

e-Health: Effects of the Internet on Competition and Productivity in Health Care

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## Introduction

National expenditure on medical care reached \$1.2 trillion or almost 14 percent of GDP in 1999, up from 8.9% of GDP in 1980, and is projected to reach \$2.13 trillion in 2007. 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 IT has not been widely integrated into health care's basic administrative processes and business functions. The internet offers the potential for cost reduction and improved productivity in many of these functions. The main potential targets for savings are: 1. administrative cost related to insurance billing, medical records and care coordination, which has been estimated at 19 percent of total spending;<sup>1</sup> 2. costs due to inappropriate care and "medical error" that result from physician uncertainty about best practices, or incomplete patient records and poor care coordination, which has been estimated at 4% of total health expenditures;<sup>2</sup> 3. "unnecessary" care, which has been estimated at 20% of the total,<sup>3</sup> much of which is insurance-induced overuse that occurs because insured patients are not cost-conscious (moral hazard); and 4. costs associated with purchasing and supply chain, where estimated savings from moving to B2B e-commerce are under 1% of total health care spending. Even if these estimates are exaggerated, include some duplication and reflect some costs that could not be totally eliminated, nevertheless, there is 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 this is not captured by standard GDP measures. But better employee health could increase labor productivity economywide, by reducing workloss due to disability and illness. Recent estimates show 13.6 percent of the total population and 22% of the 45-64 age group suffers an activity limitation due to chronic medical conditions,<sup>4</sup> and this does not include acute conditions or time out to care for sick family members. Second, because 45% of total health expenditures is tax-financed public spending, primarily the Medicare and Medicaid programs, any factor that controls these costs could reduce tax burdens and hence indirectly benefit the rest of the economy.

Some of the internet business models, such as B2B e-commerce, are similar in health care to other industries, although the potential savings may be slower to achieve in health care because of its fragmented structure. Other internet opportunities are more health-care specific, in particular, those that address costs related to imperfect/asymmetric information and to insurance/third party payment, which underlie the high costs of administration, medical error and unnecessary care.

In this paper, sections II and III outline the structure of the health care sector and its distinguishing features, as a foundation for understanding the potential role of IT and the internet. The following sections describe internet activities in healthcare, broadly categorized by the four Cs of connectivity, content, commerce and care. Effects on competition and on measured and unmeasured productivity are suggested. The concluding section summarizes findings.

## II. Industry Background

### 1. Industry Structure

Table 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 over one third and 20 percent, respectively, of PCE. Other providers include home health, nursing homes, ambulatory surgery centers, dentists and other professionals etc., with a steady shift of care from inpatient hospital 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 (see Table 2), 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 physician offices, home health and possibly other services. This consolidation was partly motivated by the hope of economies of scale and efficiency savings in coordinating care, drawing on new IT opportunities. 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 (internal medicine, emergency room, intensive care, etc.) remain poorly coordinated. Incompatible legacy systems are often 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. According to a recent survey, the top IT priorities of health care organizations over the next two years are electronic medical records, integration and improved connectivity with physicians.<sup>5</sup>

### 2. 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 fact over 80 percent of personal health care is paid through insurance, including much of care that is routine and predictable. Administration and net cost of private insurance are estimated at 5.1% of personal health care (see Table 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 over 30%. Given this subsidy, which is estimated to cost over \$100b. in foregone federal and state tax revenues, 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, since medical providers typically collect a co-payment from the patient and bill the patient's insurer for the remaining cost of the service, which may entail eligibility verification, pre-service authorization and/or post service benefit denial etc. A potentially much larger cost results from the "moral hazard" effect of insurance, that is, the tendency for insured patients and providers to overutilize services because someone else is paying the bill, and potential for excessive prices because insurance makes demand less elastic. Estimates of unnecessary care differ, depending on whether the definition is economic (marginal benefit less than social marginal cost) or based on a notion of medical appropriateness, but given the incentives, the number is surely large.

Given the moral hazard effects of insurance, 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 of moral hazard and monitor care quality.<sup>6</sup> The managed care revolution reflects a shift from the traditional patient-targeted approach of controlling costs through co-payments, towards provider-targeted incentives and controls, such as capitation payments, utilization review, selective contracting etc. These managed care strategies add administrative cost, but this is usually offset by lower care costs, due to either lower prices or fewer expensive services, and less financial risk for patients. Thus administrative inputs produce several joint products – billing/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 moral hazard control and improved clinical care, which may be much harder to measure.

The private health insurance market is extremely fragmented (see Table 3), 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, minimum benefits and, in some cases, regulate premiums and underwriting. Partly to help multi-state employers deal with divergent state regulations, the Employee Retirement Income and Security Act (ERISA) of 1974 established federal oversight over employer sponsored health plans that are self-insured. Most large firms and a significant fraction of medium sized firms are now self-insured, but often use a third party administrator (TPA), to design and administer benefits.

Public spending, which accounts for 45% of the total, is dominated by the Medicare program which covers seniors, the permanently disabled and those with end stage renal disease. Traditional Medicare, which is a

federal program run by the Health Care Financing Administration (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, with an expenditure share still under 16% of total Medicare spending. Medicaid is a federal-state program to cover 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 programs include the Veterans' Administration, the Indian Health Service, and many smaller state programs.

Thus private initiative and public regulation have resulted in great fragmentation and diversity in the health insurance industry. The upside is that this diversity reflects a very competitive insurance market place, with continual innovation as plans compete on cost and quality. One downside of diversity is the administrative complexity, as physicians and hospitals deal with multiple plans, which differ in benefits covered, billing and reimbursement protocols. But since 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, with possibly additional benefits of better control on excess utilization and more appropriate care. As discussed further below, the Health Insurance Portability and Accountability Act (HIPAA) of 1996 will establish federal standards for electronic transactions and security, which should accelerate realization of these savings.

### III. 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:

#### 1. Imperfect Information

Imperfect information underlies the structure and many of the problems in health care. This was pointed out by Kenneth Arrow in 1963; since then, medical technologies have become far more complex and imperfect and asymmetric information remain.

Consumers When illness strikes, consumers have traditionally had little information about potential diagnoses, appropriate providers and treatments, and hence have relied on physicians as agents to advise on appropriate treatment as well as to implement care. Physicians often face a conflict of interest in their role as advisor and supplier, leading to concerns over care quality and charges of "supplier-induced demand". Arrow

(1963) argues that 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 not-for-profit status of hospitals. 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 roughly 80% of health spending, although their own income is only 20% of the total. The internet offers an unprecedented source of free information for consumers on diseases and treatment options, products, provider report cards, alternative medicine etc. that is already contributing to the 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 there is widespread lack of medical consensus on best practices. Numerous studies have documented large variation in treatment patterns for the same condition across geographic areas, with significant associated cost variation that is not correlated with outcomes. Physician uncertainty about best practices is the most plausible explanation for these practice variations, which cannot be fully explained by patient demographics or insurance coverage. Phelps (1992) has estimated significant welfare loss from these practice variations, which is separate from and in addition to the insurance-induced loss due to moral hazard. Physician-oriented portals seek to address this information challenge faced by physicians, offering on-line access to medical information, decision support systems, on-line continuing medical education, etc.

Medical specialization and the fragmentation of care delivery is a further consequence of the technological complexity of medical care. General practitioners typically act as gatekeepers who form a preliminary diagnosis and then may order additional tests and refer patients to specialists. A single episode of treatment may thus entail visits to a GP, a specialist, tests read by a radiologist, a prescription for drugs that are delivered by a pharmacist, and possibly hospitalization, post-op therapy etc. 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 largely on phone, fax or mail. The resulting costs include not only administrative staff to handle the paperwork but also – possibly 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 into integrated delivery systems was premised in part on the value of shared information amongst multiple organizations across a continuum of care. 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 CIOs are skeptical about further investments. Other priorities that have preempted the limited human and financial capital available to hospitals include not only Y2K preparation, which was literally a life or death issue for health care institutions, but also changing regulations and surviving under declining reimbursement after severe cuts in the 1997 Balanced Budget Act.

The 1990s also spawned a renewed vision of idealized community health information networks (CHINs), of which some failed, others became operational via vendor-sponsorship (e.g., Wisconsin Health Information Network), and others remain works-in-progress. Although the internet may facilitate some goals of the CHIN movement, it seems plausible that the important steps will be the proprietary networks and systems, linked to medical records which will remain private.

Payers Payers, like patients, traditionally depend on physicians to determine appropriate care. This obviously limits their ability challenge unnecessary expenditures that benefit the patient/physician team but that are not cost-justified. The internet offers significant improvement in at least two ways. First, on line connections between providers and payers can provide real time information on coverage limits, practice guidelines etc. to the provider at the point of care. Modifying the course of treatment or choice of drug ex ante is potentially far more cost effective than the current ex post review process, in which reimbursement denial for services already rendered or scripts already written is a major source of time waste 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 care quality 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 both need to be able to evaluate the quality of care, controlling for other factors that affect observed outcomes, such as the patient's underlying disease severity. 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.

## 2. 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, which have been followed by some private plans. The 1996 HIPAA also implies a significantly greater role for the federal government in setting national standards. Pharmaceuticals (and some

medical devices) must obtain FDA approval of safety and efficacy before launch and 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 these costs of compliance with some of these regulatory requirements. On the other hand, the increased regulatory demands to assure privacy and security of electronic communications may mean that, on balance, the internet may add to regulatory burden, at least in the near term.

### 3. Privacy

Medical information is extremely sensitive, with legitimate fears that it will be misused, leading to discrimination in employment, in insurance purchasing etc. Concern to assure privacy of personal records is probably 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 as in the US, nevertheless have even less coordinated medical records, because they have rejected the idea 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. It remains to be seen whether these security concerns will undermine the widespread adoption of ASP models for medical records, although ASP models offer much lower cost and financial risk for providers, but with the downside of loss of control and increased security risk.

### 4. Competition and market power

Price competition in health care has increased in recent years but is problematic as long as information about quality is imperfect, such that price may be a signal of quality. Moreover, for research-based pharmaceuticals and specialty medical devices, patents are granted with the intention of limiting competition from perfect copies. Nevertheless, the internet should improve consumers' and payers' information about provider quality (e.g. through report cards) 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 on-line auctions, as discussed below.

#### IV. e-Health Initiatives

e-Health initiatives have been categorized as the “four Cs” of connectivity, commerce, content and care. In practice, of course, this is an arbitrary division due to spillovers and joint products – 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 content, connectivity, care support and commerce in a single desktop interface, in order to offer maximum convenience and ease of operation to the physician customer. Nevertheless, in order to understand the various opportunities for savings and the associated strategies of e-health businesses, we consider the four Cs in turn.

##### 1. Connectivity

Estimates of administrative cost as a percent of total health spending range widely. The NIPA estimate of administration cost is 5% of PCE, but this omits costs incurred in physicians’ office, hospitals and other providers. Lewin VHI (1993) estimates 19%, which is in the range of reasonable estimates. Wide variation in estimates of current costs and potential savings is not surprising due to joint production of administrative and clinical functions by clerical personnel. Note that patient time spent submitting claims etc. is not included, 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 percent 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; reduced physician and patient time; and reduced 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 reports
- real time verification of reimbursement eligibility
- claims processing
- appointment scheduling and referrals
- patient education and interaction
- compliance monitoring

In practice, achieving this in one system is some years away. However, significant advance is underway in the separate components of claims processing, practice management and medical records.

Claims processing. The most basic opportunity is to use the internet to process transactions between providers and insurers, to reduce billing and reimbursement costs. There are currently about 400 formats for electronic health claims in use in the US and each provider typically submits claims to multiple plans that use different formats. Specialized data clearing houses have emerged as intermediaries to offer electronic data

interchange (EDI) services that transmit claims from providers to payers in a standardized format over propriety networks, thereby realizing some savings from consolidation, reduction in personnel and processing time and reduced error associated with paper claims. EDI providers claim to reduce cost per claim from \$10-15 using paper to \$2-4 per EDI claim.<sup>7</sup> Web-based connectivity providers charge \$0.02-\$0.03 per 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. Although 62% of claims are processed electronically, this includes only 40% of physicians' claims, compared to over 80% for hospitals and pharmacies (see Table 2).

Although previous attempts to improve connectivity and coordination of care have had limited success, the internet provides a missing link, with lower cost connectivity and vastly improved functionality, including greater network potential and potential for more complex data to be shared, including eligibility verification and clinical information that has not moved to EDI. Moreover, the internet permits new ways of outsourcing IT, in particular, remote hosting of software applications by application service providers (ASPs). The ASP model offers lower hardware and software acquisition costs, lower system maintenance costs, faster implementation time and easier upgrades, and faster deployment over geographic areas. Potential problems include some loss of managerial control and lack of accountability. 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 are not for IT implementation. One factor contributing to the slow uptake of these systems is surely lack of standardization and security risks that raise costs and reduce expected benefits.

To address these issues, the Health Insurance Portability and Accountability Act of 1996 (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, referral certification and authorization. Standards are also to be set for unique identifiers for each individual, employer, health plan and provider and 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 24 months (36 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 at \$3.5-4.0b. 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 these rules as \$29.9b. for the ten year period 2002-2011, of which \$13.1b. accrues to health plans and \$16.7b. accrues to providers. The discounted present value of these savings is estimated at \$19.1b., 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. In particular, it assumes that only 11.2% of the growth in electronic claims in the 10-year period is attributable to HIPAA. Thus the total net savings from switching to web-based claims could be 9 times larger or almost \$270b. undiscounted over the 10 year period, assuming a similar rate of net savings for the 88.8% of switching that is not attributed to HIPAA. 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 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. These estimates are based on 1993 data, and seem conservative based on current per claim charges of internet companies, which are under \$0.10. Moreover, web-enabling claims processing could yield spillover benefits that encourage adoption of other online technologies. Additional impacts of administrative simplification are also not included. These estimates of net savings do not include Medicare and Medicaid, which account for over 30 percent of total spending. On the other hand, 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, this would still be almost 2% of total health expenditures ( $.1 \times .19 = .019$ ), or \$20b. per year. This estimate could be too high or too low, depending on how much of the estimated total administrative cost of 19% of PCE reflects the marginal cost of

claims handling, as opposed to other administrative functions that may be less amenable to moving on line.

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 services). Currently, these reimbursement decisions are typically made after the physician has provided the service, prescribed the drug or made the referral. Ex-post claims adjudication leads to challenges, time and aggravation for the provider, the patient and others. 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 non-preferred (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 ex-post 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 of plans and payers, and the consolidation of physicians into group practices, physician networks, etc. The make or buy options for proprietary systems entail high upfront and maintenance cost, and risks. Management services organizations (MSOs) have developed to offer outsourced practice management but have had limited success. The internet has enabled the development of application service providers (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; adding medical content and product procurement for supplies is a possible further extension. The ASP model eliminates the need for expensive hardware and software and the staff to maintain it, hence reduces the risks associated with large capital investments and facilitates upgrades. This may facilitate the automation of some office practices, such as online appointment scheduling, document imaging and storage, and hence some savings in clerical staff, or substitution of more skilled IS staff.

Who will capture the savings from moving claims processing and other associated business functions online remains to be seen, and the outcome may be a few national players or different regional patterns. 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, Healtheon/WebMD acquired the electronic health transaction firm Envoy Corp., with processes about 1b. claims a year, mostly over private networks. WebMD plans to switch these claims to the internet. In order to increase its physician subscriber base, WebMD has also acquired Medical Manager Corp. and CareInsight, 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, referrals to specialists etc. 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,

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/employee customers and for providers to participate in their networks, competitive pressures should move the market towards 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 (EMR) 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 EMR, 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. Nevertheless, uptake has been slow 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 operating costs are relatively low, particular if the personnel who handle the charts also do appointment scheduling, billing, dealing with patients etc. Even in the longer run, reduction in clerical staff may be limited unless multiple office functions are simultaneously converted to electronic. 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 towards large scale adoption of EMR with full potential savings is to make this easy for physicians. Surveys repeatedly show that physicians will only use computerized technologies 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 current practice of dictating their 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 recently acquired by MedicaLogic, presumably to encourage adoption of the electronic record by physicians who have already accepted dictating. In addition, MedicaLogic recently bought Medscape, one of the leading physician content portals which has some 280,000 physicians registered to use its online services such as access to peer reviewed journals.<sup>8</sup> Like other leading physician portals, the strategy is to offer physicians a full product line in one package, and possibly thereby encourage physicians who are attracted by one component of the package to try the other components.

An additional useful step towards realizing the potential savings from web-enabling the medical record is the development of wireless and hand held devices that give physicians access to key information during the patient encounter. Several internet companies 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 can then electronically submit the prescription to a pharmacy of the patient's choice, thereby eliminating questions of legibility and eligibility. 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 more rapidly adopted by physicians than the complete EMR. One estimate is that 9% of prescription dollars will be online by 2004.<sup>9</sup>

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

## 2. Content

Content portals, which offer free access to clinical information for providers and patients, can be viewed as a market response to the problem of imperfect information, which is the root cause of many of inefficiencies in health care. The effects of this information explosion are probably large, but are hard to predict, still less quantify. Since medical content is usually provided free to the user, its value to the user is not reflected in expenditures that are captured by the expenditure-based NIPA accounts. Content sites are largely financed by 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 sponsors general medical information to patients and physicians. Of course the problem of unmeasured e-content services is not unique to health care. Due to obvious measurement problems, the Census Bureau is not planning to attempt to measure free e-commerce services.<sup>10</sup> If the internet site's revenues were captured by 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 faced by physicians to keep up with new 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 (CME); 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 diagnosis, and better treatment choices and implementation. Rough estimates of the potential savings from improved physician information might be derived from estimates of the welfare loss from medical practice variation.<sup>11</sup> However, measured physician productivity, in terms of measured 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 24.8m. US adults or 43% of internet users used the internet for health information in 1999, and this group is growing rapidly, served by over one thousand internet sites dedicated to healthcare.<sup>12</sup> Consumer information portals offer free information on wellness and disease; treatment options and providers; chat rooms and illness support groups; programs for life style management etc.

There are serious concerns that this “information” is often incomplete, misleading, or wrong; bias is another concern given the heavy reliance of many of these sites on advertising and sponsorship revenues. Several prestigious providers and profession associations have entered this space, capitalizing on their reputation to signal credibility and quality (Mayo Clinic, Johns Hopkins University, etc. ) A non-profit 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 assuring customer privacy. The other route to establishing brand (and at the same time gain viewers and hence advertising revenues) is through media alliances (such as WebMD with CNN; CBS with Medscape; drkoop.com with AOL). The net effect of opening the flood gates of free medical information will surely be that consumers will become better informed about their medical conditions, about 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, choice of providers, better compliance with treatment regimens, and by understanding the role of life style modifications.

Second, using disease and product-specific sites or pages, pharmaceutical companies are able to target their product advertising to consumers with relevant health needs, thereby improving advertising efficiency. Pharmaceutical companies also use these sites to target patient recruitment for clinical trials.

Third, increased patient information could increase or decrease the productivity of physicians. Obviously, a more informed consumer can better control a physician who is an imperfect agent. On the other hand, a patient who is partially or mis-informed but wants to be a partner in the decision process may actually increase the physician time required per visit. Since the average physician visit lasts 10 minutes or less, this does not leave

much time for discussion in addition to the necessary examination and treatment. These time costs – which are not generally reimbursable under current fee schedules – 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 patient search 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. Systems for generating provider quality report cards have been initiated by payers and regulators, but the internet makes them readily accessible to patients, which in turn should increase providers’ incentives for quality. Virtual communities and discussion groups also facilitate informal sharing of “reputation” information about providers. Lower consumer search costs could in theory reduce the price of physician services. More competition on quality is another, not mutually exclusive possible effect.

The effect of the information explosion on total expenditures is uncertain a priori. 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. But advertisers will only continue to sponsor content sites if the combined effect of the information plus the advertising increases demand for their products. Internet advertising of health care products is predicted to grow rapidly. Jupiter Communications projects growth from \$100m. in 1999 to over \$700m. in 2004; since half is pharmaceutical product advertising, this suggests \$50m. in 1999 to \$350m for pharmaceuticals in 2004; Skila Health Report estimates online pharmaceutical product marketing of only \$11m. in 1998 (just over 1% of total DTC spending), growing to \$890m. in 2002.<sup>13</sup> 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 (DTC) advertising, this is projected to grow, relative to TV and paper ads, due to lower cost and better targeting.

In the long run, improved consumer access to self-education health resources must surely improve real health care productivity, through improved self care, 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 quality health care. On the other hand, 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 those who have health insurance.

### 3. Commerce

B2B B2B e-commerce offers significant potential savings in supply chain costs to institutional purchasers, including hospitals, integrated delivery networks (IDNs), physician offices, ambulatory surgery centers and clinics, long term care facilities etc. A large hospital may buy 100,000 items in a year, including medical-surgical supplies, radiology and laboratory supplies, medical devices (e.g. stents, implants), non-retail pharmaceuticals and capital equipment, in addition to standard items such as food, office supplies, cleaning and laundry supplies and services. Structurally, the medical products supply sector is fairly concentrated: the five largest manufacturers serve 90% of the world's hospitals and provide 70% of an average hospital's purchases (Internet Health Care Magazine, May/June 2000, p.10), but there are a large number of smaller firms and potential entrants.

With over 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 (GPO) in the hospital, nursing home, and other sectors. These GPOs consolidate buying power and negotiate discounted prices from manufacturers in return for shifting market share to their products, and negotiate product delivery from distributors.<sup>14</sup> Distribution of medical supplies and pharmaceuticals is also concentrated, with a four firm concentration ratio of roughly 75 percent. This reflects significant consolidation in recent years, in order to take advantage of economies of scale in inventory management, EDI processing, and distribution and in offering customers a full product line. Distribution margins are down to 2-3 percent. Specialty medical equipment and devices, for which personal relationships with the physician customers are important, are often delivered directly by the manufacturer.

Estimates of health care supply expenditures range from \$100b.-\$200b., depending on what is included. A widely cited study based on 1995 data estimated supply chain costs at 10% of personal health expenditures, or \$83b.in 1995, including costs borne by manufacturers (33%), distributors (26%) and providers (41%).<sup>15</sup> Based on this study, total expenditures are projected at \$200b., of which \$85b. is medical and surgical supplies, \$13b. is non-retail pharmaceuticals, and \$102b. is office, food and cleaning supplies and services.<sup>16</sup>

Estimates of the fraction of total costs accounted for by process rather than product costs range from just over one fourth to one half. EHCR report process costs at \$23b., or 28% of the total, including order management (37%), inventory management (25%), transportation (24%) and physical distribution (14%). Burns et al. (2000) report that for some IDN members in their survey, supply expenditures (excluding office, food and cleaning) account for 10-15% of their total budget, of which 30-50% are medical-surgical supply costs, 15-23% pharmacy costs and 11-24% are equipment costs. Including processing costs raises total supply chain costs to 25-30% of total budget, which suggests that processing is at least 50 percent of the total (p. 5-6). As noted earlier, 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 19% of health spending.

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

However, simply updating the EHCR estimate to 2000 levels is unlikely to provide a reliable projection for potential B2B savings going forward. The EHCR savings 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% of current costs. Factors suggesting smaller potential savings going forward include the fact that some savings have already been realized, through consolidation of manufacturers, distributors and providers, and the widespread adoption of proprietary EDI networks as well as some internet business. The five distributors, who collectively process \$80b. annually or 70% of the medical products used by hospitals, physicians and nursing homes, handled 90% of this electronically, with proprietary EDI or the internet. But another survey estimated only \$2b. in commerce-related online business transactions in 1999.<sup>17</sup> These discrepancies may reflect the fact that purchasers have a much lower rate of on-line order processing than do intermediaries, and the fact that much of the intermediary EDI is probably still proprietary rather than internet-based.

By one estimate, a phone/fax order costs \$0.63/line to enter, an EDI order costs \$0.03/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 due to network and price reduction effects from internet-based transactions. In addition, the internet should accelerate the conversion to electronic purchasing of providers, who still largely use paper, phone and fax for order entry and who in 1995 accounted for 41% of process costs. For hospitals, ordering is poorly co-ordinated between the largely autonomous departments and poorly coordinated with inventory management, and inventories are often excessive. In a recent survey of hospital and integrated system CIOs, only one CIO reported already ordering supplies online, 31% of the 213 respondents said that they plan to begin online ordering in 2000, and another 12% predict that they will move to online supply ordering within two years.<sup>18</sup> Online ordering is presumably even less in smaller institutions and in physician offices, where supplies account for only 11% of practice expense.<sup>19</sup> 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, in which case the potential savings from B2B e-commerce looking forward in 2000 could be greater than the 1995 estimate of 49% of processing costs. However, some analysts estimate only 25% savings from use of B2B by hospitals (Burns et al.p.18).

The pace of competitive entry in the e-health B2B space suggests that many see potential opportunities. The new online product procurement companies offer connectivity and an ASP model to link buyers to a larger 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; invoice disputes should decrease, etc. Some companies focus on specific product lines or market opportunities e.g. Cimtek's medicalbuyer.com provides an exchange for medical supplies between providers and wholesalers, while another component links manufacturers and wholesalers.

Although analysts estimate significant potential savings, 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 process reengineering at a time when many have difficulty covering operating costs in the face of the 1997 Balanced Budget Act reimbursement cuts and the growth of managed care. With limited funds to invest in IT, first Y2K and now HIPAA compliance are more pressing priorities. But several factors should facilitate progress in adopting 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, with subscription pricing to transfer fixed costs and risk from the purchaser to the ASP supplier, and with less security risk for supplies than for clinical records. Third, the development of standards and the activities of the GPO, distributor and vendor exchanges (see below) should reduce the costs and increase the returns to making the necessary investments. Progress is expected to be slower for smaller hospitals, nursing homes and physician offices, due to small scale and low capitalization 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, some generic pharmaceuticals etc., are reportedly already commoditized. Online catalogues and auctions may permit some price reductions by facilitating further price comparisons, expanding the possible sources of supply and eliminating supply mismatches. A group of leading GPOs and their e-commerce affiliates (including Premier/Medibuy, Novation/Neoforma, Consorta, impactHealth, and HealthTrust Purchasing Group) has recently formed the "E-Standards Work Group" to develop common standards, including universal product numbers, for ordering medical-surgical and other non-pharmaceutical products on internet exchanges. Other industry players are encouraged to participate (DeJohn, 2000). 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 towards 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.<sup>20</sup> Such price differences benefit large purchasers as well as the 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 value as intermediaries is reduced once the web reduces the costs of comparison shopping and order entry. By contrast, the distributors seem more likely to survive, since they perform essential logistics and inventory management functions

The high end specialty medical devices include larger margins over marginal cost, reflecting product differentiation, patents and the costs of R&D. An important obstacle to commoditization of 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. However, since the product life-cycle for many of these devices is one of rapid introduction of new improved generations, price pressure from B2B may be significant for older vintage products. Similar considerations apply to used capital equipment, for which on-line auctions may create a significant global market place.

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, Broadlane, empactHealth) offer online catalogs, use of electronic invoices and purchase orders, etc. 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 getting access to the online technology while the B2B firms get access to the GPO's customer base. For example, two major hospital chains Columbia/HCA and Premium 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.; Novation, a large non-profit GPO awarded an exclusive ecommerce contract to Neoforma in return for a large ownership stake in Neoforma, etc.

In response to this activity of purchasers -- who threaten to intensify price comparisons while charging vendors 5-8% fees for processing orders -- the leading supply and device manufacturers (J&J, GE, Baxter, Medtronic, Abbott) in March 2000 announced plans for a "Global Health Care Exchange". The exchange is planned to be open to any company that makes hospital products, to serve as one 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 plan is to launch the exchange in fall 2000 and go international in 2001.

In April 2000 the leading distributors (Amerisource, Cardinal Health, FisherScientific, McKesson/HBOC and Owens&Minor) countered with an online industry consortium ("The New Health Exchange") for purchasing drugs, supplies and laboratory products, in competition with the GPO and supplier exchanges. The distributors aim in particular to establish standard product information and simplify the rebate program, in addition to online

catalogs and order entry and processing. Competition between 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 is likely to take several years for the smaller institutions.

The resulting savings in clerical costs, 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 their total costs is small, hence 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 vs. “technology/quality” competition. 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 on-line purchasing results in disintermediation, with manufacturers shipping directly to the end-user rather than through distributors, shipping cost may appear as income to transportation companies such as Federal Express or UPS rather than as income to health care distributors.

B2C: B2C ecommerce is concentrated in prescription (Rx) and over-the-counter (OTC) pharmaceuticals, medical supplies, health and beauty aids, vitamins and supplements. Total B2C is estimated at \$440m. in 1999 (7% of total online health transactions), growing to \$22b. in 2004 by Forrester (2000); however other estimates are much lower, at \$81m. (Lehmans, 2000, p. 21). Estimates of on-line Rx range from \$6m to \$40m. in 1999. The federal government has proposed a plan to more closely regulate on-line pharmacies but this is not yet implemented; so far, there is a voluntary certification program operated by the National Association of Boards of Pharmacy. The concerns include illegal on-line prescriptions, without appropriate medical exam; substandard and counterfeit products; and (from a supplier perspective) imported products at prices that undercut US price levels.

Although there are at least 30 online drugstores, the stand-alone on-line drugstore is arguably a flawed business model, at least if focused on the legal supply of Rx drugs. Unlike other goods, consumers cannot legally purchase Rx drugs without a physician 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). Not surprisingly, the leading online pharmacies have either been acquired 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, CVS purchased soma.com and aligned with PBM Merck-Medco; Express Scripts purchased part of PlanetRx, which is aligned with McKesson for distribution. Ultimately, multiparty agreements seem more likely, assuming that on-line pharmacies will want to give consumers access to their PBM and their neighborhood pharmacy, whichever that may be.

The savings from on-line pharmacies are limited until the physician prescription is 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%) and refill prescriptions (estimated at 50% of all prescriptions presumably including chronic medications).<sup>21</sup> However many PBMs already handle these drugs through mail order, which permits the PBM to save the pharmacy dispensing fee, to substitute a lower cost drug where possible, and reduce the time costs for the patient. On line 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 pharmacy will offer significant savings in physician and patient time, plus reduced medical error. For purposes of national accounts, consumer time savings will not be captured; rather, this 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 the main sales items of online pharmacies are vitamins, nutraceuticals, OTC drugs and health and beauty aids, for which prescriptions and reimbursement are not an issue.<sup>22</sup> 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.

On-line insurance purchasing            The potential savings from on-line purchase of health insurance are probably small. Although web-based insurance distribution has been estimated to reduce costs by 70 percent relative to traditional agency distribution (Booz, Allen, Hamilton, Inc.), for health insurance significant scale economies have already been realized due to employer sponsorship. Roughly 80 percent of private health insurance is obtained through employment, which significantly reduces the costs related to selling, enrollment, etc. and eliminates costs related to medical underwriting, at least for medium and large groups. Employers may get 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 streamline the open enrolment process. The potential for online purchasing of individual insurance is limited to those who do not get health insurance through their employer, 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, etc. 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 a Medicare 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 enrolment.

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 broker of health plans to employers with online auction for managed care organizations to bid for employer contracts (Sageo.com); online medical savings account (MSA) (HealtheCare.com); 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 enrolment 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, have higher income etc., which tend to be positively correlated with health. On-line insurers may also choose not to operate in states that require guaranteed issue and community rating (i.e. the insurer must take all applicants at standard rates).

#### 4. Care: E-Medicine

Care The internet offers several new production possibilities for health care, although regulations prohibit 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 (email) such as online health questionnaires, requests for a prescription refill, a specialist referral or feedback for follow-up purposes. Some 30 percent of physicians report using email to interact with patients. However, e-mail is more likely to substitute for phone calls than for visits, not only because of the importance of the physical exam but also because of liability risks; payers may be reluctant to reimburse for email “visits”, if these are more prone to patient moral hazard and harder to monitor for appropriateness; and physician concern over unnecessary email visits, once travel time is eliminated as an implicit patient cost-sharing. At least one plan does reimburse \$25 for e-mails. Some health plans offer interactive gatekeeper or call centers that handle simple questions. This could increase physician productivity, by freeing the physician/ patient encounter to address more serious questions.

Patient participation in health production may be enhanced through online compliance monitoring, post-treatment disease education and management, and through self-care (see Content). 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 of 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 very costly acute episodes.

Care-related savings from use of online medical records and on line prescribing have already been discussed (see Connectivity). 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 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 insufficient scale of smaller hospitals and physician offices to support capital expenditures or lack of third party reimbursement.

Internet-based telemedicine may increase access to both physician visits and some specialty care in remote locations, prisons, etc. Centers of excellence in highly specialized fields may expand their market reach through the internet, especially for teleradiology which offers remote reading of diagnostic test. In general, however, the much touted boom of telemedicine seems to have fallen flat, and health care delivery remains a predominantly local industry.

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

The internet facilitates such data collection and dissemination. However, other obstacles to dissemination remain, 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, e.g. on outcomes and best practices. To the extent that improved knowledge improves real health productivity from given resources, this 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.

##### 5. The Internet and the Pharmaceutical Industry

Pharmaceuticals account for 10% of PCE and have been the most rapidly growing component of health care spending in recent years, driven primarily by the launch of new drugs 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 is somewhat different than for service-oriented medical providers, and is therefore briefly discussed here.

The cost of bringing a new drug to market has been estimated at over \$500m., including the costs of failures and interest costs over the 12+ years of the R&D process. Drug discovery has been revolutionized in recent years, moving from a random search for active compounds towards rational drug design, based on genomics, microbiology, combinatorial chemistry and high throughput screening. 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 US FDA and similar regulatory bodies around the world. These trials are often global and on average take over six years and tens or hundreds of millions of dollars, plus foregone interest on the funds invested and loss of patent life due to delay in launch.

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 web sites could cut several months of the typical time required. Even bigger savings could be realized if data collection during trials can 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 cost and possibly reduce some supply prices through 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 rep, and some health plans do not permit such detailing. Online physician detailing and symposia 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 the relaxing of regulations on direct-to-consumer advertising in 1997, DTC has expanded rapidly through all media forms. As already noted, online DTC advertising on disease-specific websites offers better targeting to patients as well as lower cost.

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. However, this tendency for cost reduction per drug may be offset by changes 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. 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 expenditures on drugs is also likely to increase.

## V. The Economic Impact of e-Health: Effects on Competition and Productivity

### 1. Competition

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

The start-up internet firms that offer ASP-model claims processing to physicians and hospitals may not yet be a significant competitive threat to incumbent EDI providers, but this is likely to change as more 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 countering by developing their own web-enabled systems. Whoever the winning players are, it seems likely that the winning products will be those that offer the physician office a full product line in a single package – claims processing, some electronic medical records, access to web-based content and decision support, on-line prescribing, scheduling and referrals, interactions with patients through email, and interactions with other network participants. Winning systems are also likely to be open to add-ons of new, specialized products, as these develop. Because the proprietary EDI systems do not have this 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 combining all in a single product suite, it seems likely that the medical record will ultimately be included in the web-based product portfolio for physician offices, once the other components are widely available and in use, which may be several years away. Widespread adoption of this model may be several years away, but when it is widely adopted, the overall system-wide savings could be billions of dollars per year, due to 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 email, on-line appointment scheduling, or 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, better clinical protocols etc., this 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, hence will not give any 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 B2B supplies procurement, thereby cutting their processing costs in addition to possibly getting lower prices than the GPOs can negotiate. Thus in the long run it seems likely that the GPO functions will 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 greatest effects likely for product lines where quality differences are small and price competition predominates and can intensify; effects will be less 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.

## 2. Productivity

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

$$H = h (M_1(L_1, K_1, I_1); M_2 \dots M_n(L_n, K_n, I_n); T (I_p); N (I_p); E; G)$$

Since the true output  $H$  is intangible, measurement focuses on observable medical services. Medical care expenditure is not defined in the National Income and Product Accounts (NIPA). The personal consumption expenditure (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, 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 Health Care Financing Administration's estimate of total personal health care.<sup>23</sup>

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 components of the CPI were used to deflate health expenditures until recently. But the medical CPI is a measure of prices paid by consumers, hence omits 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 per year, the medical components rose 6.5 percent, in part because the CPI measured all quality-related price increases as excess health inflation.

In the 1990s, producer price indexes (PPIs) have been substitute 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 provide better output measures for some services. For example, the PPI for hospital services uses a probability sample of medical conditions, based on diagnosis related groups (DRGs), and then tracks the change in cost of treating each condition.<sup>24</sup> Since 1991, measured medical price inflation has slowed, from nearly 6% p.a. from 1991 to 1993, near 4 percent in 1994 and 1996, and just over 2 percent from 1996 through 1998. While it might be nice to attribute this price deceleration to productivity growth due to IT, it more likely reflects the shift to PPIs from CPIs, which tended to reflect all quality and technology improvements as price increases.<sup>25</sup> 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 data, as reported in Triplett and Bosworth (2000) 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 to \$57,000 in all services and \$59,000 in manufacturing (1992 data). Moreover, average labor productivity growth in health is reported as -2.2 percent for the years 1987-1997, which implies a slowdown of -2.8 percent compared to the 0.6 percent p.a. growth rate estimated for the years 1960-1973. The story for multifactor productivity is similar, based on a BEA estimate of the net stock of 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.<sup>26</sup>

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 is no different for internet-induced care than for services the patient learns of through other media.

Second, while 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, duplicative and inappropriate care. This should reduce inappropriate use of medical resources and hence reduce measured expenditures. Real health productivity should increase but this will not be reflected in the national accounts, except to the extent that a healthier workforce is more productive generally.

### 3. Estimates of the e-health sector

There are a few widely cited estimates of the impact of the internet but most simply estimate either the value of total online transactions or the target expenditures for on-line companies, and none are based on strong foundations. Forrester (2000) interviewed 71 healthcare companies, including manufacturers, insurers, providers and online retail stores. They estimate online transactions increasing from \$6.4b. in 1999 to \$370b. by 2004, of which \$22b. is retail sales and \$348b. is business transactions; the total accounts for 22% of total HCFA-projected health spending of \$1.7t. in 2004. These projections for rapid growth in online activity appear to reflect the total value of the projected B2B shipments and claims that are processed electronically. The administrative/process costs, which are the real targets of potential savings from improved IT and connectivity, are either not included or not reported separately, and costs of implementation are not reflected.

The market capitalization of the eHealth sector gives a possible lower bound measure of the expected future value of services of internet firms, assuming that they capture fully the value of any savings they generate or new products they offer. In fact this may greatly understate the value created by the internet, to the extent that established players such as EDI firms contribute to web-based options and customers share in any savings, in order to persuade them to adopt the new systems. With these caveats on interpretation, it is interesting to note that the eHealth market cap was \$17b. in December 1999, compared to a peak market cap of the established health care IT industry if \$25b. in mid 1998.

### Conclusions

The internet will undoubtedly have a major impact on the health care sector, improving information of consumers and providers, and reducing the large share of total expenditures that is currently spent on

administrative costs, unnecessary and inappropriate care. But achieving these savings is several years away, with major hurdles still to be overcome, including the roll out and implementation of 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 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, hence diversity in practices may remain. Nevertheless, with all these caveats, the ultimate potential savings are probably at least one or two percentage points of total health spending, if they could be realized. On the other hand, there are offsetting pressures to increase utilization, including more rapid adoption of other medical technologies, increased use of drugs and other heavily advertised 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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<sup>1</sup> Lewin-VHI (1993);

<sup>2</sup> Thomas et al. (1997).

<sup>3</sup> Chassin (1998) concludes that at least 20 percent of all health care delivered in the US is unnecessary and can be safely eliminated.

<sup>4</sup> NCHS (1999).

<sup>5</sup>

<sup>6</sup>See Danzon (1994).

<sup>7</sup> Lehman (2000) p. 9. Percent of claims filed electronically is from Faulkner and Gray's 1999 Health Directory. See also Table 2.

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- <sup>8</sup> Baldwin (2000).
- <sup>9</sup> Forrester (2000).
- <sup>10</sup> Fraumeni et al. (1999).
- <sup>11</sup> Phelps, 199
- <sup>12</sup> Lehmans (2000), citing CyberDialogue reports several thousand health internet sites; other estimates are lower. Definition is obviously an issue, as well as turnover and consolidation.
- <sup>13</sup> These estimates appear in Lehmans (2000), p. 16 and p.18.
- <sup>14</sup> The GPO power to shift share is limited, however, because they lack enforcement power over their members, who continue to purchase significant fractions of their business off contract.
- <sup>15</sup> EHCR, Improving the efficiency of the health care supply chain.
- <sup>16</sup> Piper Jaffray (1999). Applying the 10% to 1999 PCE yields roughly \$100b. for supply chain costs.
- <sup>17</sup> Forrester (2000). It is unclear whether this survey includes only internet activity or also proprietary EDI.
- <sup>18</sup> Internet Health Care Magazine (May/June 2000). Of the 65% of hospitals with websites, the most common offerings were information about the organization, a directory of physicians and email; 40 % offer patient education material, 26% physician referral transactions and less than 15% offered physician access to records, drug interaction guides, physician ordering of tests and reporting of results. Only 2% offered appointment scheduling or patient access to records.
- <sup>19</sup> Forrester (2000).
- <sup>20</sup> For analogous price differences for pharmaceuticals sold for the outpatient sector, see Danzon, Patricia “Welfare implications of price differences for pharmaceuticals in the US and the EU.” International Journal of the Economics of Business, 1998.
- <sup>21</sup> Lehmans (2000), p.20.
- <sup>22</sup> There on on-line 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 etc., which are less likely to be covered by insurance.
- <sup>23</sup> McCully (2000).
- <sup>24</sup> See Catron and Murphy (1996) and Berndt et al. (1998).
- <sup>25</sup> McCully reports that from 1994 to 1996, the hospitals PPI increased at 3.2 percent per annum, compared to 5.1 for the comparable CPI; from 1995-1998 the physicians services PPI increased 2.0 percent per annum, compared to 3.5 percent for the CPI (p.10).
- <sup>26</sup> See Triplett (1999); Berndt et al. (1999);