Technology Tracks and Potential Barriers in US Healthcare Industry

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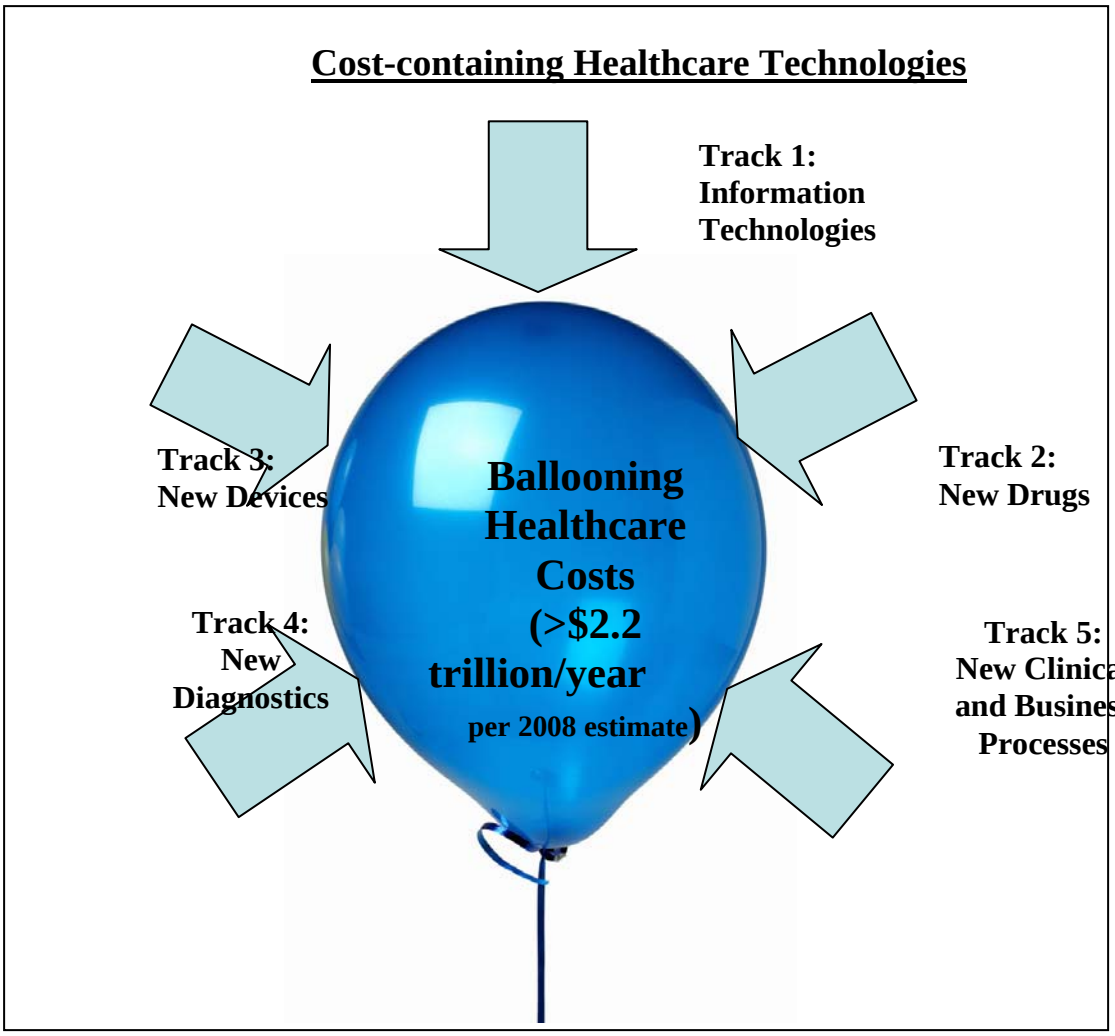
Technology is a major force of change in all industries, including the healthcare industry. The US healthcare industry is a $2.2 trillion market and accounts for nearly 16% of the GNP (Gross National Product) of US which is $13.84 trillion[1]. What is troubling is that the healthcare costs in the US are escalating at a rate much greater than the GNP growth rates, and this is putting many corporations in the US at a competitive disadvantage. A glaring example is that of General Motors which spends $1700 per car in healthcare costs which is more than the cost of steel per car. Another example is Starbucks which spends more on healthcare costs of its employees than on its purchase cost of coffee. It is well known in public discourse that the escalating healthcare costs in the US are unsustainable and will create a crisis, unless some solutions are sought to contain the costs. Technology is seen to be one of the solutions that could turn the tide of escalating healthcare costs in the US. In this paper, I will review technology trends and also their corresponding barriers that might prevent the diffusion of the new technologies in the US healthcare industry. At the outset, I wish to admit that the review is not comprehensive, given the 10-page limit of the paper, but will provide a broad framework with examples that is, purportedly, comprehensive enough to capture the wide variety of new technologies that are going to transform the US healthcare industry.

The paper is structured as follows. First I will provide a framework for technology solutions that aim to contain the ballooning healthcare costs in US. Five distinct tracks are identified in this framework. Any new technology or innovation in the healthcare industry can be classified using this framework. Next each of the five tracks is discussed in some detail with specific examples. Included in the discussion of each track is an elucidation of the benefits that promote and the barriers that prevent the acceptance of the new technologies. Finally, I conclude the paper with implications for the future evolution of the US healthcare industry.

[1] Plunkett's Health Care Industry Almanac 2008
http://www.plunkettresearch.com/Industries/HealthCare/HealthCareStatistics/tabid/293/Default.aspx



The above diagram provides an overview of cost-containing technologies that one can identify in the US healthcare industry. Five broad tracks, namely, (1) Information Technologies, (2) New Drugs, (3) New Devices, (4) New Diagnostics, and (5) New Clinical and Business Processes capture the new technologies that are sweeping the landscape of the US healthcare industry. While these tracks provide different innovations and achieve different end goals, which will be described later in this paper, one common goal permeates all of the five tracks. That common goal is to contain the rising healthcare costs. In the next section, I will discuss these five tracks one by one, giving examples of specific technologies, their benefits and potential barriers that impede them. Any new technology in healthcare industry can be pigeonholed in this framework.

Track 1: Information Technologies (IT) in Healthcare: Simply stated, IT means the use of computers, telephony, web-based technologies to automate work that was earlier performed manually. IT has transformed many manufacturing industries and is now sweeping across service industries such as healthcare. Increasingly "health care organizations are

implementing new technologies, such as Internet applications, enterprise systems, and mobile technologies in order to achieve their desired costs in healthcare delivery."[2]

A few specific examples of IT in healthcare are described next to illustrate how IT is reducing the costs of healthcare. (1) Patient records in a typical physician office are stored in manila folders and maintained manually by the office or nurse assistants in the office. It is estimated that about 20% of the office space and personnel time are spent on the manual patient records. IT is transforming these manual patient records into electronic databases resulting in significant cost savings. (2) Inventory tracking at hospitals for medical supplies used to an intense, manual, time-consuming and error-prone process. But now EDI (Electronic Data Interchange) with medical supplier companies such as McKesson for example has automated this process and made it more streamlined and reliable process again with significant cost savings. (3) Nurse call stations in hospitals, Blackberries with doctors, dictation systems, radiology readers in India who read the radiographs in India, etc., all use mobile communications and Internet to speed up diagnosis and treatment of patients resulting in reduced length of stay in hospitals, which means significant cost savings. Though these three examples are by no means exhaustive coverage of all IT usages in healthcare industry, they illustrate one indubitable fact of cost savings achieved by the deployment of IT. A whole new field called *telemedicine* is emerging in healthcare industry. Telemedicine is simply providing medical treatment remotely. Nova on PBS has recently shown remote surgery where a surgeon remotely operates on a patient.

Barriers that impede the deployment and wide-spread se of IT in healthcare are many. Foremost is the level of investment required for IT, It is not just the hardware that requires investment, the software development and training required in implementation phase also require significant investment. There is also a danger that IT systems may become obsolete forcing the healthcare organization to go through more investments just to catch up. There is a perception that IT does not matter; as IT became more powerful, more standardized and more common across all companies, it has become no more a source of competitive advantage.[3] This view fuels the resistance to change embracing IT.

Track 2: New Drugs: Simply stated, drugs are the pharmaceutical products that we take for prevention, treatment and management of diseases. Vaccines, antibiotics, chemo-therapeutics, chronic disease drugs (e.g., medications for diabetes and high blood pressure) are some examples of drugs in use. Large pharmaceutical companies such as Amgen, Genentec, Bristol-Myers Squibb, Glaxo Burroughs Wellcome, Immunex, Schering Plough, and SmithKline Beecham make billions of dollars in annual revenues by selling pharmaceuticals that their R&D laboratories have invented. Each new drug (pharmaceutical) is given a patent that gives exclusive rights to the company that owns the patent to sell the drug exclusively for the next 17 years. This gives a virtual monopoly to the company which can charge premium prices in the marketplace with out the fear of competitors coming in to steal their market share. Every new drug goes through a rigorous approval process by the FDA (Food and Drugs Administration) that requires the company to prove the safety (Phase I studies) and efficacy (Phase II studies) of the new drug. That is, every new drug has to provide statistical evidence that shows the safety and efficacy of

[2] Healthcare Informatics; **http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=1186520**

[3] Nicholas G. Carr (2004): "Does IT Matter?" **http://books.google.com/books?hl=en&lr=&id=wrROE6SLJFEC&oi=fnd&pg=PR9&dq=Information+Technology+and+Competitive+Advantage&ots=hvUh345g6i&sig=JRlFscxiKqvMQxWnpxwg-J9L-Ec#PPR9,M1**

the new drugs. The Pharmaceutical Manufacturers Association[4] regularly publishes studies that determine the cost-effectiveness of pharmaceutical drugs.

One can marshal a huge number of specific examples to establish the benefits of new drugs. It is incontrovertible that new drugs are an economical form of medical therapy and that they can substantially reduce overall health-care costs. A few examples would suffice to prove the point of economic benefits that accrue from new drugs. "A study of measles vaccines, for example, found that benefits were more than 10 times the costs over a 9-year period. A literature review shows that antibiotics, anti-tuberculosis drugs, anti-ulcer medicines, anti-psychotics and anti-hypertensive agents are all cost-effective. Specifically, in a study of the preventive use of an antibiotic, for example, the annual cost of preventing urinary tract infection was found to be US$85/patient compared to US$126 for treating the infection--a saving of 33%. Other reports showed the cost-effectiveness of beta blockers--a new class of cardiovascular drugs. The studies show that the benefits of these drugs far exceed their cost in preventing 2nd heart attacks and in treating glaucoma and angina. Many contagious diseases that were once the leading causes of death in this country have been controlled through the development in recent years of anti-infective agents. These medicines have cut death rates from such diseases as tuberculosis, influenza, pneumonia, cholera, puerperal sepsis, scarlet fever and others.[5]"

Barriers that impede the development and introduction of new drugs are mainly the cost and uncertainty of R&D. "The estimated average out-of-pocket cost per new drug is US$ 403 million (2000 dollars). Capitalizing out-of-pocket costs to the point of marketing approval at a real discount rate of 11% yields a total pre-approval cost estimate of US$ 802 million (2000 dollars).[6]" Added to the inordinately high cost of R&D is the technological uncertainty involved in the discovery process. One can never be sure if and when R&D dollars would yield results in new drugs. The high cost and uncertainty of new drug development has made drug discovery a very risky business forcing many companies to collaborate with others to share the risk.

Track 3: New Medical Devices: Simply stated, medical devices are products and equipment that are used in diagnosis, prevention, treatment and management of diseases. A simple product like a hospital bed or wheel chair comes under this genre for disease management. More sophisticated products such as MRI (Magnetic Resonance Imaging) or ultrasound for imaging also fall in this category for diagnosis of disease. Stents (small steel tubes) put inside blocked blood vessels fall in this group for treatment of disease of clogged coronary arteries. Surgical staples, orthopedic implants (put inside our weakened bones for reinforcement) and laparoscopic instruments used in surgeries are other examples. There is a vast variety of medical devices and it is beyond the scope of this paper to expound on many or all of them. The main defining characteristic of medical devices is that unlike drugs which are metabolized by the human body, the medical devices stay intact unmetabolized (i.e., chemically unaltered) by the human body. Thus, all *assist*-devices fall in this category. That is, any product

[4] Pharmaceutical Manufacturers Association: **http://www.phrma.org/**

[5] "Cost-effectiveness of pharmaceuticals: a summary report" **http://www.popline.org/docs/1435/273067.html**

[6] Joseph A. DiMasi, Ronald W. Hansen[b] and Henry G. Grabowski (2002): "The price of innovation: new estimates of drug development costs", Journal of Health Economics: **http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V8K-47P93T9-2&_user=10&_rdoc=1&_fmt=&_orig=search&_sort=d&view=c&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=d70e22f5f73c043ddea3dd561ab330f3**

or equipment that helps or assists in the clinical management of disease can be broadly put in this category. Leading companies[7] that produce medical devices are Medtronic, Baxter, Biomet, C.R. Bard, Ethicon & Cordis (Johnson and Johnson), Smith & Nephew, Guidant, Storz, Stryker, St. Jude, Kendall, Hill-Rom, Mallinckrodt, Respironics, Tyco, Zimmer, Zoll, etc. There are hundreds of small companies in the US in the fragmented medical devices industry segment, specializing in narrow applications.

Everything in the medical devices sector is done with a view to generate benefits to the patient, the provider and the payer. The benefits include helping to reduce length of stay in hospitals, recovery time and other aspects that have economic influence. Reducing length of stay in hospitals and patient recovery time by half, for example, has a huge economic impact and reducing surgery time diminishes the risks of surgery.[8] Medical devices have to prove that they are cost effective before they are marketed, as otherwise they will not be accepted in the marketplace. The merits of a new medical device are judged relative to existing solutions to the clinical problem that the device aims to solve.

Barriers that impede the wide-spread usage of new medical devices include many factors. Many of the medical device firms are small and have relative low resources. The technological complexity is very high and the potential liability for failing medical devices can be fatal to the companies. Also, there are relatively low interactions between doctors and engineers which limit the development of new medical devices, as one study showed that 82-85% of the innovation in the medical device industry comes from partnership between engineers and doctors.[8] In the US the number of engineers is going down and the number of doctors is artificially limited by accrediting boards such as the AMA (American Medical Association).

Track 4: New Diagnostics: Simply stated, diagnostics include all means and methodologies involved in diagnosing disease. Diagnosis is a precursor to treatment, management and even prevention of disease. Testing body fluids (e.g., blood, urine), imaging body parts (e.g., radiographs, MRI scans, ultrasound images), monitoring body performance vitals (e.g., saturated oxygen levels, pulse, heart rate, etc. during anesthesia before, during and after surgeries), checking blood sugar levels (e.g., for diabetes management), and many other measurement tools and techniques fall in this category. An emerging and increasingly important new sub-category is that of DNA based testing (genetic testing) that could predict future onset of diseases (i.e., potential for the onset of a disease such as diabetes for example). The fact of the matter is that diagnosis is a very important part of a clinician's protocol for making a decision for a particular treatment for a particular patient. A clinician should make quality decisions for treatment and this is enabled only by appropriate diagnostic information. Leading companies[9] that produce diagnostics include In Vivo, Siemens Medical, Philips Medical, GE Medical, Toshiba Medical, Life-Scan, Becton-Dickinson, Masimo, Medrad, Nellcor-Puritan-Bennett, QRS Diagnostic, etc. Again, there are hundreds of companies that serve the diagnostics market. It

[7] Medical Device Companies: **http://salesandmarketingnetwork.com/links.php?keyword=Device&alpha=O**

[8] Guy Lebeau (2008): "Benefits of medical devices ignored" **http://www.euractiv.com/en/health/lebeau-benefits-medical-devices-ignored/article-170288**

[9] Medical Diagnostics Companies:**http://salesandmarketingnetwork.com/links.php?keyword=Device&alpha=O**

must be noted that medical diagnostics are also used in other industries (for example, use of DNA based testing in forensics for crime solving).

The benefits of new diagnostics derive largely from doing the diagnosis job, which is a *sine-qua-non* for clinicians, faster, cheaper and better. These benefits are realized when new diagnostics increase the speed with which the test results can be fed back to the clinician at a much reduced price to the provider and with a high degree of confidence that the test results are reliable (i.e., low error rates). For example, 20 years ago testing for blood sugar used be done by boiling urine with some chemical reagents, and noting the color of the mixture after it cools down. This was a process that took at least 30 minutes. To-day a small prick of the finger with a super-fine needle followed by putting the blood drop on a dip-stick would return the test result in the matter of a couple of minutes. Becton-Dickinson is now developing a new technology to measure blood sugar without drawing blood, but by reflective light that is focused on a finger. Diagnostic information is needed by clinicians to do their job; and new diagnostics provide greater value by furnishing this required information faster, cheaper and better.

Barriers that impede the wide-spread use of new diagnostics are many. Chief among these obstacles is the resistance to change because humans are creatures of habit. It is very hard to change habits in clinical practice. Another barrier is that diagnosing a disease for which there is no cure yet is often futile. Hence genetic testing has not become very popular because the treatments of many diseases (e.g., Hodgkin's disease) are not available yet. Also, many of the diagnostics companies are small and do not have large resources to dominate the market and introduce new diagnostics in a big way. That is, they lack the market power to make change.

Track 5: New Clinical and Business Processes: Admittedly, this is a very wide track that is a catch-all category. Within this wide variety of miscellany, two distinct themes can be identified – (i) new clinical processes and (ii) new business processes. Examples are the best way to illustrate these themes. Prescription errors, due primarily to the illegible handwriting of the physicians, is a major problem resulting in significant additional healthcare costs. Through electronic prescriptions which have built-in error correction logics (e.g., contra-indications for certain drugs when used together), the prescription error rates are being minimized. This is an example of a new clinical process for the clinicians. Likewise, an example of a new business process at a hospital if its use of McKesson's IntelliShelf[10] which automates supply management on nursing floors and within specialty areas, such as cardiac cath, angiography and GI labs. This automated health care supply chain management solution immediately improves efficiency by removing manual and redundant tasks and allows nurses to completely capture supply usage for patients, procedures and floors. These are just two examples, but there are an inumerable number of innovations taking place to improve the efficiency of the healthcare systems. Medical errors, nosocomial (hospital-induced) infections, medical tourism, eHealth, preventive medicine, vaccines, wellness program, etc. are part of the galore of specifics in this category.

Again, benefits of this broad group can only be illustrated with examples. "About 2 million people a year contract hospital-related infections, and about 90,000 die, according to the national Centers for Disease Control and Prevention. The recent increase in antibiotic-resistant

[10] McKesson's Intellishelf:
http://www.mckesson.com/en_us/McKesson.com/For%2BPharmacies/Inpatient/Pharmacy%2BAutomation/IntelliShelf-Rx%2526%2523153%253B.html

bugs and the mounting cost of health care -- to which infections add about $4.5 billion annually -- have mobilized the medical community to implement processes designed to decrease infections. These include using clippers rather than a razor to shave surgical sites and administering antibiotics before surgery but stopping them soon after to prevent drug resistance[11]."

Barriers that can impede wide-spread use of new clinical and business processes include the resources required to implement the change programs and to overcome the resistance to change. To be sure, the barriers will vary widely depending on the particular change sought.

Summary and Conclusion: The Table below summarizes the five tracks with examples, benefits and barriers. Technology is advocated to be a significant force of change that will rein in the escalating healthcare costs in the US. In this paper, I have presented what I believe to be a comprehensive framework that shows how technology will manifest itself in the US healthcare industry. The five tracks are illustrated with some specific examples. Benefits and barriers in each track are also outlined in the paper. If technology works its transformational power as it did in other industries, I can expect to see the US healthcare industry become more efficient, more dynamic and much stronger delivering highest quality healthcare in the world.

[11] Smart Money: "10 things your hospital won't tell you": **http://articles.moneycentral.msn.com/Insurance/InsureYourHealth/10ThingsYourHospitalWontTellYou.aspx**

Summary Table: Technology Tracks, Examples, Benefits and Barriers				
Track # and Description	**One Specific Example**	**Benefits**	**Barriers**	**Comments**
Track1: Information Technologies (IT)	Database management of patient manila folder records in doctor offices	Cost savings Time savings Error reduction	Investment for automation; Training of personnel	IT is spreading fast across all healthcare organizations.
Track 2: New Drugs	New vaccines to prevent disease	Prevention is several times cheaper than treatment (e.g., HIV)	>$800 million to bring a new drug to market	Shared R&D to reduce risk of failure.
Track 3: New Medical Devices	Drug-coated stents for clogged coronary arteries	Reduced recurrence of heart attacks. Cost savings	Very expensive procedures. Many small firms.	Cost effectiveness will be highly emphasized.
Track 4: New Diagnostics	Genetic testing to predict onset of future diseases	Prevention Cost savings	No treatment for some diseases. Many small firms.	Case by case innovation will take place.
Track 5: New	Electronic Health	Error reduction	Significant new	There is

Clinical and Business Processes	Records (EHR)	Cost savings	investment for EHR. Who will pay the cost?	momentum behind EHR.