Viewpoint ■

Clinical Care and the Factory Floor

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Abstract The purpose of this article is to provide the author's perspective on whether it is likely or feasible that those working in the health care domain will adapt and use lessons learned by those in the industrial domain. This article provides some historical perspective on the changes brought about in the industrial domain through the introduction of new technologies, including information technologies. The author discusses how industrialization catalyzed changes in health care delivery that paralleled but lagged behind those of the broader U.S. economy. The article concludes that there is ample reason for those interested in improving the quality and effectiveness of health informatics to systematically evaluate information technology strategies used in the industrial domain. Finally, it outlines some challenges for health informaticians and a number of factors that should be considered in adapting lessons from industry to the health care domain.

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Given the major changes affecting health care today, it is appropriate to ask the question, "Can health care directly adapt and use any of the lessons learned in the corporate or industrial domain?" Until this decade, the most likely response was, "No, of course not! They are so different that the idea is not worth considering."

Why is this question worth considering today? Is there any reason to believe that there are similarities between manufacturing and health care? The purpose of this discussion is to illuminate some of reasons for extracting lessons from the industrial model. The industrial model demonstrates many different parallels with the health care domain. Because of these parallels, it was chosen for comparison despite the fact its use was almost certain to offend those informaticians who find a comparison of health care with manufacturing insulting.

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Background

The last 10 to 15 years of economic growth has been due, in part, to increasingly effective use of computer-based technologies. The downsizing trend of the last 15 years has been driven because it has been perceived to be necessary for economic survival.[1] This downsizing has been made possible, in part, by the increased productivity achieved by knowledge workers through information technology.[2] This impact of computers has come after a lag time between their general introduction and their effective use. This lag time is consistent with that seen for earlier technologic advances.

Computers have been used in health care for many years; however, their widespread use to support clinical rather than administrative or billing activities is relatively recent. Today, there is major new emphasis on the introduction of clinical information systems throughout the health care domain. The stated justification for clinical information systems is that they will allow health care organizations to decrease the cost of health care while maintaining or even improving the quality. It is certain that the health care domain and the medical informatics discipline face major challenges in the implementation of these clinical information systems. The re-engineering (another concept that the industrial domain adopted before medicine) of clinical care through the application of evidence-based medicine is an even greater challenge.

Given health care's current emphasis on cost, a review of domains in which cost has already been a priority is important. Are there lessons about the implementation of computer systems or the concomitant re-engineering of business processes in the industrial domain from which the health care domain can learn? Even a casual examination of the changes in health care in the last decade yields some clear examples of instances where this has already happened. The adoption of just-in-time material management procedures is one of the most obvious. Also, the ''just-in-time'' principle is rapidly becoming a standard for training among health care enterprises, especially as applied to the installation of new information systems.

Are there others? How far can the adoption and adaptation lessons from the industrial domain apply? Other lessons will probably cover a wide range of topics; some may seem, at first glance, not related to the effective use of computer-based technologies. However, the greatest successes in the industrial application of computer-based technologies occurred when coordinated changes were made in other functions of an organization. The ''systems'' approach originally used in industrial settings is also just as relevant for health care. It took some time to harvest the benefits of information technology investments, because organizations threw the technology at people's work but didn't change the work itself.[3] Any additional lessons will almost certainly include a broad range of topics ranging from organizational theory to change management as well as interface design and client–server computing.

There is a high probability that there are information technology lessons to be learned from the manufacturing and other industrial domains. The key question is how we identify industrial success stories so that we can also determine their use in health care? A historical perspective may be of some assistance.

Convergence

While the industrial revolution dramatically changed many activities, the professions, including health care, remained largely unaffected by it. Among the skilled craftsmen (artisans), physicians were affected the least. This was largely because their practice was not based on motor skills but rather on knowledge management. Time budget studies indicate that more than 70 percent of physicians' time is spent obtaining patient histories, performing diagnoses, and providing medical or self-care patient education—all information tasks. Relatively little time is spent on the skilled-craft aspect of practice. This is in contrast to dentists, for example, who spent most of their time on the skilled-craft aspects. Thus, physicians are an archetypal example of the knowledge worker.[1] The advances from industrialization were much easier to apply to the skilled-craft domain than to the efforts of knowledge workers.

In fact, it was not until the early part of the 20th century that some of the attributes or characteristics of the industrial revolution became evident in health care. Since then, the health care domain has adopted some of the practices common to the industrial setting, but the rate of change has been slow and the number of adopted characteristics has remained low. This subtle convergence of characteristics moved at a sedate pace for more than 50 years. The economic, regulatory, and societal pressures of the last decade have stimulated a more pronounced and rapid convergence of characteristics between health care and factory. Examining the differences in the rate and breadth of convergence during these two periods might allow us to better understand what has driven this convergence as well as some of the impediments to it.

At the beginning of the 1900s, medical practice was literally a cottage industry (Douglas Perednia, lecture at Oregon Health Sciences University at the University of Illinois at Chicago, 1996). The most common site for medical care was an office connected to a physician's home. The two world wars stimulated a change in this model that was further accelerated by advances in medical science and technology. Reliable comparisons are difficult because of unreliable casualty figures, but typhus, influenza, malnutrition, frostbite, malaria, yellow fever, and other diseases are estimated to have caused more deaths among combatants than hostile action until the 20th century. Despite the introduction of more destructive weapons, such as the machine gun and poison gas, American casualties from disease in World War I were comparable with those from combat.[4] Given these experiences, the military and civilian leaders of the United States began an effort to improve health care for both military personnel and the civilian population.

The development of the Veterans Administration hospital system also influenced government and civilian attitudes and introduced the government into health care delivery in a much more substantial way. The strong economic activity of the 1950s and 1960s and the growth in the nation's wealth made it possible to increase government funding substantially for biomedical research. These and other trends worked together to increase the quality of health care and the

nation's expectations of it. These changes were linked to other changes. Technology was expensive and needed to be located where it could be shared. Some of the new medical skills and technologies required training beyond that normally received by physicians, which led to the growth of the specialist.

All these factors conspired to drive medicine from a cottage industry toward a more industrial or factory structure. In a process that mimicked some of the stages of the industrial revolution, medical practice evolved from a cottage industry to an activity practiced in an industrial setting. The focus of medical practice switched from the physician's home to a small factory setting after World War I and to the large factory setting after World War II. By factory setting, I mean the concentration of medical practice in, first, small hospitals and clinics and then larger hospitals and clinics.

Discontinuities

While the locus of medical practice shifted toward a more industrialized setting, an analogous shift did not occur in many of its methods, theories, and practices. Medicine accepted some practices of the industrial setting, such as co-location, specialization, and shared core facilities.[5] But, it rejected many of the practices, including standardization of activities, a comprehensive quality assurance program, and a hierarchic management structure. Some of these choices were correct, and others were in error. There are many reasons why these attributes of industrialization were rejected. Some of these reasons were sound. They were usually based on the differences between the delivery of health care and the assembly of automobiles, for example. There were also clear and deep-seated impediments that were easily fundamental and very visible. For example, medical practitioners developed a culture of fierce independence and resistance to top-down management approaches. The exception was the education and management or physicians-in-training—one of the last forms of indentured servitude.

However, too often the differences between the attributes of medical practice and the attributes of industrial programs were based on less substantial or less intellectually sound issues. The distinctions between health care delivery and the corporate setting were often defined by the use of stereotypes. As is typical of all stereotypes, there was enough truth in them to prevent their easy debunking.

These stereotypes took many forms. Here are two examples. Practitioners of industrial management were inclined to dismiss the organization of medical practice as hopelessly outdated. A metaphor used was France in the 14th century—a period of strong kings, weak barons, and an occasional iron duke. When describing the organization of medical practice in terms of the 14th century, industrial and corporate managers did not often use adjectives like cohesive, comprehensive, or rational. At the same time, physicians tended to view hospital administrations and HMOs as examples of neo-Stalinism practiced by modern capitalists. Every change introduced by administrators was deemed an attempt to limit the freedom and quality of medical practice for the convenience (and the bottom line) of the corporations.

Before 1990, acceptance of these stereotypes was a major impediment. Worse, they eroded the ability of the people in a health care organization to do more than just share space and expensive resources. The adoption of the stereotypes made it nearly impossible to develop an organization of people who cooperated in a way that reflected a community of interests. The health care domain was predisposed to reject clearly valuable successes from the modern manufacturing domain. These successes included lessons clearly applicable to evidence-based medicine, such as systematic quality control, failure analysis, and standardization of activities. Furthermore, easier access to and more effective use of information technologies in the industrial domain drove these successes. For a considerable period of time, the rejection of the lessons embedded in these success stories was made easier because the health care domain was not systematically collecting the data it needed to adapt such lessons from its use. Those of us in health care knew how much we charged but little about how much things actually cost. We knew who our patients were but did not know, in a systematic way, our effect on their health.

At the same time, the management professionals in the health care domain felt free to reject lessons from other industries. The entrepreneurial nature of medical practice did not lend itself to hierarchic, top-down management. Because it was difficult to manage health care professionals by the prototypical methods, they felt immune from any responsibility to manage the health professionals or to even know much about their activities. Even today, a large majority of chief information officers in health care do not believe it is necessary for them to know much about the clinical processes of their organizations.[6]

The inefficiencies and discontinuities caused by the acceptance of these stereotypes were almost cost-free until the 1990s. Two major factors obscured the real

situation: the increasing wealth of the country and increased subsidization of health care by employers and the government; and the insulation of the health care domain from the normal economic discipline of a market economy. These inefficiencies and discontinuities are no longer acceptable, in this era of resource constraints and increasing government regulation. Today's pressures are causing the health care domain to re-examine which characteristics of the industrial setting might be adopted. Some of the most prominent issues in health care today—such as care pathways, evidence-based medicine and outcome analysis—are the result of such reappraisal.

Fortunately, the industrial domain continued to move forward during the 1990s. The need to use alternative management structures driven by the nature of an organization's activities is now widely understood. Instead of rigid adherence to a hierarchic, top-down management structure (or variations thereof), the best organizations now use other management approaches that reflect the special skills and unique characteristics of knowledge workers. Developing a community of interests is now a primary goal of employer–worker relations.

Equally fortunate is the fact that those in health care may be in a position to learn from the successes and failures of others. Health care is now acquiring the kinds of information technology resources, mainly clinical information systems, that make it possible to more easily adapt lessons from the success stories of other domains. The need for new management structures and the development of community interest is now made more evident, or urgent, by economic pressures, highlighted by some conspicuous failures of well-known health care organizations.

Future Challenges

As we enter the next century, it is likely that one of the primary challenges in health care will be to learn from the successes of others and appropriately introduce new activities and processes, but it is likely that the adoption rate will remain low. Yet this is probably also appropriate, since the risk of failed experimentation will remain high. As we begin the process of picking and choosing, there are some important issues to keep in mind.

What Is the Model for Our Organizations?

For the health care domain, the answers to this question are heterogeneous and evolving. This is particularly true for academic health science centers. In the past, health care was viewed as something in which society invested. Is that still a viable model, or is health care simply another element of our consumer-driven economy? Are our revenue models valid? predictable? How do they differ by organizational type? region? mission? Is the role of academic organizations as providers of health care providers viable? Or should new strategies be developed to discharge our educational and research missions in a new, highly competitive health care market?

God Is in the Details

As we strive to identify and learn from the successes of other domains, what are some of the key questions for health informaticians to ask? Which characteristics of health care and health care delivery are unique, and which are simply differentiated forms of more general characteristics? For those that are unique, how do we use information to support that uniqueness? Are all unique characteristics of health care delivery equally valuable? Do we as health informaticians help solve the problems of our organizations? Do we even understand them? How will these changes affect our careers and the careers of our students and trainees? What will I be doing in two years? five years? Do we understand the different needs of health care administrators, clinicians, customers (payers), and patients? Do we know enough to leverage our information technology efforts? As informaticians, what is the desired outcome—grants and publications, more efficient health care delivery, or something in between, such as solving the information-based problems of our own organizations?

Conclusion

The role and scope of health informatics activities are likely to change with the broader health care domain. Perhaps the key question is what role informaticians will play. In his classic study, *On War*, C. Clausewitz speaks repeatedly about the importance of initiative and the danger of doing nothing when faced with a key decision.[7] What does warfare have to do with today's health care challenges? The key point Clausewitz makes is that by doing nothing, we give up the initiative. So we must ask ourselves who we want making the admittedly difficult and unpleasant decisions about health care and health care informatics. It is not in our best interests that these decisions be made by others, who know less and care less about our field than we do.

During this century, the transformation of clinicans from skilled craftsmen to sophisticated knowledge

workers was driven in part by the emotional fulfillment implied by the possession and use of specialized knowledge.[8] New thinking about today's challenges, the willingness to learn from others, and bold innovation on our parts will allow growth in skill and sophistication to continue. As health informaticians we have an important role to play if we will only look at old problems from new perspectives.

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