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Patient source of learning about health technologies and ratings of trust in technologies used in their care

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Abstract

In order to design effective health technologies and systems, it is important to understand how patients learn and make decisions about health technologies used in their care. The objective of this study was to examine patients' source of learning about technologies used in their care and how the source related to their trust in the technology used. Individual face-to-face and telephone interviews were conducted with 24 patients. Thirteen unique sources of information about technology were identified and three major themes emerged; outside of the work system versus inside the work system, when the health information was provided, and the medium used. Patients used multiple sources outside of the health care work system to learn about technologies that will be used in their care. Results showed a relationship between learning about technologies from web sources and trust in technologies but no relationship between learning about technologies from health care providers and trust in technologies.

Keywords

health systems; education; patient-provider relationship; sociotechnical systems; consumer health informatics

1. Introduction

Health care work systems involve many types of users who must work together towards a shared goal of patient safety and the provision of health care. This system intertwines the interpersonal engagement of patients and their care providers, as well as their individual and shared interactions with health care technologies and other aspects of the work system. It is important to understand how technologies are used to achieve a successful work system design (Hendrick and Kleiner 2001). A key element in understanding how technology is used in the system is an exploration of the social nature of the technology and its users (Taveira and Smith 2006). Arguments have been made to consider the sociotechnical system characteristics in the implementation of medical technologies for physician users (Peute *et al.* 2009) however, patients are often an unconsidered user group in the design, implementation and integration of medical technologies.

Patient education is the process used by health care providers to inform patients of goals related to improving patient health behaviours, status, and outcomes (Koongstvedt 2001). In obstetrics the American Congress of Obstetricians and Gynecologists publishes patient education material that includes information that ranges from birth control, and sterilization to technology specific materials such as ultrasound use and fetal heart rate monitoring.

However, patient education can be provided as individual teaching/counselling, one-way information dissemination through pamphlets, lectures, films, tours, or through interactive group experiences. Patient education systems have progressed in the last 25 years and are recognized as an effective intervention in promoting self-care and management of illnesses (Redman 1993). In the 1990's computerized patient education systems were introduced in health care systems (Belda 2004). In addition to technological innovation, patient education systems have grown to include learning theory. In terms of human factors and ergonomics, efforts have been made to create standards for readable and understandable of printed patient educational materials (Merritt 1991, Reid 1995). Though other gaps continue to exist in the health care work system for the provisions of patient education, which can be described using a human factors and ergonomics framework. In terms of training, there are few standards for patient educational interventions (Redman 1993). There are inconsistencies in systemic pressure to assure workplace conditions support patient education; this can leave patient education as an opportunity for some, but not all, patients only when optimal conditions allow (Redman 1993). Also, developing and replicating best practices for patient education is largely unexplored (Redman 1993). A study of patient education training texts for nurses, found that only 43% of information included patient education (Redman 1993).

In systems where different types of workers have different social understandings of technologies and physical user experiences of the technology, a human factors and ergonomics perspective allows for a complex understanding of the work system. A human factors and ergonomics perspective can focus on the physical human body, the information processing aspect of the human, the psychological aspects of an individual, and the social human (Daniellou 2000). A sociotechnical systems perspective also allows for a deeper analysis of how the technology may be used appropriately, safely, misused, disused or abused (Parasuraman and Riley 1997). This study explores the intersection between the technological and social system in understanding patient attitudes about health technologies used to provide care or educational materials, in an obstetric work system. Health technologies are specific instruments and devices used by professionals and patient, equipment, medication, and knowledge and best practices {Andersen, 2008 #1759}.

Obstetrics is “the branch of medicine that deals with the care of women during and after pregnancy” (pg 6) (Hirst 1909). Obstetric medicine is an ideal branch to study patient's education and patient's trust of technology. According to the US census bureau 99% of women in the United States give birth in a hospital and therefore have some interaction with obstetric work systems (Martin *et al.* 2006). Obstetric patients often have recurrent relationships with health care systems and providers, allowing for multiple opportunities to receive patient education about the technologies used in their care.

This research is concerned with the social system that surrounds the patient user in a health care work system. Specifically, this study focuses on the relationship between aspects of the external environmental in the sociotechnical work system and the formation of attitudes about the technologies to be used in the internal work system (Hendrick and Kleiner 2001). Studies show that attitudes about technologies are related to the successful use of technologies and/or the rejection of technologies (Davis 1989, Venkatesh and Morris 2003). Other studies have shown that trust in one aspect of the sociotechnical work system may influence trusting attitudes about other aspects (Safran *et al.* 1998), for example, patient distrust in care providers may lead to distrust in medical technologies and the hospital (Montague and Kleiner 2008). Socially constructed understandings of technology can have complex effects on the work system's functioning (Stanney and Maxey 1997). For example, patients in obstetrics have a history of requesting unnecessary and potentially risky diagnostic services such as ultrasounds and caesarean sections, which may be an indication of over-trust (Thom *et al.* 2002, Young 2006). The request of unnecessary technologies can

have implications on the way care providers provide care, make decisions, and health care costs (Thom *et al.* 2002). Patients in obstetrics also have a history of rejecting technologies such as continuous fetal heart monitoring and intravenous therapies that may be necessary for patient safety (Garcia *et al.* 1985, Parer 2003). When a patient rejects a technology it can impact how nurses and other care providers manage their workload and it can create interruptions that can lead to errors (Flynn *et al.* 1999, Chisholm *et al.* 2001, Chisholm and Collison 2008).

The research presented in this paper supports the notion that patients are users in health care work systems and the external social environment is related to individual perceptions and attitudes about the design of health system technologies. This study explores how patients in an obstetric work system learn about technology used in their care. The research was interested in how the origin of patient learning about the technology from the sociotechnical system might be related to patients' trust and distrust of technology.

The addressed research question is, "How do patients learn about the technologies that will be used during their care and how the method they learn about the technology is related to their assessments of the technologies trustworthiness?" The research question is addressed using data from a larger research study, which compared patients' and clinicians' formation of trust in medical technologies (Montague in press). Qualitative methods were used from a human factors and ergonomics engineering perspective to address the research question, these methods have been demonstrated to be effective in the ergonomics literature to explore health systems (Hignett 2003). The qualitative methods were appropriate because research in patient trust in this context has been insufficient and this question had not been explored previously (Hoshmand 1989, Polkinghorne 1991); thus quantitative metrics or mixed-methods constructs have not been determined.

2. Methods

Individual semi-structured interviews were conducted to address the research questions, because they are useful for conducting exploratory research (Britten 1995, Patton 2001). For this study, trust was defined as "feeling comfortable with the technology used in their care" and "a belief that the technology was effective and would not fail."

2.1 Participants

Participants included patients who were mothers who had recently given birth ($n=25$), ranging in age from 19 to 35 to represent the age range for low risk pregnancies, participants were also identified as low risk through screening (Cleary-Goldman 2005). Participants were recruited on a volunteer basis by responding to fliers in the hospital or when invited to participate after giving birth. To protect privacy, identifying information was not collected from participants and dates and locations of their child's birth are not reported.

2.2 Procedures

Both the hospital and university ethics committees approved the protocol. The purpose of the study was explained verbally and in writing to each potential participant, consent was requested and each participant was informed of their right not to participate. Additionally, in accordance with health insurance personal privacy act regulations any identifying information from patients was withheld from the researcher, therefore informed consent was only provided verbally.

Individual interviews took place in the patient's room, a private space, or by telephone before the interview participants were given an informed consent form. Once verbal consent was received (due to HIPAA regulations) participants were reminded that the interview

would be audio-recorded and that confidentiality would be maintained. During the interview patients were asked: 1) How did you learn about the medical technology before you gave birth? and 2) How did learning about the technologies increase, decrease, or not affect your comfort or trust with the technology? For the first question prompts included: “(Examples are television, books, physician, friends, families, magazines).” There were no prompts given for the second question. Audio-recorded interviews were transcribed verbatim by a member outside of the research team and were emailed to one of the researchers.

2.3 Analysis

The interview transcripts were analyzed using a content analysis methodological framework. The framework involved reviewing data for each individual participant for themes and patterns; a key component of the analysis involved coding. Coding is an activity that reduces large volumes of data generated from transcripts into labelled fragments (Schwandt 2007). Data were analyzed using an inferred content scheme. This method of data analysis was developed based on the researchers perceptions of themes in the data and data involving patient knowledge (Miles and Hubberman 1994). The content analysis method involved testing hypotheses by quantifying and categorizing data (Schwandt 2007). The basic procedures involved creating codes, assigning codes to data, developing a matrix of codes and variables, and using statistics to analyze the relationships (Schwandt 2007):

The coding scheme was created after three researchers read each transcript in its entirety. Coding was done collaboratively with the three researchers. Differences between coders did not emerge, because of the nature of the coding scheme. Codes were created from participants' responses and own experiences; key components of responses became titles for codes. Key terms were then grouped with like terms to create the final coding scheme, for examples participant responses such as “web”, “Internet”, and “online”, were all grouped together for the code entitled “website.” A hierarchal coding structure was created to include major and minor codes, for example the code “friends and family” was the major code, with individual minor codes such as co-workers and parents (see Table 1). The coding framework and definitions are summarized in Table 1.

After the coding scheme was established, codes were assigned to passages of the transcript; as the coding process continued, some coding modifications were added and reconfigured. When new codes were added or reconfigured, the previous transcripts were reanalyzed as needed. The software program Atlas.ti™ was used to store transcripts, manage the coding scheme, and assign codes to transcript quotations. The software managed the study's audit trail; which outlines the research process and the iterations of the code scheme, categories and resultant theories (Miles and Hubberman 1994, Wolf 2003). Each transcript was coded using the finalized coding scheme in the software program. After coding, each coded quotation was quantified between participants by code and analyzed using the statistical program JMP.

3. Results

The interviews created over 37 hours of audio data, transcribed to approximately 350 pages of text, and over 169 codes. The results of the study regarding the construction of patient trust in medical technology will be reported in a forthcoming journal article. Participants reported that learning about the technology caused their trust in the technology to increase (n=13), decrease (n=5), and in some cases had no effect (n=6) on their trust. The hypotheses below are related to explaining the relationship between source of learning about the technology and ratings of trust.

3.1 Hypotheses

Hypotheses are presented in the results section because they were developed based on major themes in the data: inside and outside the work system, when the patient learned about the technology, and the role of media in learning about the technologies (see Table 2).

3.2 Findings

We expected patients to report their sources of knowledge about the technologies used in their care as primarily inside the work system. However, participants reported learning about the technologies through sources external to work system using books, websites, magazine, and television. The majority of the participants reported learning about the technologies from books (n=18), with television as the second source (n=13), websites (n=12), and magazines (n=4) (Figure 1). The majority of participants reported that learning about the technologies from the source they described increased their trust in the technology (n=12), as opposed to decreasing their trust (n=5) or having no effect on their trust (n=6).

Participants' experiences with learning about technologies from the internal environment varied; learning about the technology only from a source external to the work system (n=10) was reported, as was only learning about the technology from the internal work system (n=1). Inside the work system, participants stated learning about technology from both doctors (n=8) and nurses (n=5), and both doctors and nurses (n=2) (Figure 1). It was expected patients who learned about technologies from sources inside the system would have increased trust in the technologies used in their care. A Pearson Chi Square Test of Association and a Fisher's Exact Test tested, the relationship between patient learning about technologies inside the work system on their trust in the technologies. The tests failed to reject the null; $\chi^2(1) = .087$; $p < .05$ and thus it is therefore unlikely that there is an association between patient learning about technology inside or outside of the system and their ratings of trust in the technology.

Within the work system, a relationship between learning about the technologies from physicians and increased trust was expected. Based on the chi-square tests, patients who learned about the technologies from either their doctors or their doctors and other sources were not more likely to have increased trust in the technology than those who learned about the technologies from other sources. In the qualitative responses, participants described learning about technologies from doctors in both positive and negative ways.

Participant 8 described a positive learning experience with her doctor when she said:

“He explained step by step what he was going to do and why he was doing what he was doing. I was wondering about staples because I got staples with her last time and he said actually you have more scar tissue when you do that and I take the time to individually sew you from the inside out so you get least you know less and um so he was really thorough and made me feel so comfortable with him and his explanation.”

Participant 18 described frustration with learning about the technologies from her doctor when she said:

“There were times when he said a lot and there were other times when I was kind of prying for information. Like I said before, people are in a hurry and if you are not asking the right questions, you are not going to get the answers that you want so.”

Participant 10 described being proactive about learning about technologies from her doctor when she said, “my husband had to ask, he asked which one is the contraction and which

one is the heartbeat... they didn't volunteer the information...so he asked.” Other participants stated not being able to see their doctor to ask questions about the technologies. This is exemplified by Participant 16, who said, “you basically don't see your doctor the whole time until it is time for them to do what they have to do.”

Participants described learning about the technologies from nurses as the nurses explaining what the technology did. This is exemplified by quotes such as “she told us this is what this is for” (Participant 2) and “they give you a pamphlet or a lot of stuff just like what is going to happen in it” (Participant 14) and “they showed me the monitors and everything” (Participant 22).

3.2.1 When—Participants reported learning about the technologies to be used during their child's birth before the event (n=18) and during the event (n=6). It was expected that participants who learned about technologies before giving birth would have increased trust in the technologies. A chi-square test was performed to assess whether the observed differences were significant; and the outcomes were that there is no difference in ratings of trust between patients who learn about birth technologies before giving birth or during the event. The test yielded a $\chi^2(1) = .340$; $p < .05$, at the .05 level the null hypothesis cannot be rejected and it is therefore unlikely that there is an association between when patients learn about technology and their ratings of trust in the technology.

3.2.2 Media—It was expected that learning about the technologies from websites would be associated with increased trust in the technologies. A chi-square test was performed to assess whether these observed differences are significant. Two possible outcomes were identified. The first outcome was that there is no difference in ratings of trust between patients who learn about technologies from websites and the second outcome of using other methods to gain the information. The test of association resulted in $\chi^2(1) = 5.76$; $p < .05$, therefore, it is likely that there is an association between learning about medical technology from websites and their ratings of trust in the technology. Participants who used websites to learn about medical technology were more likely to report that learning about the technology increased their trust in the technology.

Participants used websites in different ways, some used the sites to look for information, some joined membership-based sites that gave them up to date information regarding their pregnancy and others joined online support groups that were embedded in information based sites. Participant 1 described using a personalized website:

P 1: “I also subscribed to a website called babycenter.com. it is a very good website, I like it a lot, they reference a lot of things from like webmd.com and they send kind of weekly updates on you know your pregnancy, what to expect this week, what to expect at your doctor's appointments, they also give really good, for your doctor's appointments, they have very set, you go once a month and then every two weeks and then every month. And they would give you questions, this is the kind of thing that your doctor should talk about at this doctor's appointment and if they don't, make sure you ask them so that I think that was a huge resources for me.”

Participant P 7 described using a specific website and a search engine to learn about technology when she said: “It was a lot of different ones. I tended to use, just for real basic information, its called babysitter.com ... just as a start to give me an idea. But then I would just Google it _____.”

Participants also described how information from the web helped them make decisions and shaped their thinking about the technology that would be used in their care. Participant P 8:

stated “I just used Google. And typed in you know c-section, or um I went through a week where I was obsessed with all the risks because I was trying to decide whether or not to just go ahead and schedule it or not um.”

It was expected that learning about the technologies from television would be associated with decreased trust in the technologies. A chi-square test was performed to assess whether the observed differences were significant. No difference was found in ratings of trust between patients who learn about birth technologies from television as opposed to those individuals who do not learn about technologies from television. The test of association resulted in $\chi^2(1) = 1.43$; $p < .05$, at the .05 level the null hypothesis cannot be rejected. It is therefore unlikely that there is an association between learning about medical technology from television and patient ratings of trust in the technology.

Television shows such as a *Baby Story* were mentioned many times, as exemplified by the quotes: “And then I guess I had, you know, seen a lot of the stuff on television on a *Baby Story* on TLC” P 20. “I watched the *Baby Story* and those type of TV yeah all during my pregnancy” P 12. “And then I used gosh, I can't believe I am saying this, I watched a *Baby Story* on TLC. For some reason when you get pregnant you automatically are programmed to that channel” P 8. I “watched um the Discovery Health Channel for a lot of information on what new technology was coming out” P 22.

4. Discussion

Patient narratives focused on three major themes: learning about the technology from the internal and external environments, learning about the technology before and during the medical event, and learning about the technology from various media sources. The discussion is organized around the aforementioned themes and findings.

The results exemplify the importance of considering external sources of information and education in the design of sociotechnological systems that include patients. The researcher expected patients to learn about technologies from sources within the health care work system, though major sources of learning about the technologies to come from outside the work system, with books, television and websites as the most reported sources. Patients who learned about the technologies from sources within the work system, such as their doctors and nurses were likely to have also learned about the technologies from a source outside of the work system. In some cases, the external source of learning was the patient's only source of information about the technology (n=10).

It was expected patients who learned about technologies inside of the system to have increased trust in the technologies used in their care. Specifically, the researcher expected patients who learned about the technologies from physicians to have increased trust in the technologies. However, there was no relationship between learning about the technology within the system and ratings of trust. There are several possible explanations for why patients who learned about the technologies from physicians did not have increased trust in the technologies such as inadequate methods of conveying information, limited information provided, and barriers in the patient-provider relationship.

Multiple barriers to care-providing relationships have been identified in the literature; time pressures that reduce individual time with patients (Mechanic 2003), interruptions (Chisholm *et al.* 2001) and inefficient communication (Ong *et al.* 1995). Health communication scholarship identifies several types of communication goals in the doctor-patient relationship; these include relationship building, exchanging information, and making decisions regarding treatment (Ong *et al.* 1995). Given the intersection of physician and nurse time pressures, interruptions and communication goals, it is not clear if doctor/

nurse teaching can take place in the work system. Studies have identified problems in information flow for both patients and physicians (Hallock *et al.* 2006). Future research is needed to develop ergonomic interventions to implement and integrate patient education in the existing work system, that often operates with limited resources (London and London 1999). Research also shows differences between different health care work systems in aspects of time, interruptions, multi-tasking and communication style; this work alludes to a need understand how distinctive system designs and training methods may be needed for individual work systems and medical domains (Chisholm *et al.* 2001).

Patient use of web based sources for health information is a topic of relevance (Eysenbach *et al.* 2002, Dutta-Bergman 2003, Murray *et al.* 2003, Rains 2007, Lemire *et al.* 2008). Some researchers in this area believe that access to web based health information has the potential to change the work system role of care providers from that of an authority source to a collaborator in the medical decision making process (Winker *et al.* 2000). In the current study, it was expected that websites would be positively associated with patients' trust and television would be negatively associated; an association between website usage and trust ratings was found, but no association between television usage and trust ratings. Web-based information about medical technology can have implications to work system design and care providing behaviour. Key questions in this area are: how is the information patients obtain from web sources integrated into the health care work system and how do patients decide which sources of information are credible? When patients use sources outside of the system to learn about technologies, they may believe sources that are not credible or not suited to their individual health needs. Disconnects between patient and care providers' ideas of credible information have the potential to jeopardize the care providing relationship and cause interruptions in work flow. A study conducted in 2003 found that 31% of 3209 randomly sampled participants looked for health related information on the Internet either for themselves or for other people (Murray *et al.* 2003). Murray *et al.*'s (2003) findings show that patients are beginning to use the Internet for health information and therefore the work system must be designed to accommodate this.

Patient assessment of credibility in information sources is a central concern in understanding how patients use web-based information (Eysenbach *et al.* 2002, Cotten and Gupta 2004, Dolan *et al.* 2004). In a study of users' assessments of credibility in health related websites, participants reported using website source, design characteristics and language to assess credibility, though no participants read sections of the site that described the makers of the site or disclaimers, and participants were unable to distinguish information from multiple sites rated credible or not credible (Eysenbach and Köhler 2002). Another important consideration is how web-based information is integrated into the existing work system. In the Murray (2003) study, 31% of their sample looked for health information on the web, of those who looked for health information, 71% presented the information they found to their doctor. The findings from this study contribute to the scholarship regarding web-based health information by providing support for the notion that information from web-sites is a major educational source for patients to learn about technology and related to patients ratings of trust in the technology used in their care.

Relationships between media and health have been identified; studies have found that after exposure to television advertisements participants rate a greater trust in web-based prescription information and increase their use of the internet for prescription information (Menon *et al.* 2002). Other studies have found a relationship between trust in health information found on the web and television (Wilson *et al.* 2008). In the current study patients used television and the web to learn about medical technologies in different ways. Patients watched television shows that dramatized the birth experience to learn about the birth process; through this they were also entertained. It is important to note that patients

only reported learning about medical technology that was to be used in their care from television shows that specifically addressed childbirth and pregnancy, and not the plethora of television shows and movies they might have been exposed to that may present birth experiences. The differentiation between specific and general television shows provides support for the notion that patients were actively pursuing specific television shows to learn about the process and the technologies that would be used in the process. Patient engagement with web-based information was more personalized and specific; patients sought information from personalized websites or they searched for specific information.

Limitations of this study include a relatively small and homogenous group of participants, though the number of participants is sufficient for the content analysis and nonparametric analysis methodologies. The results of this study are generalizable to the obstetric domain, which affects approximately 4.3 million women who give birth in the United States every year and their children (Martin *et al.* 2006). However, future research should explore a larger group of patients from a variety of health domains. The current study recruited participants from one hospital system across three hospitals and multiple care providers. In addition, demographics such as income and education should be further explored as possible variables that are associated with learning sources and trust in technologies. Future work in the health system ergonomics should continue to employ both qualitative and experimental methods to understand sociotechnical systems factors that contribute to work system functioning (Hignett 2003), in order to better understand relationships between various aspect of complex systems. Future work should also include explore physician perspectives (Carayon *et al.* 2006) in addition to patient perspectives explored in this study.

5. Conclusion

Researchers have found effective strategies for using technology to deliver patient education (Skinner *et al.* 1993, Richards *et al.* 1998, Leafer and Gonda 2000); these strategies should utilize patients' preferences for educational materials and include information about the technologies to be used in their care. Incorporating technologies inside the system that work with credible sources outside of the system may reduce variance in information between patients and providers. Studies have found that using information technologies in the form of video and mobile devices to be effective methods of disseminating patient educational material during medical events (Brock and Smith 2007). Web based sources of information may be a useful bridge between patients' tendency to look outside of the system for information regarding the technologies to be used in their care and the work system's need to provide patients with consistent, accurate information. Technological systems that provide patient education may also reduce workload for nurses and other care providers and reduce the likelihood that patients will fail to receive education.

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Relevance of the findings for ergonomics practice

The value of considering human attitudes about elements in health systems has been illustrated. This research shows a relationship between patient attitudes about medical technologies used in their care and health care work system design. Results show that patient attitudes are formed about technologies used in their care by sources within and outside of the sociotechnical work system.

Figure 1.
How Patients Learn about Technology

Table 1
Coding framework

Code	Definition
<i>When</i>	When the patient learned about the technology
Previous experience	From an experience as a patient
Before birth	Before the medical event, includes prenatal care
During birth	During the medical event
After birth	After the medical event
<i>Outside source</i>	Sources outside of medical work system
Books	Books, not to include pamphlets or magazines
Websites	Websites including social networking sites and search engines
Magazines	Magazines personal or specific to medical condition
Television	Television shows, to include informative, reality based and entertainment
<i>Non-medical people</i>	People that are not doctors, nurses or other types of care providers
Friends	Friends, including co-workers
Family	Family, includes immediate (spouse, siblings, parents) and extended family members
<i>Members of health care team</i>	Person's whose worked is associated with care providing to the patients- does not include friends/ family who are employed as care professionals
Doctor	Physician who provided care, includes prenatal and delivery
Nurse	Nurses who provided care and interacted with patient, includes all nurses who worked with a physician and were not the primary care provider, RN's, LPN, nurse assistants
<i>Specialized training</i>	Any training course the patient took to prepare for the medical event
Birth class	Training courses specifically directed at giving birth

Hypotheses

Table 2

<i>Inside and Outside the Work System</i>	1. Patients will report that their sources of knowledge about the technologies come from sources within the work systems, such as hospital education program, physicians, nurses and other hospital care providers.
	2. Patients who learn about technologies inside of the system will report increased trust in the technologies used in their care.
	3. There will be a relationship between learning about the technologies from physicians and increased trust among patients.
<i>When</i>	4. Participants who learn about technologies before the clinical encounter will have increased trust in the technologies.
<i>Media</i>	5. Learning about the technologies from websites will be associated with increased trust in the technologies.
	6. Learning about the technologies from television will be associated with decreased trust in the technologies.