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# Mobile Probes informing the design of clinical communication systems

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## Abstract

This paper describes the challenges of applying mobile probes for evaluating cellular phone UX (user experience) within operating room environment.

In 2004 we conducted "Clinical Collaboration" study using a cellular-phone based "Mobile Probes" tool to inform the design of clinical communication systems. Group of 4 anesthesia nurses and one anesthesiologist were using Mobile Probes [1] for one week self-documenting their working environment and responding to probing questions researchers sent a few times a day.

Caregivers perform life-critical tasks and they often had to limit their interaction with Mobile probes to breaks or less intense periods during their shift. Nevertheless, probes approach turned out to be promising method for evaluating the user experience of and informing the design of mobile clinical communication tools.

## Keywords

Team communications, alarm notification, location, use error, care co-ordination, situation awareness

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### ACM Classification Keywords

H.4.3. [Information Systems Applications]: Communications Applications; H.5.3. [Information Systems Applications]: Group and Organization Interfaces – Collaborative Computing, Computer-supported cooperative work; J.3. [Computer Applications] Life and medical sciences: Medical information systems.

### Introduction

Within operating room (OR) there is two teams taking care of the patient: anesthesia and surgical teams. Anesthesia team consists of an anesthesiologist and an anesthesia nurse while surgical team consists of a surgeon, a circulating nurse and a scrub nurse. The two teams usually communicate verbally or sometimes non-verbally by signs or glances, especially if patient is conscious.

Often anesthesiologists are responsible for multiple patients. They may let a resident or nurse anesthetist deliver anesthesia during the maintenance phase. Since anesthesiologist is always responsible for the anesthesia delivery detailed guidelines and instructions are given to anesthesia nurses and residents. Should patient's status change drastically anesthesiologist may be called at any moment for new instructions.

Superficially OR communications only involve the anesthesia and surgical teams. Observing a few surgeries soon reveals that there is a much larger team distributed throughout the hospital supporting the work inside operating room. Often the communication is computer-mediated. If anesthesia team uses automatic anesthesia record-keeping system charge nurse may continuously check the progress in each OR

and start re-scheduling operations if one of the operations is running late. Laboratory results appear automatically as part of the patient chart, lab technician merely notifies the OR personnel that new results are available.

### Research Goals

Conventional user research methods like observations and contextual inquiry don't give enough information about certain aspects of user experience like emotions or social interactions. What do caregivers feel, what are the stress factors, what do they think about the other members of the care team, what are their attitudes related to use of technology? What role would do caregiver's emotions (fear, joy, repulsion) play when we are designing services and tools for them? And how do we need to take into account the social relationships or hospital hierarchies when designing products? Presence of patients and colleagues makes caregivers to choose their words very carefully when they are asked about these issues during contextual interviews.

Within care environments there are places and situations where user researchers are not allowed due infection control or privacy reasons. Also, there are critical incidents that happen too rarely to be caught by observers – observing them would require 24/7 presences. Are there some ways to get "inside our users heads" and also collect information on events that happen rarely? Design Probes [2] approach holds promise to answer some of these questions.

"Mobile Probes" research carried out between April 2004 and December 2004 - in academic collaboration with design researchers at the University of Art and Design Helsinki - explored the use of cell phones for

care team communications. Mobile Probes is a Java application that allows researchers to send questions or tasks to be performed. Respondents may attach pictures to their replies. Responses are collected and organized to a web page automatically updated by the Mobile Probes server application.

We had successfully applied Design Probes approach earlier during "Nurses and Transportation" research [2]. When we were offered a possibility to pilot an early prototype of Mobile Probes tool [1] we enlisted various aspects of user experience to evaluate with it.

- Who do you communicate with and why?
- How do you feel? Delights/annoyances.
- What communication equipment do you carry at the moment? Your ideal device? Device you hate?
- What information would be useful to you at this moment? If you had that, how would you use it?
- What was the content you communicated (patient status, prognosis, strategic/tactical planning, rumors, small-talk etc.)
- What triggered communication? How long was it? How often do you communicate with this person?
- Did you use documents or technology?
- Did you delegate or hand-off the responsibility for patient care?

In addition to finding answers to specific questions we expected Mobile Probes research would produce visually rich material that we could use for illustrating user profiles and use scenarios. Depending on capabilities of the Mobile Probes tool and the group of participants we are able recruit we also wished we could collect

information on communication chains provided some of the respondents are working the same shift.

Parallel to Mobile Probes research we were developing Cellular Viewer [3] remote patient viewing tool. Any lessons learned from the mobile user experience would be directly applicable to Cellular Viewer. Thus, we could indirectly evaluate the user experience of clinical communication tools within clinical environment before the Cellular Viewer was ready for clinical testing.

## Methods

Our probes task of choice became a message describing a patient scenario followed by an open-ended question ("What would you do in this case?" or "How would you react?" or "What additional information would you need?"). Most of the tasks also included a picture-taking component. Or, we would send separate picture taking tasks like "Please, take a picture of your ideal user interface" or "Here is a picture of my favorite piece of equipment." Additionally we had standard questions "What are you doing at the moment?" or "What communication equipment you are carrying at the moment?"

In parallel with the Probes research design we approached a nearby hospital that we have research agreement with. Since we intended to use a mobile phone inside operating room and pictures would be taken within the surgical department it was decided that we seek the approval of the hospital's ethical committee. Although probes tasks were designed in such a way that no pictures would be taken of patients or care documentation we needed to make sure that all information we collect and images we receive are

stored in secure location and access to data is limited to designers and researchers only.

Since patients and their family members are not allowed to use a cell phone caregivers do not want to give the impression that using mobile phones is all right. Still, most caregivers are carrying both their personal cell phones and the ones that hospital requires them to carry.

Since each research participant had their own individual working schedule the likelihood that they would be working during the same shift and in addition working together in same operating room would be very low. Our goal of studying communication chains would only work if the participants were involved in delivering care to same patient. Because of the summer vacations we had to limit the number of participants to 4 nurses and one anesthesiologist only. Group of participants consisted of 2 male nurse anesthetists, 2 female nurse anesthetists and one female anesthesiologist. All participants had fairly long working experience and were between 30 and 55 years old. They were all using mobile phones and most of them also had broadband Internet connection at home.

We didn't want the Mobile Probes research disturb the patient care. To that end number of probes task per day was limited to 5. Caregivers were not notified of arrival of new task. Instead they were instructed to launch the application when they were not too busy, for example during the maintenance period of anesthesia.

Duration of the study was planned to be one week, but it was extended to two weeks for some of the participants that worked the night shift and had a

couple of days off from work during the research period.

Before the research period we met each participant individually giving them the Probes "package": letter of introduction stating the goals for the research, Nokia 6600 phone with a prepaid SIM card, short instructions for using the Mobile Probes application, phone's user manual and charger.

During research period preprogrammed probes tasks were delivered to participants. The set of tasks were slightly different for each participant. Some tasks were only assigned to anesthesiologist while other tasks were only assigned to nurses. Designers and researchers provided phone support to participants. The possibility of assigning follow-up tasks was not used during the research.

All participants were interviewed after the research. Interviews usually started by discussing the photos participants had taken. Then we proceeded to discuss the overall impressions regarding the potential of using cellular phones to support clinical communications. Designers made a reality-check to the cultural, environmental, information flow and task sequence models developed during the research. We sought the feedback of caregivers related to probes methodology in general and the mobile probes tool in particular.

## Results

The total number of messages received from five users was 117. Totally 68 messages had a picture attached while 49 were text only. Sometimes the attached pictures were not directly related to the questions either due confidentiality reasons or due the time of

replying - caregivers perform life-critical tasks and they often had to limit their interaction with Mobile probes to breaks or less intense periods during their shift.

Caregivers commented that the permanent questions were irritating. Another comment was that some of the tasks were in a too general level; they failed to motivate the caregivers to answer properly. In hindsight it might have been useful to send SMS messages or use some other means of interaction to prompt caregivers to perform the tasks on a given day and check the probes task list regularly. During the initial planning phase doing this was considered inappropriate.

Clinical users are used to dedicated monitoring equipment whereas mobile phones are multi-purpose tools – losing application context by pressing a wrong key was one of the problems that occurred frequently.

Usability specialists, industrial designers and design researchers created cultural and environmental models together with flow charts depicting the various use scenarios described in probes messages or based on the interviews with probes. These together with “raw” Mobile Probes materials served as a basis for concept development and brainstorming sessions [4]. User data was sorted into design drivers, concept ideas were created; one of the concepts was selected for further development. Sketches and usage scenarios illustrating the use of the selected concept were created. Use scenarios were finally presented as a video created from the sketches drawn during the workshop.

## Conclusion

Mobile Probes users' comments related to mobile phone user experience within clinical environment exposed many pitfalls that we managed to avoid while developing Cellular Viewer [3]. Despite the limitations of the prototype software Mobile Probes turned out to be a great tool for evaluating certain mobile interaction design ideas with real clinical users within the actual care environment. We are confident that we are going to use design probes approach also in the future whenever we are entering totally new markets. Space probes explore parts of the universe where no man has gone before, design probes explore the human mind, knowing our users better is always worthwhile.

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