AN INFORMED EMERGENCY:

IMPROVING PATIENT COMFORT AND COMPREHENSION
IN AND AFTER THE EMERGENCY DEPARTMENT

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My sincerest thanks to everyone who spoke with me, helped me, encouraged me, or criticized me on this project. My thanks also to the excellent care I was given by the medical professionals I encountered during my bout with kidney stones.
Several months before beginning this thesis project, I was struck one day with a pain in my abdomen that had me literally writhing on the ground. I called a friend, and through gritted teeth, I asked if he could take me to the emergency room. Upon arriving, I was again struck, this time by how unofficial the place seemed. It was not clear where to sign in, and upon locating the receptionist, I was told to have a seat and I’d be seen in a few minutes. Where were the doctors and nurses rushing to my aid as soon as I stepped in the door? I felt a bit neglected, as I could not imagine anything being more important to anybody than my pain. Eventually, I got into a bed, and several hours and several tests later I found out that I had a kidney stone. While I was waiting, I felt anxiety over whether I had been forgotten, whether my scans were being read, and upon hearing my diagnosis, great fear about my immediate future. This is not to say that I was neglected or that my care was anything but exemplary. I was quite well taken care of during my stay in the, as I’ve learned to call it, emergency department. But because of the situation I was in, I found myself wanting more attention and more information about what was going on and what was in my body.

Upon being discharged from the ED, I was given a stack of papers telling me what to do, three prescriptions, and the phone number of a urologist to make an appointment with as soon as possible. As I had never filled a prescription locally before that time, I had to find a pharmacy and get the prescription filled while on pain medication. Calling the doctor resulted in several unanswered calls, before finally being told that that doctor could not see me for several weeks. I found myself constantly shuffling through the stack of discharge instructions they gave me in an attempt to find an answer to some concern I had. The concept of kidney stones continued to frighten me, and I had little idea of what to
expect. In short, though I ultimately came out of the whole situation unscathed, stress levels were high, perhaps unnecessarily so. Like my need for verification of my problems in the ED, I needed more guidance and structure after the ED.

In ruminating on a thesis topic, I knew I wanted to tackle a project that used technology and design to help explain or guide people through a process or idea. Given my recent experiences with kidney stones, I settled on a medical theme, and ultimately decided to see if I could address some of my issues with the emergency department experience through the use of technology and design. This thesis is the result.
CHAPTER I
THE EMPOWERED PATIENT

Even as concern mounts over lack of access to affordable health care for millions of Americans, access to health information is at an historical high. The rise of the World Wide Web and the proliferation of web sites covering every imaginable medical topic means that Americans are now as potentially health literate as they have ever been in history. Patients can access volumes of information about diseases and conditions, medications, and procedures. They can solicit medical advice from both professionals and the lay public. Diagnostic tools such as FamilyDoctor.org (http://familydoctor.org) and YourDiagnosis (http://yourdiagnosis.com) allow patients to enter their symptoms and receive a probable diagnosis. Web sites like WedMD (http://webmd.com) and the Mayo Clinic’s online presence (http://mayoclinic.com) have become the first resort for many patients suffering from an ailment. Unfortunately, unfettered access to unfiltered information from a multitude of sites of highly variable reputation and reliability creates a high potential for confusion and misinformation (Gerber & Eiser, 2001). And though many of these online resources are developed with the aid of practicing physicians, they are not physicians that know the patient or are seeing the patient in person. Physicians interviewed for this project were both pleased and frustrated by access and use of these online health resources. Doctors want their patients to be informed, but with a responsible and knowledgeable hand guiding that education.

Curated Health Applications

Both physicians and patients want to have some control over the health care process (Gerber & Eiser, 2001). Patients wish to feel empowered, and physicians want to ensure
that this empowerment is medically responsible and beneficial to the patient (Gerber & Eiser, 2001). A number of efforts in recent years have begun the process of bridging the gap between unsupervised medical information and the traditional role of doctor as total and final authority. Most of these systems are designed to help patients understand conditions and procedures and make them more comfortable with the subject matter. They are given to patients by their physicians and serve to give patients some sense of ownership over their medical care.

Researchers from the Academic Medical Centre at the University of Amsterdam developed an interactive CD-ROM for cancer patients considering a stem cell transplantation. The application uses narration and animation to explain the entire procedure to patients, from preparing for the surgery to post-operation procedures. As the researchers state of stem cell transplantations, "patient education usually has to be given within limited time. Under these circumstances, patients may find it difficult to completely understand and to retain the information given" (Mank & Molenaar, 2008, p. 121). Recognizing the inherent limitations on human cognition for complex topics in stressful and time-constrained situations, the Dutch researchers sought to use the interactive medium of computer software to help patients (Mank & Molenaar, 2008, p. 125). Interaction allows for users to go at their own pace, to view as much or as little information as they wish, and to view information as many times as they need to. The researchers concluded that the software was "well accepted by patients and they appreciated getting information by means of an interactive system" (Mank & Molenaar, 2008).
Chicago-based Emmi Solutions, LLC (http://emmisolutions.com) develops patient-centric web sites that are distributed and supervised by healthcare providers and hospitals. These interactive applications help prepare patients for surgeries, manage chronic conditions, and learn to live with medical devices, among other topics. Patients are given an access code to a web site that has been specialized for them. Using narration and animation, the Emmi web sites guide patients through the ins and outs of their medical topic. Patients are advised on medications, procedures, risks, and benefits. As Emmi notes, the extremely simple user interface and elementary language used by Emmi ensure that even those with low health literacy will be able to benefit from the programs (Demo Video, http://emmisolutions.com). While viewing the web site, patients can submit questions...
concerning specific topics to their doctor to be discussed face-to-face. Emmi’s internal testing has found that 97% of patients reported that the programs answered questions they would have asked their doctor (Demo Video, http://emmisolutions.com).

FIGURE 2. Emmi Solutions web site.

From 2003 to 2006, researchers at the University of London and the Center for Outcomes & Evidence at the Agency for Healthcare Research and Quality in Rockville, Maryland developed and tested an interactive mobile application for HIV patients. The application uses narrated videos followed by questions about the preceding video that the patient must answer. The videos and questions relate to the nature of HIV, how to prevent its spread, how to live with it, and the consequences of not taking medications properly. Even with the relatively primitive technology and information design used in the study, the application found success. Ninety-four percent of patients reported that the application made remembering pertinent medical information easier (Brock & Smith, 2007).
The Cleveland Clinic, a renowned hospital system based in northeast Ohio, is in the process of fully digitizing all aspects of patient care (Harris, 2010). With the Clinic’s MyConsult service (http://my.clevelandclinic.org/eclevelandclinic/myconsult), patients from around the country and even the world can talk to a Clinic physician about their medical concerns. With consulting at a distance, patients and physicians are able to determine if a visit to the Clinic would be beneficial. With the MyChart (https://mychart.clevelandclinic.org) and MyPractice (http://my.clevelandclinic.org/eclevelandclinic/mypractice) services, patients are able to access all of their medical records online. What patients view mirrors what their physicians have access to. The net result of Cleveland Clinic’s digital health care services are patients with much greater access to medical information that has been tailored for them, and not generalist information floating about in the wilds of the Internet.

**The Emergency Gap**

Many other such interactive experiences have been developed for conditions ranging from children’s leukemia to hip arthroplasty in the elderly. The message to be brought away from all these new applications is clear: engaging patients in a direct way using interactive technology can be a powerful tool for increasing health care comprehension. These applications give patients a degree of ownership and feeling of control and understanding over their medical situation (Dragone, Bush, Jones, Bearison, & Kamani, 2002). What these offerings do not address, however, are the medical situations outside of a traditional established doctor-patient relationship. Patients facing emergency situations are beholden to the circumstances they find themselves in. While nothing can remove the trauma of a medical emergency, there are opportunities for greater transparency and
accessibility in emergent care. This thesis describes an initiative for empowering patients with knowledge and guidance that has been curated by their emergency physician, with the hope that the experience with the emergency department becomes less stressful and more comfortable. These goals will be sought through the use of consumer technology and the graphic design of interactive applications.
CHAPTER II
EMERGENCY DEPARTMENTS BY THE NUMBERS

Since the world’s first specialized trauma care center opened at the University of Louisville Hospital in Louisville, Kentucky in 1911, emergency departments have become central and defining features of health care in the United States (Brown, 2000). Because of their namesake urgency, they are given prominence in all signage and wayfinding on hospital sites. They are often the primary and sometimes only department that patients will interact with. In short, emergency departments are the public face of hospitals. Visits to the ED are increasing every year, exceeding 119 million in 2006, according to the Centers for Disease Control (Pitts, Niska, Xu, & Burt, 2008). From 1996 to 2006, the number of emergency department visits increased by 32 percent (Pitts, Niska, Xu, & Burt, 2008) The uncertain future of public health care in the United States ensures the continued importance of emergency departments to both patients and hospitals.

The term “emergency department” is misleading, however. A fraction of the patients seen in the ED are actually suffering from immediately life threatening injuries and conditions. Around fifteen percent of patients visiting the ED are triaged as “resuscitation” or “emergent,” requiring care within one to fourteen minutes (Pitts, Niska, Xu, & Burt, 2008). Corroborating this, a physician interviewed for this project indicated that the percentage of critical cases at his ED, twenty-five percent, was higher than the average. Physicians and nurses interviewed said that many patients treat the ED as a walk-in clinic. The importance of the emergency department to patients in the United States has risen as health insurance has become out of reach for more and more Americans (Cetta, Asplin, Fields, & Yeh, 2000). Lacking both a regular physician and health insurance,
patients turn to the ED when they have a medical problem, regardless of whether it is an "emergency" or not (Grumbach, Keane, & Bindman, 1993). Over seventeen percent of patients entering the emergency department are uninsured (Pitts, Niska, Xu, & Burt, 2008). Uninsured patients visit the ED more than twice as often as those with private insurance (Pitts, Niska, Xu, & Burt, 2008).

Those emergency department cases that are not critical are not thus necessarily trivial. Many patients come to the ED due to pain or disability that inhibits their life to the point that they cannot wait for an appointment to receive care (Grumbach, Keane, & Bindman, 1993). It becomes necessary for them to seek treatment immediately, though they likely will not be classified according to the highest levels of emergency by the patient triage. Waiting will be involved for the majority of patients entering the ED. In fact, only seven percent of non-critical ED patients have a wait time of less than fifteen minutes (Pitts, Niska, Xu, & Burt, 2008). The average stay in the emergency department is 2.6 hours (Pitts, Niska, Xu, & Burt, 2008). Over twenty percent of patients in the ED stay for six hours or more (Pitts, Niska, Xu, & Burt, 2008).

Emergency departments serve entire communities, but they disproportionately serve "older adults, racial/ethnic minorities, recent immigrants, people with chronic diseases and those with low socioeconomic status" (Ginde, Clark, Goldstein, & Camargo, 2008). Patients aged seventy-five years and older were the second most represented age group per capita. Blacks are about twice as likely to be in the ED as whites (Pitts, Niska, Xu, & Burt, 2008). Not coincidentally, blacks are also almost three times as likely to be living in poverty as whites (Kaiser State Health Facts, 2008). These groups are especially susceptible to low health literacy. Health literacy can be defined as "the degree to which
individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions” (Ratzan & Parker, 2000, p. 147). Low health literacy has been linked to “utilization of fewer preventive services, greater emergency department (ED) utilization, higher rate and length of hospitalization, and increased healthcare expenses” (Ginde, Clark, Goldstein, & Camargo, 2008).

Difficulty in comprehending medical information is not limited to marginalized demographic sectors, however. Nearly half of American adults have been shown to have difficulties understanding health information (Nielsen-Bohlman, Panzer, & Kindig, 2004). Nearly half of ED patients are between the ages of fifteen and forty-four (Pitts, Niska, Xu, & Burt, 2008). In Massachusetts, about twenty-seven percent of ED patients have a college degree, and about forty percent have incomes three times or more relative to the Federal Poverty Level (Long & Stockley, 2009). Even among educated, well-off patients, there is potential for confusion and misdirection. As Nielsen-Bohlman, Panzer, and Kindig (2004) note,

Even people with strong literacy skills may have trouble obtaining, understanding, and using health information: a surgeon may have trouble helping a family member with Medicare forms, a science teacher may not understand information sent by a doctor about a brain function test, and an accountant may not know when to get a mammogram. (p. 2)

Emergency departments are the frontlines for the consequences of low health literacy (Williams, Counselman, & Caggiano, 1996). Letting problems worsen to the point of requiring an ED visit, not knowing where else to turn, and failing to adhere to prior physicians’ orders all result in visits to the ED (O’Brien, et al, 1997).
A Note on Process

As part of this thesis, three physicians, including the director of emergency services of a large hospital system, and one nurse with backgrounds in the emergency department were interviewed in regard to the challenges of working in the ED, the goals of caregivers for ED patients, the information that patients should know while in the ED and after, perceptions of patients’ experiences in the ED, existing ED practices in regard to patient communication, procedures for discharges, and thoughts on the effectiveness of existing discharge instructions and where they might be improved. Two additional emergency physicians were shadowed as well as interviewed, where they were observed tackling the difficulties of diagnosis, the dynamics of interaction with new patients, and their use of information technology to track patients and provide them with discharge instructions. Sample discharge instructions were collected from several hospitals. The observations and answers obtained from these interviews and ethnographic research were meshed with existing literature on the subject, as well the researcher’s own experiences in the emergency department as a patient to help develop the proposals within this thesis. Many of these findings and observations are found throughout this paper, while some are evidenced in the applications themselves. Samples of discharge instructions and other uses of information technology mentioned elsewhere in this paper were used to guide the development of the interactive applications that are detailed in the following pages.
CHAPTER III
INSIDE THE EMERGENCY DEPARTMENT

The Technology of Care

Emergency departments are quite successful in dealing with an enormous number of patients with diverse backgrounds, abilities, and conditions. This is partially because the technology behind caring for and managing such volumes of people has increased with great sophistication over the years. Software from companies like Meditech (http://meditech.com) and Eclipsys (http://eclipsys.com) allow ED physicians to keep track of patients through multiple visits to the emergency department. The software logs and stores all pertinent information, including diagnoses, treatments, tests and procedures performed; all communiqué and documentation from other departments; and images from all scans performed on the patient. San Mateo, CA-based Epocrates, Inc. (http://epocrates.com) develops applications for mobile devices such as the Apple iPhone and RIM Blackberry that allow physicians to view detailed medical information with the swipe of a finger. Physicians can read up on medications, infectious diseases, lab tests, and more while “in the field.” They can also perform dosage calculations and view drug interactions. A recent survey by Epocrates found that one-fifth of physicians plan to buy an iPad, Apple’s recently released tablet computer that uses multitouch technology for input. Epocrates is developing new software for the iPad and other companies will soon join in. Mt. Sinai Hospital in Toronto (http://mountsinai.ca) has developed an in-house iPhone application that “gives physicians secure, remote access to patient records, test results, vital statistics, and medical literature from its vast internal data network” (iPhone in Business, 2010). Mt. Sinai’s efforts show that hospitals themselves are willing and able to make the investments
necessary to realize a more technologically sophisticated hospital environment. Touch screen devices will no doubt soon become essential weapons in physicians’ arsenals, helping them take notes and keep track of patients and their conditions.

**The Challenges of the Emergency Department**

While the technology for managing patients and assisting physicians continues to advance, the experience of patients in the emergency department has remained fairly primitive. The challenges of activating patients, maintaining transparency, and aiding comprehension in the emergency department are numerous. Generally speaking, emergency departments are chaotic places. The combination of a walk-in clinic atmosphere with frequently life-threatening emergencies occurring in one space ensures that the ED is the most necessarily “unfinished” place in a hospital. Keeping patients informed often falls on the shoulders of nurses and residents who are not tending to other duties. Physicians will do what they can to explain things to patients and inform them as to the status of proceedings, but time is limited and patients are frequently not of a mindset to express their concerns to a physician (Chugh, Williams, Grigsby, & Coleman, 2009).

Compounding the usual pitfalls of diagnosis and treatment is the reality of the relationship between emergency physicians and their patients. Unlike the dynamic between a patient and his primary physician, which is marked by a familiarity that strengthens the understanding of the patient’s condition by the doctor, a patient–emergency physician relationship is usually non-existent and thus the physician has little to go on but obvious signs and whatever trust he or she can build in the patient’s mind in a short amount of time (Rhodes, et al, 2003).
Researchers from Brigham and Women’s hospital in Boston found that the biggest factors in patient dissatisfaction in the emergency department included “help not received when needed…poor explanation of causes of problem…not told about potential wait time…not told when to resume normal activities…poor explanation of test results…and not told when to return to the ED” (Sun, et al, 2000, p. 426). The study concluded that “breakdowns in patient communication are inevitable in EDs that rely solely on the individual efforts of busy physicians and nurses, who are distracted by a constant stream of patient demands, telephone calls, documentation requirements, and other administrative tasks” (Sun, et al, 2000, p. 434). A 2003 study by the University of Chicago looked at the poor state of the patient–emergency physician relationship. Among other things, the researchers found that patients were able to describe their problem to their physician without interruption a mere twenty percent of the time (Rhodes, et al, 2003).

**The Patient’s Experience**

As experienced and observed, patients visiting the ED play a largely passive role: waiting for beds to open up, waiting for physicians and nurses to see them, and waiting for tests to be completed. Though this is largely a natural consequence of being a “patient,” there are steps that can be taken to make patients feel more empowered, both in perception and in reality. Ensuring that patients feel empowered while in the emergency department means keeping them informed about what is going on in as transparent and immediate manner as possible.

A major concern of patients is wait time (Thompson, Yarnold, Williams, & Adams, 1996). Patients do not want to wait to receive care and relief. Several emergency physicians interviewed spoke of patients demanding immediate answers and total relief of symptoms.
As Derlet and Richards (2000) note, "improvements in technology, new pharmacologic agents, advances in medical science, heightened standards of practice, and residency training of emergency physicians have all contributed” to the unrealistic expectations of emergency departments by both patients and administrations (p. 65). The ED is often seen as something of a panacea; a high-tech cure-all with, in the words of one physician, “fast food service.” Another physician spoke of patients’ belief in a “magic wand” that the emergency department was in possession of. The reality of course is far different, as medicine is an imperfect science filled with educated guesses and trial and error. Derlet and Richards (2000) write that “it may take hours to exclude a serious and occult diagnosis” especially since “the overall complexity of patients presenting to EDs has increased” (p. 64). Patients want to get in and out of the emergency department as quickly as possible. If patients must be made to wait, then they should be told why they are waiting, so that anger or confusion is not needless or misdirected (Derlet & Richards, 2000).

A study completed by Northwestern University School of Medicine in 1995 found that patients’ perceptions of waiting time and information delivery played a significant role in patient satisfaction in the ED, while actual waiting times did not. The study concluded that “providing information, projecting expressive quality, and managing waiting time perceptions and expectations may be a more effective strategy to achieve improved patient satisfaction in the ED than decreasing actual waiting time” (Thompson, Yarnold, Williams, & Adams, 1996, p. 657). A study conducted by the Department of Emergency Medicine at Loma Linda University Medical Center in Loma Linda, CA found that playing a video in the ED waiting room improved patient satisfaction. The video "showed the sequence of steps from entry into the department to discharge, the nature of triage and causes for
delays, the different services offered by the emergency department, and the roles of each of the department staff members” (Corbett, White, & Wittlake, 2000, p. 67). The researchers concluded that an “informational videotape for patients in waiting areas may be a useful tool to educate about emergency medical services, to reduce anxiety, and to improve satisfaction with the emergency department stay” (Corbett, White, & Wittlake, 2000, p.67).

**EmergiPad**

Such studies show that the experience of emergency department patients can be improved outside of the actual medical care that they receive. The use of technology could be a vital tool for assisting and comforting patients as they make their way through the ED. Unfortunately, most of the technological advancement seen in the ED has remained largely confined to the provider side of the physician–patient equation, as detailed earlier. The growing acceptance and embrace of portable touchscreen device use in hospitals creates an opportunity to use a tablet computer such as the Apple iPad for more than helping physicians keep track of patients and access medical information. Touchscreen devices can help patients directly. An application on an iPad could ease the anxiety of waiting by “distracting” patients with information relevant to their situation. The application could also inform patients as to what they will experience in the emergency department and why. Finally, the application could help physicians and nurses care for the patient by opening new avenues of communication. A tablet computer with the proposed application installed, herein dubbed the "EmergiPad," would be given to the patient upon checking in to the emergency department. The patient would then have it with them for the duration of their stay in the ED. In cases where patients are incapacitated to the point that they cannot use the EmergiPad, they obviously would not be given one and alternative means of enhanced
communication may be considered. If patients are alert and lucid, but perhaps unable to hold an EmergiPad, a bed-mounted version might be offered. Another option would be for the EmergiPad to be given to whomever accompanies the patient to the emergency department. Description of the EmergiPad follows, and is also viewable in animated, narrated form at http://bendansby.com/thesis.

The EmergiPad fulfills the goals of distraction, information, and communication with four primary components. The first component (Figure 3) presents an overview of the patient’s situation in the emergency department. Here, the patient can view a quick summary of pertinent information, including their complaint and their diagnosis if available. The patient can also read biographical information on their attending physician, to help them feel more comfortable with an unfamiliar doctor. The patient can update their emergency contact information on the fly, without needing to tell a nurse if that detail changes. Below the patient summary section, the patient can see how the situation in the rest of the ED is affecting their wait time. Physicians and nurses interviewed mentioned that patients are often myopic, and do not take into consideration the effect other patients may have on wait times in the ED. By plainly telling patients what is going on, that myopia can be broadened somewhat. Below the time status, patients are alerted and instructed to use the other features of the application, all of which will be discussed. Finally, the patient is urged to keep their pain level updated. The “one to ten” pain scale is widely used in the health care industry. With this feature, patients will be assured that their nurse knows their status at all times. If a patient selects a level of seven or higher, this will automatically trigger a nurse alert, so that the nurse can make any appropriate decisions concerning pain management. The patient can also tap the Nurse Alert button, to call the nurse for pain relief or any other reason.
Welcome to the Emergency Department.

We are currently waiting for a hospital bed to open up. Afternoons are our busiest time of the day. Your estimated time of wait is one hour.

In the meantime, please enter any questions or thoughts you have about what you’re experiencing today. This will help your physician and nurse better treat you and get you on the mend quicker. Tap here or use the navigation at the bottom of the screen.

Please feel free to use the television and music features on this device while you wait. Try to relax and please trust that we’re doing everything we can to treat you as quickly as possible.

Lastly, keep us updated on your pain level. If you think you need pain medication or assistance, just tap the nurse alert button.

Please rate your pain.

1 2 3 4 5 6 7 8 9 10

FIGURE 3. EmergiPad home screen.
The second component (figure 4) of the application is dubbed "Doctor Dialog."

Here patients are given a venue to enter any thoughts they have on their condition or give any information to the physician and nurses that they feel is relevant, as well as ask questions. Patients may not remember to ask certain questions or deliver certain information while the doctor is at their bedside. They might also be too embarrassed about something or feel that a detail is not worth concerning a doctor with. Using the EmergiPad, patients can enter their thoughts with an onscreen keyboard or record an audio message with the device’s built-in microphone. With Doctor Dialog, patients are free to communicate at their own pace in their own way. The patients’ remarks would be synced with the physicians’ and nurses’ own computer or portable device and so caregivers will stay connected to the patient at all times. This component increases the level of communication between patient and caregivers, leading to better care, fewer mistakes, and greater ease of mind.
Doctor Dialog

In order to help you as much as we can, it’s important that your doctor knows as much about you as possible. Please use this space to tell us anything you think might be important, including any other symptoms you’ve had recently, any medicines you’re taking or cannot take, and anything else that comes to mind.

I am allergic to penicillin.

Been having headaches recently too.

I have a family history of diabetes.

+ add new note

FIGURE 4. EmergiPad Doctor Dialog.
Tests and Procedures (figure 5) is the third component of the EmergiPad. As the name implies, here patients can view what tests and procedures will be performed on them while they are in the emergency department. Tests and Procedures uses a graded system, where items are color coded as to whether they are complete, in process, or have not yet begun. Patients can read information as well as watch videos about each item, so that they gain an understanding of why it is being done and what it involves. Besides educating and reassuring the patient, these explanations can serve a practical role, as patients will be alerted to potential problems with a procedure. For example, a patient with claustrophobia who was scheduled for an MRI could alert her physician or nurse and appropriate adjustments could be made.

The Tests and Procedures component also keeps patients updated as to the status of their tests. Often a patient will have a scan done, and expect the scan to immediately provide the answer for alleviating their condition. The reality is far less seamless. Scans have to be processed, then delivered from the Radiology Department to the ED. The physician must then read and interpret the scans, not always a straightforward task. EmergiPad tells patients exactly where in the process their tests and procedures are, and explains why something may be taking longer than the patient expects. The Tests and Procedures component of EmergiPad increases transparency between the patient and hospital, and helps patients understand exactly what they are going through and why.
Tests & Procedures

When patients have abdominal pain, there are several things we do to help better understand why the pain is occurring. On this screen, you can see what we’re going to do and the status of things we’ve already done.

Tap any item to see a video explaining the procedure or test.

**Blood Work**

We have looked at your blood and do not notice anything out of the ordinary. This helps us narrow down exactly what is causing your pain.

**CT Scan**

We have completed your CT scan and your doctor is looking at it. Reading a CT scan takes some time, because your doctor has to interpret the images and figure out what, if anything, looks important.

**X-Ray**

We have completed your x-ray, but have not yet received it from the radiology department. When the hospital is busy, it can take some time to receive things from other departments.

**MRI**

An MRI is a machine that lets us see detailed images of your body. If the CT Scan and X-Ray are not clear, we will use an MRI. Please watch the video explaining the MRI and let us known if you have any concerns.

*Figure 5. EmergiPad Tests and Procedures.*
The fourth primary component of EmergiPad is called simply Diagnosis (figure 6).

If and when a patient’s physician makes a diagnosis, an explanation of it will appear on this screen. The explanation is both textual, written in plain English, and in video form.

Patients can view an animation that explains and shows what the diagnosis means. The Diagnosis component gives more options to both physicians and patients when it comes to explaining conditions. Because medical topics are often difficult to explain verbally, especially in an environment such as the emergency department, a method for simply and visually informing patients could prove beneficial to patients and their caretakers. The animations in Diagnosis could also be used as a reference for physicians when talking to their patients, much as doctors in a clinical setting will point to a poster on the wall or a scale model of some part of the anatomy. Viewing the diagnosis also gives patients a chance to formulate any questions they may have about a certain aspect of the condition. Watching the explanation on their own touchscreen device at their own pace affords the patient a chance to reflect on what they have seen more than a rushed verbal explanation from a physician or nurse would.
Diagnosis

We think that you have a kidney stone. Your doctor will provide you with instructions on what to do about this when you leave.

Kidney stones are little rocks made out of minerals that form in your kidneys. Right now, the kidney stone is in your ureter, which is a path that connects your kidney with your bladder. The stone is trying to move through the ureter, but it’s a tight fit, and is stabbing the ureter with its jagged edges. That’s why it hurts so much. Please watch this explanation for more information.

FIGURE 6. EmergiPad diagnosis.
Also available on the EmergiPad are components that allow the patient to watch television and listen to music. In this way, the EmergiPad provides mental relief from the strains of being in the emergency department. By integrating entertainment features into the EmergiPad, the application and device become a source of focus and even comfort for the patient.

A study by the Kern Medical Center in Bakersfield, California concluded that “hospitals serving large populations of non-English speaking patients need to devise strategies to improve communication with non-English speaking patients” (Crane, 1996). At any time, on any screen of the EmergiPad, the patient can switch the language of the application from English to a different language. If an area has a particularly high number of residents who speak a certain language other than English, this can be configured to be the default secondary language option. Additional language options could also be made available on a case by case basis. Offering the EmergiPad in alternative languages greatly decreases the need for interpreters in the emergency department. While English-speaking users gain greater comprehension and comfort through its use, non-English speakers are helped even more, having complex and confusing topics broken down in a language that they are comfortable with.
CHAPTER IV
AFTER THE EMERGENCY DEPARTMENT

After patients have been seen by the emergency physician and, where appropriate, a diagnosis is made or wounds and injuries have been taken care of, the patient is discharged from the emergency department. Along with the discharge, patients are given instructions, which are usually printed, sometimes written, and sometimes explained orally. These instructions contain information such as an explanation of the patient’s diagnosis or injury, how to care for the condition, and what medications to take. Patients are also often told to see a physician for follow-up care. Because they essentially tell the patient what to do to get better, the quality of the discharge instructions will play a significant role in determining how the patient recovers from their injury or diagnosis.

Problems with Discharge Instructions

Discharge instructions currently in wide use by hospitals are a vast improvement over earlier methods, which were largely handwritten and devoid of explanatory content (see figure 7). Current systems merge the patient’s hospital records with explanations of the patient’s condition as well as the procedures and medications that should be taken going forward. This information is compiled by a computer program into a word processing document and printed out on several loose sheets of paper. Discharge instructions for a kidney stone from one hospital (figure 8) consisted of eight sheets of unbound paper, with no stylistic differentiations between different sections of the instructions.
FIGURE 7. Older style discharge instructions.
Beyond the major issues of information design inherent in discharge instructions such as those seen in figure 8, other problems present themselves. The most significant flaw is the reading level at which the discharge instructions are written. They are primarily written at an eighth to thirteenth grade level, while the median reading level for emergency department patients is sixth grade (Chugh, Williams, Grigsby, & Coleman, 2009). This leads to a fundamental problem of comprehension. Physicians interviewed reported that the discharge instructions they used were overly technical and detailed. One physician said that his hospital’s discharge instructions were full of legalese intended to protect the hospital from lawsuits. Complex and unnecessary language can cloud the overall message of instructions and distract from what is important to the patient. Full understanding is vital when the subject is health care, and any misunderstandings are cause for concern. Another
issue with existing discharge instructions is their lack of customizability. Existing systems deliver boilerplate information, some or most of which may not be relevant to a patient’s case. If a doctor wishes to make qualifications, additional sheets must be attached. These will likely be in a different format than the rest of the materials, and separate from related information.

Compounding the aforementioned problems is the fact that the instructions are often not adequately explained verbally to patients before they leave the emergency department. As Chugh, Williams, Grigsby, and Coleman (2009) note, "healthcare professionals receive minimal formal training on communicating clear and concise discharge instructions tailored to the patient's learning ability" (p. 12). Researchers at the University of Chicago found that the average time spent going over discharge instructions with patients was 76 seconds, with the lowest observed interaction being an incomprehensible two seconds. The researchers note that "information on diagnosis, expected course of illness, self-care, use of medications, time-specified follow-up, and symptoms that should prompt return to the ED were each discussed less than 65% of the time" and that "only 16% of patients were asked whether they had questions, and there were no instances in which the provider confirmed patient understanding of the information" (K. V. Rhodes, et al, 2003, p. 262).

All of these problems add up to a disunited and potentially confusing takeaway for the patient. A 2009 study by the University of Michigan, Ann Arbor found that seventy-eight percent of patients demonstrated a deficiency of comprehension of their emergency department discharge instructions. Even more troubling is that a mere twenty percent of patients with deficiencies recognized that their understanding was less than complete. Patients were falsely confident of their comprehension, believing that they understood what
they in fact did not (Engel, et al, 2008). In their conclusions, the Ann Arbor researchers suggested that “the content and organization of discharge instructions should be considered as a possible means of improving comprehension. Instructions may help to improve understanding if they clearly emphasize all domains of the visit (diagnosis, ED care, post-ED care, and return instructions)” (Engel, et al, 2008, p. 460).

**Improving Discharge Instructions**

Hoping to address some of these concerns, a comprehensive overview of discharge instructions by the University of Colorado at Denver recommended that hospitals implement a number of initiatives to improve patient comprehension of discharge instructions. These recommendations include graphic instructions, instructions using a variety of media, instructions using illustrations, a computerized assistant to reinforce discharge instructions, redesigning written instructions with larger fonts and use of color, and limiting instructions to focus on essential information (Chugh, Williams, Grigsby, & Coleman, 2009). Researchers at the George Washington University Medical Center in Washington, DC tested how simplified discharge instructions could improve patient comprehension. Their simplifications included reducing the complexity of language, for example, changing “elevate wound(s) above the level of the heart to reduce swelling” to “keep the wound above your heart to keep swelling down” (Jolly, Scott, & Sanford, 1995, p. 444). The researchers also made the instructions more approachable by breaking down long paragraphs into simplified bullet points. The researchers concluded that these sorts of simplifications do indeed improve patient comprehension (Jolly, Scott, & Sanford, 1995). A 1994 study by the East Carolina University School of Medicine tested the effects of adding illustrations to emergency department patients suffering from lacerations. The
study found that the addition of illustrations does improve comprehension, particularly among nonwhites, females, and those without a college education (Austin, Matlack, Dunn, Kesler, & Brown, 1995). A similar study conducted in 2008 by the Harvard Medical School concluded much the same as the East Carolina study (Zeng-Treitler).

**Instructions on the Web**

The emergency follow-up instructions proposed in this thesis seek to address the issues inherent in current discharge systems and to incorporate the recommendations of the aforementioned researchers. The primary form that these instructions take is a web site. As discussed in the beginning of this paper, the Internet has become an essential resource for those seeking health information. This thesis seeks to take advantage of the interactivity and connectivity of the web by making discharge instructions into a web site that not only helps patients understand what to do following the emergency department, but allows them to take action. Broadband adoption in the United States is at over sixty percent (Anderson, 2009). The poor are both the most likely to be in the ED as well as the most likely to not have Internet access, but 44 percent of them access the Internet at public libraries (Becker, 2010). These numbers will only continue to rise as the federal government rolls out its national broadband plan. Description of the online discharge instructions follows, and is also viewable in animated, narrated form at http://bendansby.com/thesis.
When patients are discharged from the emergency department, they would be given a web address with a number that uniquely identifies them. Alternatively, this web site could be integrated into an existing online health system that the hospital uses or a site such as Google Health (https://google.com/health). Once patients are logged in to the web site, they can begin taking advantage of the features offered. The web site shares a visual...
vocabulary with the EmergiPad and includes many of the same features and options. The home page, or My Instructions (figure 9), displays a rundown of the patient’s status, including their diagnosis and information about their physician, should they want to know more and did not take advantage of said feature in the EmergiPad. The My Instructions page also highlights the different pages of the web site and urges the patient to action on all of them.

In addition to taking care of the practical concerns related to a medical condition, patients must understand what is happening with their body. Though they may have been given a diagnosis and explanation of that diagnosis by the doctor or a discharge instruction sheet, patients are still often unclear on what exactly is going on with their condition. Conventional wisdom on a subject like kidney stones may lead to mental anguish and uncertainty. The idea of a rock passing through the urinary system is frightening, but careful analysis and understanding of the condition can help allay fears. Looking up information on the Internet is problematic, as it is in no way guaranteed to be accurate or typical of the patient’s specific case. Though perhaps less vital for patients’ physical health than taking medication or seeing a specialist, understanding one’s condition is of great importance to the mental well being of the patient (Engel, et al. 2008).

The My Condition (figure 10) page is similar to the My Diagnosis page on the EmergiPad. It provides both text and a video with narration describing the patient’s condition and what it means for them. Descriptive and explanatory information is delivered in as simple and plain language as possible, making it accessible for patients of all levels of education, without being condescending or inaccurate. The animated, narrated
explanation provides a visual, sequential experience that should prove more effective than an abstract textual description.

![My Condition section of discharge web site.](image)

Medications are often prescribed to patients leaving the ED. These often must be filled at a pharmacy unaffiliated with the hospital. Prescriptions are usually given on a loose sheet of paper, one that is often smaller than the discharge instructions (figure 11). The
prescriptions must be taken to the pharmacy in person, which is sometimes a trying endeavor for those recently released from the hospital. Some discharge instructions contain information about the medication, while in other cases the patient is left in the dark as to the medication’s specific purpose and potential side effects. Medications that have been prescribed by an emergency physician must be filled, picked up, and taken according to the physician’s instructions, although some hospitals now call in prescriptions for patients. Multiple medications are often prescribed to emergency patients, and it is vital that they be taken each according to their own dosage and schedule. The discharge instructions web site seeks to unify, clarify, and simplify the process of obtaining and taking medications.

![Sample prescription sheet](image)

**FIGURE 11.** Sample prescription sheet.

The My Prescriptions page allows patients to view their prescriptions in a clear, friendly format. Patients can read about the function of the medication and view its
side effects if they so desire. Included in this information is when and how patients should take the medication. Patients can fill a prescription from this page as well. The system uses the patient’s home address to find participating pharmacies near the patient. Patients can pick their preferred pharmacy and choose to have the prescription delivered or kept at the pharmacy for pick-up. Thus the entire process of filling prescriptions and taking them is centralized into a single, user-friendly page.

**FIGURE 12.** My Prescriptions section of discharge web site.
In addition to taking medications, certain exercises or procedures may need to be performed or recommendations followed in the interim between emergency visit and seeing a specialist. Patients suffering from, for example, kidney stones, are encouraged to increase their intake of fluids, use a urine strainer, and get exercise. The My Tasks (figure 13) page

**Figure 13.** My Tasks section of discharge web site.
allows patients to read about these in approachable language. Future versions of the software could allow for patients to mark and track their adherence to these recommendations.

Following the ED visit, patients must make an appointment with a physician for follow-up care. If patients have a physician they see on a regular basis, they are generally told to go to them. Similarly, if a patient has an orthopedist and is admitted to the emergency department with an orthopedic problem, they are told to go to their orthopedist. However, patients often do not have regular doctors, and indeed are in the emergency department precisely because of this fact. Protocol for these situations varies from hospital to hospital. Some direct patients toward a specific physician, often within the same health system as the ED hospital. Others will tell patients to simply see a doctor with a speciality relating to the patient’s condition.

My Appointments (figure 14) guides patients through making a follow-up appointment with a physician and gives them more options and information than they traditionally would. Patients are presented with a list of recommended physicians in their area. Patients can read biographical information of the doctors and see a photo, so that they can find someone they would be comfortable with. Patients can then schedule an appointment with the physician of their choosing directly on this page. The system interfaces with the doctors’ existing schedules, allowing patients to see all available times, eliminating the trial and error often experienced when attempting to make an appointment by phone. Also eliminated are stressful hold times and unanswered calls. The process of making an appointment with My Appointments is quick, easy, and straightforward.
My Appointments

Doctors that help people deal with kidney stones are called urologists. Urologists know about the kidneys and the bladder, and the problems that people sometimes have with them. It is very important that you schedule an appointment with a urologist as soon as possible. On this page, you can schedule an appointment with one of our recommended urologists.

Dr. Victoria Adams

General Urology
1537 S. Water St.
Kent, OH 44240

Dr. Adams has been practicing for ten years. She is board certified and a member of all major ranking categories. Dr. Adams grew up in Ohio State University School of Medicine. She has conducted research into improving post-operative recovery for kidney stones.

Dr. Geoffrey Timmons

Summa Western Reserve
5 Arch St.
Akron, OH 44304

Dr. Timmons has been practicing for thirteen years. He is board-certified and a member of all major professional organizations. Dr. Timmons grew up in Toledo, OH and attended medical school at Northeast Missouri School of Osteopathy. He completed his residency at Akron City Hospital.

Dr. Nigel Leightfield

Physicians Urology
537 Franklin Ave.
Akron, OH 44304

Dr. Leightfield has been practicing for six years. He is board-certified and a member of all major professional organizations. Dr. Leightfield grew up in Glasgow, Scotland and went to attended medical school at New York University. He completed his residency.

FIGURE 14. My Appointments section of discharge web site.
Patients often have questions after they leave the emergency department. These may be medical in nature or they may be procedural. Though the ability of physicians and nurses to give medical advice over the phone or email is limited, there are often occasions where clarifications or recommended courses of action can be given to the patient. For patients however, calling the emergency department can seem a dubious prospect. The
seemingly transitory nature of the staff and patients might lead a patient to believe that they are on their own after they leave the ED. Of course this is not true, and ED staff welcome follow-up inquiries. There is also the question of who exactly to call and when. The My Questions section of the web site (figure 15) gives patients an official, straightforward way of asking questions of their caregivers. Patients are encouraged to use the feature and can choose how they wish to converse once their question is responded to. My Questions ensures that should patients have questions, they will know how to get answers.

A physician interviewed noted that the emergency department will sometimes call patients after they have left the ED in order to provide updated results on tests or new analysis of scans. Rather than forcing the patient to juggle new and perhaps conflicting information in their head, the discharge web site could be dynamically updated to reflect the new information. As with the EmergiPad, the discharge web site includes an option to change the language of the text, making it universally available to all patients.
CHAPTER V
OPPORTUNITIES AND CONCLUSIONS

Based on the recommendations and findings of researchers cited in this paper and elsewhere and observations and conclusions drawn while preparing this project, the EmergiPad and its online discharge counterpart would prove useful for both patients and caregivers. The EmergiPad lets patients know what is going on in the emergency department and why they are there, reducing anxiety and keeping the patient’s mind off of waiting. It helps patients and physicians by opening more channels of communication, improving diagnosis and care. The online discharge instructions simplify and clarify the directives of post-emergency department procedures for patients, and give them integrated avenues for seeking medication and followup care.

The proposals presented in this thesis nevertheless merely scratch the surface of what is possible with interactive technology in emergency medical situations. In addition to complimentary devices like the EmergiPad, emergency departments could offer wireless interfaces with cell phones and other mobile devices that patients have with them. Physicians equipped with tablet devices could interact with their patients in new ways. If patients were to use their own devices, their connection to the emergency department could persist after they leave, and be provided with discharge instructions and reminders within the same interactive environment that they used in the ED. The discharge instructions could also provide access to any scans and other test results produced while the patient was in the emergency department.

The end goal would be to have a fully integrated, fully persistent, multimedia and multi-device interface for patients to use in all their medical situations, emergency and otherwise. As the United States creeps slowly toward a future where true universal health care is a reality, it is
possible to envision every citizen having their own medical web presence where all the patient’s medical information is kept and which is accessible from anywhere on any suitably capable device, perhaps using something like the Continuity of Care Record standard (http://astm.org/Standards/E2369.htm). This would be similar to the services offered by the Cleveland Clinic mentioned at the beginning of this thesis, but carried across any hospital and any sort of medical visit, be it clinical or emergent.

Regardless of what form these applications and interactive experiences end up taking, they should always be crafted with the goal of healthy and informed patients, and not technology for technology’s sake. The report from the Health Literacy, eHealth, and Communication workshop sums up the aspirations of this project and others like it:

…the use of emerging interactive health information technologies, often referred to as eHealth…[have] the potential to improve access to the health care system for traditionally underserved populations and to increase the capacity to provide tailoring and customization for individual patients and consumers. eHealth systems can also improve clinical decision making and adherence to clinical guidelines; provide reminder systems for patients and clinicians, thereby improving compliance with preventive service protocols; provide more immediate access to laboratory and radiology results; and, when integrated with clinical decision support systems, help to prevent many errors and adverse events. (Hernandez, 2009, p. 1)

This thesis and its potential future iterations seek to achieve some of these goals for a subset of the patient population that is often given short shrift in the debate over health care access and health literacy. Good health is not achieved merely through medicine and technology, but foremost with knowledge and empowerment.
REFERENCES


