Building and Testing a Patient-Centric Electronic Bedside Communication Center
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ABSTRACT
In this article, the authors describe the development and pilot testing of an electronic bedside communication center (eBCC) prototype to improve access to health information for hospitalized adults and their family caregivers. Focus groups were used to identify improvements for the initial eBCC prototype developed by the research team. Face-to-face bedside interviews and questions were presented while patients used the eBCC for usability testing to drive further development. Qualitative methods within an iterative, participatory approach supported the development of an eBCC prototype that was considered both easy to use and helpful for accessing tailored patient information during an inpatient hospitalization to receive acute care.

The acute care hospital environment is complex, dynamic, and fast paced. Poor communication between providers and patients and their families, and the exclusion of patients from active involvement in their own care are significant problems that can contribute to deficiencies in providing safe, patient-centered health care (Agency for Healthcare Research and Quality [AHRQ], 2011; The Joint Commission, 2012). Communication failure due to inadequate information is a common cause of adverse events (AHRQ, 2011). Providing patients with information for engagement in their care plan is recommended as a key means to prevent errors from occurring (AHRQ, 2011). Securing information about their condition and having an opportunity to review that information can be particularly important for hospitalized older adults, for whom medical decision making may consist mainly of understanding information and clear communication, rather than personal involvement in selecting one treatment over another (Ekdahl, Andersson, & Friedrichsen, 2010).

Recent federal legislation (Centers for Medicare & Medicaid Services [CMS], 2012) provides incentives for hospitals and health care providers to engage patients in their care and to use technology in a meaningful way. There has also been an uptake in the use of personal health records by consumers for accessing information to manage their health at home (Kaelber, Jha, Johnston, Middleton, & Bates, 2008). For example, more than 66% of older Americans with Internet access routinely search for health information online (Fox, 2004). However, few examples exist of providing patients with access to similar levels of health information during an acute hospitalization. In a previous study, our research team found that providing access to tailored fall-prevention information at the bedside to all care team members (including patients and family) prevented falls in acute care hospitals, and that this strategy was most effective with patients 65 and older (Dykes et al., 2010).

Building on these findings, we then conducted focus groups and expanded the core set of information...
beyond fall prevention to include 36 specific bedside information requirements needed by patients and family caregivers to engage in the recovery plan (Caligtan, Carroll, Hurley, Gersh-Zaremski, & Dykes, 2012). We hypothesized that an electronic bedside communication center (eBCC) that included this core set of information could bridge the communication gap between the health care team and patients during a hospitalization to receive acute care. We found that the core information requirements needed to populate the eBCC fit within the following categories (Caligtan et al., 2012): (a) plan of care, (b) tailored patient education, (c) communication of safety alerts, (d) diet restrictions, and (e) medications.

The purpose of this article is to describe the iterative, participatory approach that our team used to leverage the findings from our previous work (Caligtan et al., 2012; Dykes et al., 2010; Dykes, Carroll, Hurley, Benoit, & Middleton, 2009) and to build and test an eBCC prototype for use by patients and family caregivers during hospitalization to receive acute care.

The research questions were:
- What are the user interface requirements for the eBCC?
- Can hospitalized patients use the eBCC?
- Can older patients use the eBCC?
- What recommendations do patients and family caregivers have to improve usability and usefulness?

METHOD

We conducted a multiphase study to translate the eBCC from concept to prototype. The study was reviewed and approved by the Human Research Committee and conducted at two academic medical centers in the northeastern United States. Participants in focus groups included former patients, their family caregivers, and hospital volunteers who had been recent inpatients or caregivers. Interviews at the bedside were conducted with hospitalized inpatients. Stratified purposive sampling was used to ensure at least half of patients selected were older than 64. Inclusion criteria included inpatient admission on a medical unit, older than 18, awake

### Figure 1: Iterative Participatory Software Development Process

Note. eBCC = electronic bedside communication center.

### TABLE 1

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
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<tbody>
<tr>
<td>Orientation to the environment</td>
<td>Information to orient patient/family caregivers to the care team, professional roles, and the hospital environment. Examples include the current date/time, names and pictures of care team members, information about the hospital, and current weather.</td>
</tr>
<tr>
<td>Schedule</td>
<td>Information to inform patient/family caregiver about scheduled events, consultations, and tests. Also includes daily routine, such as mealtimes and a link to the menu used to order meals by telephone.</td>
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<tr>
<td>Notes</td>
<td>Questions or concerns of patient/family caregiver to be discussed during rounds or with individual providers.</td>
</tr>
<tr>
<td>Health information</td>
<td>Information to engage patient/family caregiver in their recovery. Examples include medication schedule, test results, tailored patient education information. The Infobutton (Cimino, 2006; Maviglia, Yoon, Bates, &amp; Kuperman, 2006) standard was used to provide high-quality information from public domain websites, such as MedlinePlus® and FamilyDoctor.org, tailored to a patient’s primary problem. Infobuttons (Cimino, 2006; Maviglia et al., 2006) are also used to provide context-specific information related to laboratory tests and medications.</td>
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and alert, cognitively intact, able to understand and speak English, able to articulate observations regarding communication needs, and able to provide feedback on the eBCC prototype.

**Iterative Participatory Software Development**

While the high-level eBCC components were defined by our previous research, additional work was needed to flesh out each category and develop an early prototype that could be shared with end users (Mihailidis, Krones, & Boger, 2006). An iterative participatory software development process (Figure 1) was used to develop a series of prototypes incorporating the expertise of end users, including research team members, software developers, patients, and family caregivers, while concurrently testing the eBCC components (Table 1). The qualitative research that informed the process began with storyboard mock-ups (Prototype 1) that were gradually refined into a web-based user interface (Prototype 2) based on findings from focus groups (described in detail elsewhere, Caligtan et al., 2012). The revised eBCC (Prototype 3) was accessed via the Internet on a secure mobile tablet device, tested at the bedside with hospitalized patients, and is the focus of this article. eBCC Prototype 3 used web services to leverage structured coded data from the electronic record and displayed that information at the bedside within the eBCC user interface (Figure 2). Therefore, during the usability test, patients were able to view their own medication schedules and test results, and the educational content was tailored based on their primary reason for hospitalization. Hospitalized patient and family caregiver responses to the eBCC prototype and suggestions for improvement were documented. Recommendations based on the bedside usability testing were compiled and integrated in the eBCC software.

**ANALYSIS**

Patients participated in bedside interviews to validate the concept of using the eBCC with hospitalized patients and to test the usability of the eBCC Prototype 3. Each component of the user interface and associated content was reviewed. At the end of the demonstration, patients were provided an opportunity to use and familiarize themselves with the eBCC system. The facilitator then asked patients a series of questions to assess their ability to use the eBCC prototype and locate key information. For example, patients and family members were asked to identify the next time they would have a blood sample drawn, when they could next receive pain medication, or to find information about their condition. If a patient had difficulty with a particular task, the facilitator probed to identify patient suggestions for improving the user interface.
Responses were audiorecorded. At the end of the session, patients were asked to share their overall thoughts about the eBCC and whether they would routinely use the eBCC if it were available at their bedside.

RESULTS

Eight hospitalized patients and three family members on general medical units agreed to participate in the bedside usability testing of eBCC Prototype 3. Participants ranged in age from 37 to 90 (mean age = 64), and the majority were 65 or older (n = 7). The usability of the eBCC was evaluated by asking each participant (n = 11) to use the eBCC to locate information.

The results are displayed in Table 2. The majority of participants said they would use the eBCC if it were available at their bedside. One patient, a 90-year-old man, reported that he does not use computers and he “prefers to get his information from humans.” He went on to say that his “85-year-old brother would like the eBCC because he has three computers at home.” Another patient, an 82-year-old woman, stated that she has a computer at home but does not use it and would find no use for the eBCC while hospitalized. She said that she does not want “one more thing to worry about.”

However, her family members said they would use the eBCC and that they thought it would be an excellent tool for seeking information on their mother’s behalf.

Summary of Feedback and Requirements for eBCC Software

In general, patients and family caregivers reported satisfaction with the eBCC components and the types of information available. Most patients reported that they liked the tailored educational content. None of the patients were aware of the National Library of Medicine’s MedlinePlus® or the FamilyDoctor.org websites and said they would use them at home to access reliable health information. Patients and families reported that they liked to see pictures of their nurses and attending and responding physicians, and appreciated the links that defined the professional roles of hospital workers. Patients wanted this section expanded to include any provider or hospital worker who had contact with them during their hospitalization. Some of the participants recommended adding the ability to page, text, or e-mail messages to nurses, physicians, case managers, and other providers from the bedside. The family caregivers reported they would like to add videoconferencing to the eBCC so they could connect with out-of-town family members and potentially include professional providers.

Patients and family caregivers reported that they liked to see the schedule and the ability to access their menu. Many requested the option of ordering meals online. Patients and family caregivers reported they liked the ability to look up their medication schedule, test results, and that...
they liked the Infobuttons (Cimino, 2006; Maviglia, Yoon, Bates, & Kuperman, 2006; Figure 3) that provided tailored evidence-based content. Several participants recommended making the Infobuttons larger. The patients reported that they liked the graphics and icons and requested that when selected by the user, the associated text should open the content.

While most participants reported that they liked the software, most of the patients older than 64 had trouble with the touch screen hardware that was used during the usability testing sessions. Some participants had never used a touch screen and were looking for “back buttons” on the screen. Most participants agreed that the touch screen was easy to use with brief instruction and that eBCC should include this functionality. All patients preferred a keyboard to using the on-screen keyboard. All of the patients younger than 65 were able to write using the handwriting recognition and internal keyboard, while many of the older patients did not prefer this method for data entry. Some of the older patients and the family caregivers requested voice recognition as a means for entering notes.

CONCLUSION

Federal legislation (CMS, 2012) provides incentives for hospitals to engage patients in their care and to use technology in a meaningful way. Leveraging technology to provide hospitalized patients with information about their condition and an opportunity to review that information with care team members is one strategy for engaging patients in their recovery plan. The eBCC prototype uses structured coded data from the electronic record and displays that information at the bedside in a way that can be understood and used by hospitalized patients. While some patients may choose to avoid technology while hospitalized, other patients or family caregiv-

ers may appreciate the opportunity to use tools, such as the eBCC, to become a full partner on their health care team.

REFERENCES


