Computer-Mediated Mobile Messaging as Collaboration Support for Nurses

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Abstract. Collaboration in hospitals is coordinated mainly by communication, which currently happens by face-to-face meetings, phone calls, pagers, notes and the electronic patient record. These habits raise problems e.g., delayed notifications and unnecessary interruptions. Dealing with these problems could save time and improve the care. Therefore we designed and prototyped a mobile messaging solution based on two specific scenarios coming from observations at a cardiology department of a Norwegian hospital. The main focus was on supporting the work of nurses. One prototype supported patient management while another one dealt with messages related to medication planning. The evaluation of the prototypes suggested that messaging-based collaboration support is worth to explore and also gave ideas for improvement.

Keywords. mobile messaging, hospital collaboration, communication, prototyping

1. Introduction

Coiera et al. found that clinical work is knowledge intensive, highly mobile, done in teams and is constantly interrupted [1, 2]. Ellingsen showed that EHR systems are better at supporting stationary, office work, while have poorer performance as to the ability to support in-ward mobile, interrupted work and multidisciplinary cooperation [3, 4]. EHRs suited physicians in the ward of our observations but much less nurses. Physicians spend most of their time in front of their desktop computer while nurses work in a semi-nomadic way changing their location frequently between wards, examination places, physician’ and nurse’ rooms. Additionally, nurses do not own a desktop computer but one PC is available for a group of them usually.

A study claims that clinical distractions may account for 43% of medication errors [5]. Some of our recent surveys point out cases of delayed or even lost test results which can be led back to inappropriate process management. This suggests that dealing with the issues of unnecessary interruptions and timely delivery of up-to-date information is necessary. The health workers are to a large extent themselves responsible for identifying and prioritizing tasks [6] and they like to be so. Therefore the solution should not be one which shapes the work at a ward regardless of current habits but one that aligns with these habits.

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We introduce some related work in the next section following by the description of the two specific messaging systems. After that, the prototypes and their evaluations are discussed and finally, we sum up our experiences.

2. Related Works

A collaborative handheld system was developed by Munoz et al. [7] for a Mexican hospital. They extended the instant messaging paradigm by adding context-awareness to support the intensive and distributed nature of information management within hospitals. Four contextual elements were considered: location, delivery time (period), role reliance and artifact location and state. Software agents [8] were used to review the context and decide: (1) which activities to perform, (2) when to perform them, (3) what type of information to communicate and (4) to whom. The prototype system was a success and the hospital wanted to deploy a real version but according to our correspondence with them, it has not happened until last year. Their approach reflects the system perspective (managing information) while our approach prefers the user perspective by focusing on the collaboration side of the problem.

Another attempt for supporting coordination in hospitals is the AwareMedia system by Bardram et al. [9]. They use large interactive displays to promote social, spatial and temporal awareness combined with a shared messaging system. Their main focus is to support coordination at operation wards. The big difference between their approach and ours is that they use large stationary devices for the coordination of a specific situation (surgery) while we apply small mobile devices for more general situations.

The base for our research was laid down in Sørby’s and Nytrø’s work [10] in which they analyzed the communicative behaviors of physicians in hospital wards.

3. Messaging Support for Patient Management and Medication

Our interviews, tests and observations involved people from the Cardiology Department of St. Olav’s Hospital in Trondheim, Norway. We designed two messaging prototypes based on two scenarios observed in 2005 [10]. We went back to the department to check reality, to gain new insights and to clarify requirements. Later, paper-based prototyping sessions were carried out followed by the implementation and evaluation of the prototypes. The first scenario covered an examination schedule where the ultrasound machine was not available in time and thus a resident was delayed. The second scenario illustrated a change in the medication plan and the involved tasks.

We suggested a message mediating system for physicians with a planning module in the core as a first approach. The system was in charge of accepting declarations of tasks, allowing subscription to tasks, informing involved people about changes and reminding them when a task was due.

3.1. Field Study with Physicians in the Focus

We went back to the Cardiology Department of St. Olav’s Hospital in Trondheim to check reality. One female and two male residents (physicians in training) were
followed by informatics students in groups of two on a Monday\(^2\) and a Tuesday morning (9am–1pm) and interviewed them afterwards. They focused on examination scheduling and medication planning and learned the every day practice of this department.

The normal day of residents begins with a general meeting of the department followed by the pre-round meeting involving the resident, nurses and maybe the chief physician. They discuss recent developments, study medical records and test results, consult other clinicians and order examinations. Most decisions are made at the general meeting. Next, the resident and a nurse do the ward round where physical examinations are performed and the patients are informed. The ward round is followed by a discussion in the resident’s office. The resident’s afternoon is mainly spent with administration.\(^3\)

Three students were focusing on examination-related issues while the other three on medication management. The first group found that the two types of ordered examinations (e.g., cycling test and ultrasound) are sometimes ordered using a computer and sometimes using a paper list. The physicians prefer the first type since they are in front of their PC most of the time. In the case of ordering a cycle test using the paper list, a physician has to go to the appropriate department and write the patient’s name on a list. When the examination is due, a nurse from that department comes to get the patient and together with a nurse assigned to the patient, they take him/her to the lab. The physician is paged either if (s)he has to be part of the examination or if the results are ready.

According to the observations of the second group, medications are changed during the pre-round meeting and the ward-round using a paper-based system managed by nurses. Nurses are in four shifts and they have to check the medication by each shift. During the two mornings, three problematic cases appeared. In the first case, a patient was transferred from another hospital and it had to be decided whether she needed to take the previously described drugs. In the second one, a nurse found that a patient transferred from another ward was taking too high dosage. In the last case, the prescription of the drugs for a patient to be discharged had to be clarified.

After considering the experiences, we decided to focus more on nurses since (1) they are much more mobile, (2) they do not have a PC per person and (3) messaging can lower their mental load since they can “forget” about an issue when they communicated it to the responsible person.

### 3.2. Paper-Prototyping Session with Nurses

Two paper-based prototyping sessions were carried out at the department with 3-3 nurses. In the first session, the nurses were confronted with a patient management system focusing on examination schedules. They could access their messages and a list of the scheduled examinations of their patients on the current day using a simple menu. Their opinion was asked about the menu system, the four types of messages and their content. The messages were: (1) reminder — to remind the user when an examination related to her/him is due, (2) confirmation — that a previous message of the user was read, (3) examination change — when an examination could not be carried out as

\(^2\) Monday is the first day after the weekend when more new patients arrive and thus, it’s not a typical day like the remaining days of the work week. For example, the chief physician helps out for the residents by discussing the new cases with them.

\(^3\) Some variations in this daily procedure may happen.
scheduled, (4) result – when the result of a previous examination was available. The feedback of the test persons was positive. They indicated that the system could result in a more effective information distribution, which is more convenient and time saving than the current pull-based approach. They also liked the comprehensive overview of their daily activities and suggested a new functionality: a call button to reach the next of kin.

In the second session, five medication-related messages displaying different amounts of information and a number of possible reactions when receiving a message were presented to three nurses. They preferred the message that contained the following information: the name of the sender, the patient identifier and a short description of the new event. They stated that this was necessary and sufficient to judge the importance of the message. Out of roughly 20 functions (with some intentional semantic overlap) the test persons chose three distinct functions as reaction to a message: (1) OK or confirm, (2) forward to another nurse if busy, (3) remind or read later. During the interviews, all of the nurses emphasized that the system can ease the current situation where doctors’ messages (in charts or on paper notes) do not always reach them at all or just too late. They also liked the confirmation function which meant that the addressee cannot deny having received the message. From the test persons’ comments regarding interruptions, we think that this can be more of an issue for the physicians. The nurses’ work seems to be less sensitive in this respect. For example they suggested solutions like “I could give it to a colleague and have her to deal with the message when I’m busy” which would not really work in the case of a physician.

4. The Prototypes and Their Evaluations

We used HTC TyTN II devices and C# with the .NET platform to implement the prototypes. This device has a touch screen and for convenient operation it needs a stylus. (It also has a slideable mini-keyboard which was momentarily ignored.) Both designs were evaluated in the usability laboratory of the Norwegian EHR Research Centre with four people: one nurse and three healthcare researchers. The original plan was to work with the nurses involved in the paper prototyping sessions, which did not prove to be possible within the time span of the project. The tests used the Wizard of Oz setup where one of the researchers operated as the message dispatcher. The environment and the scenarios were introduced and the test persons were trained with the system beforehand.

The two scenarios included a doctor, a nurse and a patient (1) in a pre-round meeting and (2) in daily routine situations where the test person played the role of the nurse. Four messages were sent out in both cases: two about changes and two notifications. Arrival of a message was signaled by a beep. After the tests, structured interviews about usability and design were performed.

The test persons reported an easy use of the examination support system which implies its potential to improve the efficiency of the nurses’ work. However, it was found that in the ward round situation, the device might take away the focus from the patient (also reported in [11]). In the case of the medication management support, the test persons found that messaging is a viable alternative for some parts of the current communication practice. According to the nurse participant’s opinion, it is a more discrete way of interrupting someone and it does not introduce new interruptions. The
test device required interaction using both hands, which was generally remarked as a limitation. Another suggestion from the user side was to include a delay or snooze message to signal that one is busy and will deal with it later. In both cases, the issue of the message arrival signaling came up. The suggestions showed that more control with different signaling types would be useful.

5. Summary and Future Work

Our focus in this paper is on computer technology that can support collaboration by managing communication, namely on mobile messaging. However, the main requirements for such systems are still to be formulated. To make a first step in this direction, two messaging system prototypes were designed with nurses as users. Both the care professionals and the hospital ward had limited time available for our study, yet we were able to validate our idea that computer-mediated messaging can be useful in supporting clinical collaboration. The feedback of the test persons suggests a more effective, convenient and reliable information distribution improving their collaboration. Further positive effects foreseen are a decrease in the number of unnecessary interruptions and clearer responsibility relations. Although the investigation was limited to a specific ward, our experience promises a more general applicability of the solution.

As a next step, we want to extend the scope of our observations and develop a general support system to realize a non-intrusive, situation-aware, context-enabled plan manager, based on computer-mediated messaging.

References