Viewpoint ■

The Business Value of Health Care Information Technology

MARK C. FRISSE, MD

A b s t r a c t   The American health care system is one of the world's largest and most complex industries. The Health Care Financing Administration reports that 1997 expenditures for health care exceeded one trillion dollars, or 13.5 percent of the gross domestic product. Despite these expenditures, over 16 percent of the U.S. population remains uninsured, and a large percentage of patients express dissatisfaction with the health care system. Managed care, effective in its ability to attenuate the rate of cost increase, is associated with a concomitant degree of administrative overhead that is often perceived by providers and patients alike as a major source of cost and inconvenience. Both providers and patients sense a great degree of inconvenience and an excessive amount of paperwork associated with both the process of seeking medical care and the subsequent process of paying for medical services.

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Traditionally, health practitioners have sought a return to traditional fee-for-service payment to mitigate the inconvenience associated with managed care. More populist proposals include universal health insurance or mandatory enrollment in health maintenance organizations. Advocates of managed care argue that the business methods required for effective trials of this approach are only beginning to be realized. By all accounts, information technology is a necessary part of these initiatives, but there is universal consensus that our current systems are inadequate to the task. (Oxford Health System's difficulties in 1998, for example, have been attributed in part to inade-

quate deployment of information technology.) To this author, the model for the current generation of health care information systems is strikingly similar to that for the information systems employed by the Internal Revenue Service. In each case, the system allows for low-cost changes to administrative code brought about by legislation, but in both cases the "ripple effects" of additional complexity and administrative burden far exceed the cost of immediate change. To paraphrase a quotation attributed to Major Richard Dailey, made about his police force during the 1998 Chicago Democratic Convention, our information systems "are not here to create disorder; they are here to preserve disorder."

This case explores one alternative source for models in health care delivery. Through an examination of a typical patient experience, we explore Porter's notion of the value chain and "just-in-time" logistics common to successful organizations like Wal-Mart and Amazon.com (see Suggested Readings). We close with a brief discussion of how these logistics and inventory systems apply to health care. Clearly, logistics are important in patient care, accounts receivable are a cause of severe working capital problems in health care, and the logistics of caring for patients are becoming more complex. But the concepts we discuss have an even greater importance: Effective management of these issues through information technology may restore our most precious commodity—time.

Affiliation of the author: Washington University, St. Louis, Missouri.

Correspondence and reprints: Mark E. Frisse, MD, Associate Professor and Associate Dean, Medical School Library, Washington University, Campus Box 8132, 660 South Euclid Avenue, St. Louis, MO 63110. e-mail: ⟨frisse@medicine.wustl.edu⟩.

The Patient's Perspective

Harriet Stone was furious. For the third month in a row, she sat at her kitchen table facing a large pile of insurance claims forms and bills resulting from the hospitalization of her 17-year-old son, Frank. "My son's illness was a nightmare, and I got used to that," she said. "But I don't know why the hassles and paperwork have to make a terrible experience even worse."

Ms. Stone is a single mother of two children living in Parma, Ohio, a suburb of Cleveland. She works in a department store and, like many of her colleagues, did not take very seriously the open enrollment period for health plans. Grateful simply to have a job with health benefits, she chose a care plan that included her children's pediatrician, Dr. Bob Young. Her decision was based primarily on price. She assumed that the good health of her family would remain intact and that Dr. Young would take care of any problems they might have.

Ms. Stone was not aggressive in seeking medical sources. She had not seen a physician since her divorce six years ago. Her son Luke, age 8, had seen Dr. Young two years earlier and seemed in good health. Her older son, Frank, had not seen Dr. Young for four years. "I guess I should have checked with my pediatrician about this," she said, "but his phone is always busy and since his name was on the list of panel physicians, I selected the plan I did so that I'd be able to keep in touch with him and figure out when my children needed tetanus shots and the like. I just assumed everything would be OK."

Ms. Stone didn't give the matter another thought until her elder son, Frank, approached her with the complaint of a 3-cm mass in his right calf, which had been present and apparently enlarging over a six-month period. Frightened, Ms. Stone immediately called Dr. Young's office. Told that Dr. Young would call back within the hour, Ms. Stone stayed home from her job and waited for the call. Three hours later she called again, and again waited. At 3:00 PM that afternoon, Dr. Young finally returned her call. Like Ms. Stone, he was alarmed by the symptoms and told her to make an appointment for her son. When transferred to the appointment secretary, Ms. Stone was asked to give a long litany of information, including the health care plan information taken from the card in her wallet. When hearing her son's age, the appointments secretary told her that her health care plan did not allow 17-year-olds to see a pediatrician and that he would have to see a family practitioner. "Who do you recommend?" Ms. Stone asked. The appointment secre-

tary told her to check the list of physicians covered by her plan and find a physician in her area. The secretary would not make a recommendation, nor would he transfer her call back to her pediatrician.

"This was the beginning of my frustration," she later said. "It should have warned me of what was to come. First, I was annoyed that this clerk had to ask me all this information about my son when he'd been cared for there his entire life. Second, I couldn't believe he wouldn't expedite a referral to a physician. Everyone was alarmed by what was going on."

Ms. Stone then went looking for her copy of the physician listing covered by her health care plan. She could not find it. The next day, she spent her morning break in the human resources office at work obtaining a second copy of the plan. Two friends, not employed with her, mentioned names of physicians who were not in the plan. A third friend identified her family physician in the list, and the next day Ms. Stone called to make an appointment with this physician, only to find out that he was no longer enrolled in the plan. "I went back to my human resources office the next day. They told me that doctors change plans so much that by the time they print the books they are already obsolete! They said it cost over $10 per employee every time they distributed materials during open enrollment. I told them that I didn't care what it cost, but I sure as heck wanted to see something that would help me when I needed it. Human resources was useless. Their people didn't seem to know any more about the health care system than I did."

After an additional week of effort, Ms. Stone was finally able to make an appointment with Dr. Jane Nold, a family practitioner who could see her son the following week. Dr. Nold examined the lump and noticed that it seemed hard and nonmobile. She said that he would need an x-ray but that it would take a day to get appropriate approval for the test. Dr. Nold was called to an emergency later that day, and the approval forms were not completed for three days. Ms. Stone then took her son for the x-rays and made another appointment with Dr. Nold. Dr. Nold said that the results were not good and that she would have to refer Ms. Stone's son to a specialist. She said this would take a day or two while the paperwork was completed.

"I guess it was the following week that I really hit the roof," Ms. Stone said. "Someone from a specialist's office I'd never heard of said that my son was to come in the following week and be seen. This woman proceeded to ask me a lot of personal questions about my son and then asked me all the same information the

appointment clerk had asked at my pediatrician's office and at the family practitioner's office. This was the third time I had to tell people all this information. I wanted to talk to someone about my son's illness, not talk over and over again about his provider number.''

Over the ensuing two weeks, things moved more quickly. Each day brought more bad news. Her son underwent a biopsy, and two days later she was told he had a form of sarcoma of the bone. Results of an extensive array of diagnostic tests suggested no metastases. He later was referred to an oncologist, who recommended aggressive surgery, adjuvant chemotherapy, and radiation. Over the weeks, the horrible and painful days of care became a sad, intolerable, grinding routine. "I liked the nurses and doctors, when I saw them,'' Ms. Stone said. "And my son seemed to take things pretty well.''

Paying the Bill

Frank Stone underwent successful treatment for osteosarcoma. While he was recovering from his illness, his mother was suffering from an incomprehensible array of bills, charges, claims, counterclaims, and paperwork. "One month I'd get a letter saying they weren't going to pay the full charges for his radiation and that I owed them $5,000. The next month I got another piece of paper that said everything was paid for. Later, I received a call from a collection agency threatening me if I didn't pay the $5,000 I owed. It took me three weeks to straighten this out, but I don't really know what happened or why they dropped the claim.'' Commenting on the array of charges, she said, "My son received most of his medical care from a prominent medical school. I thought that since they were one school I'd just get one bill like I do from my credit card company, but instead, I got different bills at different times. Putting the whole thing together was like trying to solve a jigsaw puzzle.''

Overall, Ms. Stone was furious. "My son needed me to be a supportive mom, but instead, I had to spend a great deal of my time learning to be an insurance clerk. I read that we're spending a lot of our health insurance dollars on administrators, but you sure couldn't tell there was much administration from the experience I had. This system is crazy and broken, but you don't realize it until you get sick and it's too late to do much about it.''

Although optimistic about her son's future health, Ms. Stone is very concerned about the future of her son's health care costs. "Now I know my insurance rates are going to go up, and I'm really worried about losing my job. And what's going to happen when my son gets a job? Are they going to look at his history of bone cancer and say, 'No way are we going to hire this sick guy; he might get expensive'? Sometimes I wish the people in charge of this whole system would get sick; then they'd see what a mess we have on our hands.''

The Provider's Perspective

Both Dr. Young and Dr. Nold found the system every bit as burdensome as did Ms. Stone and her family. "I guess I can understand a contract that prevents me from caring for grown-up kids I've known my whole life,'' Dr. Young said. "But when they leave my practice, rarely if ever does any of their medical history go with them. And when it does, it's just a huge stack of paper in my own writing—and sometimes I can't even read some of my own past notes. I guess my receptionist should have been able to determine immediately that Frank Stone was too old to be in the practice, but she just assumes they are eligible and starts collecting the mountain of data required to bring him into the office. I'd like to get some sort of checklist to expedite these sort of things, but we're already buried under an avalanche of paper.''

Dr. Nold echoed Dr. Young's complaints. "I know I'm not a cancer specialist,'' she said, "but I sure can tell you that a hard fixed lump in the calf of an adolescent is trouble. I should have been able to get things moving more quickly toward a diagnostic workup.'' Commenting on the paperwork burdens, she said, "I had to spend a lot of extra time completing paperwork when I already knew this was serious. Then I had to battle with somebody on the phone and argue in defense of my patient. They didn't want to send him to a specialist and kept asking me really stupid questions like, 'Are you sure this isn't an infection?' and 'Why can't you just observe the lump for several weeks?' I'm sick of these people practicing medicine.''

Finding the Value in Information Technology

This case points out the obvious: Our health care system does not meet the expectations of patients, providers, employers, insurers, or payers. Who, one asks, benefits from this dysfunction? Why is it allowed to persist?

Clearly, much of the issue centers on our values and on one inescapable reality: We simply cannot afford as a population to pay as much for the health care of others as we would like to have paid for the care of our own loved ones in their time of need. As long as

illness is something that happens to "somebody else," we are in a quandary. Although we cannot address the ethics of managed care and the implications of conflicting value systems, we can explore how the latter can be affected by better information technology.

This can happen in two ways. First, we can recognize that information technology often does not work because it tries to model the goals and values of disparate and often opposing actors in the health care debate. How can a system be created that both maximizes the delivery of medical services requested by a patient or provider while at the same time rationing these services at the behest of payers with limited financial resources? Second, we can recognize that our current system is often illogical, wasteful, and inefficient. While debate rages over the high salaries of physicians and executives or the rapidly escalating costs of pharmaceuticals and nursing home care, we seem to ignore the massive waste that is the result of an ineffective communication system adding undue overhead to the management of our health care system.

Why, one asks, should the health care industry—consuming over 14 percent of the GDP—be allowed to function with information systems that seem to preserve inefficiencies rather than abolish them? Why should information officers have such tunnel vision that they do not focus on systems that emphasize global effectiveness rather than parochial, short-term cost containment?

After decades of research and work, the informatics community has not witnessed the impact it would like on these dysfunctional processes. The promise of innovative clinical systems has not been realized in a systematic way. This discussion is intended to explore whether such potential can be realized further if we in the informatics community examine more closely the successes and failures of other industries and attempt to apply these lessons to our own profession.

Our discussion today is focused on a few simple concepts—the notion of value and the value chain, the role information technology plays in the logistics of retailing, a brief discussion of inventory and its relationship to medical practice, and the fundamental shifts in relationships and financial models brought about by new markets between providers and consumers, fostered by the evolution of the Internet. We conclude with the hypothesis that we have much to learn by looking outside health care for solutions to pressing social needs.

Porter's Notion of the Value Chain

In the 1960s, Peter Drucker stated that a business was an organization that took knowledge and materials from an external environment, transformed these elements, and returned to the external environment something of greater value. In other words, a business adds value to ideas and materials by incurring internal costs to achieve external benefits. Porter expands on this concept by discussing his notion of a "value chain." Porter's view states:

> This concept (the value chain) divides a company's activities into the technologically and economically distinct activities it performs to do business. We call these "value activities." The value of a company creates is measured by the amount that buyers are willing to pay for a product or service. A business is profitable if the value it creates exceeds the cost of performing the value activities. To gain competitive advantage over its rivals, a company must either perform these activities at a lower cost or perform them in a way that leads to differentiation and a premium price (more value).

Michael Porter's work on strategy provides a framework for understanding information technology's value to different stakeholders. Porter identifies core support activities that include infrastructure, human resource management, technology development, and procurement. These core support activities make possible the entire range of activities in an enterprise, from inbound logistics through operations and outbound logistics, to marketing, sales, and service.

These concepts seem applicable to clinical care. In the case of most medical centers, the core support activities include infrastructure, human resource management, knowledge management, and knowledge application. The activities made possible by these include patient registration, referral, delivery of care, communication with other members of the health care team, therapy planning, home care, and claims processing (Table 1).

For many reasons, medical informatics has been reluctant to adopt a business and strategy framework in formulating its own destiny. In the early days, our discipline focused on the immediate needs surrounding the creation of health care information systems for clinical use. Early work emphasized not value but feasibility. Although ongoing work expands this notion to apply to a broader range of patient care and educational research, the strategic context is never explicit and the value of some activities may not be the subject of sufficient scrutiny. Although our field's long-standing interest in clinical decision support and

outcome management asserts a value proposition for information technology, most of us do not ask the simple questions: Where is the most value to be obtained by information technology in clinical care? To whom is the value conferred? What are the costs associated with different value-added initiatives? To what extent do decisions made for one component of health care affect the costs and benefits of the application of information technology to other components?

The scenario in the case of Ms. Stone demonstrates a fairly neglected but critical area of need for informatics research—the numerous challenges that "surround" the clinical encounter. Most of the individuals described in this case found the health care *system* to be the problem, not the interaction with physicians or support for clinical information management. Indeed, it was the complex, baroque, and impenetrable bureaucracy surrounding the family's managed care plan that contributed greatly to the patient and family's perception of care.

To understand new ways of thinking about the value added to information technology, one should examine

Table 1 ■

Health Care Information Value Chain Components

Many new vendors of health care information technologies have on their Web sites illustrations demonstrating the complexity of health care services. In addressing complexity, information systems confer value. This complexity encompasses many steps, including:

- Determination of eligibility

- Referrals and authorizations

- Claims submissions

- Information access and reporting

- Membership management

- Care management

- Results reporting

- Claims management

- Practice management, premium billing, capitation/risk pools, claims processing

- Scheduling and demand management

- Group purchasing and integrated supply chain management

- Health risk appraisals and wellness education

- Secure e-mail

lessons learned in other industries. Often the firms of interest are not considered "hi tech," but on closer look it is apparent that effective information technology is critical to their overall success.

Wal-Mart

Wal-Mart's success is an excellent example of the value chain and its application. Most people think of Wal-Mart as a retail company. This writer thinks of it also as an information technology company. Its success is clearly the result of good merchandise, good locations, and great employees. But one can see the same combination of goods, location, and service in many retail companies that have not achieved the same outstanding performance. What, then, are the other sources of Wal-Mart's success, and how does information technology play a role?

More than anything else, Wal-Mart exploits the value chain at every step, from the manufacture of goods through consumer purchase to customer support after the sale. The goods they sell to the public may be physical, but internally, theirs is a commerce of information. Wal-Mart has near-real-time data on what customers want, what they buy, what they return, and even what they steal. Looking outside their own walls, the company knows what their competitors sell and what goods and services differentiate the competition from themselves.

To achieve these results, Wal-Mart has a sophisticated sales and order management information system. As items are scanned at the checkout counter in a remote location, the transaction details are stored in a database for later transmission to Wal-Mart headquarters. There, these data are not merely assembled; they are used to make real management decisions. In contrast to the rhetoric of data-driven decision making, Wal-Mart puts the rhetoric into action in a systematic way. In addition to regular meetings among a wide range of Wal-Mart managers, the company has representatives from their major suppliers onsite at all times. Rather than hide data from their wholesalers, Wal-Mart shares data and through this partnership streamlines the relationship between the people who make goods and the people who buy goods.

Wal-Mart doesn't merely decide what goods and services to buy and where these goods should be delivered; it employs a sophisticated network of suppliers, stores, and regional warehouses placed so that their delivery trucks rarely run empty. When a truck delivers goods at one store, it often picks up supplies or other goods from a nearby distribution channel for a

subsequent delivery. The Wal-Mart trucks one sees on the world's highways are rarely empty.

Wal-Mart's competitors attempt to do the same things, but in general they do not seem to be able to incorporate these same good ideas into a plan of action quite as effective as that of Wal-Mart. Some lack the information systems to create the near-real-time data management system critical to Wal-Mart's success. Others may have the data they need but may not know how to make good use of the data. As in health care, the difference between success and failure is a matter of a few percentage points in net revenue. To achieve their success, Wal-Mart consistently executes millions of small steps just a little bit better than most anyone else.

Wal-Mart uses information to minimize the time an item sits on the shelf and, in effect, to ensure the most rapid delivery of an item from the factory floor to the consumer. This means that at any given time, Wal-Mart has less money tied up in inventory and, accordingly, is less likely to have in its possession large quantities of less desirable goods that must be sold at a steep discount or loss. This control of inventory is critical to the overall value of Wal-Mart.

Amazon.com

Perhaps the most striking example of inventory management in the world of digital commerce is the stupendous rise in fortune of Amazon. Much as Wal-Mart changed the fundamentals of general goods retailing, Amazon has changed the fundamentals of the book industry and Internet commerce in general. Key to Amazon's early success was their total lack of inventory. Rather than spend money to build bookstores, fill them with books and employees, and wait for customers to come, Amazon chose to gamble that consumers would use the Internet to ask for what they wanted. Simply put, Amazon would wait for customers to request a book and would then obtain payment via credit card for the retail price of the book and the shipping costs. Only then would they actually purchase the book and ship it to the consumer. Instead of placing most of their resources into property and inventory, Amazon put their resources into increasing the information consumers could obtain about books and leveraging their size to obtain low-cost, rapid delivery of books from supplier to consumer. Increasingly, Amazon.com is the brand that is about information—information about books, videos, music, auction items, and other materials. Increasingly, they make the experience of buying a book intensely personal to millions of customers. As you buy more and more from Amazon.com, the company's in-

formation systems learn about your preferences and interests. Bricks and mortar are generic and appear the same to everyone. Increasingly, Amazon's investments in information make their wares appear to be tailored to only one special customer—you.

Where is the "Inventory" in Health Care Delivery?

Wal-Mart, Amazon.com, and other organizations make effective use of technology by putting their resources where value can be obtained. Both companies mentioned here obtain value through better control of one of their most precious assets—their inventory. Where, one might ask, is the equivalent of inventory in clinical medicine? This author believes that in medicine, one of our most squandered resources is the amount of time spent seeking medical care, delivering medical care, and paying for medical care. Put simply, the inventory of clinical medicine is time, and the value gained by information technology may be to allocate this precious resource more judiciously.

Many analogies can be found between the inventory of material goods and the time consumption in medical care delivery. We present four examples to facilitate discussion.

- First, matching of supply and demand for nursing and other professional personnel in health care settings is critical for efficient operations. Unmatched resources are wasteful.

- Second, there is great value in addressing the logistics of patient flow. A patient kept waiting incurs a cost for doing so, either in time alone or in a deterioration of health. Like any other consumers, demanding patients can take their business elsewhere if their provider does not offer the goods and services they want at a convenient location and time.

- Third, the relationships between Wal-Mart and its vendors may serve as a model for research and support relationships involving health care providers. Perhaps "suppliers" (be they information technology personnel, clinical researchers, or vendors of medical goods) should have a greater physical presence, like that of the suppliers who work in Wal-Mart headquarters. Perhaps these "suppliers" should share additional financial risk for care, as many physicians now do. (Perhaps if information technologists assumed a degree of financial risk similar to that shared by clinicians, our systems would run more effectively.)

■ Fourth, resource allocation in health care is a real-time problem, as are public health information, clinical care, and education. There are analogies between the real-time acquisition of purchase information in the checkout lane and the acquisition of clinical and financial data in the patient care setting.

Conclusions

Health care services present logistics and inventory problems similar to those faced by Wal-Mart, Amazon.com, and other concerns. Relationships between the various contributors to health care services—insurers, payers, physicians, home health care practitioners, nurses, therapists—are every bit as crucial as those between Wal-Mart and its suppliers. Like Wal-Mart, health care has as its goal the effective provision of a desired set of goods and services with the least possible overhead. Like Wal-Mart, the health care manager should understand that incurring expense to realize a goal is acceptable, but incurring unnecessary expense is and should be anathema.

America's competitive health care system is constraint-based and, hence, poorly performing segments of the system will not meet the goal of high-quality patient care. (Indeed, because some baseline level of quality and service is essential, many will not survive at all.) Porter's work suggests that this competitive advantage can be achieved only through a combination of superior cost performance and a degree of differentiation that allows for higher charges and hence a higher tolerance for costs. Retail and manufacturing firms exemplify the kinds of successes that may be realized in health care systems. Critical to their success is the effective coordination of a wide range of complex activities in the most effective way. In achieving this degree of coordination one saves wasted time —the "inventory analog" of clinical care.

Suggested Reading ■

1. Health care expenditure data can be found at the Health Care Finance Administration's Web site. Data from their 1997 National Expenditures Report are available at http://www.hcfa.gov/stats/nhe-oact/hilites.htm.
2. Porter M, Millar V. How information gives you competitive advantage. Harvard Business Review. Jul–Aug 1985. Available online as product 85415 at http://www.hbsp.harvard.edu. Similar discussions are available in Porter M. Competitive Advantage: Creating and Sustaining Superior Performance. Free Press, 1998.
3. One description of the Wal-Mart story can be found in Harvard Business School case 9-794-024, available at http://www.hbsp.harvard.edu/hbsp/adv as product 794024. Similar cases about Amazon.com can be found at the same source.