Chapter 17
Technology Transforming Healthcare:
Tipping Points, Strange Attractors, and a Singularity

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ABSTRACT

Information and knowledge technologies, both alone and embedded in other advancing technologies, will transform health care. These technologies become part of health care because they bring efficiencies until they reach a tipping point where health care cannot function without them. These technologies add to the complexity of health care further creating a complex adaptive system. They function as strange attractors, or focal points, for intense, persistent, and accelerating change, which transforms the culture and control mechanisms of health care. Such smart technologies as artificial intelligence combined with genomic and nanotechnologies may bring about such a radical change that we could not return to today's health care system. For the transformation to be optimal, health care needs to address such issues as quality improvement processes, more intelligent electronic security, new control mechanisms, redefinition of the boundaries of health care enterprises, and a change from operating in discrete to continuous information flows.

INTRODUCTION

Technology, especially information and knowledge technology, will continue to exponentially transform health care. Health care is vulnerable to this transformation as it is a loosely coupled, distributed system spanning a wide range of enterprises and settings with their own decision makers: clinics, health facilities, public health offices, in-home chronic disability and aging services, insurance and health maintenance organizations, and behavioral health services integrated with medical and dental services. In all these settings, the focus of health care is the health of individuals and communities.

Information and knowledge technology, as traditionally expressed in software applications and also as expressed embedded in genomic and nanotechnology forms, is in the forefront of this

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transformation. Information and knowledge technology is also embedded in new logistics and telecommunications, in new materials and biochemistry, in smart buildings and efforts to be green, in evidence based and actuarial driven design, and in other parallel advances.

While health care has an understanding of information technology in the wide range of applications from word processors with spell checkers and electronic records systems to payroll and ERP – enterprise resource planning – systems, knowledge technology is less widely understood. Partly this is because knowledge based systems and artificial intelligence are often used to quietly enhance existing information systems.

TRANSFORMATION DRIVERS

In health care's drive to be explicit about best practice, to thoroughly document services and results within taxonomies, to improve processes with evidence-based design, to strive for consistency and quality through reviews of services, health care personnel have extracted and made explicit vast amounts of specialized knowledge. Increasingly this knowledge is represented in forms that fulfill a precondition that will increasingly allow computers to reason over this information. If health care provides knowledge systems with access to information and data, these knowledge systems can apply the represented knowledge to the information, and draw conclusions and inferences that will provide advice to humans. Given both real time access to information and control of appropriate physical systems, these knowledge systems can be cybernetic, developing feedback loops, and can act as thermostats do in regulating a building's consistent temperature.

While technology is visible in transforming health care, the persistent drivers of change come from the economy and society. These drivers are complex and exponential: cost, underserved populations, the coming demographic tsunami, and globalization.

Cost containment is more than just reducing expenditures. Cost containment also includes increasing the value or utility ratio to cost. In an industry where technology change is so rapid and both extends health care's capacity and raises expectations of increased competence, cost containment is not being applied to a static system. While health care might reduce personnel costs in a hospital cancer unit by thousands, the cost of the newest cancer pharmaceuticals increases by tens and hundreds of thousands. Still society strives to contain health care costs (Moroney, 2003).

Underserved populations and a coming demographic tsunami of an aging population increase the pressure to serve all, and early, while containing costs. These populations adapt to health care information technology. "The most common factor influencing the successful use of the interactive technology by these specific populations was that the consumers' perceived a benefit from using the system" (AHRQ, 2008, p. v).

Ever closer global neighbors are becoming relevant to each nation's health care system. Poor health and epidemics in once far away lands are no longer far away. Thus, among other examples, Canada's Global Public Health Intelligence Network (GPHIN) searches the Internet for advance warning of outbreaks of, for example, SARS (Mykhalovskiv & Weir, 2006).

The choice is not between the cold inhumanity of technological health care or human-intense health care. The choice is between optimal health care or less-than-optimal health care. Technology alone is not sufficient for adequate health care. Technology is only a part of the solution. Technology must be a part of the solution.

INTELLIGENCE

The question is often stated as how much technology? A better question is rather how much