

A Tablet Computer Application for Patients to Participate in Their Hospital Care

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Abstract

Building on our institution's commercial electronic health record and custom personal health record Web portal, we developed a tablet computer application to provide interactive information to hospital patients. Using Apple iPad devices, the prototype application was provided to five patients in a cardiology step-down unit. We conducted detailed interviews to assess patients' knowledge of their inpatient care, as well as their perceptions of the usefulness of the application. While patients exhibited varying levels of comfort with using the tablet computer, they were highly enthusiastic about the application's ability to supply health information such as their inpatient medication histories and photographs of their care providers. Additional research is warranted to assess the benefit such applications may have for addressing inpatient information needs, enhancing patient-provider communication and improving patient satisfaction.

Introduction

Evidence suggests that the patient–practitioner relationship has a considerable impact on trust, adherence to treatment regimens, and patient satisfaction¹⁻⁶. In the hospital, a patient's opportunity to communicate with his or her care providers is often limited by logistical and time constraints. Moreover, members of the care team change frequently as a result of shift-change, scheduling, specialty consults, and transfers (e.g., ICU to ward). As a result, patients are often unclear about the identities and roles of the people taking care of them. O'Leary et al. found that only 32% of hospitalized patients could correctly name a single one of their hospital physicians⁷.

We hypothesized that tablet computers, such as the Apple iPad, would provide an effective platform for hospital patients to receive interactive information and enable them to participate more actively in their care. Building on our institution's custom personal health record Web portal (myNYP.org), we developed a tablet computer application that accesses clinical data from our commercial electronic health record (Eclipsys Sunrise, Allscripts Corp., Chicago, IL). As part of a larger study to assess the impact of the technology on patients and their care providers, we provided the application on Apple iPad devices to five patients in a cardiology step-down unit. Detailed interviews were conducted to assess patients' knowledge of their inpatient care, as well as their perceptions of the usefulness of the application.

Background

Historically, health information technology in hospitals has been targeted primarily to clinicians rather than patients^{8,9}. The development of online personal health records has generated useful knowledge about patient participation in the healthcare process outside of the hospital setting. Although patients believe that compliance with treatment regimens will improve if they have the opportunity to read their own charts,^{10,11} this opportunity is not typically afforded to most patients while they are in the hospital.

The 2009 National Research Council report, *Computational Technology for Effective Health Care: Immediate Steps and Strategic Directions*, outlined important themes required to achieve the Institute of

Medicine's vision for 21st century healthcare. One of the stated requirements is: "Empowerment of patients and their families in effective management of health care decisions and execution,... education about the individual's conditions and options, and support of timely and focused communication with professional health care providers"¹². Empowerment of patients in this manner is needed not only in home and ambulatory care settings, but particularly when patients are admitted to the hospital. The lack of access to information and active engagement in their hospital care makes patients and their families feel alienated, uncertain, and anxious^{13, 14}. For example, Wilcox et al. found that patients in an emergency department had multiple unmet information needs, including inadequate knowledge about the identity of their care providers, their medications, and their plan of care¹⁵.

Investigations where information is provided to patients to assist them in understanding their clinical situation have been effective in promoting joint patient-provider decision-making, reducing decisional conflict, and increasing patient adherence to their care plans¹⁶⁻¹⁸. Unfortunately, reviewing tailored information with each patient is costly in terms of time and resources¹⁹. The availability of mobile, low-cost tablet computers provides an opportunity to overcome this challenge. Such computers can enable patients to view care information, updated dynamically over the course of a hospital stay, in a single application. In addition to displaying care information, tablet computers can also be used provide educational information to patients. To our knowledge, no studies have been performed to investigate the role that tablet computers can play in providing information to hospital patients and facilitating communication with their care providers.

Methods

The site of the study was Columbia University Medical Center, a large urban academic medical center that is part of NewYork-Presbyterian Hospital (NYP). The hospital transitioned to computerized provider order entry and electronic nurse charting in 2004, and the electronic health record was also used extensively for results review and provider documentation. At the time of the study (March 2011), approximately 1 million electronic orders and 100,000 practitioner notes were being entered in the electronic health record (EHR) each month.

In 2009, NewYork-Presbyterian launched www.myNYP.org, a personal health record portal that, upon patient request, stores demographic and clinical data in Microsoft HealthVault. The portal was made available to all patients at the institution (initially excluding adolescents), but additional consumer health content was developed that specifically targeted cardiovascular health. The additional information included text, images, and video presentations to help patients understand their conditions, tests, and procedures.

Using myNYP.org as a foundation, we developed a prototype application targeted toward patients in the hospital who were physically and mentally capable of using a tablet computer. A diagram of the system architecture is shown in Figure 1. For convenience in developing the prototype application, user authentication was handled locally and not through HealthVault (i.e., pilot users of the system were not required to create a Microsoft HealthVault account). A Data Access Module was developed that queried (through SQL) the inpatient EHR for patient-specific information such as demographics, care providers, active and discontinued medication orders, and detailed medication administration records. The information queried from the EHR was updated in real-time, providing the tablet application with a fluid, dynamic interface. For example, when a physician modified a medication order or a nurse recorded the administration of a medication, the tablet application displayed the new information almost instantaneously. Auditing of user actions was also implemented for research and security purposes.

A sample screen from the tablet computer application is shown in Figure 2. Photographs of care providers were displayed along with the persons' name and role on the care team. The photographs were accessed from a temporary, manually-updated database developed for the pilot study; a forthcoming enhancement will use the electronic version of the photographs that are printed on the hospital's staff identification badges. By touching the "Hospital Medications" link, the patient's active and discontinued medications were displayed alphabetically by name, along with information on the dosage, frequency, and last administration time for each. Touching the medication name launched

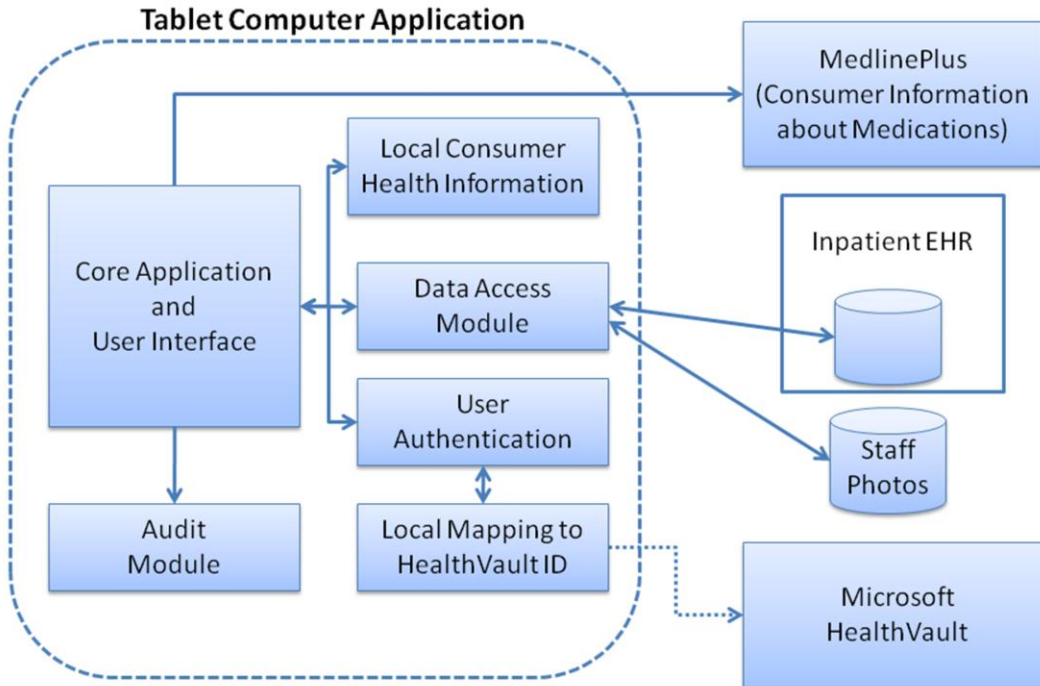


Figure 1. Block diagram of the modules used in the tablet computer application.

myNYP.org YOUR PERSONAL HEALTH CONNECTION WITH NewYork-Presbyterian Welcome back, CARMEN Sign out

MY HOSPITAL VISIT MY HEALTH EXPLAINED MY HEALTH TOOLS MY DOCTORS

Hospital Visit Information for CARMEN SANDIEGO

My Care Team

Attending Physician	Senior Resident	Resident/NP/PA	Nurse
Susan Restaino			

Other Care Providers

David Vawter

The following are your hospital medications. If you have questions about a medica

Active Medications

Drug Name	Dosage	Frequency	Last Given Time
Aspirin EC Oral	81 MG	daily 9am	3/15/2011 10:00:00 PM
Atorvastatin Tab +R+	10 MG	bedtime	3/16/2011 9:00:00 AM
Esomeprazole Oral	40 mg	daily 9am	3/16/2011 9:00:00 AM
Meperidine HCl Inj	25 mg	Daily	3/16/2011 12:00:00 PM
Metoprolol Tartrate Oral	100 MG	daily 9am	3/16/2011 9:00:00 AM
Selegiline Oral	5 MG	Daily	3/16/2011 8:30:00 AM

Home Medications My Notes/Questions

Dr. Oz shares the benefits of managing your medical records at myNYP.org. Play Video

Figure 2. Sample screen from the tablet computer application given to cardiology patients. An overlay of the medication history view is shown, with patient-specific information from the medication orders and administration record dynamically obtained from the electronic health record.

MedlinePlus Connect, allowing patients to view context-specific medication information targeted to consumers that is freely available and maintained by the National Library of Medicine²⁰. Touching the last administration time for a medication opened a window showing the entire administration history for the hospitalization. Other information from the EHR, such as laboratory test results, radiology studies, problem lists, and progress notes were not accessible to patients using the tablet application.

With institutional review board approval, we conducted detailed semi-structured interviews with five patients in a step-down cardiology unit. The patients were selected to be invited to participate in the study after consultation between the patient's providers and one of the authors (SR), an attending cardiologist. Patients were included based on their physical and mental capability to participate and their ability to speak English. After providing informed consent, patients were supplied with an iPad device and encouraged to use the application. The interviews focused on patient satisfaction with, knowledge of, and engagement in their hospital care, and specifically on how the tablet computer application might impact each. As part of the structured interview, each patient completed a 25-item survey to assess the acceptability and feasibility of the survey for inclusion in a larger study of the technology. The survey was derived from the validated Telemedicine Satisfaction and Usefulness Questionnaire, which includes two sub-scales, satisfaction/engagement and usefulness, which have internal consistency reliabilities of 0.96 and 0.92, respectively²¹.

Results

The interview participants came from a wide variety of educational and cultural backgrounds. All were male cardiothoracic surgery patients; their mean age was 55.4 years. The average hospital length of stay at the time the interview was conducted was 5.4 days (the range was 3 to 8 days). In one case, the patient's spouse jointly participated in the interview; in another, the patient's son participated along with his father. None of the patients had used a personal health record before. All patients reported having Internet access at home. Only one had previously used an iPad.

The survey instrument was deemed acceptable and feasible for use in a broader evaluation of the tablet computer application. Patients appeared to adequately comprehend and appropriately responded to each survey item. Themes that emerged from the structured interviews were: 1) patient satisfaction and sense of engagement in the care process, 2) perceived usefulness of the tablet computer application, and 3) desirable functionality to enhance the application.

Satisfaction and Perceived Engagement

Patients were generally very satisfied with the care they received at the hospital. Nevertheless, all five study participants felt that the tablet computer application would improve their satisfaction with their care and help them feel more engaged in the process. One patient stated: *"If I'm monitoring what's going on, my care team will treat me better, because they know that I know what's going on. There will be more honesty and better service."* Another patient commented on the benefit the tablet computer would have as a memory aid, particularly when dealing with the acuity of illness and the stress of hospitalization. He said: *"I have down time when I'm resting and if I get information during that 'down' time—I won't remember it. So I'd like to be able to get all that info when I'm more 'up' and not miss it."*

Usefulness of the Tablet Computer Application

The patients interviewed believed that the tablet computer application was very useful. When asked specifically about the utility of having access to their hospital medication history, all five patients rated this as "Useful" or "Very Useful" (4 or 5, respectively, on a 5-point scale). Patients commented that with the application, they would feel less of a burden to remember everything related to their medication management. One patient mentioned that having the administration record is helpful because "nurses make mistakes too." Others reflected on the application's ability to help them track changes in dose or frequency of a medication. One patient said: *"I liked seeing confirmation that certain things I asked about regarding medications were in there. Like, I asked for a Tylenol, and I can see that they gave it to me. And I asked them to stop giving me something that made me feel strange—and I see that they discontinued it. I like seeing that they discontinued all those drugs. It makes me feel better."*

The link to MedlinePlus to provide consumer-friendly explanation about specific medications did not always work properly. (A string-matching search was used rather than RXNorm CUIs or NDC codes because of technical limitations of our EHR.) Patients were enthusiastic about the information available from MedlinePlus, but two expressed frustration with the functionality of the tablet application. One patient summarized his experience as follows: “*When I clicked on meds, I got search results. I had questions about an injection and I never found out what it was. I still plan on asking the nurse, but I’d like a short definition without searching. When I’m not feeling well I’m not going to go through search results or another web page even.*”

The information on care team members (name, role and photograph) was perceived to be extremely useful to patients. Most patients reported being well acquainted with certain members of their care teams (for example, a specific nurse-practitioner or surgeon), but others were not familiar. In some cases, patients recognized care team members by their photograph, but did not know their names. Patients noted that having access to the names and photos on the tablet was superior in some ways to listing certain team members (e.g., the nurse, physician assistant, and attending physician) on the whiteboard. One patient noted that the photographs helped to create a personal connection that would make him feel more comfortable and provide him with confidence that the team knew who *he* was. He said that the care team information helped him to “not feel lost” in the busy hospital environment. Another patient expressed optimism that having the care provider information would help him interact more with his care team “because I’d know who they are.”

Suggested Enhancements for the Tablet Computer Application

Interview participants provided a variety of suggestions for improving the tablet computer application. Several inquired whether it would be possible to use the tablet to send messages to their care providers. One patient was particularly sensitive to the time constraints of his attending physician, but felt that one of the PAs with whom he felt comfortable might be able to answer questions he sent to her using the tablet computer. As an example of the types of questions he might ask, he said, “*I would email her to ask if this [a specific symptom] is something I should worry about.*”

Four of the five patients mentioned a desire to access additional information about their care providers, such as their education and training credentials. As one patient stated, “*I’d like to see background info: where they went to school, who has actually got an MD.*” Another patient suggested using the tablet computer as a means for patients to provide feedback on the quality of their care and their satisfaction with specific care providers. Other enhancements recommended by patients included a mechanism to help them coordinate follow-up appointments once they were discharged and the ability to enter their home medications and compare them with their inpatient medications.

Discussion

Though our pilot study distributed the tablet computer application to only five patients in a single surgical cardiology unit, the feedback obtained through the patient interviews was encouraging. While patients who participated in the interviews were satisfied with their care, it was clear that many unmet information needs exist, and there is room for improvement in educating patients about their hospital care and engaging them in the process. Our findings are consistent with a recent survey by Cumbler et al., which found that while 90% of hospital patients desired to review their inpatient medication list for accuracy, only 28% of patients reported having seen their medication list²². Applications that respond to unmet information needs of hospital patients may also be beneficial for improving patient satisfaction, a metric that could be measured using standardized satisfaction scores provided by organizations such as Press Ganey.

Usability

As with any consumer technology, ease of use is a primary design consideration for patient-facing technologies, and perhaps usability is even more important for technologies intended for use in the hospital setting²³. The patients who were interviewed in our pilot study were selected because they were fluent in English and their health condition was stable enough for them to participate. In situations where a patient is not physically well enough to use a tablet computer, the device may still be beneficial

if it can be configured for use by family members or other caregivers. Four of the five study participants had not used an iPad before; as a result, they exhibited some reluctance with using the device and some initial confusion in navigating through the application. In terms of the overall usability of the device and application, one patient stated: “*After a minute of my son explaining it to me, I was able to use it easily.*” Another suggested that it would be difficult to use the device immediately after returning from surgery due to concerns about poor coordination and vision. These observations bespeak the need for tablet computer applications used by patients to follow good user interface design principles—for example, we have already begun refining our application to improve the size and layout of links and icons.

Privacy Concerns

While none of the study participants raised specific concerns about privacy and information security, these are important topics that must be addressed. Among the chief concerns identified was how to authenticate users to the tablet computer application. We provided patients with a temporary user ID and password that was generated specifically for the pilot study. A future version of the application may rely on authentication services provided through Microsoft HealthVault to be consistent with the outpatient version of our institution’s personal health record portal. While this method would add an additional burden on patients by requiring them to register for a HealthVault account, it may provide a long-term benefit of helping patients to enroll in the outpatient patient health record (PHR) application before leaving the hospital.

Care Team Identification

Patients mentioned the care team information and photographs as one of the most useful features of the table computer application. Providing this information to patients presupposes that it is accurately documented in an electronic format, preferably in the EHR. Other investigators have described the difficulty of capturing accurate information about a patient’s care providers because of the frequency of shift changes and the large number of individuals participating in hospital care^{24, 25}. In a previous investigation, we discovered that patients on the cardiology service at our hospital with a 3–5 day hospital stay had over 30 different practitioners, nurses, therapists, technicians, and other staff who accessed their chart in the EHR system. It is little wonder that patients are sometimes confused as to the names and roles of the people taking care of them. EHR vendors can help address this challenge by supplying tools for designating care team membership that are efficient and useful to clinicians; for example, we have argued that such information should be integrated with electronic processes supporting patient handoff for practitioners and nurses²⁶.

Clinician Attitudes about Patient Access to Data

One of the remaining uncertainties associated with deploying the tablet computer application to hospital patients is the attitude clinicians may have regarding the technology and impact it may have on their work. The pilot project was enthusiastically received by the clinicians with whom the investigators had personal contact during the patient interviews. Many volunteered to have their photographs taken by members of the study team and took time from their shifts to learn about the project and educate their patients. Nevertheless, we did not conduct a formal, anonymous survey, nor has the technology been deployed widely enough to make definitive statements about its impact on clinicians. There is a definite possibility that providing patients with information about their hospital care may result in more questions for their care providers. Other consequences of the technology might include frustration on the part of clinicians if they feel that patients have too much ability to scrutinize their actions.

Wilcox et al. conducted a survey of attending physicians following the trial deployment of a patient-facing information display in an emergency department. Results from her study indicated that physicians are highly favorable toward sharing medication and care provider information electronically with patients during clinical encounters²⁷. In the OpenNotes project, Delbanco and colleagues are inviting patients to electronically review notes written by their primary care physicians²⁸. While clearly optimistic about the potential benefits of sharing ambulatory visit notes with patients, Delbanco also raises concerns about possibly confusing or worrying patients and complicating rather than improving communication. More work is needed to understand patient information needs and how information technology can be used to address them²⁹.

Conclusion

To our knowledge, this study was the first to provide hospital patients with a tablet computer application intended to improve their engagement in the care process. From the detailed interviews conducted with five patients in a cardiology step-down unit, we learned that the application was perceived to be a useful tool for providing information and increasing patients' engagement in their care. While patients exhibited varying levels of comfort with using the tablet computer, all were enthusiastic about the concept. Additional research is warranted to assess the benefit such applications may have for addressing inpatient information needs, enhancing patient-provider communication and improving patient satisfaction.

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