Spring 5-15-2013

Designing for Fall Prevention in Hospitals

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Designing for Fall Prevention in Hospitals

A Masters of Design Thesis Project
By Emily Sappington
Designing for Fall Prevention in Hospitals
By Emily Sappington

A thesis submitted for the degree of Master of Design, Interaction Design
The School of Design: Carnegie Mellon University

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Abstract

A hospital fall can be a tragic event for both the patient and hospital staff. This design thesis aims to discover technology solutions that will aid communication about fall risks and prevention tools in the hospital. The intent of this research is to gain insights about the exact needs of all stakeholders in a healthcare setting and to iteratively design with their feedback. The overarching goal of this project is to design a solution to aid a variety of healthcare providers in delivering more patient-centered services and to communicate more effectively with one another about hospital falls. More communication and transparency about hospital falls should decrease fall rates and thus save patients the painful and traumatic experience of falling in the hospital.
Introduction
Introduction

A hospital fall can be a tragic event for both the patient and hospital staff. This design thesis aims to discover technology solutions that will aid communication about fall risks and prevention tools in the hospital. By investigating the problem of hospital falls from a design perspective, solutions can be demonstrated to a number of hospital stakeholders as they are being made. This inclusive co-design process allows stakeholders to provide input for the design team so that a more useful and helpful solution can be offered to hospital workers to help them decrease hospital falls in their units.

It is predicted that the number of hospital falls could reach one million a year given statistics on reported hospital falls [1]. The topic of falls is critical because of surrounding policy, which dictates that insurance companies will not cover costs related to a patient's fall in a hospital. As a result, a patient’s fall from a hospital bed (intentional or not) is credited to the nurses, who spend the most time directly serving the patient. Overworked and understaffed nursing units now tackle the issue of preventing falls, as well as completing other health-related tasks for the patient.
Design Process
Design Process

The phases in this project include Discover (literature review and secondary research); Define (focus setting and primary research); Design (concept generation, evaluation, and iteration); and Deliver (create final designs and specifications). The design solutions are intended to improve communication between hospital staff members as all stakeholders work to decrease fall rates in hospitals.

As a means of articulating stakeholder needs, designs were created to address the pitfalls of current hospital fall interventions. These designs were then tested in a design evaluation to gauge the usefulness of designed solutions. This three-step process of researching, designing, and evaluating with stakeholders was repeated again.

Discover.

Four weeks were spent reviewing literature and conducting secondary research.

Define.

Four weeks were spent for focus setting and primary research in the form of informal interviews with hospital staff and informal observations.

Design.

Following research, an early design phase allowed for the creation of rough mock-ups of design concepts.
to ensure all possible needs are met with these hospital fall prevention tools. Following an initial stakeholder evaluation, concepts were filtered to fit the scope of this thesis project, and a phone application and fall board to conduct meetings around were investigated further. Four surveys on these two topics were sent to prospective customers and users, and the data used in each type of device was tested through scenarios. The surveys provided more specific feedback about what information would be important to both nurses and administrators, two groups who dealt most with hospital falls, from different perspectives. Once this research was synthesized, the decision was made to make a mobile application. The decision to make an iPad application lead to several iterations, and finally a cohesive design was formulated that satisfied the needs of both nurses and administrators, respectively.

The concluding results will be given to Quarlaris for future work on hospital fall prevention applications.

A basic 5-phase design approach was created first.
Project Timeline

The following timeline shows the steps and design activities in this thesis project, broken into two stages.

**Phase 1**

- **September 2012**
  - Initial problem discovery & literature review
  - After conversations with Qualaris, decide on Falls

- **October 2012**
  - Interviews & hospital site visits
    - Interviews with nurses, managers, OAs, PTs, administrators, and Doctors
    - Observation at St. Clair hospital and MSKCC

- **November 2012**
  - Concept generation - designing six solutions for hospitals to prevent falls

- **Early December 2012**
  - Preparing for design evaluation with healthcare workers visiting CMU (interactive, images, demos)

**Phase 2**

- **Late December 2012**
  - Evaluation of 6 concepts with healthcare workers

- **February-March 2013**
  - Scenario survey sent to healthcare workers

- **February-March 2013**
  - Screens designed for mobile application

- **March-April 2013**
  - Screens designed for tablet app

- **May 2013**
  - Complete all screens and deliver final to CMU & Qualaris
Related Work
Related Work

I began with a literature review spanning publications on general technology use in hospitals, and specific publications on fall prevention in hospitals. Medical literature defines a fall as any event in which a patient has an unplanned descent to the floor, harm-causing or not [6]. Morse’s classifications of hospital falls [4] provided a starting point to understand the types of hospital falls that occur: accidental falls often triggered by an environmental obstruction, anticipated falls that can be caused by confusion or new disorienting medication, and unanticipated falls which stem from sudden health events such as heart attacks and strokes [4]. The first two categories became the primary focus for this project, as unanticipated falls are difficult to predict and design for. Of these types of falls, hospital fall-related injuries range from 6% to 44% according to Morse’s classification of hospital falls [4].
to different reports, with an estimated 11,000 fatal falls per year [1]. In addition to emphasizing the severity of the hospital fall problem, similar nursing and medical articles also provide insight on the causes of this problem. It is often reported that patients attempt to walk or reach for something because they believed the nursing staff was “too busy” [3] and patients did not want to bother them. Because of this tendency combined with patients underestimating the effects of medication and unfamiliar environments on their stability, hospital falls are a common occurrence. Many researchers cite the difficulties working in this space because fall prevention is not a topic where one can perform controlled studies or have access to patients who experience falls. Some note difficulties working in this space due to the fact that many stakeholders perceive falls to be inevitable, and not preventable with the use of tailored solutions or design tools [5]. When looking at the hospital setting in particular, one research study focused on communication breakdowns surrounding hospital falls. The research phase in this paper concludes that “ineffective or insufficient communication among team members” is largely to blame for adverse events such as hospital falls [11]. Another study mentions that problems span various locations in the hospital, and that collaborative communication is missing in this setting when addressing hospital falls. To alleviate this, the researchers increased communication with scripted huddles and interactions between hospital staff members [11].

When problem-solving to reduce communication errors, some hospital staff state that occasionally when a patient call button was pushed, they did not know how to respond [5], thus slowing their speed in providing aid that would help prevent a fall. Successful hospital fall interventions often included communication tools for both the patient and hospital staff members [2]. Similarly, customizing which interventions are used with particular patients seems to be a common and helpful practice to ensure that only effective tools are being implemented [2]. When discussing communication tools, hospital staff point to signage as a main communication tool [5] to alert them of patients that are of a higher fall risk category. Despite the helpful nature of signage, staff also admitted that over time the standard signs blend into the background and the staff becomes “immune” to their messages [5].
Although communication among hospital staff is important to decrease falls, the patients must also be addressed as a key stakeholder in this problem. When communicating directly with patients, it is important to not remove their autonomy and to frame fall prevention positively [3]. Researchers cite that welcoming language and collaborating with the patient to find compromises can be important to preventing falls [5]. Much of the design research work in this space focuses on solutions for patients, and a study focusing on elder patients preventing falls proved to be helpful inspiration with how one can gameify this experience [10]. For falls rehabilitation in particular, games designed for seniors proved to be a means of encouraging physical movement [10]. Early in the research process, it became clear that this thesis work would be mostly used to decrease fall rates for elderly patients. Because the majority of fall risk patients in hospitals are senior citizens, research that focused on their unique needs was referenced for future design considerations. One study on virtual tools for the elderly proved enlightening for potential avatar generation. Though this research showed that older users felt little connection to male or female avatars, elderly users were attracted to animal avatars [7]. This finding towards avatar preferences would later be applied to the Care Companion design.

Some designers have used sensors to predict when a patient will fall a mobile device is used to administer tests given to patients to evaluate their fall risk [8]. These tests include two-minute walks, standing up and sitting, and reported findings to an iPhone application [8]. This design solution works well to prove that an algorithm could detect gate changes, however did not address the hospital setting where patients may experience short-term physical disability [8]. Following some of the observational strategies employed by related projects, research began with informational interviews with healthcare stakeholders. Borrowing from other design methodology used for this topic, observations were arranged so that I too could witness healthcare workers responding to health-related incidents in their workplace [9]. The stakeholders who may someday use fall prevention tools created by this thesis would later be elicited to provide feedback in a participatory design setting, similar to the healthcare research I've gathered [9] [10].
Interviews & Observations
Interviews & Observations

A local Pittsburgh healthcare quality improvement software company, Qualaris, has helped facilitate much of the research involved with this topic. Qualaris offered as a starting-point their perception of the issues related to hospital falls, and connected me with several local healthcare workers who were interested in offering their thoughts on fall prevention. Weekly meetings with Qualaris to review research and design progress, as well as previews of the software the company is currently creating for hospitals has proven an invaluable asset to this thesis research.

Interviews were conducted with hospital workers, including nurses, doctors, nursing assistants, managers and directors. One-on-one interviews were held to assess problems in the hospital space as seen by different stakeholders. During one to two hour meetings, I would ask first broad-sweeping questions about fall prevention such as “How do you feel about Hospital Falls at your hospital?” and “What do you perceive to be the cause of these falls”. Often these conversations lead to stories of patients with particularly difficult personalities or observed miscommunications in their units. One doctor mentioned that he wished there was an efficient way for nurses to pass on feedback about how the patient does overnight with particular medicine. A nursing manager shared insights about how many older male patients are resistant to ask for help because outside the hospital they are healthy, not on medication, and physically able. These types of patients see the nurses helping them move to the bathroom as overbearing help they do not need or want. A director shared a print-out including an Excel table of hospital units and their recent patient falls, which she shared was not helpful in explaining the “whole story” of a unit’s fall numbers. Based on this kind of table, a unit could be penalized for a high fall number when the falls may have all come from one extremely difficult patient. A doctor shared research findings that show how particularly mentally ill patients can cognitively deteriorate if restrained to a bed, explaining how physical restraints are not appropriate for fall prevention and should be
avoided. A nursing manager shared one particular story of how a doctor entered a patient’s room, began a routine examination, and was quickly called away to attend to an emergency case. Because the patient was a high fall risk, their bed was always to be lowered near the ground, so that they would not sustain injury if they fell. Unfortunately, the doctor was not aware of this, and so he raised the bed to do the examination, and then neglected to put it back how he found it. This patient fell, and were it for more clear communication, the bed might have been returned to a safe height before the patient fell. A theme began to emerge from these interviews: falls could be prevented if only communication was easier.

Following the interviews, a day of observation proved most insightful for gathering the problems that lead to
hospital falls. I arrived at St. Clair Hospital early in the morning to observe nurses, certified nursing assistants, and other hospital workers in two different units. Some fall risk circumstances seemed hard to avoid, such as a patient withdrawing from drugs and alcohol who repeatedly tried to escape because he thought he was going to attend a Renaissance fair. Throughout the day stories were shared with me about how individuals combatted the problem of falls “I treat everyone like they are the highest level fall risk” one physical therapist told me, as she described how every patient was handled with the most assistance possible. I noticed red socks and bands that were often hidden, standing out when tied to a bed railing. Nurses explained how they found it valuable to distinguish between harm risk patients and fall risk patients, as fragility and instability differ from patient to patient. I witnessed nurse meetings when staff discussed how the patients fared overnight, and talked about which patients they should be on the “lookout” for during the day. Some expressed problems with getting all staff to respond to a fall promptly, while some staff shared frustration with patients who were too independent and unaware of their physical inabilities. Other observations seemed to hold such simple solutions they were frustrating to witness. When a particular alarm sounded in the nursing unit, this was a cue for the nurses and certified nursing assistants to get up and respond, because a patient had either left their bed or chair, and was moving somewhere unassisted. The problem is that these particular nursing units, like many others, were centralized, and so it is hard to locate where exactly an audio tone is coming from. Throughout the day I witnessed nurses and certified nursing assistants stand up and spin for a valuable few seconds, while trying to locate which direction to run towards. This is one observed pain point that would eventually because a design concept presented to hospital staff. Other design concepts were generated from both research into technology being deployed in hospitals, interviews, and related work.

Early on it became clear that many healthcare workers interact with the patient to varying degrees, and so their impact on the patient’s likeliness to fall would vary accordingly. A stakeholder heat-map was developed to track which health care workers interacted with the patient the most.
visits vary due to Director’s role, however most are preoccupied with other tasks
visits vary based on recency of surgery or procedure, but are short
visits once a day if the patient is mobile and cognizant
visits once an hour, more if needed
visits most often
In most St. Clair nursing units, already crowded walls accommodate a dry-erase board dedicated to a detailed summary of a recent fall event.

Magnets with leaves on them were used at one local hospital to signal fall risk patients, until it was decided that over time the magnets did little to remind people.

A board in the nursing unit shows patients with varying conditions and medications. This board also calls out which patients are a fall risk, and is updated daily.

At UPMC one unit motivates nurses to prevent falls by promising them a pizza party for every 100 days without a fall. This unit has only gone 10 days without a fall.
What happens when a hospital fall occurs?

A breakdown of which health care workers respond and what they do after a patient falls in the hospital.
In coming weeks

Unit director assesses fall in a staff meeting

The next day

Physical therapist works with patient to avoid falling

Nursing staff discuss the fall
As can be seen in the map, many hospital stakeholders touch the topic of a patient’s fall, but few actually interact with the patient directly. Those who may hold meetings and discuss the fall, are almost never present for the fall, and are left to later summarize reported facts about the event. This leads to a potential game of telephone as information is transmitted. Before a fall event occurs, fall prevention tools are discussed merely in the form of spreadsheets and checklists, not allowing for notes or comments about patient circumstances. The current Excel or paper-and-pen tools being used to communicate about hospital falls are insufficiently delivering information, as communication breakdowns are apparent, as can be seen by the example here.

Throughout the hospital it became evident that the biggest issue around hospital falls was communication. Communication errors were not merely patients understanding to press their call buttons, but also related to communicating with stakeholders to be mindful of fall risk patients, or explaining that all hospital workers should respond when a bed or personal alarm is sounded, and also to communicate between units to share successful interventions and work to improve the entire hospital’s fall rates. Given the variety of interactions that fall numbers relied upon, it made sense to look at where communication breakdowns were occurring. On the following page is a short summary of the communication needs addressed by location in the hospital.

### Fall Audit

<table>
<thead>
<tr>
<th>Unit:</th>
<th>Date:</th>
<th>Med/O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admission Fall Assessment level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of questions answered “yes”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appropriate level assigned?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was rationale documented?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does admission assessment and first nursing assessment agree?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall level assigned</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of questions answered yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If 2 or more questions answered yes which level was assigned by the nurse?***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is there documentation to support the choice?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are prior assessments in agreement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is there documentation to support the changes in levels?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nursing interventions:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHECK THE PATIENT’S RECORD. Are the appropriate fall precautions in place as documented?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If there is a bed alarm is it on?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*** If the nurse answers yes to one question the patient must be a level 1. 

**If the nurse answers yes to more than one question this does not mean the patient is automatically a level 2. They must use their own judgment if the patient is at risk for a level 1 or 2 and record their rationale accordingly. The nurse must identify the correct level fairly, upon transfer, and if there is a change in condition. In addition, it is important to appropriately place the fall precautions that are required for the patient’s safety.**

A current UPMC Fall Audit form used by Administrators is limited in how one checks off what interventions are used.
In the patient’s room

- Reminders for other stakeholders who enter the space infrequently
- Temporary information (not patient-facing) on what fall interventions should be used
- Information for patients and/or family
- An alternative to the Safety Sitter

At the nursing station

- Patient alarm directional aid
- Best practices
- Updating dashboard on falls
- Story to analyze or discuss recent fall

In the unit hallway

- A reason to go in and check on the patient
- Patient alarm directional aid
- Transparency and information, including incentives, updating more than current bulletin boards

At hand

- Patient location and status
- Information and story
- Suggested fall interventions as to what should be used, when
Design Concepts
Design Concepts

To address the communication breakdowns surrounding falls, the above needs-sorting was used as inspiration for potential design solutions. Six design concepts were created to articulate a possible solution to the needs discovered in the literature review phase. Needs for patient knowledge, reminders for those who see patients less, and information-sharing tools for nurses would drive many of the concepts created. As literature indicated that a one-size-fits-all approach can sometimes fail [2], several design concepts were visualized to address the hospital fall problem from various perspectives. The following solutions are designed to exist within the patient’s room, in the hospital hallways, and in the nursing station, so that each concept addresses different users respectively. The six concepts include: Door Signs, Care Companions, Fall Boards, a Bedside Checklist, Alarm Maps and Bed Lights.

The concepts serve not only as a way to articulate possible solutions, but also as a critical conversation catalyst to put in front of hospital fall stakeholders. By allowing hospital workers to critique hospital fall solutions, this design process acknowledges their expertise and gives these workers a voice in the creation of tools they may one day use.
Door Signs

Each hospital room will include a door sign in the hallway made of inexpensive screens that will change images based on patient activity. Door signs will be used outside each room to alert all hospital staff of patient locations and happenings. Screens will show whether a patient is in their room or not, in the bathroom, if a fall has occurred, or if the patient has been alone for too long. This added location visibility will better prompt and direct staff in hallways to assist patients. With a peripheral color change, all hospital staff will be made aware of when they should help assist a fall risk patient without adding more noise to an alarm-saturated environment.

Pros:
• Draws hospital workers into the patient’s room to respond
• If nurses lose track of time, the hallway tells them how long a patient has been alone

Cons:
• Additional cost to purchase one for each room

Four screens show different Door Sign stages depending on the patient’s location and time spent alone.
Care Companions

Inside hospital rooms, Care Companions appear on an additional screen in the patient's visual range from bed. During hospital observations, a Safety Sitter was explained by staff members as a person who is hired, out of the nursing staff budget, to sit with difficult patients who tried to leave bed often. These individuals acted as babysitters and did little more than verbally coax the patient to not leave bed. The Safety Sitters were sometimes effective, but were also costly and made some patients feel as though they were being infantilized by the hospital. Modeled after a hospital Safety Sitter, the Care Companion monitors movement and will trigger once the patient appears to be moving in a manner that may risk a fall. A variety of animal choices will allow patients to choose their own digital pet, adding to their own feelings of independence and choice. These animal avatars serve to educate patients about fall risks and could introduce staff members upon entering the hospital room. The care companion is triggered to tell the patient to stay in bed by a camera that faces the patient's bed. In previous studies [cite here] cameras have been used to detect when a patient’s body is leaning or about to fall or get out of bed. This early warning of monitoring body positioning can allow for a calm intervention before the patient’s position triggers the urgency of an alarm.

Pros:
• Does not degrade older patients like a Safety Sitter does
• Would not cost the unit per-use like the Safety Sitter does
• Has potential to be engaging and interactive for bored patients
• Agent does not patronize while it teaches patients

Cons:
• More adventurous approach to Fall Prevention
• Not all patients may like the characters
Fall Boards

Currently, many nursing stations use fall boards as a place to display to the organization a recent hospital fall event in an effort to encourage reflection and discussion of falls. This interactive version of a fall board can be used to communicate information about recent fall events and to share fall statistics across hospital units. The boards tally each day without a fall with tree leaves, making background graphics more beautiful and color-rich as a unit successfully prevents hospital falls. Interactive elements allow administrators to gather information on how staff respond to falls and how past fall events are analyzed. Comments sections and short surveys serve as a tool to gather data on fall-related issues in the hospital, which administrators can then use to inform equipment purchases, education tools and best practices.

Pros:
- Increases transparency in the hospital
- Lets nurses do more than read a fall story, but also respond and contribute
- Administrators can harvest feedback from all nursing units
- The conversation about a recent fall is brought to a larger group

Cons:
- Showing fall rates may be too much transparency for some hospitals
Bedside Checklist

A handheld tablet with a checklist for interventions allows nurses to evaluate what fall prevention steps should and are being used on particular patients. The interface will take patient information and suggest intervention items such as specific beds or floor mats. The hospital’s best practices can be recommended through the tablet’s interface, and later compared to what a nurse has chosen to implement with a particular patient. A summary of fall intervention tools can be sent to other stakeholders and notes can be left for the patient’s doctor.

Pros:
• Helps nurses know what interventions to use
• Keeps a record of interventions for both nurses and administrators to check later

Cons:
• Hospital would have to generate a “perfect” list of suggestions for interventions, which varies a lot
• May slow down nurse’s workflow

Screens show the home of the checklist app and a summary of interventions.
Alarm Maps

Audio alarms are a common intervention in hospitals; however, they are not necessarily easy to locate. A visual alarm map will help nurses and hospital staff more quickly respond to a fall. The maps will locate the fall visually so that staff can locate the shortest path to the patient’s room from their location. Maps appear on signage and computer screens to prompt all staff members when a patient needs assistance.

Pros:
• Helps nurses locate patients quickly
• Visual map will speed up response time

Cons:
• May be distracting or disruptive for non-responders

An Alarm Map sample as it would appear on one’s work computer. Details show fall level and people in the room.
Bed Lights

A patient’s fall risk level may impact the way the patient is moved, treated, or left in their room. Bed lights serve as a symbol of a patient’s fall level when someone enters the hospital room. This ambient addition alerts doctors and other stakeholders that they should be extra cautious when moving the patient and offer to help, but does not disrupt the patient’s experience in the room. The location within the patient’s room is particularly helpful for stakeholders who do not see the patient on a daily basis and need a visual cue to be reminded to handle higher fall risk patients with care.

Pros:
• Inexpensive alerting solution
• Designed to not be viewed by the patient and to not alarm them

Cons:
• Changing lights adds another task for nurses to do
• In the past, similar interventions have been ignored over time

Renderings of how the Bed Light would appear in two hospital rooms.
Design Evaluation
Design Evaluation

Various hospital stakeholders including two administrators, one doctor, four nurses and two nursing unit directors evaluated the six aforementioned design concepts during two design evaluation sessions. They provided feedback on the design concepts, debating which interventions would be helpful in their units. While I did not build functional prototypes, I used an iPad to simulate hospital displays, signage, and click-through Flash demos of dynamic notifications.

Overall the session’s participants felt positively about the design concepts, and appreciated that the designs did not take a “one size fits all approach to fall prevention” to quote on administrator. Many participants thought of other forms for the information, stating: “I want this on [my] workstation on wheels” or “I want this on my mobile”. Evaluation feedback indicated that the Bed Lights would most likely not be carried forward as a useful intervention. Though the light was a reminder, maintenance of its status as patients switched rooms could add extra work, and stakeholders expressed concern that it could be overlooked after some time.

“The more you can give me at my fingertips, I would love that”

- Hospital Nurse
The Care Companions were met with a positive reception and are being considered to fill other patient needs in the hospital room, such as occupying and “talking to” patients in psychiatric units. Others thought it would be a good fit for ailing children in pediatric units for similar reasons. Door signs could be modified to meet HIPPA regulations, and should be made as inexpensive as possible. Many nurses and administrators liked the fact that the signs cued someone to stop into a patient’s room, “I like the fact that it shows how long they have been alone” one participant noted. Alarm Maps were deemed to be immediately helpful for locating alarms. It was not surprising that nurses appreciated how the Fall Board concept kept a feature they often use, presenting a recent fall story in detail. One nurse noted “reading what happened makes it real”, a reason to keep the written narrative of the fall story present. Fall Boards were seen as helpful for data-gathering for administrators, as well as

“I support transparency”

- Hospital Administrator

Emily presenting concepts to one group at the evaluation.
a conversation centerpiece for nursing units. When it was shown how data could be synthesized and emailed, one participant noted “I love the information sharing” and another “I like this infographic handout” when data was shown translated to printed PDF sheets. The interventions were appreciated for the ways in which they added transparency and encouraged action from staff members when imminent falls were detected.

“A [Safety] Sitter you don’t have to pay?!”

- One nurse’s reaction to the Care Companion concept
Surveying Specifics
Feature Survey

Next, a month was taken to consider the design concepts presented to hospital workers and which ones it made the most sense to focus on for the remainder of this thesis project. This reflection lead to the selection of two concepts that would be used most by hospital staff and that could be easily adopted by hospitals. A phone application for hospital staff would present information in a more personal, private manner, while a hospital fall board would facilitate nursing station meetings and overall hospital transparency around falls. Design concepts that were popular with staff, such as the alarm map and patient-tracking concepts used in the Door Signs, would be appropriately applied to these two mediums. A survey was created to test the relevance of particular features in a phone application or on a fall board. To ensure that the features were explained clearly, several brief scenarios were written to convey how particular features would be used and by who. To control and test if at this stage in the research, I had proper understanding of the problems facing hospital staff, questions asked if each of the stories were relatable to the participant. With each feature scenario I also asked if they would use the particular feature, and at the end of the survey I asked how likely they were to use it. All of the app or fall board’s features
were also presented in a list and participants were asked to select what features they would like to have access to, and which ones they would want to exclude from the app or fall board. Respondents answered every question of the two surveys, depending on their role as either nurse or administrator, and many left comments. The findings from ten administrators and eleven nurses were next analyzed to help narrow the scope of this potential fall prevention tool.

### Transparency

**For staff, patients & family**

Jane starts her day by checking in on her unit board. No falls overnight, and no new stories means the hospital and her unit are doing well this week.

After welcoming a new patient, Robert, Jane is rolling the patient to his room with his Doctor. “Nurse, I’m worried about falling, I hear that can be awful.” Robert says. Jane points to the image that appears when the nursing unit board is not being used, where there is a tree that’s leaves symbolize how many days the unit hasn’t had a fall. “As you can see, we haven’t had a fall in quite some time, you are in good hands here.” she replies as they head off to get settled in his room.

A scenario from the fall board survey, targeted towards nurses.

### Administrator

**Keeping on top of each Unit's falls**

William is a hospital administrator at St. Francis hospital. He spends his days having meetings and making sure everything is running smoothly. Each Friday he has what is called “Falls Friday”. He starts by examining his phone app on falls, and then she speaks with staff in specific units.

Today he’s stopped into 4F to ask about interventions they’ve been using that differ from other units. Despite an older population, 4F has had two months without a fall. Gathered around the Fall Board, the nursing staff presents how their interventions differ from others. William then drafts up a her weekly Falls email to the hospital sharing her insights from the unit visit.

A scenario from the fall board survey, targeted towards administrators.
Rounding Nurse

Communicating with stakeholders

Antio likes to work as he goes. He is always back-and-forth with his computer, updating files and checking patient information.

Now with his new phone app, after discussing a patient’s “wobbly” feelings at night, he can quickly check their patient records and see medication information. Within seconds he attaches a comment to the patient’s Doctor advising to reevaluate a sleeping pill dosage. Before even moving onto the next patient’s room, Antonio has taken some action on his patient to create a better hospital experience.

Phone in hand, he is onto the next room, “When was their last fall?” he wonders.

One of the scenarios presented to nurses that reflects common activities and app features.
Survey Findings
Survey Results

Overall, the nurses and administrators found the scenarios relatable to their work experience, which served as confirmation that these features had the potential to address their needs. In these scenario surveys, eleven nurses and ten administrators were surveyed. When responding to the survey about a nursing unit board, the majority of nurses supported transparency efforts in the hospital and said they would show a display of fall rates to patients and their families, to impress upon them the importance of preventing hospital falls. There were a small few respondents who felt that they would not want the hospital or nursing unit’s overall fall rate to be displayed, and this can be adjusted for with a feature to allow managers to hide content. Nurses did, however, want more information in their nursing unit. Best practices, fall prevention information, a feedback section, and a recent fall story won the majority of votes for information that nurses would like to be displayed on a board. Comparative data, however, was not viewed as a useful or necessary feature to the nurses. Administrators, on the other hand, did respond positively about comparative data being visible and available. Half of the ten administrators surveyed responded that they would like to see hospital statistics displayed, and eight out of ten responded that they would like to have comparative data with individual units highlighted available on the nursing unit boards.

When analyzing the concept for a phone application, the scenarios were crafted to showcase the potential for information at both the nurse and administrators’ fingertips. The majority of those surveyed felt the scenarios were relatable to their everyday work at the hospital. Scenarios which explained how unit fall statistics could be accessed on a mobile device before a monthly meeting, were received positively, as one administrator responded “This would be wonderful!!”. Understandably, as administrators have little personal interaction with patients, the surveyed administrators did not respond with interest in having patient information or patient location on their mobile device. Nurses, however, responded with overwhelmingly
positive feedback for having patient fall risk level, patient information, patient fall history, and patient information being available on their mobile device. One nurse responded to the survey: “Having a mobile application with up-to-date information about patients would be very helpful.” Overall unit and hospital statistics were not a priority feature on the phone app to nurses, but references to helpful information such as best practices, a recent fall story, and preventative information was rated highly. This feedback would help structure the easy of information access on a mobile device for hospital administrators and nurses. The disparity in both parties’ feedback would guide the design plan for a two-sided app: one tailored to nurses’ needs, and one customized for an administrator’s use.
App Design
App Design

It was determined that given the differing needs of both administrators and nurses, two apps that are a part of one system would be designed. Though a fall board was received positively, for the purposes of this project, as well as the client’s progress with hospitals wanting an app for fall prevention, a mobile application was chosen to be designed in detail. The form of a final application design underwent a few changes as this project concluded. First, a mobile cell phone device was noted to be ideal by healthcare workers, however once presented in scenarios, holes were poked in exactly how information would be protected. Both nurses and administrators noted that: “the hospital does not allow staff to use their own phones.” and “...would phones be only in the hospital? What happens if someone loses phone etc. a challenge is the balance to use very effective technology vs. of breaches, inappropriate sharing of information.” Most respondents made note of HIPPA, a National patient information protection policy. The small form of the phone was criticized for the fact that
it could be easily lost, and many were concerned about having a second work-only phone that one could not take home. A PC tablet was the next form considered because market prices for a Windows 8 tablet are far lower than prices for an Apple tablet. The client, Qualaris, then indicated that the hospitals they were working with had a bias towards Apple products. Though the product may not be any more “secure”, the administrators at these hospitals felt they were, and so an iPad application for falls prevention was created.

App design iterations began after an extensive search for iPad design, and iPad interface principles. Rather than a realistic rendering of a notebook or a paper hospital chart, a more digital interface was chosen, with traditional iPad menu bars and navigation. The Qualaris branding would be introduced in slight elements, such as orange actionable buttons, and magenta-pink color accents for visual direction.

Early iPad app design included a constant side bar and notifications.
Mark is a nurse at St. Jude’s. He arrives to work and sits down with his iPad to check on his patients. It appears all of his patients are either in their beds or off to Physical Therapy, so he sits back and checks on the status of a patient he has been keeping an eye on lately.
His patient, Lorraine, had a fall almost two weeks ago and now Mark checks her status every morning when he gets to work. Luckily, she didn’t fall last night. Thankfully the fall she had a while back wasn’t serious, but Mark finds it helpful to be able to check her status and have the opportunity to quickly reach out to Lorraine’s Doctor if he needs.
Mark taps “Back” to view the patient map again. Suddenly, an orange frame around one rooms appears and a popup displays over the patient map. The patient in room 408 has just gotten to the bathroom by themselves. This is his colleague, Pat’s patient. He notices that she is about to pour herself some coffee, and he yells to Pat to stop in and check on her patient in 408 first. Pat stops over to the room, and helps her patient in the bathroom, avoiding a fall.
With some time to spare before his rounding meeting, Mark decides to see if any new falls occurred overnight in the entire hospital. A new story has populated overnight, about a fall on another floor. Mark reads the story, and then checks off what he thinks about it in the response panel.
Once his answers are captured, Mark sees the questionnaire box flip over to reveal the answers that his colleagues gave in response to the fall story. Mark is a bit surprised by a few of the answers, so he goes on to check Best Practices and examine the fall interventions that could have been used in this situation.
On the Best Practices page, Mark flips on both Fall Level types to see what is suggested for a patient like the one in the Fall Story. Looking at the required interventions, he sees that a low bed, bed alarm, and scripted discussion are the most used interventions. He then takes some time to click the blue arrows and learn more about each intervention.
Janet arrives at work, and the first thing she does is open her Fall Prevention App. Because she is an Administrator at St. Jude hospital, the app opens to a unit comparison dashboard that tells her the fall rates for all units, highlighting the best and worst performing units.
Janet spoke to some nurses yesterday who mentioned bed alarms and safety sitters as their favorite interventions, so she drags those to the comparison space. After dragging the two interventions to the graph, two lines appear that show percentage compliance with interventions. This maps over the fall rates of units to show how interventions correlate to fall rates. She can see here that safety sitters and bed alarms really do help when compliance is high.
After moving some other interventions into the graph Janet decides to get to work. Janet needs to spend the morning auditing a hospital unit, so she opens the audit page. The home page shows units that have not been examined in a while, as well as a summary of her most recent audit of 2A from yesterday afternoon.
Now that Janet is auditing Unit 4F, she walks room by room, enters the patient type and then checks off all of the interventions she sees in the room. Interventions used to prevent falls are categorized by being either mandatory or suggested. Once Janet is finished entering any comments or adding other interventions that were not suggested, she taps “Submit” and moves onto the next room.
Future Work
Future Work

It is anticipated that Qualaris will continue the next generation of fall prevention app development. With a staff including developers, and freelance designers on-hand, the app can be created and customized for a pilot hospital’s needs. After discussing this design thesis with designers and health care professionals, it has become apparent that this work has a much broader application than just falls. In-patient or rehabilitation settings, nursing homes, and home monitoring applications are all places that could benefit from this thesis work, and with that comes a variety of scenarios that fit the use of this sort of application. Children with aging parents can use this technology to monitor if home health aids are taking care of and spending time with their parents. Nursing homes can use similar technology to track patient care, best practices, and room-visits.

As Qualaris moves forward with the Fall Prevention app for hospitals, future concepts were discussed in the form of new interface design directions. One concept translates the interface to a series of questions with content waiting to be filled by administrators. Units and interventions could be compared as administrators choose which content fills in a question. This Mad-Lib style approach could more easily articulate what the results of some complex graphs and diagrams offer.
Final Thoughts
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This thesis project tasked itself with combatting the problem of patients falling in hospitals by addressing communication concerns and increasing transparency in hospitals. The resulting application was conceptualized out of observation, evaluative sessions, stakeholder feedback, iterative design and refinement with the client. Qualaris will continue work on a future version of the fall prevention application. While an application cannot prevent all hospital falls, this solution aims to increase transparency, the sharing of fall prevention tools between hospital workers, and mindfulness of fall risk patients. The partnership with Qualaris proved to be a valuable resource both for gaining access to hospitals and for practical critique of a product that should be in hospital workers’ hands within the next year.

Special thanks for Faculty Advisor, Jodi Forlizzi and to Daniel Bishop of Qualaris for their support with this thesis project. This material is based upon work partially supported by the National Science Foundation under grant #EEC-0540865.
References


