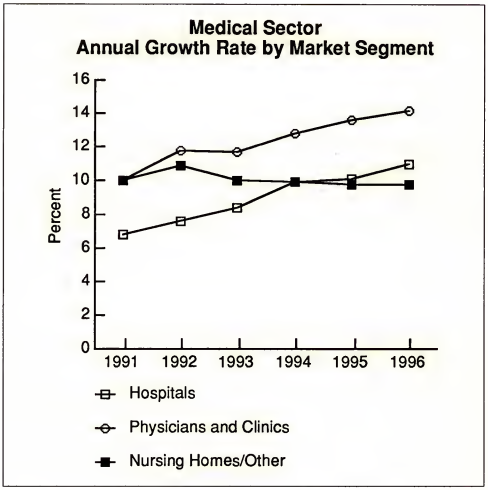


EXHIBIT IV-6



These projections show hospitals emerging from the most severe cost constraints in the middle of the period and starting to add more new information service capabilities. The growth rate in information services for physicians' and other professionals' practices will grow steadily. INPUT anticipates no disruption of a steady 10-11% growth for nursing homes and the other segments of the industry.

Competitive Environment

This section discusses the competitive environment for information services within the medical industry. Leading vendors are identified and representative vendors are profiled.

A
Vendor Characteristics and Competitive Trends

Control of the market for information services in the medical industry is moderately concentrated, with the top five vendors accounting for about one-third of all revenues. Specifically in processing services, the top two vendors alone control one-third of the business. In turnkey systems, the top five have about half of the business.

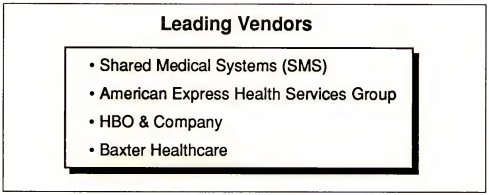
Most large and small information services vendors selling into the medical industry are exclusively or very highly concentrated in this industry. Often they draw key personnel from the medical industry for their operational expertise, and the knowledge they maintain and continuously extend about the specialized world of medical operations is regarded as an important competitive asset.

With a few vendors dominating the business and thus serving the industry's common needs, smaller vendors selling to the medical industry tend to offer more-specialized niche products, such as specialized hospital department systems.

B
Leading Vendors

Given the top-heavy nature of the medical industry information services vendor environment, only the four leading vendors in Exhibit V-1 have estimated market shares of 5% or more.

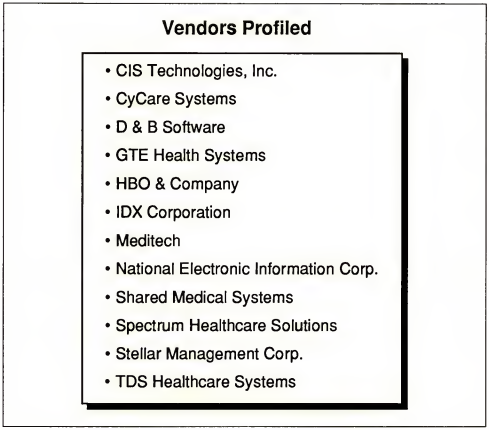
EXHIBIT V-1



C
Vendor Profiles

A representative group of medical industry information services vendors, as listed in Exhibit V-2, is briefly profiled in the following section.

EXHIBIT V-2



1. CIS Technologies, Inc.

CIS submits electronic claims to 85 insurance carriers—as well as Medicare, Medicaid, and NEIC. Through The Electronic Highway™, an on-line system, CIS can process all claims for submission to all carriers. CIS—headquartered in Tulsa, Oklahoma—serves more than 300 hospitals in 19 states. The company's 1990 revenues were $10.2 million. CIS is a public company and was previously half-owned by Swiss Reinsurance Co. (Zurich, Switzerland). CIS charges hospitals $10 per bed per month, which averages to between 75 cents and $1 per claim processed.

2. CyCare Systems

CyCare reports revenues of $86 million in 1989, split relatively evenly among processing services, network services, and software products. CyCare's main product—available as software (operating on the mainframe or at the PC level) or on a processing service basis—serves the needs of physicians' groups and clinics for accounts receivable, patient registration, appointment scheduling, and electronic claims submission (or EDI). CyCare's EDI-oriented Claims Clearinghouse is the other major service, providing translation and retransmission services to speed electronic claims filing.

In terms of involvement with key new technologies now impacting information services for the medical industry, CyCare has a major commitment to leadership in EDI for medical claims. Also, the company is now starting to field-test and install RDBMS-based integrated information systems that connect physicians' group practices and hospitals.

Competitively, CyCare believes that today's market requires much more than strong product capabilities. Beyond features, CyCare emphasizes the initial and continuing support and service it provides with its products. Also, CyCare is committed to further use of advanced technologies, as it has done in its EDI service.

3. D&B Software

The medical industry business of newly formed D&B Software is primarily based on the business built up over the years by the Management Science America component. D&B's $36 million in medical industry business is primarily concentrated in mainframe software products and their maintenance over time. In addition to general financial, human-resources, and materials management software products that are specifically tailored to the needs of hospitals, D&B Software offers decision support software in alliance with Comshare's Executive Information System. This software is specific to hospital concerns about case mix, product mix, and profitability. About one-quarter of D&B Software's medical industry revenue is in professional services, primarily in strategic

planning, implementation, and software audits related to D&B Software products. The remaining 75% is in systems integration, tying D&B systems to patient care systems from vendors such as TDS Healthcare Systems, Shared Medical Systems, and HBO & Company.

The key new-technology area that D&B Software is working in is image processing. In conjunction with IBM's ImagePlus systems, D&B will offer imaging capabilities in its next generation of hospital software for 1992-1993.

Competitively, D&B Software tries to steer clear of feature-to-feature comparisons. Rather, it emphasizes its 20-year commitment to the medical industry and its strong team of dedicated health care sales reps and systems consultants. Emphasizing its base in the evolving IBM mainframe architecture, D&B notes that full compliance with IBM SAA will be a keystone of its next generation of software and that it supports DB2 as a strategic direction if customers so require.

4. GTE Health Systems

GTE has acquired its way into the medical industry information services business, assembling revenues totaling $30 million in 1989. The overwhelming proportion of this revenue today is mainframe software applications for hospitals and HMOs to support both financial and clinical needs—including costing, charging, and patient information. As a communications company, however, GTE clearly has strong plans for its EDI-based electronic claims service: a clearinghouse between the hospital and multiple payors that operates both in the claims submission and reimbursement directions. With a continuing lack of medical-industry EDI standards, GTE reports that the clearinghouse function is critical to making such electronic transactions possible today.

GTE Health Systems intends to be a major player in four separate new technologies that will be important to medical information services. First, GTE will use its experience as a local telephone company to pioneer the networking of local communities of interest for medical information and services—especially hospitals, physicians, and laboratories. Second, it is researching optical-disc and image-processing technologies. Third, it wants to use telephone industry experience to take a lead in expanded voice recognition applications for entry of information, as is being done now in laboratory and radiology departments. Finally, it is now prototyping medically oriented expert systems.

GTE Health Systems emphasizes three key factors in its competitive positioning. Its software is solidly IBM-based, and now covers midrange systems as well. The GTE parent company is a worldwide communications and networking company, capabilities it judges will become more important to the medical industry. Finally, the companies it has acquired

in medical information services collectively represent a broad and deep base of experience, and GTE reports that it is integrating acquisitions effectively into a single business unit, and not losing staff and the key medical-industry expertise it needs to compete effectively.

5. HBO & Company

HBO (Atlanta, Georgia) had $200 million in revenues in 1990. Approximately 53% of HBO's revenue derives from minicomputer-based turnkey system and maintenance services; 26% from professional services, systems operations, and customer services; 15% from software product licenses; and 6% from decision support processing services. In late 1990, HBO introduced its first network application, Questnet. HBO's plans for Questnet are to build a nationwide network to link HBO customers with HBO support, insurance companies, credit bureaus, Medicare, and data base services providing clinical, financial, and market information. Questnet is offered over the IBM Information Network.

6. IDX Corporation

Operating exclusively in the turnkey hardware (IBM and DEC) and software systems business, IDX posted revenues of about $75 million in 1989, split evenly between hardware and software. It sells generally the same set of application software capabilities—patient registration, accounting, and accounts receivable—into the medical segments of clinics and medical schools, managed care institutions, and hospitals.

In terms of new technologies, IDX is applying the increasingly cost-effective levels of computing power available in today's hardware to extend the ease of use of its systems. In particular, it is targeting the professional user whose system access is occasional, not regular, and who must be guided and encouraged to use the system by new forms of prompts, icons, and interface technologies such as mice and touch screens. Regarding system modification, IDX is working to ease the burden of adapting the system to continuing changes in government regulations and reimbursement structures by providing more-advanced system modification tools for in-house staffers with limited programming skills.

Competitively, IDX positions itself on its solid 21-year track record in medical information services, its strong financial position, and the acknowledged medical systems expertise of many of its staff.

7. Meditech

In 1989, Meditech sold $41 million worth of application software into the hospital segment—for financial, patient care, clinical, and administrative functions. The software operates on DEC and Data General minicomput-

ers and is available as separate modules or in integrated packages that include some or all functions.

In new technologies, Meditech is now prototyping the second generation of a patient care portable terminal that attaches to the belt. This terminal provides important input and output capabilities directly to the care provider, rather than requiring more-expensive bedside systems that also involve heavy costs for networking. Meditech is also exploring technologies for transfer of images such as X-rays.

Meditech's key competitive strengths are heavily technical. Its product's modular design allows hospitals to start with just one piece or any combination, reserving full flexibility to add other modules at any time; most customers start with several modules. In addition to its technological strengths, Meditech cites its presence in the business since 1969.

8. National Electronic Information Corp.

National Electronic Information Corporation (NEIC), based in Secaucus, New Jersey, is the largest claims clearinghouse in the nation. It processes all the electronic claims for about 30 large commercial insurers that underwrite its costs. Hospitals, physicians' offices, and other regional claims-processing clearinghouses send their claims to NEIC for processing. (A clearinghouse that processes claims directed to any of the 30 carriers in the NEIC consortium must submit those claims to NEIC). NEIC processed claims for approximately 20% of the nation's community hospitals last year. NEIC offers hospitals personal computer software to edit claims for its payers. Initial set-up costs are about $10,000, with a $3,000 annual maintenance fee. About 200 hospitals are using the company's software.

9. Shared Medical Systems (SMS)

SMS (the company appears to prefer that name these days) is the acknowledged leading vendor in medical information services, with $350 million in 1989 U.S. revenues, 90% of which derived from hospitals and the remainder from physicians' groups and clinics. Although downplaying the Shared portion of the company name today, SMS earned about half of this revenue from the hospital processing services business that gave the company its name and leadership position, with the other half evenly split between software products and turnkey systems. SMS systems serve clinical and financial functions, in some cases operating in a mixed mode where clinical information is entered and used on local, distributed computer systems for direct needs and then uploaded to SMS processing centers for aggregation—especially to meet financial needs for accountability.

SMS is positioning itself to lead the industry in three key technologies for the 1990s. First, it is using the latest LAN communication technologies to integrate existing departmental computer systems and newly installed systems. Second, SMS sees image-processing using optical-disc technology as very important, especially in changing the use of information systems by departments such as radiology. Third, SMS is committed to RDBMS technology as the key to increasing the accessibility of information systems.

As the leading vendor, SMS places heavy competitive emphasis on company size, growth, and stability during 21 years in the business. In particular, SMS notes, many customers of McDonnell Douglas Health Systems (sold to American Express) and Baxter Healthcare and IBM (which merged operations into Spectrum Healthcare) felt abandoned or otherwise burned by vendors that users falsely believed were committed to the business. SMS reports that large investments during the 1980s began paying off in 1989 and 1990 in the form of attractive new systems capabilities that customers value. Finally, SMS is strengthening itself competitively by adding emphasis to systems for physicians and clinics, and by selling more effectively to hospitals by arguing that the capability of a single, integrated SMS system to serve both environments will help attract physicians and win referrals of patients.

10. Spectrum Healthcare Solutions

The integration of Baxter Healthcare and IBM medical industry operations into Spectrum Healthcare Solutions resulted in a 1989 revenue stream estimated at $75 to $100 million. Virtually all of this revenue derived from software products and related services, and just 5% to 10% from consulting professional services. The software sold today serves the hospital and individual-physician markets, providing both clinical and financial functions. Spectrum intends to enter the managed care market as well, and has announced and demonstrated—for first quarter 1991 delivery—integrated hardware and software for bedside patient care information systems.

The key new technology that Spectrum is targeting—beyond the prior offerings of either parent company—is the bedside patient care technology. The system demonstrated is based on IBM PS/2 hardware (meeting industry wipedown and sterilization requirements) and new software modules developed jointly; it will fully support LAN connection and server technologies. Other new technologies under development are confidential.

Spectrum's key competitive strength is its combination of Baxter's and IBM's strength and market presence in medical information services. Each parent company can cite its historical presence in the industry since the 1970s. Also, Spectrum positions itself as working to help strengthen the medical industry itself, through more-effective use of medical informa-

tion systems. Spectrum points out that hospitals still fail to see the power of the contribution that information systems can make to effective operations, with a new recognition of the potential value of clinical and patient care systems up against a legacy of limited information systems budgets. The type of vendor stability Spectrum/IBM/Baxter offers, it believes, will help hospital management move toward the multiyear commitments required to realize this power.

11. Stellar Management Corporation

Based in San Francisco, California, this company provides PC software and processing services to hospitals and physician's offices. Its StellarNet (running on the IBM Information Network) supplies health care providers with automated doctor's report preparation and claims submission processing. Completed claims are transmitted from the provider to the payer via StellarNet at an unattended transmission time established in the PC. Providers receive an electronic acknowledgement for each claim. A complete transmission report is prepared the next morning. For insurance carriers that do not receive processed claims electronically, Stellar will print the claims on paper and send them by overnight courier. StellarNet is not a billing service or claims payor. It merely processes claims and passes them on to payors.

12. TDS Healthcare Systems

TDS derived 60% of its $75 million in 1989 revenue from software products and 40% from professional services; a new offering of processing services is not yet significantly contributing to revenue. Its patient care and accounting system software (now offered as a new on-line processing service as well) handles clinical and financial functions, operating in the IBM environment on either mainframe or minicomputer platforms. In professional services, TDS provides computer-based training, consulting, installation, and system integration/interface services.

In somewhat indirect fashion, TDS is participating in two key new technologies. To assist the development and implementation of important new communications standards, it is working on committees for HL7 and MEDIX. In image processing, TDS is not selling a system directly, but rather is working with optical-disc vendors on systems that can save TDS records, and is consulting with hospitals in joint efforts to establish interfaces with such systems.

In its competitive positioning, TDS first cites the breadth and value of the functionality that its system offers to nurses and physicians, who use it directly. TDS notes that its system has always incorporated light-pen access technology, and that this technology has been a key to professional-level acceptance of the system. TDS is now testing touch screens and other user interfaces to determine the next step in facilitating use of its system and thus increasing professional-level market penetration.

Conclusions and Recommendations

A

Industry and IS Market Conclusions

Although significant disruption to the medical industry's needs for information services is possible in the 1995-2000 timeframe—in the form of some kind of nationalized health care financing—the industry should otherwise continue on a reasonably steady growth path in terms of requirements for information services. In general, cost containment and service accountability pressures will serve to heighten needs for new financially oriented systems and services, although funding will remain constrained. Patient care enhancements, image processing, and networking/system integration as drivers of information services use appear to be strong trends in the mid- to long-term. Short-range uncertainties—such as demonstrated proof of new concepts, selection or resolution of competing technologies (for example, the future role of UNIX for networking/integration), and securing capital investment funds—still need to be resolved.

B

User Issues and Recommendations

Key technological issues that medical industry information services users face are summarized, from discussions throughout this report, in Exhibit VI-1.

Key business issues faced by medical industry information services users are summarized in Exhibit VI-2.

Recommendations for users that derive from the issues outlined in this section are summarized in Exhibit VI-3.

EXHIBIT VI-1

Key Technological Issues for Vendors

- Integrating multiple old and various new systems
- Connecting financial and clinical systems
- Pioneering new patient care systems
- Encouraging and securing systems used by medical professionals
- Adapting systems to changing reimbursement and documentation requirements
- Achieving mainframe power with networked workstations and PCs
- Providing intra- and interinstitution networking
- Implementing electronic transfer of images and medical records
- Using EDI for electronic billing and other information interchange functions
- Using RDBMSs for executive information systems

EXHIBIT VI-2

Key Business Issues

- Costs and revenues
  - Tracking and containing costs
  - Cutting clinical costs
  - Documenting care
  - Billing electronically
  - Identifying unprofitable services
  - Marketing services
- Services
  - Boosting professional support
  - Integrating departmental systems
  - Speeding access to records
  - Networking doctors and hospitals
- Implementation
  - Building inside versus buying outside
  - Investing in alternate technologies

EXHIBIT VI-3

User Recommendations

- Place high emphasis on flexibility of information systems to adapt to changing reimbursement and documentation realities
- Identify and invest in high-value cost-accounting capabilities that support profitability analysis, including RDBMSs
- Educate professionals in cost-consciousness and win their support for use of information systems
- Balance investments in financial or administrative systems versus clinical, patient care, image processing, and medical records information systems
- Determine quickly how well old systems can be integrated, versus needs to replace those systems to achieve connectivity
- Reconsider the use of processing services, mainframes, and minicomputers in light of cost-effectiveness trends toward networked workstations and PCs
- Evaluate the benefits of a systems operations approach to hospital information systems management. Consider tradeoffs between the hospital's mainline expertise in medical services and the cost/benefits of having expert contract management of the critical operations/IS function
- Establish central control of departmental systems
- Plan future networking architectures carefully and for maximum flexibility. Consider UNIX.
- Commit to maximum use of EDI-based electronic billing
- Determine how to cost-justify new information systems with nontraditional benefits in light of competing capital investments

C
IS Vendor Issues and Recommendations

Recommendations for information services vendors derive from the same sets of issues that were examined for users and are summarized in Exhibit VI-4.

EXHIBIT VI-4

Vendor Recommendations

- Emphasize cost-accounting and the potential for tight controls and ease of reporting for all financial systems
- Integrate financial, administrative, and clinical product lines
- Architect and design systems so that single entries to records directly update billing accounts and required documentation files
- Where appropriate, incorporate reimbursement flexibility and EDI for electronic claims processing in applications software
- Incorporate RDBMSs and executive information systems oriented toward profitability analysis
- Define strategies to win acceptance by skeptical medical professionals. If the physicians are sold, physicians will sell the institution
- Incorporate image-processing and medical records support
- Broaden networking and integration flexibility, both within the product line and to other vendors' products. Consider UNIX.
- Consider re-architecting using mainframe and minicomputer platforms—away from processing services, and toward networked PCs and workstations
- Help users build and win acceptance for their IS needs by using cost-benefit analyses

Definitions

No industry-specific terms have been used in this report.

See the separate volume, INPUT's *Definition of Terms*, for general definitions of industry structure and delivery modes used throughout INPUT reports.

Forecast Data Base

A

Forecast Data Base

Exhibit B-1 presents the 1990-1996 information services forecast for the medical (health services) sector.

EXHIBIT B-1

Medical Sector
User Expenditure Forecast by Delivery Mode, 1990-1996
($ Millions)

Delivery Modes	1990 ($ M)	Growth 90-91 (%)	1991 ($ M)	1992 ($ M)	1993 ($ M)	1994 ($ M)	1995 ($ M)	1996 ($ M)	CAGR 91-96 (%)
Sector Total	3,974	10	4,394	4,910	5,505	6,185	6,994	7,957	13
Processing Services	500	5	526	551	577	604	632	660	5
- Transaction Processing	500	5	526	551	577	604	632	660	5
Turnkey Systems	928	7	994	1,060	1,116	1,161	1,192	1,269	5
Applications Software	869	13	985	1,125	1,296	1,505	1,768	2,089	16
- Mainframe	344	7	369	395	422	446	470	500	6
- Minicomputer	266	9	290	316	344	375	409	449	9
- Workstation/PC	259	26	326	414	530	684	889	1,140	28
Systems Operations	753	15	866	1,024	1,212	1,429	1,682	1,986	18
Systems Integration	224	10	247	277	309	339	375	419	11
Professional Services	254	7	272	295	320	347	381	411	9
Network Services	446	13	504	578	675	800	904	1,126	17
- Electronic Info Svcs	274	11	304	338	380	431	493	556	12
- Network Applications	172	16	200	240	294	369	471	570	23

B
Forecast Reconciliation

EXHIBIT B-2

Medical Sector
1991 MAP Data Base Reconciliation
($ Millions)

Delivery Modes	1990 Market				1995 Market				90-95 CAGR per data 90 rpt (%)	90-95 CAGR per data 91 rpt (%)
	1990 Report (Fcst) ($ M)	1991 Report (Actual) ($ M)	Variance from 1990 Report ($ M)	Variance from 1990 Report (%)	1990 Report (Fcst) ($ M)	1991 Report (Actual) ($ M)	Variance from 1990 Report ($ M)	Variance from 1990 Report (%)		
Total	4,083	3,974	-109	-3	7,338	6,994	-344	-5	12	12
Processing Services	500	500	-	-	644	632	-12	-2	5	5
Turnkey Systems	928	928	-	-	1,192	1,192	-	-	5	5
Applications Software	891	869	-22	-2	1,843	1,768	-75	-4	16	15
Systems Operations	833	753	-80	-10	1,825	1,682	-143	-8	17	18
Systems Integration	231	224	-7	-3	427	375	-52	-12	13	11
Professional Services	254	254	-	-	443	381	-62	-16	12	9
Network Services	446	446	-	-	964	964	-	-	17	17

Exhibit B-2 provides the 1991 forecast reconcilation for the medical (health services) sector. The only changes for the 1991 forecast are:

- Applications software products—This delivery mode grew somewhat slower in 1990 than planned. The result is a 2% reduction in market size to $869 million.
- Systems operations—Careful review of this sector resulted in a 10% reduction in overall market size. At the same time the CAGR for the next five years rose from 17% to 18%.

About INPUT

INPUT provides planning information, analysis, and recommendations for the information technology industries. Through market research, technology forecasting, and competitive analysis, INPUT supports client management in making informed decisions.

Subscription services, proprietary research/consulting, merger/acquisition assistance, and multiclient studies are provided to users and vendors of information systems and services. INPUT specializes in the software and services industry which includes software products, systems operations, processing services, network services, systems integration, professional services, turnkey systems, and customer services. Particular areas of expertise include CASE analysis, information systems planning, and outsourcing.

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Formed as a privately held corporation in 1974, INPUT has become a leading international research and consulting firm. Clients include more than 100 of the world's largest and most technically advanced companies.

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