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PATRICIA M. DANZON
MICHAEL F. FURUKAWA

Health Care: Competition and Productivity

NATIONAL EXPENDITURE ON medical care reached $1.2 trillion, or almost 14 percent of gross domestic product (GDP) in 1999, up from 8.9 percent of GDP in 1980. By 2007 health care spending is projected to reach $2.04 trillion.[1] The potential economic impact of improved productivity in health care is therefore huge. Although medical technology has been the main contributor to this increase in health spending, advanced information technology (IT) has not been widely integrated into health care's basic administrative processes and business functions.[2] The Internet offers the potential for cost reduction and improved productivity in many of these functions. The main potential targets for savings are

—administrative cost related to insurance billing, medical records, and care coordination; together, these costs have been estimated at between 12 and 15 percent of total health care spending;[3]

—costs attributable to inappropriate care and "medical error" that result from physician uncertainty about best practices or from incomplete patient

1. HCFA (2000).

2. A survey by Fuchs (1996) found that 84 percent of health economists concur that the diffusion of new technology is the main driver of health care costs. Dorenfest (2000) found that IT investment in health care more than tripled during the 1990s, with annual expenditures for products and services rising from $6.5 billion in 1990 to a projected $20.4 billion in 2000.

3. OTA (1995), citing Lewin-VHI (1993).

records and poor care coordination; these costs have been estimated at 4 percent of total health expenditures;[4]

—"unnecessary" care, which has been estimated at 20 percent of the total, much of which is insurance-induced overuse that occurs because insured patients are not cost-conscious (moral hazard);[5] and

—costs associated with purchasing and the supply chain; estimated savings from moving to business-to-business (B2B) e-commerce are less than 1 percent of total health care spending.[6]

Even if these estimates are exaggerated, include some duplication, and reflect some costs that could not be totally eliminated, there is still clearly potential for significant savings that could release resources for spending on new clinical technologies or on other goods and services.

In addition to these direct, potentially measurable savings, productivity improvements in health care delivery could yield indirect benefits to the rest of the economy, through better population health, lower patient time costs, and lower public budget expenditures. Health improvement is the ultimate output of the medical services sector, but that output is not captured by standard GDP measures. Nonetheless, better employee health could increase labor productivity throughout the economy by reducing work loss caused by disability and illness. Recent estimates show 13.6 percent of the total population—and 22 percent of the 45–65 year age group—suffers from chronic medical conditions that limit activity.[7] That estimate does not include acute conditions or time out to care for sick family members. Moreover, because tax-financed public spending accounts for 45 percent of total health expenditures, primarily for the Medicare and Medicaid programs, any factor that controls these costs could reduce tax burdens and hence indirectly benefit the rest of the economy.

The application of the Internet to health care, commonly referred to as "e-health," is a diverse and complex undertaking.[8] Health care uses some of the same Internet business models, such as B2B e-commerce, used in other industries, although the fragmented structure of the industry may slow the

4. Thomas and others (1999).

5. Chassin (1998) concludes that at least 20 percent of all health care delivered in the United States is unnecessary and can be safely eliminated.

6. Based on EHCR (1996).

7. Kramarow and others (1999, table 59, p. 220).

8. For an overview of the Internet and health care, see Computer Science and Telecommunications Board and National Research Council (2000), Mittman and Cain (1999), and Nicholson (1999).

realization of potential savings. Other Internet opportunities are more specific to health care, particularly those that address costs related to imperfect or asymmetric information and to insurance and third-party payment, two factors that underlie the high costs of administration, medical error, and unnecessary care.

This paper outlines the structure of the health care sector and its distinguishing features as a foundation for understanding the potential impact of IT and the Internet. It then describes Internet activities in health care, broadly categorized by the four "Cs": connectivity, content, commerce, and care. Effects of these activities on competition and on measured and unmeasured productivity are suggested. The concluding section summarizes findings.

Industry Background

The diversity of medical care, its fragmentation, and the overlay of third-party payment create the potential for Internet-based savings—but also obstruct their realization.

Industry Structure

Table 7-1 shows the breakdown of personal consumption expenditure (PCE) in the National Income and Product Accounts (NIPA) and the National Health Accounts from the Health Care Financing Administration (HCFA). Hospitals and physicians dominate the provider side, accounting for more than one-third and one-fifth, respectively, of PCE. Other providers include home health, nursing homes, ambulatory surgery centers, dentists and other professionals, with a steady shift of care from inpatient hospitals to these diverse outpatient settings over the last two decades. The supply side includes pharmaceuticals, medical devices, equipment, and supplies, which are sold to providers and retail pharmacies.

Each of these sectors remains highly fragmented (table 7-2, column 1), despite significant consolidation in the 1990s through the formation of hospital systems, physician practice management groups, and integrated delivery networks (IDNs) that link one or more hospitals with a network of physicians, home health services, and possibly other services. It was hoped that this consolidation could take advantage of new IT opportunities to realize economies of scale and efficiency savings in coordinating

Table 7-1. *NIPA Medical Care Expenditures, 1992, 1994, 1996–98*

Billions of dollars, unless otherwise indicated

Expenditure	*1992*	*1994*	*1996*	*1997*	*1998*
Selected NIPA health care expenditures, total	763.1	858.1	948.1	991.9	n.a.
Personal consumption expenditures	741.5	838.1	932.3	977.6	1032.3
Drug preparations, sundries[a]	75.9	85.8	100.3	108.1	116.8
Ophthalmic products, orthopedic equipment[b]	13.0	15.0	17.6	19.4	21.2
Physicians	167.3	181.0	199.1	206.9	219.6
Dentists	37.6	42.9	48.4	52.0	54.8
Other professional medical services[c]	85.2	103.6	119.7	125.1	131.8
Hospitals and nursing homes	319.2	353.9	390.8	408.5	428.4
Hospitals	269.0	299.9	327.6	341.9	357.1
Nonprofit hospitals	183.5	200.8	213.5	221.3	230.6
Proprietary hospitals	30.3	32.4	38.7	41.6	43.3
Government hospitals	55.2	66.6	75.4	79.0	83.2
Nursing homes	50.2	54.1	63.2	66.7	71.3
Health insurance	43.3	55.8	56.6	57.6	59.8
Medical and hospitalization insurance	37.6	44.4	45.3	46.9	49.7
Income loss insurance	2.1	1.6	1.0	1.2	1.4
Workers compensation	3.6	9.8	10.3	9.6	8.7

Government consumption expenditures and gross investment[d]	21.6	20.0	15.8	14.3	n.a.
Federal	14.3	16.7	17.5	17.2	n.a.
Veterans medical care	14.3	16.7	17.5	17.2	n.a.
State and local hospitals	7.3	3.3	–1.8	–2.9	n.a.
Addenda:					
Gross domestic product	6,318.9	7,054.3	7,813.2	8,300.8	8,759.9
Selected NIPA health expenditures as percent of GDP	12.1	12.2	12.1	11.9	n.a.
National health accounts[e]	785.6	889.1	976.5	1,019.0	n.a.
Personal health care	740.7	834.0	924.0	969.0	n.a.
Administration and net cost of private insurance	44.9	55.1	52.5	50.0	n.a.
National health accounts expenditures as percent of GDP	12.4	12.6	12.5	12.3	n.a.

Source: McCully (1999).

n.a. Not available.

a. Includes prescription and nonprescription drugs and medical sundries. Excludes drug preparations and related products dispensed by physicians, hospitals, and other medical services.

b. Includes eyeglasses, contact lenses, and prosthetic and orthopedic appliances.

c. Consists of osteopathic physicians, chiropractors, private duty nurses, chiropodists, podiatrists, optometrists (excluding optical goods), home health care, and medical laboratories.

d. Previously published estimates. Government consumption expenditures and gross investment by type and function consistent with the 1999 comprehensive revision have not yet been published.

e. Health Care Financing Administration. Figures exclude public health expenditures, research, and construction.

Table 7-2. *Number of Health Care Providers and Implementation Costs for HIPAA Administrative Simplification Rules, 2002–11*

Type of health care provider	*Number of health care providers (2002 est.)*	*Average cost*	*EDI (percent)*	*Total cost (millions of dollars)*	*Savings (millions of dollars)*
Federal hospitals	266	250,000	88	92	. . .
Nonfederal hospitals <100 beds	2,639	100,000	88	364	. . .
Nonfederal hospitals 100+ beds	2,780	250,000	88	960	. . .
Nursing facility <100 beds	9,606	10,000	90	134	. . .
Nursing facility 100+ beds	8,833	20,000	90	247	. . .
Home health agency	8,900	10,000	90	184	. . .
Hospice	2,027	10,000	90	28	. . .
Residential mental health/retardation/ substance abuse facilities	22,339	10,000	10	134	. . .
Outpatient care centers	24,034	10,000	75	300	. . .
Pharmacy	43,900	4,000	96	256	. . .
Medical labs	9,500	4,000	85	51	. . .
Dental labs	7,900	1,500	50	12	. . .
DME	112,200	1,500	50	168	. . .
Physicians solo and groups less than 3	193,000	1,500	50	290	. . .
Physicians' groups 3+ with computers	20,000	4,000	90	112	. . .
Physicians' groups 3+ no automation	1,000	0	0	0	. . .
Osteopaths	13,600	1,500	10	12	. . .
Dentists	120,000	1,500	30	144	. . .
Podiatrists	9,100	1,500	5	8	. . .
Chiropractors	32,000	1,500	5	26	. . .
Optometrists	18,800	1,500	5	16	. . .
Other professionals	33,400	1,500	5	28	. . .
Total (undiscounted)	. . .	. . .	. . .	3,566	20,200
Total (discounted)	. . .	. . .	. . .	3,300	14,100

Source: Federal Register, August 17, 2000, Table 2.

care. But the reality has fallen short, and many IDNs are integrated only in name and some business systems, with little online sharing of clinical information and patient records. Within specific hospitals, individual departments (general medicine, emergency room, intensive care, and others) remain poorly coordinated. Existing IT systems (known as legacy systems) are often incompatible and still based on mainframes rather than client-server platforms. The resulting lack of real-time, integrated patient records and poorly coordinated care have been identified as major contributors to medical errors.[9] According to a survey published in June 2000, health care organizations said their top IT priorities for the next two years are electronic medical records, integration, and improved connectivity with physicians.[10]

Financing

Health insurance is an integral part of the health care sector and has a pervasive influence on the cost and structure of the medical services industry. Although insurance is in theory intended to protect against unexpected, catastrophic expense, in practice insurance pays for more than 80 percent of personal health care, including much that is routine and predictable. Administration and net cost of private insurance are estimated at 5.1 percent of personal health care (see table 7-1). The expansion of private insurance has been driven by the tax subsidy to health insurance, whereby employer contributions are tax-exempt income to employees, implying a subsidy to insured medical care (including administrative costs) at the employee's marginal tax rate, which averages more than 30 percent. Given this subsidy, it is not surprising that employees choose plans with comprehensive coverage. The resulting insurance and medical norms become the standard for public programs.

Insurance adds an extra payment transaction for each service, because medical providers typically collect a co-payment from the patient and bill the patient's insurer for the remaining cost of the service—a transaction that may entail eligibility verification, preservice authorization, and postservice benefit denial. A potentially much larger cost of insurance results from the "moral hazard" effect, that is, the tendency for insured patients and providers to overutilize services because someone else is paying the

9. Kohn, Corrigan, and Donaldson (1999).
10. HIMSS-IBM Leadership Survey (2000).

bill, and from the potential for excessive prices because insurance makes demand less elastic. Estimates of unnecessary care differ, depending on whether the definition is economic (meaning that marginal benefit is less than social marginal cost) or is based on a notion of medical appropriateness, but given the incentives, the number is surely large.

The moral hazard effects of insurance mean that administrative expense is not necessarily a pure deadweight loss to be minimized. Many administrative functions are designed not only to pay providers, but also to control moral hazard and monitor the quality of care.[11] The managed care revolution reflects a shift away from the traditional patient-targeted approach of controlling costs through co-payments and toward provider-targeted incentives and controls, such as capitation payments, utilization review, and selective contracting. These managed care strategies add administrative cost, but that is usually offset by lower costs of care, attributable to lower prices or fewer expensive services, and less financial risk for patients. Thus administrative inputs produce several joint products—billing and reimbursement, moral hazard control, and care. The Internet, by improving information and data exchange, could therefore offer savings not only through lower administrative costs, as conventionally measured, but also through better monitoring and improved clinical care, which may be much harder to measure.

The private health insurance market is extremely fragmented (table 7-3, column 1), reflecting local differences in medical care infrastructure and regulatory structure and proliferation of health plans as they compete to find better trade-offs between cost control and freedom of choice. Insurance regulation is a state function, under the McCarran Ferguson Act of 1945. States have adopted a range of different regulations to address solvency, set minimum benefits, and, in some cases, regulate premiums and underwriting. Partly to help multistate employers deal with divergent state regulations, the Employee Retirement Income and Security Act (ERISA) of 1974 established federal oversight of employer-sponsored health plans that are self-insured. Most large firms and a significant fraction of medium-size firms are now self-insured, but often use a third-party administrator to design and administer benefits.

Public spending is dominated by the Medicare program, which covers seniors, the permanently disabled, and those with end stage renal disease.

11. Danzon (1992).

Table 7-3. *Number of Health Plans and Implementation Costs of HIPAA Administrative Simplification Rules, 2002–11*

Type of health plan	*Number of health plans*	*Average cost*	*EDI (percent)*	*Total cost (millions of dollars)*	*Savings (millions of dollars)*
Large commercials	250	1,000,000	90	350	. . .
Small commercials	400	500,000	50	200	. . .
Blue Cross/Blue Shield	400	1,000,000	100	98	. . .
Third-party administrators	400	500,000	50	375	. . .
HMO/PPO	400	250,000	60–85	487	. . .
Self-administered	400	50,000	25	1,875	. . .
Other employer health plans	400	100	0	127	. . .
Total (undiscounted)	. . .	. . .	. . .	3,512	16,600
Total (discounted)	. . .	. . .	. . .	3,300	11,600

Source: Federal Register, August 17, 2000, Table 1.

Traditional Medicare, a federal program run by the HCFA, has a uniform reimbursement structure nationwide, although it is administered by local intermediaries. In addition, the Medicare+Choice program offers seniors the option of selecting an approved private plan as an alternative to traditional Medicare. The number of plan offerings in Medicare+Choice fluctuates, depending on reimbursement levels. Medicaid is a federal-state program covering eligible low-income women and children, other needy groups, and long-term care. State autonomy, subject to federal constraints, has resulted in considerable diversity in structure and benefits. Many states contract with local private plans to administer benefits to Medicaid enrollees. Other public health care programs include the Veterans' Administration, the Indian Health Service, and many smaller state programs.

The diversity of the health insurance industry resulting from this private initiative and public regulation reflects a very competitive insurance marketplace, with continual innovation as plans compete on cost and quality. But it also makes for administrative complexity, as physicians and hospitals deal with multiple plans that differ in benefits covered and in billing and reimbursement protocols. But because plans must contract with providers and attract enrollees, they should internalize the "hassle costs" that they impose. Thus it is not clear that this diversity is excessive, except to the extent that the tax subsidy to health insurance subsidizes administrative expense as well as medical services. In any case, the Internet offers the potential to reduce measured administrative costs, plus unmeasured time

costs of providers and patients; better controls on excess utilization and more appropriate care may be additional benefits. As discussed in more detail later, the Health Insurance Portability and Accountability Act (HIPAA) of 1996 authorized the federal government to establish federal standards for electronic transactions and security, which are intended to accelerate realization of these savings.

Characteristics of Health Care

Certain basic characteristics of health care contribute to the structure of the industry, its present inefficiencies, and the potential productivity gains from the Internet.

Imperfect Information

Imperfect information underlies the structure and many of the problems in health care.[12] Illness is stochastic, and uncertainty may confound both diagnosis and optimal treatment of patients. Rapid change in medical technology may exacerbate information asymmetries among both patients and providers. Because health states and outcomes are imperfectly observable, adverse selection and moral hazard can create further inefficiencies. The integration and communication aspects of the Internet hold much promise for mitigating the problems caused by imperfect and asymmetric information.

CONSUMERS. When illness strikes, consumers have traditionally had little information about potential diagnoses or appropriate providers and treatments and hence have relied on physicians as agents to advise on appropriate treatment as well as to implement care. The complexity of medical services means that information is costly, and search may impose a barrier to access for consumers. Physicians often face conflicting incentives in their role as advisor and supplier, leading to concerns about quality of care and charges of "supplier-induced demand." Asymmetric information between physicians and their patients (and third-party payers) underlies the requirements for professional licensure and other regulations on who can practice medicine, traditions of strong professional norms, and

12. Arrow (1963).

not-for-profit status of hospitals.[13] Others have argued that these regulations serve as barriers to entry that restrict competition and raise costs. Regardless of the origin of these institutions, the outcome is that physicians direct a much larger fraction of health spending than is reflected in their own income, which is only 20 percent of the total. The Internet offers an unprecedented source of free information for consumers on diseases and treatment options, products, provider report cards, and alternative medicine, information that is already contributing to a more consumer-driven health care system.

PHYSICIANS. In a world of perfect information, physicians, patients, and payers would understand symptoms, know the best course of treatment, and be able to evaluate the quality of care actually delivered. In reality, the rate of change of medical technologies outpaces the ability of technology assessment to evaluate them and the ability of many providers to keep up. Evidence-based medicine is in its infancy, and medical consensus on best practices is lacking. Numerous studies have documented large variation in treatment patterns for the same condition across geographic areas, which cannot be fully explained by patient demographics or insurance coverage. Physician uncertainty about best practices is the most plausible explanation for these practice variations, which have significant associated cost variation that is not correlated with outcomes. These variations impose a significant welfare loss, which is separate from and in addition to the insurance-induced loss attributable to moral hazard.[14] Physician-oriented Internet portals seek to address this information challenge, offering physicians such services as online access to medical information, decision support systems, and online continuing medical education.

Medical specialization and the fragmentation of care delivery are further consequences of the technological complexity of medical care. General practitioners (GPs) typically act as gatekeepers who form a preliminary diagnosis and then order additional tests and refer patients to specialists. A single episode of treatment may thus entail visits to a GP and a specialist, tests read by a radiologist, drug prescriptions filled by a pharmacist, and possibly hospitalization and postoperative therapy. Each of these providers may operate as an independent, separately located business unit, each with a separate medical record on each patient. Coordinating care and transmitting information across the continuum of care currently depends

13. Arrow (1963).
14. See Phelps (1992) on welfare loss.

largely on phone, fax, or mail. That entails not only the costs of the administrative staff required to handle the paperwork, but also the potentially much larger costs of duplicative or inappropriate care that results from incomplete patient records at the point of treatment.

The 1990s wave of mergers, acquisitions, and consolidation of various health care providers into integrated delivery systems was premised in part on the value of sharing information among multiple organizations across a continuum of care. Communicating across disparate entities—within a single organization or between trading partners—necessitated connectivity across an enterprise and potentially throughout a community or region. The promised benefits included lower cost, higher quality, better measurement of quality, and lower costs of transacting with payers. In practice these promised benefits were at most partially realized, and integration of information systems remains largely unfulfilled. Existing legacy systems have been costly failures but remain a barrier to integration and to Internet adoption, as many executives and boards are skeptical about further investments in information technology. Other priorities that have preempted the limited human and financial capital available to hospitals include compliance with changing regulations, and surviving under declining reimbursement after severe cuts in the 1997 Balanced Budget Act. Moreover, the Y2K problem—ensuring that computers could deal with the transition from 1999 to 2000—was literally a life-or-death issue for health care institutions.

The 1990s also spawned a renewed vision of idealized community health information networks (CHINs). Some of these failed; some, such as the Wisconsin Health Information Network, became operational through vendor sponsorship; and others remain works in progress.[15] Although the Internet may facilitate some goals of the CHIN movement, it seems plausible that the important components will be the proprietary networks and systems, linked to medical records that will remain private.

PAYERS. Payers, like patients, traditionally depend on physicians to determine appropriate care. This obviously limits their ability to monitor and challenge unnecessary expenditures that benefit the patient and the physician but that are not cost justified. The Internet offers significant improvement in at least two ways. First, online connections between providers and payers can offer real-time information on coverage limits and practice guidelines to the provider at the point of care. Modifying the course of treatment or choice of drug before it is delivered is potentially far more

15. Starr (1997).

cost effective than the current after-the-fact review process, in which denial of reimbursement for services already rendered or scripts already written is a major waste of time and aggravation to physicians and patients. In the longer run, better systems for tracking treatments, costs, and outcomes can provide the basis for data-driven, evidence-based practice protocols or norms of care for specific conditions. So-called outcomes studies are an infant but burgeoning industry, financed by government and private payers, because evidence-based studies offer the necessary foundation for eliminating inappropriate and unnecessary care. The feasibility of these studies depends heavily on IT, of which the Internet is one critical component.

More generally, improved information about the quality of care and outcomes is key to the efficient functioning of markets for health plans and medical care, as for other goods and services. As patients select health plans and providers and plans contract with providers, they need to be able to evaluate the quality of care, controlling for other factors that affect observed outcomes, such as the severity of the patient's underlying disease. The measurement of risk-adjusted outcomes and of provider care quality and the dissemination of this information become more possible with the advances of IT in general and the Internet in particular.

Regulation

Medical providers, suppliers, and insurers are heavily regulated by state and federal agencies. States regulate licensure and practice of professionals and insurance, which has contributed to diversity in health plans and treatment norms. The federal government has played a significant role in setting standards for reimbursement through the Medicare program, and some private plans have followed these standards. The 1996 HIPAA also implies a significantly greater role for the federal government in setting national standards for medical information. The Food and Drug Administration (FDA) must approve pharmaceuticals and medical devices for safety and efficacy before they can be marketed, and these products must comply with good manufacturing practices. The huge costs of the very paper-intensive drug approval process may be reduced through electronic filings. Regulatory compliance costs are a major contributor to administrative costs. The Internet may reduce the costs of complying with some of these regulatory requirements. At the same time, the increased regulatory demands to assure privacy and security of electronic communications may mean that, on balance, the Internet may add to the regulatory burden, at least in the near term.

Privacy

Medical information is extremely sensitive, and patients have legitimate fears that it will be misused, leading to discrimination in employment and in buying insurance. Concern about assuring privacy of personal records is a greater barrier to web-enabling transactions in medical care than in other industries. Indeed, several other countries with nationalized health care systems and hence no diversity of payment systems have even less coordination of medical records than there is in the United States, because they have regarded the use of unique patient identifiers as a threat to patient privacy. Even if the technology problem is solved by encryption and authentication technologies, the risk of human error or intentional misuse remains. Privacy concerns could undermine the widespread adoption of application service provider (ASP) models for medical records and claims processing. These ASP models offer much lower cost and financial risk for providers but have a greater potential for loss of control and increased security risk.

Competition and Market Power

Price competition in health care has increased in recent years but remains problematic as long as information about quality is imperfect and price is used as a signal of quality. Patents are granted for research-based pharmaceuticals and specialty medical devices with the express intention of limiting competition from perfect copies. Nevertheless, the Internet should improve consumers' and payers' information about provider quality (through report cards, for example) and about price dispersion and hence stimulate price competition. Increased price competition seems most likely for the types of medical products that are amenable to B2B exchanges and online auctions, as discussed later.

E-Health Initiatives

E-Health initiatives have been categorized as the "four Cs" of connectivity, content, commerce, and care. In practice, of course, spillovers and joint products make this an arbitrary division; for example, improved connectivity or content can improve care. Moreover, the most successful business models, at least among those that target physicians, are likely to offer con-

tent, connectivity, care support, and commerce in a single integrated interface, in order to provide maximum convenience and ease of operation to the physician customer. Nevertheless, to understand the various opportunities for savings and the associated strategies of e-health businesses, we consider the four Cs separately.

Connectivity

Estimates of administrative cost as a percent of total health spending range widely. The NIPA estimate of administration cost is 5 percent of PCE, but this estimate omits costs incurred in physicians' offices, hospitals, and other providers. More generalizable studies estimate 12 to 15 percent, which is in the range of reasonable estimates.[16] Wide variation in estimates of current costs and potential savings is not surprising given joint production of administrative and clinical functions by clerical personnel. Patient time spent submitting claims is not included in any of the estimates, leading to a downward bias in estimates of real administrative costs of the health care system; however, patient time spent in care is also omitted from PCE, so this bias may not affect the percentage spent on administration.

The connectivity ideal would link providers, payers, and patients in a seamless system that could in theory reduce clerical staff and paperwork, reduce physician and patient time spent on administration, and reduce the incidence of inappropriate and unnecessary care. The components of the ideal system include online access to

—electronic medical records (EMR)
—clinical decision support and payer guidelines, if any
—prescribing, test ordering, and results reporting
—real-time verification of reimbursement eligibility
—claims processing
—appointment scheduling and referrals
—patient education and interaction
—compliance monitoring

In practice, achieving these features in a fully integrated system is some years away. Significant advances are under way, however, in the separate components of claims processing, practice management, and medical records.

16. OTA (1995), citing Lewin VHI (1993); Office of the Inspector General (2000) estimates average administrative expenses of 15 percent for managed care organizations.

CLAIMS PROCESSING. The greatest opportunity for cost savings through the Internet may be through processing transactions between providers and insurers, thus reducing billing and reimbursement costs. Many different formats for electronic health claims are currently in use in the United States, and each provider typically submits claims to multiple plans that use different formats. Specialized data clearinghouses have emerged as intermediaries to offer electronic data interchange services that transmit claims from providers to payers in a standardized format over proprietary networks, thereby realizing some savings from consolidation, reduction in personnel and processing time, and reduced error associated with paper claims.[17] EDI (electronic data interchange) providers claim to reduce costs per claim from $10–$15 using paper to $2–$4 per EDI claim.[18] Web-based connectivity providers charge under $1 a claim, but there may be an additional monthly charge. Moreover, to the extent that these sites generate revenues from advertising and sponsorship, they may offer these services at less than their full marginal cost.

Most hospitals and insurers have managed to achieve some degree of computerization, but most physician offices and smaller health care entities remain mired in paper-based systems (see table 7-2). Although 62 percent of all claims are processed electronically, only 40 percent of physicians' claims are processed this way, compared with close to 90 percent or more for hospitals and pharmacies. Previous attempts to improve connectivity and coordination of care have had only limited success. Now the Internet provides a missing link, offering connectivity at a lower cost and vastly improved functionality, including greater potential for networking and for sharing more complex data, including eligibility verification and clinical information that has not moved to EDI. Moreover, the Internet permits new ways of outsourcing IT, including remote hosting of software applications by application service providers. The ASP model offers lower hardware and software acquisition costs, lower system maintenance costs, faster implementation time, easier upgrades, and faster deployment over geographic areas. Potential problems include some loss of managerial control

17. Forty percent of the 65 claims clearinghouses surveyed in 2000 received claims via the Internet, compared with 31 percent in 1999. Of those clearinghouses that did not use the Internet, 28 percent said they expected to by the end of 2000. About one-third of responding clearinghouses used the Internet to transmit claims, and 12 percent that did not do so at the time of the survey expected to by the end of 2000. Briggs (2000).

18. Rouse and Chalson (2000, p. 9). Percent of claims filed electronically is from Cohen (1996). See also table 7-2.

and risk of confidentiality. On balance, it seems likely that outsourcing to ASPs will accelerate the adoption of electronic claims processing, practice management, and ultimately other functions, particularly by physician practices and smaller institutions, which may be optimally scaled for care delivery but not for efficient IT implementation.[19] Two factors contributing to the slow uptake of these systems are lack of standardization and the potential for loss of medical privacy. In addition, physicians with existing practice management systems would need to integrate the web service with their existing computers, which would require costly software interfaces over and above the subscription fees.

To address these issues, the HIPAA requires the federal government, through the Department of Health and Human Services (DHHS), to adopt standards for financial and administrative transactions, and data elements for those transactions, including claims and encounter information, health plan enrollment, eligibility, premium payment, and referral certification and authorization. Standards are also to be set for unique identifiers for each individual, employer, health plan, and provider and for security standards to govern health care EDI. For each type of transaction, the standards specify the format, data elements required, and code sets where applicable. Health plans and providers are required to comply within twenty-four months (thirty-six months for small health plans) after the effective date of the final rules (October 2000 for electronic transactions). Providers are not required to use EDI, but if they do, they must comply with the standards. DHHS estimates aggregate HIPAA compliance costs for the administrative simplification rules at $3.5 billion to $4 billion, with additional costs for the privacy regulations (tables 7-2, 7-3).[20] HIPAA should accelerate the conversion to web-based systems, because nationwide standards should expand the potential scale of operations and hence facilitate the entry of online companies, which currently need to gain critical mass separately in each locality. Moreover, faced with the costs of making existing EDI systems HIPAA-compliant, providers may find investment in Internet technologies a lower-cost alternative.

The DHHS estimates the total net savings from the electronic claims regulations at $29.9 billion for the ten-year period ending in 2011, of which

19. Gartner Group, of Stamford, Connecticut, estimates that by 2005 approximately 20 percent of all patients will be using a medical record that resides in an ASP service. See Alan Joch, "EMR the Web Way," eMD Online (www.edotmd.com.s00/cover/htm [Summer 2000]).

20. Industry estimates of compliance costs are as high as $25 billion.

$13.1 billion is predicted to accrue to health plans and $16.7 billion to providers. The discounted present value of these savings is estimated at $19.1 billion, using a 7 percent discount rate. This is the estimated impact of standardization as a result of HIPAA, not the full impact of the switch to electronic claims processing, or the switch from EDI to web-based claims processing. In particular, it assumes that only 11.2 percent of the growth in electronic claims in the ten-year period is attributable to HIPAA. Thus the potential total net savings from switching to web-based claims processing could be nine times larger, or almost $270 billion, undiscounted, over the ten-year period, assuming a similar rate of net savings for the 88.8 percent of switching that is not attributed to HIPAA.[21] The DHHS cost estimates are based on 1999 estimates of the percent of claims that are billed electronically, by provider type, as shown in table 7-2. The estimated savings per claim processed electronically is $1 for health plans, $1.49 for physicians, $0.86 for hospitals, and $0.83 for others.[22] These estimates are based on 1993 data and seem conservative compared with current per-claim charges of Internet companies. Moreover, web-enabling claims processing could yield spillover benefits that encourage adoption of other online technologies. Additional impacts from administrative simplification are also not included. Nor do these estimates of net savings include Medicare and Medicaid, which account for more than 30 percent of total health expenditures.[23] At the same time, these estimates do not reflect possible costs from introducing uniform systems that deter innovation in health plan management. Rigidity in measurement systems may induce rigidity in management systems and slow innovation in insurance design. But if the long-run savings from moving to web-based claims processing is only 10 percent of current administrative expense, that would still be almost 1–2 percent of total health expenditures ($0.1 \times 0.15 = 0.015$). This estimate could be too high or too low, depending on whether the estimated total administrative cost of 12–15 percent of PCE is too high or too low, and on how much of the total administrative cost is represented by claims handling, as opposed to other administrative functions that may be less amenable to moving online, and on the systemwide savings from using the web.

21. This estimate also assumes that the cost savings per percent of automation are constant, whereas in practice there may be increasing or decreasing returns to scale that raise or lower the net savings.

22. Workgroup for Electronic Data Interchange (1993).

23. Early estimates by HCFA projected that the Medicare Transaction System, a new single automated system for processing claims, could save $100 million annually (GAO 1994).

Additional but unmeasured potential savings could be realized from web-based provider-payer links through real-time, online eligibility verification, referral authorization, and claims adjudication (verification from the payer that it will pay for a particular drug or service). Currently, these reimbursement decisions are typically made after the physician has provided the service, prescribed the drug, or made the referral. For example, for a significant fraction of drug prescriptions, the pharmacist calls the physician's office to ask whether an alternative drug can be substituted because the prescribed drug is nonpreferred (has a higher co-payment) on the patient's formulary. Even more costly are the cases where the patient receives expensive services, only to learn that they will not be reimbursed, leading to reclaiming and possibly litigation. Point-of-service eligibility verification could thus save time for providers, patients, pharmacists, and payers and result in better care and less aggravation for all parties.

PRACTICE MANAGEMENT. The management of physician practices has become more complex, with proliferating numbers of plans and payers and the consolidation of physicians into group practices and physician networks. The make-or-buy options for proprietary systems entail high upfront and maintenance costs and high risks. Management services organizations have developed to offer outsourced practice management but have had limited success. The Internet has enabled the development of ASPs, which charge a monthly fee in return for web-based access to remotely hosted practice management applications to handle administrative, financial, and clinical tasks; medical content and product procurement for supplies are possible further extensions of the ASP model. Because the ASP model reduces the need for expensive hardware and software and the staff to maintain it, it reduces the risks associated with large capital investments and facilitates upgrades. This in turn may lead to the automation of some office functions, such as online appointment scheduling and document imaging and storage and hence to some savings in clerical staff or substitution of more skilled information systems staff.

It remains to be seen whether a few national players or various regional players will capture the savings from moving claims processing and other associated business functions online. In addition to the start-up Internet-based companies, the traditional EDI companies are moving their systems online or allying with the Internet companies. For example, WebMD acquired the electronic health transaction firm Envoy Corp., which processes about 1 billion claims a year, mostly over private networks. WebMD plans to switch these claims to the Internet. To increase

its physician subscriber base, WebMD has also acquired Medical Manager Corp. and CareInsite, to offer an integrated web portal that interfaces with doctors' existing software systems and can handle interactions with health plans, such as patient-eligibility checks and referrals to specialists. Countering these Internet upstarts, several insurer/health plans (Foundation Health Systems Inc., PacifiCare Health Systems Inc., WellPoint Health Networks Inc., Cigna Corp., and Oxford Health Plans Inc.), which together cover about 30 million people, are collaborating on a unified strategy for Internet-based claims handling, called MedUnite, presumably to avoid the transactions fees charged by the intermediaries. Although collaboration by incumbents might be viewed as a move to deter new entrants, physicians are unlikely to want to get their other services from health plans, hence opportunities for full-service intermediaries are likely to remain. Moreover, since health plans must compete for employer and employee customers and for providers to participate in their networks, competitive pressures should create incentives for adoption of the most efficient alternative or mix of options.

MEDICAL RECORDS. The holy grail of connectivity is the transformation of the current paper-based medical record into an electronic medical record that is accessible to all necessary providers and possibly to the patient. Each provider currently dictates or writes a separate medical record; hence linking these records should eliminate duplicative paperwork, duplicative treatments, and medical errors. A few large hospital systems have implemented proprietary EMRs, but costly failures abound.

Web-enabling the EMR expands the potential users and uses, and several Internet companies have entered this space. For example, MedicaLogic Inc. initially sold only client-server electronic medical records software accessible on private networks (a Windows-based application, Logician). In September 1999 it introduced an Internet-based version, which it leases to physicians on a monthly basis. The clinical and financial advantages of electronic medical records are large and incontrovertible.[24] Nevertheless, the EMR has been slow to catch on for several reasons. Privacy of the medical records remains a concern. Physician inertia is another obstacle, for reasons of cost, limited benefits as long as the network is limited, and process costs associated with changing the way they practice. It may be that, since the costs of installing the legacy paper-based systems are sunk, the marginal

24. Dick, Steen, and Detmer (1997).

operating costs are relatively low, particularly if the personnel who handle the charts also schedule appointments, do the billing, and deal with patients. Even in the longer run, the potential for reduction in clerical staff may be limited unless multiple office functions are simultaneously converted to electronic systems. Moreover, since many physicians are linked into IDNs or networks with other physicians, these systems choices are made at the network rather than the individual physician level.

A necessary step for moving toward large-scale adoption of EMRs with full potential savings is to make data entry easy for physicians. Surveys repeatedly show that physicians will use computerized technologies only if it saves them time. This rules out systems that require the physician to sit at a terminal during a patient encounter, which is less convenient than the current practice of dictating notes during or after the patient encounter or annotating the paper record. The dictated notes may already be transmitted to specialized transcription services, in which case web-enabling the resulting records should be simple. One of these transcription companies, Total eMed, was acquired by MedicaLogic, presumably to encourage adoption of the electronic record by physicians who have already accepted dictating. In addition, MedicaLogic bought Medscape, one of the leading physician content portals, which had some 480,000 physicians registered to use its online services such as access to peer-reviewed journals.[25] Like other leading physician portals, the strategy is to offer physicians a full product line in one package and to encourage physicians who are attracted by one component of the package to try the other components.

Another useful step toward realizing the potential savings from web-enabling medical records is the development of wireless and handheld devices that give physicians access to key information during the patient encounter. Several Internet companies (such as AllScripts and iScribe) already offer software combined with a handheld device to enhance drug prescribing. Using the handheld device, the physician can check the patient's prescription history, insurance coverage, and formulary status of specific drugs and then generate a printed prescription. Under some systems the physician might be able to submit the prescription electronically to a pharmacy of the patient's choice. Most pharmacists are already electronically linked to payers for reimbursement processing. By eliminating the time-wasters for physicians of phone calls from pharmacists or patients, online prescribing devices may be

25. Telephone conversation with Rick Turoczy, manager, Corporate Marketing, MedicaLogic, January 12, 2001.

more rapidly adopted by physicians than the complete EMR. One estimate is that 9 percent of prescription dollars will be prescribed using these devices by 2004.[26] The three largest pharmacy benefit management companies recently announced a joint venture (called "Rxhub") to develop an electronic exchange to facilitate online prescribing.[27]

Potential savings from online prescribing devices include time saved for physicians, patients, and pharmacists, and reductions in inappropriate prescribing with its associated costs. A recent study reported that the use of a real-time, integrated clinical information system in a major hospital led to challenging and subsequently changing 386 orders a day, an 81 percent decline in medical errors (such as the wrong drug or wrong dose), in addition to a reduction in unnecessary lab tests, a shorter average length of stay, and lower mortality rates.[28] The percent of hospital staff and physicians with access to the Internet is increasing rapidly, creating the necessary customer base for ASP-hosted applications.

Content

Content portals, which offer free access to clinical information for providers and patients, can be viewed as a market response to the problems of imperfect information and costly search, which is the root cause of many inefficiencies in health care. The effects of this information explosion are probably large but are hard to predict, much less to quantify. Since medical content is usually provided free to the user, its value to the user is not reflected in the expenditure-based NIPA accounts. Content sites are financed largely by site sponsorship and advertising revenues, which appear as expenses in the accounts of sponsoring firms, such as pharmaceutical companies. One implication of the heavy reliance on advertising is that the products of the sponsoring companies are somewhat misrepresented in the national accounts: in this case the drug company provides not only drugs and drug advertising, but also general medical information to patients and physicians. Of course, the problem of unmeasured e-content services is not unique to health care. Because of obvious measurement problems, the Census Bureau is not planning to attempt to measure the output of free e-commerce services.[29] Even if an Internet site's revenues were captured by

26. Boehm (1999); Rind and others (1997).

27. Ann Carms, "Trio of Big Pharmacy-Benefit Managers Announce Plans for Electronic Exchange," *Wall Street Journal,* February 23, 2001, p. B11.

28. Bates and others (1998).

29. Fraumeni, Lawson, and Ehemann (1999).

Census surveys, they would likely be attributed to e-commerce rather than to health care.

PHYSICIAN PORTALS. The Internet significantly reduces the time and money costs physicians face to keep up with new medical technologies and new evidence on the effectiveness of new and old technologies. Several sites provide online access to a wide range of medical journals, practice guidelines, and protocols from respected sources; online programs for continuing medical education; and business training for practice management. Decision support tools are available to facilitate the interpretation of symptoms, diagnosis, and selection of treatment options. Despite some resistance to "cookbook medicine," these tools are likely to be increasingly used if they are available on handheld devices for use in real-time treatment decisions.

These online information tools should increase physicians' productivity in producing real health, assuming that better information leads to more accurate diagnoses, better treatment choices, and improved implementation. Rough estimates of the potential savings from improved physician information might be derived from estimates of the welfare loss from variations in medical practices.[30] Physician productivity, however, measured by visits per hour or per week, could increase or decrease. Fees per visit are unlikely to fall, assuming that quality is improved. Moreover any potential time savings for physicians may be offset by increased demands from patients, in response to consumer content sites.

CONSUMER INFORMATION PORTALS. Some 24.8 million U.S. adults, or 43 percent of Internet users, used the Internet for health information in 1999, and this group is growing rapidly, served by more than one thousand Internet sites dedicated to healthcare.[31] Consumer information portals offer free information on wellness and disease, treatment options and providers, chat rooms and illness support groups, and programs for lifestyle management.[32]

There are serious concerns that this "information" is often incomplete, misleading, or wrong; the heavy reliance of many of these sites on advertising and sponsorship revenues also raises questions of bias. Several prestigious providers and professional associations, including the Mayo Clinic

30. Phelps (1992).

31. Rouse and Chalson (2000), citing CyberDialogue, reports several thousand health Internet sites; other estimates are lower. Definition is obviously an issue, as well as turnover and consolidation.

32. A Pew poll found that web surfers use the web more frequently to seek medical information than any other kind of information. "Web Users Search for Medical Advice Most Often," *Wall Street Journal,* November 27, 2000, p. B14.

and Johns Hopkins University, have entered this space, capitalizing on their reputations to signal credibility and quality. One nonprofit foundation, Health On the Net, has a system of voluntary certification (HONcode) to signify compliance with standards for reliability of information, for distinguishing content from advertising, and for ensuring customer privacy. The other route to establishing "brand-name" recognition (and at the same time gain viewers and hence advertising revenues) is through media alliances (such as WebMD with CNN; Medscape with CBS; drkoop.com with AOL). The net effect of opening the floodgates of free medical information will surely be that consumers will become better informed about their medical conditions, possible treatment options, and their choice of providers.

Better consumer information could increase both measured and real productivity of the health care sector in several ways. First, informed consumers should be more productive participants in the care process, with more appropriate initiation of care, better choice of providers, better compliance with treatment regimens, and better understanding of the role of life-style modifications. Second, using disease and product-specific information, suppliers are able to target their product advertising to consumers with relevant health needs, thereby improving advertising efficiency. Pharmaceutical companies also use these mechanisms to target patient recruitment for clinical trials.

Third, increased patient information could increase or decrease the productivity of physicians. On one hand, a more informed consumer can better control a physician who is an imperfect agent. On the other hand, a patient who is misinformed but who wants to be a partner in the decision process may actually increase the physician time required per visit. This additional time spent in discussion does not generally result in additional reimbursement under current fee schedules and may be one reason why some physicians do not welcome the more "informed" patient. Some portals offer physicians their own physician-specific web pages that can be used for selecting the information sources that they recommend to their patients, so that physicians can at least try to steer the patient searching for information in directions that will increase rather than reduce the productivity of the encounter. Sharing of the patient record, scheduling, and reporting test results are other options.

Better-informed consumers may stimulate better price and quality competition. Payers and regulators have initiated systems for generating report cards on provider quality, but the Internet makes them readily accessible to

patients, which in turn should increase providers' incentives to meet quality standards drawn up by the National Committee for Quality Assurance. HealthGrades.com offers direct consumer rating of physicians, hospitals, and health plans. Virtual communities and discussion groups (such as HealthGate.com) also facilitate informal sharing of "reputation" information about providers. Lower consumer search costs could in theory reduce the price of physician services.[33] More competition on quality is another possible effect.

The effect of the information explosion on total health care expenditures is uncertain. Increased consumer awareness of symptoms and ability to recognize treatable diseases could in theory lead to substitution of self-care, prevention, or nontraditional treatment options. However, advertisers will continue to sponsor content sites only if the combined effect of the information plus the advertising increases demand for their products. Internet advertising of health care products has been predicted to grow rapidly. Jupiter Communications projects growth will rise from $100 million in 1999 to more than $700 million in 2004. Since half of the Internet health care advertising is for pharmaceutical products, this estimate suggests an increase from $50 million in 1999 to $350 million for pharmaceuticals in 2004. Skila Health Report estimates that online pharmaceutical product marketing of only $11 million in 1998 (just over 1 percent of total pharmaceutical direct-to-consumer spending) would grow to $890 million in 2002.[34] If use of online medical content indirectly increases the demand for drugs, this may generate additional physician visits to get the necessary prescriptions. Although the Internet is still a small fraction of direct-to-consumer advertising, its share is projected to grow, relative to TV and paper ads, because of its lower cost and better targeting capabilities.

In the long run, improved consumer access to self-education health resources must surely improve real health care productivity, through improved self-care and more productive interactions between patients and physicians, and because less asymmetric information will reduce the potential for inappropriate and unnecessary care and possibly reduce prices, adjusted for quality. Nevertheless, overall expenditure on health services seems likely to increase, particularly for advertised products. There may be concerns that the "digital divide" will exacerbate inequities in access to

33. Pauly and Satterthwaite (1981) find some empirical evidence of this.

34. These estimates appear in Rouse and Chalson (2000, pp. 16, 18).

quality health care for those without connections to the web. Conversely, the Internet may serve as an equalizer. The uninsured may have relatively better access to the free information that is offered over the Internet than they have to the information that requires a visit to the doctor, for which they would pay a higher out-of-pocket cost than would those who have health insurance.

Commerce

E-commerce promises significant potential savings in the purchase of supplies used in the health care industry, although estimates of those savings vary considerably. Savings generated by business-to-consumer e-commerce, such as the purchase of prescriptions or insurance over the Internet, are likely to be much more limited.

B2B COMMERCE. Business-to-business e-commerce offers significant potential savings in supply chain costs to institutional purchasers, including hospitals, integrated delivery networks, physician offices, ambulatory surgery centers and clinics, and long-term care facilities. A large hospital may buy 100,000 items in a year, including medical-surgical supplies, radiology and laboratory supplies, medical devices (such as stents and implants), nonretail pharmaceuticals, and capital equipment, as well as standard items such as food, office supplies, and cleaning and laundry supplies and services. Structurally, the medical products supply sector is fairly concentrated: the five largest manufacturers serve 90 percent of the world's hospitals and provide 70 percent of an average hospital's purchases, but there are a large number of smaller firms and potential entrants.[35]

With more than 5,000 hospitals and 400,000 physicians, plus home health, long-term care, and other providers, the customer base is highly fragmented. This fragmentation has been partly overcome through group purchasing organizations (GPOs) in the hospital, nursing home, and other sectors. These GPOs consolidate buying power to negotiate discounted prices from manufacturers in return for shifting market share to their products and to negotiate product delivery from distributors.[36] Distribution of medical supplies and pharmaceuticals is also concentrated, with a four-

35. Margaret Ann Cross, "Supply Giants Make an Internet Splash," *Internet Health Care Magazine,* May/June 2000, p.10.

36. The GPO power to shift share is limited, however, because GPOs lack enforcement power over their members, who continue to purchase significant fractions of their business off contract.

firm concentration ratio of roughly 75 percent. This reflects significant consolidation in recent years to take advantage of economies of scale in inventory management, EDI processing, and distribution and in offering customers a full product line. Specialty medical equipment and devices are often delivered directly by the manufacturer because personal relationships with the physician customers are important.

Estimates of expenditures on health care supplies range from $100 billion to $200 billion a year, depending on what is included. A widely cited study called Efficient Health Care Response (EHCR), based on 1995 data, estimated supply chain costs at 10 percent of personal health expenditures, or $83 billion in 1995, including costs borne by manufacturers (33 percent), distributors (26 percent) and providers (41 percent).[37] Based on this study, total expenditures are projected at $200 billion, of which $85 billion is medical and surgical supplies, $13 billion is nonretail pharmaceuticals, and $102 billion is office, food, and cleaning supplies and services.[38]

Estimates of the fraction of total costs accounted for by process, rather than product, costs range from just over one-fourth to one-half. The EHCR study reports process costs at $23 billion, or 28 percent of the total, including order management (37 percent), inventory management (25 percent), transportation (24 percent), and physical distribution (14 percent).[39] A more recent survey reports that for some IDN members, supply expenditures (excluding office, food, and cleaning) account for 10–15 percent of their total budget, of which 30–50 percent are medical-surgical supply costs,15–23 percent are pharmacy costs, and 11–24 percent are equipment costs. If processing costs are included, total supply chain costs increase to 25–30 percent of total budget, which suggests that processing is at least 50 percent of the total supply chain cost.[40] Clerical and other personnel often perform multiple functions in addition to supplies processing; hence identifying the marginal cost of supply processing may be difficult, leading to over- or underestimates. It is also likely that this cost of supplies processing is included in the estimate of total administrative cost at 15 percent of health spending.

37. EHCR (1996).

38. Marhula and Shannon (2000, p. 33). Applying the 10 percent to 1999 PCE yields roughly $100 billion for supply chain costs.

39. EHCR (1996).

40. Burns and others (2000, pp. 5–6).

A commonly used basis for estimating the savings from B2B e-commerce is still the EHCR estimate that 49 percent of the $23 billion processing cost (or $11 billion) could be eliminated. More than half of this estimated cost saving came from efficient product movement, and the remainder was from information sharing and order management. Updating these figures by applying the same percentages to 1999 PCE would yield an estimated gross savings of $14 billion before deducting costs of implementation of electronic processing.

Simply updating the EHCR estimate to 2000 levels is unlikely, however, to provide a reliable projection for potential B2B savings going forward. The estimate was based on a comparison of best practices to actual practice in 1995, before the development of web-based processes. Since then, both actual and best possible practices have changed, and the future potential savings could be larger or smaller than 49 percent of current costs. The fact that some savings have already been realized through consolidation of manufacturers, distributors, and providers and that proprietary EDI networks as well as some Internet business have been widely adopted all suggest a smaller potential savings going forward. The five distributors, who collectively process $80 billion annually, or 70 percent of the medical products used by hospitals, physicians, and nursing homes, handled 90 percent of this processing electronically, using proprietary EDI or the Internet.[41] But another survey estimated only $2 billion in commerce-related online business transactions in 1999.[42] These discrepancies may reflect the facts that purchasers have a much lower rate of online order processing than do intermediaries and that much of the intermediary EDI is probably still proprietary rather than Internet-based.

By one estimate, a phone or fax order costs $0.63 a line to enter, an EDI order costs $0.03 a line, and the Internet reduces this to $0.01 or less. Thus web-enabling existing EDI systems may yield only modest additional savings to distributors. But these estimates ignore the potential systemwide savings attributable to network and price reduction effects from Internet-based transactions. In addition, the Internet should accelerate the conversion to electronic purchasing by providers, which still largely use paper, phone, and fax for order entry. For hospitals, ordering is poorly coordinated not only between the largely autonomous departments, but also with

41. Burns and others (2000).

42. Boehm (1999). It is unclear whether this survey includes only Internet activity or also proprietary EDI.

inventory management, and inventories are often excessive. In a recent survey of chief information officers of hospitals and integrated systems, only one reported already ordering supplies online, 31 percent of the 213 respondents said that they planned to begin online ordering in 2000, and another 12 percent predicted that they would move to online supply ordering within two years.[43] Online ordering presumably occurs even less in smaller institutions and in physician offices, where supplies account for only 11 percent of practice expense.[44] Given the advances in web-based technologies but the lag in adoption, it is possible that the gap between actual practice and current best practice is even greater than in 1995. If that is the case, then the potential savings from B2B e-commerce looking forward from 2000 could be greater than the 1995 estimate of 49 percent of processing costs. Some analysts, however, estimate only 25 percent savings from use of B2B by hospitals.[45]

The pace of competitive entry in the e-health B2B space suggests that many see potential opportunities. New online product procurement companies, such as Neoforma.com and Medibuy.com, offer connectivity and an ASP model to link buyers to a large pool of vendors, using either catalogue or auction models, which should offer savings in processing costs and in lower prices. Online ordering should reduce paper, fax, phone, and personnel costs; automated inventory tracking and replenishment systems avoid waste or inadequate inventory levels and off-contract ordering; and invoice disputes should decrease. Some companies focus on specific product lines or market opportunities; for example, one component may provide an exchange for medical supplies between providers and wholesalers, while another component links manufacturers and wholesalers.

Although analysts estimate significant potential savings from online ordering, the fact that providers have not rushed at the opportunity suggests that significant obstacles remain. These include the decentralized administrative structure of hospitals; incompatible legacy systems in the different components of IDNs; and reluctance to invest in the systems and

43. Howard J. Anderson, "CIOs Forecast a Boom in Internet Activity," *Internet Health Care Magazine,* May/June 2000. Of the 65 percent of hospitals with websites, the most common offerings were information about the organization, a directory of physicians and e-mail; 40 percent offer patient education material, 26 percent physician referral transactions, and less than 15 percent offered physician access to records, drug interaction guides, physician ordering of tests and reporting of results. Only 2 percent offered appointment scheduling or patient access to records.

44. Boehm (1999).

45. Burns and others (2000, p. 18).

process reengineering at a time when many have difficulty covering operating costs in the wake of federal cuts in reimbursement levels, the growth of managed care, and the need to comply with HIPAA. But several factors should facilitate adoption of web-based systems. First, the flat or declining pricing environment facing hospitals and other providers implies strong pressure to reduce costs. Second, the growth of ASP options permits outsourcing of the IT responsibility, an attractive option for providers because subscription pricing transfers fixed costs and risk from the purchaser to the ASP supplier. Because fewer privacy concerns are involved in purchasing supplies than in sharing clinical records, ASP models may be adopted first for these B2B functions. Third, the development of standards and the activities of the GPO, distributor, and vendor exchanges should reduce the costs and increase the returns to making the necessary investments. Small scale and low capitalization is likely to slow the switch to online ordering for smaller hospitals, nursing homes, and physician offices unless online purchasing of basic supplies becomes simply one component of standard practice management software.

The price reduction potential from B2B in health care differs across the range of products. Prices for basic supplies and disposables, such as rubber gloves, bandages, and some generic pharmaceuticals, are reportedly already at competitive levels. Online catalogs and auctions may permit some price reductions by facilitating further price comparisons, expanding the possible sources of supply, and eliminating supply mismatches. Leading GPOs and their e-commerce affiliates (including Premier/Medibuy, Novation/Neoforma, Consorta, and HealthTrust Purchasing Group) have recently formed the Coalition for Healthcare Standards to develop common standards, including universal product numbers, for ordering medical, surgical, and other nonpharmaceutical products on Internet exchanges. As this push for transparent catalogue pricing proceeds, one unresolved question is whether actual transactions prices will also converge. Traditionally, manufacturers give discounts ("chargebacks") to large GPOs that are able to move market share toward their products. Essentially, this discount system permits manufacturers to segment the market and charge different prices based on buyer demand elasticity, as reflected in ability to move share.[46] Such price differences benefit large purchasers as well as the

46. For analogous price differences for pharmaceuticals sold for the outpatient sector, see Danzon (1998).

manufacturers, so they may see less advantage in an open exchange system in which prices are at some intermediate level without discounts. If so, large hospital systems may do better by ordering directly from manufacturers, bypassing the GPOs, whose intermediation value is reduced once the web reduces the costs of comparison shopping and order entry. In contrast to the GPOs, the distributors seem more likely to survive, since they perform essential logistics and inventory management functions.

High-end specialty medical devices often have larger margins over marginal cost, reflecting product differentiation, patents, and the costs of research and development. An important obstacle to pure price competition for these products is the role of specialist physicians in selecting the products that they use based not only on price, but also on quality and follow-up service, including having the technician-salesperson present in the operating room when the device is inserted. Because the product lifecycle for many of these devices is shortened by the rapid introduction of new improved generations, price pressure from B2B may be significant for products of older vintage. Similar considerations apply to used capital equipment, for which online auctions may create a significant global marketplace.

The battle is on for the control of the Internet-based health care supply chain, and the long run structure remains uncertain. A number of start-up B2B firms (such as Medibuy, Neoforma, and Broadlane) offer online catalogs and electronic invoices and purchase orders, thereby threatening the traditional turf of the GPOs. Not surprisingly, the major GPOs or their parent hospitals have taken over or formed alliances with these B2B firms, with the GPOs gaining access to the online technology while the B2B firms gain access to the GPO's customer base. For example, two major hospital chains, Columbia/HCA and Premier, are allied with Medibuy, which acquired empactHealth; Tenet, another large hospital chain, partnered through its GPO BuyPower with online supplier Chemdex to form Broadlane Inc.; and Novation, a large nonprofit GPO, awarded an exclusive e-commerce contract to Neoforma in return for a large ownership stake in Neoforma.

In response to this activity of purchasers—who threaten to intensify price comparisons while charging vendors 5–8 percent fees for processing orders—the leading supply and device manufacturers (J&J, GE, Baxter, Medtronic, and Abbott) in March 2000 announced plans for a "Global Health Care Exchange." The exchange, which is to be open to any company that makes hospital products, will serve as a single site where purchasers can

execute and track their transactions. The exchange will not set prices or conduct auctions. Pricing and purchase terms must be settled with the manufacturer separately.

The leading distributors (Amerisource, Cardinal Health, FisherScientific, McKesson/HBOC, and Owens&Minor) have countered with an online industry consortium (HealthNexis) for purchasing drugs, supplies, and laboratory products, in competition with GPO and supplier exchanges. The distributors aim in particular to establish standard product information and simplify the rebate program, in addition to offering online catalogs, order entry, and processing. Competition among these initiatives, combined with standardization, should accelerate the adoption of online purchasing, at least by the larger institutions. Full adoption of a web-based supply chain by the smaller institutions is likely to take several years.

The resulting savings in clerical and inventory costs and possibly some supply price reductions could in theory reduce service fees charged by hospitals, physicians, and other institutional providers, particularly for those services with a significant supply content. In practice, however, the savings as a percent of the total costs is small, so the potential price reduction is probably small. Moreover, any savings may be offset by increased adoption of other new medical technologies, depending on incentives for price competition as opposed to competition on the basis of technology or quality. In that case, real health productivity may increase, but productivity as measured in the national accounts may remain unchanged or fall. To the extent that online purchasing results in disintermediation, with manufacturers shipping directly to the end-user rather than through distributors, shipping costs may appear as income to transportation companies such as Federal Express or UPS rather than as income to health care distributors.

B2C COMMERCE. Business-to-consumer (B2C) e-commerce is concentrated in prescription and over-the-counter pharmaceuticals, medical supplies, health and beauty aids, vitamins, and supplements. One estimate put total B2C at $440 million in 1999 (7 percent of total online health transactions), and projected it would grow to $22 billion in 2004.[47] Other estimates of current B2C commerce are much lower, at $81 million.[48] Estimates of online prescription drug sales in 1999 range from $6 million to $40 million. The federal government has proposed a plan to regulate

47. Boehm (1999).

48. Rouse and Chalson (2000, p. 21).

online pharmacies more closely, but it has not yet been implemented; so far, the only control on online sales is a voluntary certification program operated by the National Association of Boards of Pharmacy. The concerns include illegal online prescriptions issued without appropriate medical exam; substandard and counterfeit products; and (from a supplier perspective) imported products at prices that undercut U.S. price levels.

Although there were at least thirty online drugstores, the stand-alone online drugstore is arguably a flawed business model if it is focused solely on the legal supply of prescription drugs. Consumers cannot legally purchase prescription drugs without a physician's prescription, and if the consumer has insurance coverage, the transaction must somehow trigger reimbursement from the payer to the pharmacist. (Over-the-counter drugs, which do not require a prescription and are typically not reimbursed are a small but growing share of total pharmaceutical expenditures.) Not surprisingly, the leading online pharmacies have either been acquired by or aligned with the bricks-and-mortar pharmacies, which deliver the drugs, and with pharmacy benefit managers (PBMs), which represent the payers, negotiate discounted prices, and reimburse the pharmacy. For example, the drug store chain CVS purchased Soma.com, an online pharmacy, and aligned with the PBM Merck-Medco. Another PBM, Express Scripts, purchased part of the online PlanetRx, which is aligned with distributor McKesson. Ultimately, multiparty agreements seem more likely, assuming that online pharmacies will want to give consumers access to their PBM and their neighborhood pharmacy, whichever that may be.

The savings from online prescriptions are limited until physician prescriptions can be transmitted directly online to the pharmacy, eliminating the need for the patient to take a paper script to the pharmacy. Exceptions are chronic medications (34 percent) and refill prescriptions (estimated at 50 percent of all prescriptions, presumably including chronic medications).[49] Many PBMs already handle these drugs through mail order, however, which permits the PBM to save the pharmacy dispensing fee, to substitute a lower-cost drug where possible, and to reduce the time costs for the patient. Online pharmacies thus offer little in addition to existing mail order services, at least until the physician prescription is transmitted directly online to the pharmacy. Online prescribing combined with online pharmacies will offer significant savings in physician and patient time, plus reduced medical error. For purposes of national accounts, consumer time

49. Rouse and Chalson (2000, p. 20).

savings will not be captured; rather, they may show up as increased expenditures on overnight and other delivery companies, as in the case of mail order.

Given these obstacles to buying prescription drugs directly over the Internet, it is not surprising that a major share of sales of online pharmacies are vitamins, nutraceuticals, over-the-counter drugs, and health and beauty aids, for which prescriptions and reimbursement are not an issue.[50] Online pharmacies, like other consumer portals, are likely to derive their revenue partly from advertisers such as pharmaceutical companies, which may find this a cost-effective medium for targeting specific patient subgroups and for recruiting patients for clinical trials.

ONLINE INSURANCE PURCHASING. The potential savings from online purchase of health insurance are probably small. Although web-based insurance distribution has potential to reduce costs relative to traditional agency distribution, significant scale economies have already been realized for most health insurance because of employer sponsorship. Roughly 80 percent of private health insurance is obtained through employment, which significantly reduces the costs related to selling and enrollment and eliminates costs related to medical underwriting, at least for medium and large groups. Employers may reap some savings from using the web to comparison shop for health insurance products and from moving their employee benefit functions online, using the web to give employees information about health insurance options and to streamline the open enrollment process. The potential for online purchasing of individual insurance is limited to those who do not receive health insurance through their employer and to supplementary and disability policies.

The potential savings from e-health insurance would be larger if employers follow through on threats to drop their group plans or convert them to defined contribution plans, in which they make a fixed contribution to each eligible employee but leave the employee considerable autonomy in choosing how that contribution is spent. Some start-up companies are developing products that offer alternative networks of physicians to employees with these plans. Another potential use for e-health insurance is the Medicare+Choice program, which offers seniors the choice of private health plans as an alternative to the traditional Medicare plan. Similarly, if

50. There are online pharmacies that sell drugs either without a prescription or with the prescription available after the consumer responds to a few questions online. This phenomenon is likely to be confined to so-called "life-style" drugs, such as Viagra (for erectile dysfunction) or products for baldness, weight reduction, and the like, which are less likely to be covered by insurance.

a Medicare prescription drug benefit is added in a form that offers choice to seniors, the web could be a useful vehicle for disseminating information on plan options and handling enrollment.

Currently available business models illustrate these alternatives, including defined contribution plans with community healthcare exchanges (MyHealthBank.com); cafeteria-style health plans allowing the beneficiary to build his or her own provider panel within an employer-budget constraint (Vivius.com); online brokers of health plans to employers with online auction for managed care organizations to bid for employer contracts (Sageo.com); online medical savings accounts (HealtheCare.com); and high-deductible catastrophic coverage for individuals (eHealthInsurance.com)

One issue facing insurance providers in any medium is the risk of adverse selection. Online distribution lacks the personal interview and even the phone conversation, which insurers may use to obtain health risk information. Nevertheless, online enrollment may achieve more positive selection than insurance that is sold over the phone, if high-risk individuals are reluctant to report their conditions over the Internet, or if those who use the Internet are on average better educated and have higher income, factors that tend to be positively correlated with health. Online insurers may also choose not to operate in states that require guaranteed issue and community rating (that is, the insurer must take all applicants at standard rates).

Care: E-Medicine

The Internet offers several new production possibilities for health care, although regulations constrain the practice of medicine online.

The online provision of care by physicians to patients seems likely to be limited to various uses of clinical messaging (e-mail) such as online health questionnaires, requests for a prescription refill, a specialist referral, or feedback for follow-up purposes. Although surveys vary widely, one reports that only 10 percent of physicians say they use e-mail to interact with patients.[51] E-mail is more likely to substitute for phone calls than for visits, however, not only because of the importance of the physical exam, but also because of liability risks. Moreover, payers may be reluctant to reimburse for e-mail "visits" if these are more prone to patient moral hazard and

51. (www.medem.com/Corporate/press/corporate_medeminthenews_press023.cfm); Westberg and Miller (1999).

harder to monitor for appropriateness, and physicians may be concerned about responding to unnecessary e-mail visits, once travel time is eliminated as a cost to the patient. Some health plans offer interactive gatekeeper or call centers that handle simple questions. This could increase physician productivity, by reserving the physician/patient encounter to address more serious questions.

Patient participation in health production may be enhanced through online monitoring and post-treatment disease education and management, and through self-care. Some health plans encourage patients to complete online risk assessments, track their own health status in a personal database, and interact with the plan to monitor compliance, for example, with drug regimens. More generally, the Internet should reduce the cost and improve the effectiveness of disease management programs that are operated by health plans, pharmaceutical companies, hospital systems, and others. These programs target patients with chronic conditions such as diabetes and asthma, who account for a large and growing fraction of total health spending. Patient compliance with basic regimens, such as glucose monitoring, can avert costly acute episodes.

Care-related savings from use of online medical records and online prescribing have already been discussed. More generally—and even harder to measure—the Internet may accelerate the diffusion of new technologies such as new surgical techniques, by increasing awareness of and education in using the new techniques. Since new technology is the main driver of rising health care spending, this acceleration could stimulate spending growth, to the extent that lack of knowledge is the binding constraint on diffusion. This impact will be less if the binding constraints are more often lack of third-party reimbursement or the insufficient scale of smaller hospitals and physician offices to support capital expenditures in the technology.

Internet-based telemedicine may increase access to both physician visits and some specialty care in remote locations, prisons, and in other situations where patients and providers cannot easily meet face to face.[52] Centers of excellence in highly specialized fields may expand their market reach through the Internet. An example is teleradiology, which offers remote reading of diagnostic tests. In general, however, the much-touted boom of telemedicine seems to have fallen flat, and health care delivery remains a predominantly local industry.

52. See Darkins and Cary (2000) for an overview on telemedicine; also Mandl, Kohane, and Brandt (1998).

Online clinical decision support using expert systems has already been discussed. Online access to clinical data repositories for measuring and monitoring outcomes not only serves to inform consumers, as discussed earlier, but also provides a knowledge base and incentives for providers to benchmark and improve quality of care. Several states have mandated the collection of hospital discharge data through health data organizations for provider report cards and population-based outcomes research.[53] Hospitals and insurers create data warehouses to profile physician-specific practice patterns, identify performance improvement opportunities, and define clinical pathways.

The Internet facilitates such data collection and dissemination. Other obstacles to dissemination remain, however, including conflict over data ownership and incentives for institutions to use IT and knowledge management as a strategic weapon to gain competitive advantage. There may be a conflict between the need for proprietary intellectual property rights, in order to encourage innovation, and the "public good" interest in the widest possible dissemination of information, for example, on outcomes and best practices. Greater knowledge that improves real health productivity from given resources will not be reflected in national accounts, whereas data collection and mining costs may show up in the costs of hospitals, physicians, or employee benefits managers.

The Internet and the Pharmaceutical Industry

Pharmaceuticals account for about 10 percent of health expenditures and have been the most rapidly growing component in recent years. The growth has been driven primarily by increased insurance coverage, leading to more prescriptions and patient switching from older, less costly drugs to newer, more effective, or more convenient products that are often more expensive. The impact of the Internet on the pharmaceutical industry—particularly on its research and marketing practices—is somewhat different than for service-oriented medical providers and is therefore discussed here briefly.

The cost of bringing a new drug to market has been estimated at more than $500 million, including the costs of failures and interest costs over the twelve or so years of the research and development (R&D) process. Drug discovery has been revolutionized in recent years, moving from a random search for active compounds toward rational drug design, based on

53. Donaldson, Lohr, and Bulger (1994).

genomics and microbiology and using technology intensive tools such as combinatorial chemistry, high throughput screening, and robotics. The most costly part of R&D is development, which includes refining the formulation and dosage of a promising drug candidate, then testing in human clinical trials to demonstrate safety and efficacy, subject to approval by the Food and Drug Administration (FDA) in the United States and similar regulatory bodies around the world. These trials are often global and on average take more than six years and tens or hundreds of millions of dollars, plus forgone interest on the funds invested and loss of patent life attributable to delay in launch.[54]

The Internet may reduce these high costs of drug R&D in several ways. The new tools of drug discovery are extremely data intensive, and the Internet facilitates the efficient management and manipulation of data. Enrolling patients and physician investigators for trials through disease-specific websites could cut several months off the typical time required. Even bigger savings could be realized if data collection during trials could be moved online, with electronic submission initially from clinical investigators worldwide to the host company, and then from the company to the FDA, yielding savings in clerical time, paperwork, and data error. B2B procurement of supplies for drug manufacturing and other operations should save administrative costs and possibly reduce some supply prices though online bidding, similar to B2B in other industries.

Pharmaceutical marketing has traditionally focused on "detailing" of individual physicians by trained representatives. This is an enormously costly and time-consuming way of getting information and samples to physicians. Many physicians limit the encounter to one or two minutes per representative, and some health plans do not permit such detailing. Online physician detailing and symposiums could potentially reduce the drug company's costs of detailing; for the physician, time costs may be the same but scheduling of the online detail could be more convenient. Since regulations on direct-to-consumer (DTC) advertising were relaxed in 1997, DTC advertising has expanded rapidly through all media forms. As already noted, online DTC advertising on disease-specific websites lowers advertising costs to pharmaceutical companies while allowing them to target patients more effectively.

These uses of the Internet to increase efficiency in R&D and marketing should in principle reduce the cost of developing and marketing a given drug. This tendency for cost reduction per drug may be offset by changes

54. Pharmaceutical Research and Manufacturers Association (2000).

in the type and cost of drugs produced; for example, genomics and bioinformatics make possible the development of drugs that were inconceivable under traditional discovery methods, leading to higher failure rates and costs, at least initially. Similarly, Internet-based marketing may be used as a complement rather than a substitute for other forms of marketing, leading to higher total sales for a given drug. If so, real health of patients should increase, but total expenditure on drugs is also likely to increase.

The Economic Impact of E-Health on Competition

The effect of Internet initiatives on competition in health care can be related to each of the four Cs. At a minimum, the start-up Internet firms put competitive pressure on incumbents in several areas. More broadly, Internet and other information technology strategies may offer new ways for providers, suppliers, and payers to compete on price and quality.

The start-up Internet firms that use the ASP model to offer claims processing to physicians and hospitals may not yet be a significant competitive threat to incumbent EDI providers, but that could change as more health care providers and payers sign up and network effects take hold. HIPAA-based standardization may be a significant impetus to this trend. Established EDI providers are responding to the new source of competition by developing their own web-enabled systems. Whoever the winning players are, it seems likely that ultimately the winning products will be those that offer the physician's office a full product line in a single package that includes claims processing; some electronic medical records; access to web-based content and decision support; online prescribing, scheduling, and referrals; interactions with patients through e-mail; and interactions with other network participants. Winning systems are also likely to be open to adding on new, specialized products as they are developed. Because proprietary EDI systems have less flexibility in adding new and more complex products, web-based products are likely to dominate. The one possible exception to this is the electronic medical record. For this clinical information, privacy is a greater concern and the web-based ASP model is more vulnerable than proprietary systems. But given the cost savings and convenience of a single product suite, it seems likely that the medical record will ultimately be included in the web-based product portfolio for physicians' offices, once the other components are widely available and in use. Widespread adoption of the single product suite ASP model may be several years away, but if it is

widely adopted, the overall systemwide savings could be billions of dollars a year from reduced administrative cost; less medical error and unnecessary care; and more productive physicians, office personnel, and patients. Of course, the savings to the health care system could be less, to the extent that the vendors of these services capture part of the savings through their pricing strategies. But these markets seem highly contestable, so competitive entry should reduce prices to competitive levels and possibly lower, if advertising remains an important source of site revenues.

The Internet may stimulate competition between providers, as report cards and chat rooms disseminate information about perceived quality. Some physicians may also compete by offering Internet services, such as e-mail and online appointment scheduling, or by offering websites with patient-targeted content that they are willing to discuss during visits. In general, there may be both quality competition and price competition, with net effects uncertain.

Large hospitals and IDNs may be able to support the fixed costs of proprietary systems. If these can be used to improve care quality, through reduced medical and prescription error and better clinical protocols, they can significantly reduce costs and gain at least a medium-term competitive advantage on both cost and quality, relative to competitors that have inferior information management systems. Indeed, now that the potential savings from reducing inpatient days have been largely exhausted, achieving significant cost reductions will require changing practice styles to eliminate waste, error, and suboptimal practices. These potential savings in clinical costs are likely to yield sustainable competitive advantage; by contrast, savings in administrative costs from moving to web-based claims processing or B2B procurement could yield large, ongoing cost savings, but these are accessible to all competitors and thus will not give a sustainable competitive advantage to any single firm.

The start-up B2B firms that offer online catalog and auction models for supply sourcing are posing a significant competitive threat to the GPOs. The B2B firms offer hospitals and other institutions the opportunity to move to web-based supplies procurement, thereby cutting their processing costs in addition to possibly getting lower prices than the GPOs can negotiate. Thus in the long run GPO functions seem likely to be absorbed by web-based marketplaces or exchanges, whether run by the GPOs or by start-up Internet competitors.

The use of online catalog and auction models will stimulate competition in the medical supply sector, with the greatest effects likely for product

lines where quality differences are small and price competition predominates and can intensify; lesser effects are likely for the highly specialized devices. Similarly for pharmaceuticals, online catalogs and auctions may stimulate even more price competition for multisource, off-patent products with several generic producers. For on-patent, single-source drugs, aggressive price competition is more likely in therapeutic classes with multiple compounds with the same mode of action and very similar effect profiles than in therapeutic classes where each compound has significantly different effects or side-effects.

The Economic Effect of E-Health on Productivity

The production function of health H embeds the production functions of the various medical services, $M_1 \ldots M_n$, which use as inputs specialized labor L, capital K, and information I; inputs of patient time T and nutrition and life-style N, both of which depend on the patient's knowledge base I_p; and other social and environmental factors E and genetic makeup G:

$$H = h\,[M_1(L_1, K_1, I_1); M_2 \ldots M_n(L_n, K_n, I_n); T(I_p); N(I_p); E; G]. \tag{7-1}$$

Since the true output H is intangible, measurement focuses on observable medical services. Medical care expenditure is not defined in the NIPA. The PCE accounts do measure purchases of medical goods and services by individuals, including services financed by private or public insurers, and premiums less benefits and dividends for medical and hospitalization insurance, including workers' compensation. The other components of GDP—gross private domestic investment, exports, and government consumption and investment—include other components of spending related to medical care, but these are not always identified separately. The share of GDP accounted for by these NIPA medical expenditures has been 0.3–0.5 percentage points less than the HCFA's estimate of total personal health care.[55]

Real output and productivity are generally obtained by the double deflation method, which separately deflates output and input expenditures by their respective price indexes. Measures of productivity are therefore only as accurate as the price indexes used to derive them. The medical care

55. McCully (1999).

components of the consumer price index (CPI) were used to deflate health expenditures until recently. But the medical CPI is a measure of prices paid by consumers and does not include prices paid by third-party payers, which now account for roughly 80 percent of total expenditures, more for hospitals and physician services and less for other medical services. Moreover, the CPI traditionally priced individual medical service inputs, such as a hospital room, rather than some quality-constant measure of output of health. Between 1985 and 1995, while the overall CPI rose 3.6 percent a year, the medical components rose 6.5 percent, in part because with this measurement methodology, the CPI measured all quality-related price increases as excess health inflation.

In the 1990s producer price indexes (PPIs) were substituted for CPI components for hospitals (1993), physicians (1994), nursing homes (1995) and home health (1997). PPIs are superior in that they include care financed by third-party payments and are based on more appropriate output measures for some services. For example, the PPI for hospital services uses a probability sample of medical conditions, based on diagnosis-related groups, and then tracks the change in the cost of treating each condition.[56] In the 1990s measured medical price inflation slowed, from nearly 6 percent a year, from 1991 to 1993, to near 4 percent in 1994 and 1995, and to just over 2 percent from 1996 through 1998. Although it is tempting to attribute this apparent price deceleration to productivity growth spurred by information technology, the deceleration more likely reflects the shift to PPIs from CPIs.[57] The PPIs also reflect the lower prices paid by managed care plans and their gain in market share relative to traditional indemnity insurance.

The Bureau of Economic Analysis (BEA) data show the health services sector employs 6.9 percent of the labor force and has relatively low labor productivity: $45,000 in health care compared with $57,000 in all services and $59,000 in manufacturing (1992 data).[58] Moreover, average labor productivity growth in health was –2.2 percent for the years 1987–97, which implies a slowdown of –2.8 percent, compared with a 0.6 percent average annual growth rate estimated for the years 1960–73. The story for multifactor productivity is similar, based on a BEA estimate of the net stock of

56. Catron and Murphy (1996); Berndt and others (1998).

57. McCully (1999) reports that from 1994 to 1996, the PPI for hospitals increased at 3.2 percent a year, compared with 5.1 for the comparable CPI; from 1995 to 1998 the PPI for physicians' services increased 2.0 percent a year, compared with 3.5 percent for the CPI.

58. Triplett and Bosworth (2000).

plant and equipment as a proxy for an index of capital inputs. But these estimates of health care productivity growth may be seriously downward biased by the upward bias in health care price indexes.

At least two dimensions of e-health activity are likely to increase real health productivity. First, the vast increase in free medical information that is available online to patients and physicians should increase productivity of resource use throughout the health care industry, as patients play a more informed role and physicians make better informed diagnoses and treatment choices. This could result in an increase or decrease in total expenditure, with differences across services. In particular, use of pharmaceuticals is likely to increase due to online advertising, which is a major source of funding for e-health sites. Some of this increased use may be appropriate, as patients learn more about their symptoms and availability of drugs to treat them; some of the increased use may be less appropriate but demanded because of insurance. This tendency for insurance to stimulate overuse (moral hazard) is no different for Internet-induced care than for services the patient learns of through other media.

Second, although content sites give physicians better access to general medical information and online decision support, electronic medical records will ultimately make the patient-specific information more readily available and hence reduce errors as well as duplicative and inappropriate care. This should reduce inappropriate use of medical resources and hence reduce measured expenditures. Real health productivity should increase, but this increase will not be reflected in the national accounts, except to the extent that a healthier work force is more productive generally.

Conclusions

Undoubtedly the Internet will ultimately have a major impact on the health care sector, improving information available to consumers and providers and reducing the large share of total expenditures that is currently spent on administrative costs and on unnecessary and inappropriate care. But achieving these savings is several years away. The recent decline in market valuations of e-health firms probably reflects more realistic estimates of the time and costs involved in realizing the potential. Major hurdles must still be overcome, including rolling out and implementing HIPAA standards for electronic claims, medical records, and privacy; combining the various components of the ideal physician office

suite into a simple and cost-effective package; and making the new technologies sufficiently attractive to encourage adoption by physicians and hospitals.

Estimates of savings or effects on competition and productivity attributable to the Internet are highly speculative because the ultimate technologies and the rate of uptake are still uncertain, and effects on prices are uncertain. Moreover, health care delivery is likely to remain highly fragmented, which means that diversity in practices may remain. Nevertheless, with all these caveats, the ultimate potential savings are probably equal to at least one or two percentage points of total health spending. This may not show up as lower total spending because of offsetting pressures to increase utilization, including more rapid adoption of newer and more expensive medical technologies and increased use of drugs and other products. Even if the net effect is for little decrease or even an increase in the rate of growth of health spending, real productivity in the health care sector is likely to increase. But these improvements in real health will not be captured in the national health accounts.

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