Engineering a Better Healthcare Experience

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Abstract

In 2009, the Obama administration made healthcare reform its top priority and passed the Health Information Technology for Economic and Clinical Health (HITECH) Act, which authorized the Health and Human Service department establish programs that improve healthcare by promoting better information technologies and encourage adoption of electronic health records. Meanwhile, the Centers for Medicare and Medicaid Services (CMS) began certifying EMR products under "meaningful use" guidelines. This paper explores the current state of usability within the healthcare industry. I begin with a brief history of human-computer interaction research, before laying out some of the unique user experience challenges that healthcare presents. I then outline a set of usability heuristics and design best practices that should be considered when building medical applications. I also look at the importance of mobile devices within clinical settings. I conclude with a holistic discussion about why the user experience of clinical IT tools is so intimately linked to the humanistic patient experience, and the overall quality of the personalized care they receive.

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In 2009, the Obama administration decided to make healthcare reform one of its highest priorities. What followed was a politically charged thunderstorm that involved many debates, town hall meetings, compromises, and unprecedented media drama. Amidst all the noise over "death panels," pre-existing conditions, and the freedom to choose your own doctor, one of the most important pieces of this reform has been conspicuously absent from this general public discourse: the digitization of patient health records and the overall evolution of healthcare IT.

At the beginning of 2009, the Health Information Technology for Economic and Clinical Health (HITECH) Act was passed. This important piece of legislation grants the Health and Human Services (HHS) department "the authority to establish programs to improve health care quality, safety, and efficiency through the promotion of health information technology (HIT), including electronic health records and private and secure electronic health information exchange" ("Electronic Health Records," 2011). The HITECH Act was primarily designed to promote the development and adoption of Electronic Health Records (EHRs) through government incentives and other programs. According to The Office of the National Coordinator for Health Information Technology (ONC), EHRs promise more complete, accurate information that can be easily accessed and shared between doctors' offices, hospitals, health plans, or even patients' families in a secure manner. They also promise to empower patients so that they can become more actively involved in the management of their own individual and family's health ("Electronic Health Records," 2011).

In parallel, the American Recovery and Reinvestment Act authorized the Centers for Medicare and Medicaid Services (CMS) to provide some of these incentives to providers based on "meaningful use" of EHRs ("Meaningful Use: A Definition," 2009). Since then, the true

definition of meaningful use has taken many months to hash out. In July 2010, CMS finally drafted what they called the "final rule," which includes 25 different objectives that an electronic medical record (EMR) product must support in order to be officially certified for meaningful use (Silva, 2010). Meanwhile, the National Institute of Standards and Technology (NIST) and ONC have begun offering their own incentives. The ONC awarded $60 million in grants to several research institutions to innovate new solutions for the challenges that health IT faces (Mosquera, 2010).

Perhaps even more interesting, however, is the ONC and NIST's recent focus on health IT usability. According to Mosquera (2011), many providers and health IT professionals believe there is "uneven usefulness, ease of usability and user satisfaction among EHRs." (para. 4). In response, the NIST and ONC are each developing an official process and consistent set of procedures for evaluating, testing, measuring, and validating usability EHRs (Mosquera, 2011). The goal is to help providers make better choices when they purchase EMR products, ensuring that these providers have access to a transparent, standardized, and objective rating of the user experience quality that various products can offer to their practices or hospitals. Mosquera suggests that adoption of EHRs cannot effectively occur until the technology becomes fully centered on the user's goals, objectives, tasks, and workflows.

In this paper, I will take an in-depth look at the usability of healthcare IT systems. I will begin with a brief history of human-computer interaction research, tracing its rise to prominence within IT development and the public sphere. I will then describe why usability is exceptionally critical in healthcare, as I lay out some of the unique user experience challenges that this industry presents. I will continue by outlining a set of heuristics and best practices that any medical application should adhere to. I will also take a look at the importance of mobility within any

clinical setting. Finally, I will conclude with a more holistic discussion of healthcare in America and discuss why the user experience of clinical IT tools is so intimately linked to the humanistic patient experience and the overall quality of the personalized care they receive.

Human-Computer Interaction: A Brief History

From Human Factors to Human-Computer Interaction

In the early days of the Internet, user-centered design was merely an obscure professional practice and few companies truly appreciated its meaning or value. Human-computer interaction (HCI) was born out of the engineering-centric field of human factors. Before the widespread adoption of personal computers, human factors was typically concerned with airplane cockpits, safety-critical control room systems, and various military applications. The main concern of human factors was error prevention, safety, and efficiency.

According to Dumas (2007), HCI really began in 1982 with a meeting between psychology and human factors researchers, called "Human Factors in Computing Systems." Inherently multidisciplinary, HCI is a practice inspired by ergonomics, human factors engineering, cognitive science, behavioral psychology, sociology, anthropology, archeology, and even architecture. On the surface, it might appear that the evolution of the field has occurred relatively slowly, as this new breed of academics and industry experts increasingly attempt to apply traditional scientific methods to the design of truly usable interactive computer systems (Dumas, 2007). However, researchers have taken a keen interest in building more natural interactions between humans and computerized machines for several decades now. Many of the conventional paradigms and interactions that we take for granted today were initially born within scientific research institutions such as MIT, Stanford, and Xerox PARC, and funded by DARPA, NASA, and other government agencies (Myers, 1996). These include direct manipulation with a

pointing device such as the stylus or the mouse; movable, resizable, layered window containers; word processing and text editing; spreadsheets; email; chat; and computer-aided design (CAD) (Myers, 1996).

Apple and IBM Lead the Charge

While Xerox PARC is often credited with the creation of the modern graphical user interface (GUI) and ubiquitous computing (Reimer, 2005), Apple is really the company that brought awareness to the general public about the importance of usability (Dumas, 2007). They created new expectations in the market for technological products that were simple, intuitive, and fit unobtrusively within the user's environment. People, for the first time, believed that they should be able to turn on computer or use an electronic device without requiring extensive training or specific expertise in computer operation. In effect, Apple became a powerful public relations arm for the HCI research movement of the 1980s. Apple managed to capture the public's imagination and open their eyes to the unlimited potential that can arise out of a user-centric vision that shifts the focus from individual features and technology specs to a more comprehensive user experience, identifying how the computer or device can actually enhance the user's work or personal life.

As Apple sold its dream to the general population, IBM took on the enormous task of redefining business software development, and incorporating HCI research methods into the process. John Bennett of IBM helped introduce the concept of usability engineering to make more functional products that increase productivity and efficiency (Dumas, 2007). This is a more practical HCI methodology that is less dogmatic from an experimental research perspective, but still involves the direct gathering and analysis of contextual field data and usability testing results. Usability engineering includes both qualitative and quantitative research methods. It

emphasizes early HCI involvement, contextual ethnography, iterative design/evaluation cycles, and the construction of flexible prototypes at increasing levels of fidelity.

Usability ROI

Around this same time, companies also started to conduct cost/benefit analyses in order to determine the actual ROI of such usability methods (Dumas, 2007). Indeed, these companies experienced dramatic improvements in key performance indicators, such as task completion rate and user loyalty, after building usability into their process. These improvements were sometimes at a factor of 10 times or more. Today, usability methods continue to provide a highly significant ROI (Jacobs, 2008).

Why Usability is So Critical in Healthcare

Clearly, user-centered design can dramatically benefit technological systems and applications in any industry, but in healthcare, the need is much more critical. Poor usability can directly and indirectly contribute to massive increases in costs for health plans, providers, patients, and our government. Usability problems can also jeopardize patient safety and lead to unnecessary treatments, pain, suffering, or even death. Human factors first became entrenched as a necessary field within the domain of airplane cockpits and military applications because users absolutely must be able to operate these systems with little or no human error. It is literally a matter of life or death for the people involved. One could argue that healthcare is quite a similar domain in this regard.

Cost Control

In terms of cost control, a poor user experience can increase the need and time required for training and reading through manuals amongst new users (Potnis, 2009). Potnis points out that an aging population of users who are not typically very experienced or proficient with computers

may exacerbate this issue. If a system is difficult enough to use, or if it forces users to dramatically change the way they do their work, it will likely not be adopted. This is a very real problem. In a recent American Medical Association (AMA) Board of Trustees report, Hoven (2011) states, "It is well documented that the most common barrier to successful EMR implementation is the impact of an EMR on clinical productivity and workflow" (p. 5). The healthcare industry's rate of adoption of digitized technology has been significantly worse than other industries for over 20 years, and bad usability is identified as one of the major culprits (Belden, Grayson, & Barnes, 2009). When user adoption does not occur, this naturally leads to a major increase in opportunity costs from buying a system that users ultimately will bypass or refuse to use (Potnis, 2009).

Proactive Design

Beyond the goal of making systems intuitive and easy to learn right out of the box, medical care systems must be designed proactively. They must include a significant buffer of tolerance, in order to protect patients from inevitable user errors that occur in a distracting hospital or doctor's office environment. Goldstein (2009) warns that these systems need built-in intelligence that monitor and analyze what the healthcare professionals are requesting against the patient's electronic health record (EHR) so the systems can alert providers when something doesn't quite make sense or if there are potential complications from patient allergies, drug interactions, etc. He quotes Dale Sanders, the current Chief Information Officer for the Cayman Islands Health Services Authority, "They do far more good than harm, but we can't sit here and blindly believe that they are error-free." In fact, Belden et al. (2009) report that 25% of medication errors can be associated with computer technology, with the vast majority of these errors related to data entry. Goldstein goes on to recommend greater public oversight and standardization. He also suggests a

greater focus on interoperability between heterogeneous systems that enables a reliable, flexible exchange of information between various providers, public agencies, and other relevant institutions. Finally, he reminds us that regardless of how user-friendly a system inherently might be, a poorly planned installation and initial deployment can create significant risks to patients, especially if users are not adequately trained.

Unique User Experience Challenges in Healthcare

The Poor Usability Reputation of Health Plans

In 2010, Forrester reported that health plans scored worse in customer experience than any other industry for the third year straight (Temkin, Chu, & Catino, 2010). This study included nine different health plans, and only Kaiser reached 67% on Forrester's Customer Experience Index, which equates to "Okay." Most of the others dipped well into the "Very Poor" classification. Shockingly, United Healthcare and Anthem (BCBS) even managed to score a significantly lower index than when Forrester rated them in 2008.

While this Forrester study only focused on health plans and the applications that they directly provide, it is likely representative of the healthcare industry's more global dysfunction and struggles with incorporating information technology. This is especially true because the manner in which health plans operate has such a massive influence on information technology in America's healthcare system as a whole. The health plans' lack of cooperation and inability to create industry standards has contributed to many technical limitations and daunting challenges for anyone hoping to build applications that truly improve the patient and provider experience (Kesler, 2009). Logistically, the varied, underlying structure of America's privatized healthcare system adds a significant amount of complexity to both the provider user experience and, ultimately, the resulting patient care experience. The administrative and financial requirements

that health plans require surrounding such things as eligibility and benefits, billing, claims, referrals, and authorizations with health plans, can often be intrusive within the provider-patient relationship (Belden, et al., 2009). This has been amplified as health plans ask providers to increasingly take on the burden of tracking metrics surrounding various procedures in order to measure quality of care. In other words: return on investment (ROI).

Complex Information and Data Needs

Beyond the role of the health plans, the healthcare industry presents many unique challenges for user experience professionals and system architects. Healthcare workers require a complex set of information needs, and these vary greatly from one setting or context to another (Belden, et al., 2009). Doctors, nurses, technicians, admins, and other provider team members each have specific information needs. These needs change throughout a given day, as they move from one patient or another and perform their various tasks. Beyond a single provider setting, there are over 50 specialties that the AMA recognizes (Belden, et al., 2009). This expands the matrix of technology and information needs in the healthcare field even further.

Medical care applications must be flexible and intelligent enough to dynamically present the most appropriate information and functionality in any given context, but the technology must also be transparent enough to fade to the background and not interfere with the number one priority of providers: taking care of the patient. Furthermore, it is important to remember that most medical workers are continuously distracted, constantly dealing with interruptions as they attempt to multi-task (Belden, et al., 2009). This means that more data is not always better. Prioritization and well-thought-out visualization of data are paramount. It also means that many of these workers require mobility in their technology. They are used to carrying around paper charts, patient files, and notes everywhere they go. As these tools and artifacts become digitized,

they must maintain the same mobility and simple characteristics that providers have become accustomed to since the medicine field was born.

Additional Challenges

Additional user experience challenges come from various competing standards and required compliance with a number of mounting government reforms and regulations, such as the Health Insurance Portability and Accountability Act (HIPAA) (Potnis, 2009). These were developed with the goal of protecting patients' privacy, safety, and health, but they also create technical design constraints that must be worked around. They also make it tougher for usability professionals to conduct certain user research and discovery activities, since these regulations strengthen laws surrounding confidentiality of patient information (Pontis, 2009). Finally, there are the more general obstacles that almost all industries face when attempting to inject new information technology into established institutions. These include deployment costs, resistance to change, fear or avoidance of technology, as well as longstanding, ingrained habits (Belden, et al., 2009).

Heuristic Best Practices: The Building Blocks of a Better Healthcare User Experience

With all the challenges and criticism surrounding digital healthcare systems today, it is important to define what a good user experience in healthcare might actually look like. This can perhaps best be done by identifying heuristics and best practices that are most relevant to medical care applications.

Transitioning to Rich Internet Applications

The overwhelming trend in recent years has been to build medical applications in a web-based environment. Therefore, I will focus particularly on the usability of web apps. It is important to remember, however, that many of the same best practice principles apply to all

software, regardless of whether it exists in a browser or in a traditional desktop container. This is even truer now that modern web applications often behave almost identically to their desktop counterparts. This similarity to desktop software can be seen in such examples as Google's office apps, Balsamiq's Mockups, and Apple's MobileMe Suite. These are richly interactive applications that happen to run in a browser.

The advantage of web-based apps in the medical field is that the end user is not required to locally perform installs or code upgrades on each machine that the software is used on. Additionally, all data and preferences are safely saved in real time on remote servers. Of course, a doctor's office must have a consistent and constant Internet connection in order to use the apps, but that is already a general requirement of many healthcare systems. After all, they must frequently access many different databases or services to send requests and collect patient data from health plans, other providers, and even various public agencies.

In general, a healthcare system needs to be both rich and simple to use (Pontis, 2009). This requires a backend that includes flexible database architecture and a dynamic presentation layer that is able to take advantage of AJAX and other modern Web 2.0 technologies. These capabilities allow pages to be more interactive, while reformatting the presentation and organization of information on the fly to fit the user's current context, task, and electronic device (e.g. desktop, tablet, smartphone, etc.). In order to achieve this flexible architecture, Pontis (2009) emphasizes the need to migrate and modernize legacy systems because a networked solution is only as good as its weakest link. Of course, such system migration is also important to address issues of compatibility and interoperability.

Natural, Consistent, and Familiar

First and foremost, a healthcare application must feel natural, consistent, and immediately

familiar According to Belden, et al. (2009), this means that the design must intuitively map to users' expectations and facilitate users' common tasks by faithfully supporting the workflow they operate within. The interface should also be both internally and externally consistent. In other words, it needs to follow best practice design conventions of other similar software while strictly maintaining these conventions throughout the entire application. These design practices can help make the system interactions more predictable for users and increase the chances they will be able to use the software to accomplish their tasks both accurately and efficiently.

Language and Terminology

One of the most important strategies for building a more natural and familiar healthcare system is to ensure that the language and terminology inherently matches the user's own language (Hoven, 2009). This means avoiding the use of jargon, abbreviations, and acronyms whenever possible (Pontis, 2009).

Belden et al. (2009) additionally emphasize being concise and unambiguous. As a specific recommendation, they recommend never using all uppercase for more than a word or two because this can be interpreted by the user as shouting. Furthermore, all caps make it much harder for people to scan the text quickly. The word shape model, which Woodworth, an experimental psychologist, first discovered in 1938, explains why lowercase words can be read quicker than uppercase ones (Larson, 2004). According to Larson, "Lowercase text enables unique patterns of ascending, descending, and neutral characters" ("Model #1: Word Shape," para. 4).

Presentation and Structure of Information

Information presentation and structure are both extremely important in healthcare applications because, as discussed earlier, doctors and other medical workers are often distracted

and multi-tasking. Therefore, these users need to be able to accurately gleam information from a screen as quickly as possible while they attempt to care for their patients. This primarily means that all text and graphics must be clearly displayed (Pontis, 2009).

Navigation and page layout.

According to Hoven (2009), the UI must be organized purposely, both in terms of navigation and page layout. Hoven elaborates by stating that related content should be grouped together and unrelated content should be separated with whitespace. This reasoning is based on a longstanding school of thought in cognitive psychology known as Gestalt Theory. Chang, Dooley, and Tuovinen (2002) discuss the importance and value of Gestalt Theory principles in medical application design. They point out how Gestalt laws such as balance, continuity, proximity, and closure can make a webpage much easier to scan, read, and interpret. Gestalt Theory also provides clues on how to most effectively emphasize and prioritize pieces of information (Chang, et al., 2002). For example, the best way to make something stand out is to break patters of similarity. However, at the same time, the focal point law reminds designers to be judicial in what is emphasized on a page because too many focal points will only confuse and overwhelm readers Chang, et al., 2002).

Belden, et al. (2009) warn that healthcare applications must not be visually cluttered. They recommend a density of 40% or less. In order to achieve this optimal density, Belden et al. suggest using the “80/20 rule”. This rule specifies: only include content and features that 80% of users will need, 80% of the time.

Mindful use of colors.

Finally, medical UI designers should ensure that colors are used sparingly and consistently so that users can easily interpret their meaning (Belden, et al., 2009). Colors also have

accessibility implications. To accommodate those who are color blind, it is always good to have a secondary distinguisher, and not just use color exclusively to emphasize a piece of information (Belden, et al., 2009).

Context, Cognitive Overload, and Efficiency

Designing for unique contexts and situations is incredibly important within a medical care environment. This means providing all information that is required for the immediate task at hand, while not obscuring such critical resources with redundant content (Hoven, 2009). In other words, irrelevant tasks should either be hidden or pushed to the background (Pontis, 2009). In terms of functionality, only transactions that users necessarily need to complete their current core tasks should be visually salient on the screen (Belden, et al., 2009). These required functions must be transparent and obvious to the user. Belden, et al. also discuss how designers of healthcare applications should generally assume that the medical staff using their systems are stressed, pressured for time, paying limited attention, and most likely multi-tasking. They therefore suggest avoiding visual interruptions and screen changes whenever possible. This means not obscuring content with dialog boxes and leveraging modeless design strategies (e.g. allow users to edit and view data on the same screen rather than having to switch into a special edit mode).

Not only is it important to make sure that all of the user's required resources are easily accessible, but it is also paramount that workflows are designed as efficiently as possible. In order to assist users, Belden, et al. (2009) suggest providing decision-making tools and other features that may help speed up task performance. It can be very helpful to provide contextual metrics and present summarized data in semantically meaningful ways. Belden, et al. additionally recommend limiting scrolling, required visual searches, and mouse movements to

make user tasks more efficient and less tedious. Meanwhile, on the backend, Pontis (2009) emphasizes optimizing performance to minimize page load and server response times.

Data entry.

Data entry is one of the most common activities in a medical setting. Therefore, good form design is crucial to an expedient workflow. In order to make data entry in forms more efficient, designers should consider providing default values whenever appropriate, enabling auto-tab (e.g. automatically moving the focus to the next field as the user is entering a phone number), and providing additional shortcuts for experienced users (Belden, et al., 2009). Pontis (2009) proposes user assistance features such as auto-population of fields, type-ahead field suggestions, and contextual prompts for non-obvious fields that describe what the field is asking for and where to find the information.

Single Sign On

Systems can be made more efficient by implementing a unified, single-sign-on solution, so that users are not forced to login repeatedly every time they switch from one application or system to another (Hoven, 2009). Having to constantly login and remember multiple username/password credentials can be cognitively taxing, time-consuming, and frustrating for hospital and doctor's office staff.

Adaptive user interfaces.

IBM recognizes the importance of contextually aware applications in healthcare that minimize cognitive load and maximize efficiency. Ramachandran (2009), an IT specialist at IBM in Canada, discusses the concept of "adaptive user interfaces." He describes how adaptive UIs can adapt to different user types and scenarios through both presentation of information and navigation. By understanding the knowledge level and goals of the current user, and adaptive

interface can hide irrelevant content and only show the most important information for that user up front. If these users desire additional data or functionality, then they can actively request these resources by clicking on strategically placed links. This is known as "progressive disclosure." For presentation of information, Ramachandran also recommends hiding excessive explanations for power users and only showing fields that are relevant to the current user when collaborative data entry is required. In terms of navigation, Ramachandran discusses how adaptive interfaces can provide personalized views that offer the shortest path for current users to complete their most important tasks. Individual workflows should be understood well enough so that relevant cross-links can be place within a page, thus allowing a seamless, natural flow from one page to the another. According to Ramachandran, such interfaces should also be able to dynamically recognize the user's current position on a page and react accordingly to facilitate data entry and suggest next steps.

Forgiveness and Feedback

As medical staff are distracted by interruptions and multi-tasking, it is vital that healthcare systems have a high user-error tolerance and that they provide clear feedback to the user at all times (Belden, et al., 2009). For Belden, et al., this means concisely describing what is about to happen if a user takes an action and then summarizing what has already happened after the action (i.e. submission) is complete. They state that providing such feedback, along with robust error prevention mechanisms, allows users to casually explore the application and learn through discovery, without the constant fear of breaking something or accidentally hurting their patients. This also changes the subjective experience of users, making them feel more confident, comfortable, and competent in the interaction. A positive emotional experience will increase the potential for adoption (Norman, 2003). Hoven (2009) advises that medical systems should be

built in a flexible, forgiving manner that reduces the cost of mistakes and allows users to undo any destructive action. Goldstein (2009) adds that systems should include medical alerts to warn doctors about concurrent, conflicting treatments or drug interactions.

Ease of Install and Configuration

One of the most important things that often get overlooked is the initial configuration of a healthcare system when it is first introduced into a medical environment. Goldstein (2009) quotes David Collins from the Healthcare Information and Management Systems Society, "Risks are sometimes created not by the systems themselves but by the way they are installed and the way the staff are trained." Many doctor's offices don't have the luxury of dedicated IT staff, and the people that work there may not be technologically savvy. Configuration tasks such as user permissions, data migration, record syncing, and electronic information sharing must be carefully designed to avoid any potential patient-related privacy or safety issues.

The Importance of Mobility in Healthcare

In 2006, Skyscape surveyed over 2,800 medical professionals, asking about their use of mobile devices (Ryder, 2006). The survey results showed that over 80% of medical professionals believe PDAs and other mobile devices have reduced medical errors, while also making them more efficient. An overwhelming majority of survey respondents recognized PDAs as an "important or "critical" tool that allowed them to effectively take care of more patients in less time.

A recent survey conducted by Software Advice, a specialized software review company, asked physicians, nurses, medical students, and others in the medical field about their ideal tablet experience. The survey showed that most would buy and use a tablet regularly. Tasks they saw themselves performing on a tablet included lab order requests and results, drug reference and e-

prescriptions, taking notes, medical imaging, billing and claims, and clinical decision support. The most important aspects of a tablet user experience were quick data entry (i.e. efficiency) and software selection. Some survey respondents pointed out that a tablet couldn't be effective with a desktop operating system simply ported onto it. It must be designed from the ground up for mobile use and multi-touch interactions. A majority of users preferred direct finger interactions to a stylus or voice dictation (Thorman, 2010).

It seems that with the user requirements listed above, Apple's iPad would be the perfect device for medical workers. Unfortunately, according to the Software Advice survey, the iPad still has some critical shortcomings that may keep it from achieving widespread adoption in hospitals and doctor's offices, at least immediately (Thorman, 2010). One of the biggest current problems with the iPad is that it is too fragile and it is not resistant to liquids or dust. This means that an additional, bulky case may be required to adequately protect it in a healthcare environment. The iPad also doesn't have a native barcode scanner, although the new generation's built-in camera may potentially be useful for this. Similarly, there is no native fingerprint access sensor, which may be required for HIPAA compliance and more efficient authentication. Finally, Thorman (2010) claims there are no sophisticated EMR or other professional-grade software apps available for the iPad yet. Most are still Windows based, although the new trend toward browser-based applications may change this. Still, developers of these applications will need to build adaptive versions of these web applications that are optimized for the iPad and/or various smartphones so that they can realistically be used on a small, touch-screen mobile device.

More importantly, medical software companies must recognize the contexts that mobile devices are most effective within. Some tasks in a workflow make more sense on a stationary

desktop console while other tasks require more mobility. The overarching idea here is that various computer form factors should collaboratively complement rather than completely replace each other.

The Invisible Patient

A big part of user experience is stepping back and looking at the more fundamental, global issues with how technology is implemented within an institutional system. In healthcare, user experience is dramatically affected by legal, financial, political, and other logistical factors. Kessler (2009) bluntly states, "The medical industry has a vested interest in inefficiency." He worries that too many blindly assume technology will automatically solve all of our healthcare problems in the United States. The question is how can technology be more creatively utilized to not only improve the direct user experience of healthcare workers, but also the overall patient experience of those who need medical care?

An Inefficient Business Model

Kessler (2009) believes that the current business model within the healthcare industry is too heavily focused on number of treatments, procedures, and hospital stays. Because it has taken this industry so long to become digitized, wasteful spending on ineffective treatments has run rampant. Without heterogeneous system interoperability and more usable interfaces, adoption rates remain low and critical information cannot be effectively shared across providers, health plans, public agencies, and patients. Moreover, the common patient and provider data that does exist is still notoriously inaccurate and inconsistent across various databases (Kessler, 2009).

Humanizing Healthcare Technology

Duffy (2009), the former chief experience officer at Cleveland Clinic, asks, "How can we

humanize the way we deliver that technology?" She believes that too many healthcare workers forget that their primary job purpose is not to satisfy the desires of health plans, specialty physicians, and pharmaceuticals, but rather it is to help patients and ensure that they feel satisfied with their clinical experience. Kessler (2009) suggests that the industry needs to transition from a sickness model to an early detection and preventative care model. Therefore, the payment system must be centered on prevention rather than treatment. This includes mass screenings and statistical analysis of risk factors, as well as continuous tracking of what treatments are most effective across various populations (Kessler, 2009). Duffy (2009) states:

> The elephant in the room is that this whole system is not designed around the patient. The whole system is designed to deliver technology and the customer traditionally is not the patient, it's the specialty physician; because that's what gets reimbursed in healthcare today, not healthy food, nutrition, or wellness prevention. They're the ones who drive the revenues in the institution.

She finds it problematic that nurses are increasingly asked to do more administrative tasks that keep them away from actually being at their patient's bedsides and helping them. Legal liabilities also create huge rifts in the doctor-patient relationship. Rather than comforting patients, doctors and patients are throwing consent and insurance forms in front of them, discussing all the things that may go wrong, rather than what the patient needs to do to become healthy again. Duffy reminds us that patients remember personal relationships the most. It is really the emotional experience that is most important to them. Patients automatically assume that doctors will provide them with the latest technologies and that adequate safety measures have been implemented to protect them. What they really hope for is to be treated in a personal, respectful manner, and have their pain and fears acknowledged. Duffy strongly recommends that we

redesign the healthcare system around "listening to the voice of the patient."

Improving the Doctor-Patient Relationship

One of the most important ways that technology and HCI can help improve the patient experience is to facilitate an educational, mutually informed doctor-patient relationship. One major issue is that patients don't often understand the terms or language used by doctors, and this can leave them confused, dependent, and fearful (Weinman et al., 2009). Patients also have a very poor conceptual understanding of basic anatomy. In their research study on patients' anatomical knowledge, Weinman, et al. (2009) found that even with the vast amount of health information available over the Internet and the increased media focus on health, patient knowledge has not improved. This lack of anatomical knowledge can negatively affect the doctor-patient relationship and leave patients unsatisfied. The authors of this study found that a shared vocabulary greatly increases patent satisfaction. Also, it is quite beneficial when doctors have access to visual aids so that they can easily point at affected areas while they discuss diagnoses and treatments.

At the 2009 Healthcare Information and Management Systems Society (HIMSS) conference, Microsoft and Amalga showcased an augmented reality solution to help doctors and patients share and collaborate with information ("Microsoft Surface and Amalga ," 2009). Using Microsoft Surface technology, Amalga developed an application in which doctors can visually point to various interactive artifacts, including medical imaging and lab results. The virtual documents can be expanded, rotated, contextually morphed, and instantly shared via simple, secure access mechanisms. Patients are able to actively participate in conversations and visually learn about what is going on with their bodies. This shared interface and common language between doctors and patients can greatly empower the patient to become less dependent, as well

as more involved in their own wellness and healing process.

In other efforts to improve doctor-patient relationships, some researchers have conducted experiments to explore systems that allow patients to directly read physicians' notes (Dolan, 2009). They were curious how such real-time access to clinical notes might change the dynamics between a physician and a patient. The idea is that this might help increase patient education and active participation. According to Dolan (2009), many worried that such transparency may open the door to more claims and patient anxiety over certain notes that they find alarming or scary. Others optimistically believed that such a note-sharing system could fundamentally change the way doctors write their notes and communicate to their patients. It could lead to valuable discussions in which physicians can correct misconceptions that patients may have. More transparency may also encourage physicians to adopt a more tactful and personal attitude toward their patients.

Conclusion

User experience in healthcare clearly requires a multi-faceted approach in order to truly improve the quality of patient care, while also making the system more efficient and effective. Healthcare IT professionals must engage in more ethnographic field research in order to clearly understand contextual workflows and what it is actually like for medical workers to use their technology within a clinical environment. In addition, iterative validation activities should occur regularly throughout the development process. Psychology and HCI academic literature can certainly help to inform valuable heuristics for the design of user interfaces in medical systems, However, as I have illustrated in this paper, the most important things always seems to come back to workflow and context, which really do require direct ethnography to comprehensively understand. Researchers and industry analysts are now beginning to understand the high value of

mobile devices within a clinical setting, but as the Skyscape (Ryder, 2006) and Software Advice (Thorman, 2010) surveys showed, just simply porting desktop applications to mobile tablet computers is not going far enough.

Finally, future medical systems must find ways to address the more global, systematic problems that plague America's healthcare system. In particular, this means re-centering the focus on the patient, while providing humanistic tools that help patients become more actively involved in their own health. The most interesting thing about healthcare user experience is that it necessarily extends beyond the medical staff that technically uses the IT systems. Of course it's noble to make jobs easier for doctors, nurses, and other clinical workers, but their primary task is to take care of patients. This means that medical IT systems must enable the staff to create the best patient experience possible. Within this setting, the key takeaway is that user experience and patient experience will forever be intrinsically linked together.

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