

## For Discussion

# Failure to Provide Clinicians Useful IT Systems: Opportunities to Leapfrog Current Technologies

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### Summary

**Objective:** To discuss why clinical information systems are failing.

**Method:** Subjectively analyzing the development of clinical IT systems during the last decades.

**Results and Conclusions:** The challenge is to anticipate what information clinicians need and then deliver it in a way that is tailored for their unique views. Clinicians need workstations that offer the highest level possible of user-determined flexibility and customization. We envision and outline a so-called point of care workstation, automatically scaling to the display, hardware capacity, operating system, applications (local or distributed) the user needs and across diverse health IT systems.

### Keywords

Clinical workstations, health professional workstations

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## The Problem

Over five years ago the Institute of Medicine (IOM) concluded that health care professionals (HCP) needed to interact effectively and efficiently with the health information technology (IT) systems that contain the data they need to perform their daily tasks [1]. Today the United States still trails behind Denmark, the Netherlands, and other industrialized nations in the adoption of health IT according to the Commonwealth Fund [2]. Only one in ten US physicians used electronic health record systems that included prescription and diagnostic test orders, test results, and physician notes [2] and only 11% of hospitals have fully operational electronic medical record systems [3]. Why?

This challenge paper believes that the IOM study cited above **incorrectly** assumed that today's health IT (HIT) systems can "effectively and efficiently" support HCP users. We postulate that the failure of provisioning HCPs with effective and efficient HIT systems is **the principal reason** why HIT system adoption has failed. This conclusion is underscored by experiences like that at Cedars-Sinai in Los Angeles, where physician protestors (most of them internists) forced the Medical Center to turn off its computerized order entry system less than four months after it became fully operational [4]. This response, replicated elsewhere, is a wake-up call for the industry. If health IT fails to make the day easier for nurses and doctors, health IT has failed those it is meant to serve.

Today's HCPs, many who cut their IT teeth on highly successful video games, iPods and cell phones, simply expect that the devices they use will actually help them. Many still perceive using health IT as what the Dean of Harvard Medical School calls "a forced march" [5]. As clinicians, they must use many different information sources, but "own" none of them. Clinical reasoning is complex and highly individualized. Caring for patients requires obtaining data and gleaning information and knowledge from the data – and doing so in settings that are increasingly interdisciplinary, value-driven, patient-centered. The information needs of physicians vary widely, by age, education, experience, and cognitive style; and their thought processes vary by specialty and practice setting.

Human factors are clearly an important design challenge that has been solved by other market sectors. The IOM [1], in attempting to explain away the lack of HIT adoption, grouped these in two main categories. The first category includes the interrelationships among healthcare professionals and within and across offices and institutions, all of which impact workflow and continuity of care. Since the 1990s, these organizational issues have received increasing attention in the health IT community. The evolving consensus that "changing systems means changing behaviors" [4] is making change management and organizational development components the gold standard in health IT implementations. Again, the emphasis has been on "benefits realization" work to change HCP behaviors to adopt HIT rather than to assess the system, HIT, and its users, as a whole.

The second category involves cognitive issues. Recent research on unintended adverse consequences [6] and "e-iatrogenesis" [7] (patient harm enabled or precipitated by health IT) documents the impact human factors have on healthcare delivery and outcomes – areas that health IT is intended to improve. It is no surprise that HIT systems which purport to help clinicians actually matters, as they are neither effective nor efficient. To prevent medical errors and ease workflow, informaticians are studying how clinicians process information. Their research assesses cognitive and workflow

considerations in critical [8] and emergency [9] care. One "cognitive blueprint" for a psychiatric emergency department is based on the concept of "distributed cognition" used to study collaborative decision making in airline cockpits and air traffic control towers [10].

## Where We Need to Go

Human factors research in other industries holds great promise for the health IT industry. By highlighting the performance and acceptability issues, it clarifies the concerns industry must address in establishing design requirements for systems. Doing so will allow the industry to move beyond adoption issues and provision clinicians with point of care workstations they can use.

And they will. National surveys show physicians to be avid adopters of information technology, using it at a much higher rate than the general public [11, 12]. Today's clinicians grew up with Nintendo and, compared to their senior colleagues who grew up with character mode displays, are much more technically astute. They simply have no tolerance for any technology they feel does not help them or meet their needs.

This is the "value proposition" for clinicians: If technology eases their work in compelling ways, they will adopt it, just as they have adopted cell phones and personal digital assistants. In the first quarter of 2007, one in two physicians reported using a PDA, up from three in ten in 2001 [13]. Rapid adoption of devices that offer new capabilities is a marketplace phenomenon, as in the rise of the iPod (with medical journals and continuing medical education now available via Podcast) and, more recently, the iPhone (with impacts yet to be seen). For physicians, who value their autonomy, the fact that these are personal technologies they can control is no doubt a plus.

Both nurses and physicians want a product that "can help them do everything they need to do at the point of care" [14]. In this regard, clinicians are no different from other consumers: they want a product that does what they need done. According to Harvard Business School's Clayton Christensen, im-

proving the product requires understanding the job. In his view, attempting to focus on a "typical" customer may target "phantom needs" and limit market size, while job-defined markets tend to be larger [15]. Certainly there is no one "typical" physician; clinicians vary by education, experience, specialty, practice setting, and individual cognitive differences.

Why are clinical information systems failing? We suggest that it is a more fundamental "systems" failure. The computer science domain lacks the methods and tools to represent the complexity of user tasks, the contexts and sets of information and knowledge that must be harvested for context-relevant information push and pull in health care. Further, health IT system vendors lack the skills, tools, and probably the financial resources to create truly useful systems for clinicians. As Nobel Prize winning physicist Max Planck stated, "in the correct formulation of the question, lies the key to the answer". The question here is: "Why has health IT failed to provide the systems and appliances that clinicians will use?"

To begin, the health IT industry is incredibly fractured, with a huge number of vendors, all of them protecting their share of the revenue. Those moneys are spread out over way too many companies, each with employees, stockholders, and stakeholders. Like a fizzled nuclear weapon, the health IT space lacks critical mass. In other IT sectors, major companies have invested heavily. Database technology – already "jump started" with funding from the Defense Advanced Research Projects Agency (DARPA) and the High Performance Computing and Communications Council (HPCC) – has grown extraordinarily sophisticated as a direct result of investments by the private sector, including Oracle, IBM, and Microsoft, among others. There has been no comparable story in health IT.

The challenge is to anticipate what information clinicians need and then deliver it in a way that is tailored for their unique views, including task structures and real-time situations [16], and for their own "thoughtflow" [17], how the individual clinician thinks about the problem he or she is solving.

In an environment of real-time data, data seeks the clinician as often as the cli-

nician seeks data. This changes “thoughtflow” [17] – how the clinician accesses, assesses, prioritizes, and acts upon data – and consequently alters established workflow patterns. The system interface must permit the clinician to transition seamlessly to a mode of operation that is compatible and consistent with his or her thoughtflow. Any device or functionality that causes delay or requires additional paths is likely to encounter resistance. Clinicians will adapt, if they see the value of doing so. Clinicians want systems that support and enhance their work – in short, that ease it, not complicate it.

Historically, developers have failed to tap the experiential expertise of practicing clinicians. Clinical thoughtflow cannot be understood by those who have not practiced, cared for patients, and taken on all of the associated responsibilities resulting from their every thought and action. Computerized structured documentation that requires responses to every question posed in text books has nothing to do with the manner in which experienced clinicians gain the information that they feel they need. Workflow is determined by thoughtflow, and an understanding of thoughtflow can come only from clinicians [17-19].

Clinicians need workstations that offer the highest level possible of user-determined flexibility and customization. They need systems that anticipate their needs, fetch whatever data may be required, and are deeply customized without the individual user having to “program” the device. In July 2007, the departing head of the National Health Service in Britain stated he was “ashamed” of some of the IT systems developed during his tenure, that they were unusable because they were built “without listening to what end users want. They have taken some account but then they had to take a lot more ...” [20].

It is critically important to engage experienced clinicians in a rigorous research and development process that also involves the computer and information science communities. Their collaboration is key to formulating an algorithmic understanding of what clinicians need. This level of understanding is essential to useful IT systems.

## Our Vision: What The Clinician Wants in a Point of Care Workstation

We envision a user interface that is “owned” by the clinician and can move from device to device, installable on whatever target hardware the user connects with, automatically scaling to the display, hardware capacity, operating system, applications (local or distributed) the user needs and across diverse HIT systems [21].

We envision an intelligent and adaptive interface that allows individual clinicians to customize what they enter and what they see, to most closely suit the way they think.

We envision a virtual repository of data that connects securely to whatever source of information is required by the clinical user – electronic records, results, references, and more.

We envision an adaptive and flexible interface that acknowledges context, allows for culturally specific variables, and gives access to reference information specific to displayed content.

## The Technologies Enabling this Vision

Some of the capabilities have already been developed and are already benefitting other industries. Others are the focus of current work at computer and information science research laboratories. These advances make it possible to address the engineering requirements for a point of care workstation system [22]:

- platform independence
- diverse input/output capabilities
- ubiquitous access
- easy customizability by the user
- ability to work with existing and emerging systems
- open architecture that accepts commercial off-the-shelf components
- ability to manage multiple tasks, and multiple patients

The functionalities provided by a point of care workstation system require an archi-

ture that couples three interacting software modules with a suite of specialized applications [22]:

- an information broker to interface the workstation system with existing information resources and network services
- a task/context manager to track and support multiple activities and multiple patients
- a human computer interaction manager to present information to and gather information from the clinician in ways that are easily understandable and consistent with the clinician’s preferences

The above requirements and functionalities were recognized over a decade ago, and critical research areas were identified even earlier. An international conference detailed these requirements [21]. Information scientists acknowledged the need for a robust modeling strategy that continuously inferred information from user inputs and behaviors. They described the four domains encompassed by the knowledge base required by an adaptive interface [23]:

- knowledge of the user, or expertise
- knowledge of the interaction, or modalities of interaction and dialogue management
- knowledge of the task/domain, or the ultimate purpose of the problem area and its goals
- knowledge of the system’s characteristics.

The advances in the understanding of human computer interactions and the interactive interface make it possible to expand and extend usability benefits, while factoring in the security and privacy concerns so critical to health care [24]. In like manner, increased attention to culturally specific variables and different cultures’ approaches [25] to cognition and problem solving can help pave the way to making a workstation that adapts to the clinician, rather than the clinician adapting to the system. This will be a win-win situation, leading to greater acceptance of the technology by greater numbers of health care practitioners in an increasingly global marketplace – and a world where both developed and developing nations face very real challenges in health care.

Today hardware from major industry players serves as the base for multiple health information systems from multiple vendors. Any hardware provider stands to benefit from the national mandate for health IT. There may be new and profitable market opportunities in the areas of middleware for information brokering. There may also be the opportunity for major suppliers to translate their expertise in point of sale technology to point of care products.

## The Challenge: Taking the Next Step Toward this Vision

As Dr. Christoph Lehmann and coauthors did in the preceding editorial [26] we also ask you in this challenge paper to send comments, suggestions, and thoughts about what you think the next steps should be to meet this challenge. To further discussion of this critical area, the editor will publish insights from your replies in the next issue.

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