Research of a m-Health App Design for Information Management of MDTMs

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Abstract. The m-Health apps have been adopted broadly in both medical and family environment. They hold potential to support the work of medical staff and provide help in individual health care. However, the emphasis on the benefits of mobility and the functionality is not enough. Relatively little empirical research guides for the app development. The m-Health apps should be developed for specific purposes with the consideration of the specific users and using contexts. This paper introduces a research for a m-Health app design in support of information management for multidisciplinary medical team meetings (MDTMs) in order to enhancing meeting efficiency. The contextual design methods were used as the guideline for the design. The app design based on tablet was developed and tested by medical teams in this study. The results indicated that the most medical staffs held positive and supportive attitudes to the m-Health app as an intervention in their medical meetings. The recommended app helped medical staffs including oncologists and nurses etc. to improve their meeting efficiency through information management such as setting up meeting schedule, making records for meetings, updating the patients' information, etc. The results also revealed that the choices of different mobile platforms should be taken into account when developing m-Health apps since it would greatly influence user experience in utility and usability in the specific contexts. Design recommendations were summarized for future design.

Keywords: m-Health app · MDTM · Contextual design
Information-management

1 Introduction

M-Health apps have been popular nowadays in our work and daily life. They are the applications for mobile health which as defined covers "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistant and other wireless devices" [1]. The apps for lifestyle and wellbeing used for personal health guidance, information reminders [2] etc. are also

included in. As an emerging and rapidly developing field in HCI, the benefits of m-Health apps in medical practice as well as healthcare management have been recognized. It is worth mentioning that in medical practice which is complex depending on different users, contexts and purposes, the adoption of m-Health apps is usually taken seriously by taking many factors into account. The medical staffs like doctors and nurses usually work busily with various medical activities. Especially for these working with cancers, for instance, the paediatric oncologists in a children's hospital, the multidisciplinary medical team meetings (MDTMs) which are supposed to discuss of patients' status, to exchange medical treatment ideas, to get helps from internal or external support and to make critical decisions, etc. are often scheduled. To ensure the efficiency of MDTMs, paediatric oncologists should make enough information preparation before the meetings, concentrate on the information during the meeting process, and make use of the information from the meeting afterwards for medical practices. It seems a big burden for paediatric oncologists as they need to do much extra work except their ordinary jobs. However, literatures and designs focusing on either improve meeting efficiency by technology [3], information sharing at MDTMs [4] or the collaboration of multidisciplinary team members [5], little touch the problem of meeting information management by taking the holistic process: pre-meeting——during meeting — post-meeting into account. Tools or devices for instance, appropriate m-Health apps are potentially helpful to support their management of the information for MDTMs. With these questions as a starting point: Whether medical staffs need such a tool as a support to deal with the MDTMs, what the tool would be, how it would work to support, this research was based on the contextual design methodology including observation of the daily work of paediatric oncologists and interviews to get insights into user needs and design directions. Next, a mobile app design was proposed by prototyping and then tested by the paediatric oncologists. Finally, results were collected and discussed for further the development.

2   Related Work

Multidisciplinary medical team meeting (MDTM) is common in medical field. As team work is a tradition in healthcare [3], it means that people with different disciplines backgrounds in healthcare meet together in a meeting at a given time to discuss patients and treatment decisions [6]. MDTMs are also possible to be held with people distributed thanks to the modern technology of teleconference. They serve as a mean to improve communication and decision-making by involving in medical and surgical personnel, nurses and allied health professionals [7]. MDTMs have been becoming a standard practice worldwide for teamwork in the field of healthcare, to formulate an expert-derived management plan, to ensure quality and safety in the delivery of health care services.

Cancer care is such a complex process involving activities such as diagnosis, treatment, rehabilitation and the related supportive care and therefore a wide range and numbers of healthcare professionals involve in it. Treatment for Paediatric oncology is a huge challenge for medical professionals because the patients are young and even more fragile. In many countries nowadays, regular MDTMs have been considered as an

integral part of medical care and they have been used widely in paediatric cancer treatment due to children's physiological and psychological conditions. Efficient MDTMs can improve coordination and communication between multidisciplinary medical team members, and enhance discussion and decision-making for treatment with more positive outcomes as well.

In the Netherlands, about 500 children between 0–18 years diagnosed with cancer every year [8]. The collaborative nature of the cancer diagnosis and treatment calls for more meetings for discussion and collaboration. Weekly MDTMs seem to take place in all the hospitals with a paediatric cancer centre. The Dutch Journal of Medicine published an article with the title "Better multidisciplinary consultation fits better care" [9], giving an overview of criteria which can be used to test the efficiency and quality of the MDTMs, including preparation, roles, responsibilities, discussion of case history, meeting, recommendation. Nearly all of the criteria are related with medical information. That means medical information management such as information input and output, information storage, information sharing etc. is a vital factor influencing MDTMs. Efficient and effective information management can greatly improve MDTMs' efficiency. Hence, it is necessary and important to develop appropriate tools to assist information management for multidisciplinary medical team meetings.

Multidisciplinary medical team meeting is a dynamic interaction in nature. It is often conducted through talk, and sometimes by sharing documents, images and videos. Meanwhile, as healthcare system is highly mobile because of multiple clinical locations such emergency departments, operating rooms, intensive care units, etc. [10], information for MDTMs might refers to many other related aspects besides the information during the meetings. Hence, the information management referring to MDTMs is a system involving three main stages: pre-meeting management, during meeting management and post-meeting management as well. It is more complex especially when teleconference is involved in. It requires high flexibility and personal control of the information inherently. However, mobile apps provide possibilities to tackle these challenges.

Mobile devices such as smart phones, tablets are increasing viewed as handheld computer due to their powerful on board computing capability, capacious memories, large touch screen and open operating system [11]. Mobile health application (m-Health app) is a rapid growing trend in healthcare which can support information collection and management [12]. With the convenience and flexibility to download m-Health apps, medical resources become available. Both in theory and practice, it has been very obvious that m-Health apps can help medical professionals to better utilise their valuable working time, simplify communication, enhance working efficiency and effectiveness. In MDTMs, m-Health apps might facilitate in many aspects such as reducing medical errors, providing more flexibility, improving discussion and decision making for treatment etc. As the information technology develops, there have been many kinds of m-Health apps for different purposes. Functionalities such as communication, remote diagnosis, education, even visualisation of medical images are the main focus. The user interface and interaction design of these apps become quite favourite as well. However, there are some limitations during their development, for example apps are often designed with little health professional involvement [12] and patients' information security is

usually a potential problem of medical risk. There have been many apps for medical information system, most of which are focused on self-care information and open medical information accessing, but little are specially for information management for MDTMs.

The motivation of this research is to find a way in which design can contribute to MDTMs. We visited several main hospitals with paediatric cancer department in the Netherlands. There is a weekly MDTs including paediatric oncologists, radiotherapists, children radiologist, nuclear medicine physician, paediatric surgeon, nurse specialist etc., to discuss and evaluate patients' conditions and treatment. And then decisions are formally made for further steps. Most of the multidisciplinary medical team members are always busy with work. Thus, it usually happens with inadequate clinical information or lack of necessary information before and during the MDTMs. It may have some negative effects on the discussion and decision-making in MDTMs. At the same time, we noticed that nearly all the medical professionals have a smart phone or iPad and use these mobile devices from time to time for working or personal purposes even they are always busy with work. The visits indicated that m-Health apps are the possible solutions which can assist information management for MDTMs with useful functionality and user-friendly interface and interaction, so that the efficiency of MDTMs can greatly enhanced and more children patients can be cured.

3   Methodology

Four phases were included in this research, and contextual design methodology, a structural and well-defined UCD process providing methods to collect information or data about users, and interpret data in a structural way [13] was used as the guideline. The first phase referred to user study and we carried out research by visiting the paediatric oncology department in several main hospitals in the Netherlands to collect user needs and identify concerns of medical professionals about MDTMs. During the visiting, observation was conducted and recorded by video both in the daily work of the paediatric oncologists as well as other MDT members like nurses and in the MDTMs. Semi-structured interviews focused on perspectives on MDTMs were made to get more feedback. In the second phase, after all the documents were analysed, we identified the design directions and developed it with prototyping. Then in the final stage, a test was proposed aided by a questionnaire and interview to gather comments on functionalities and usability. the questionnaire was based on USE questionnaire [14] which is popular in getting feedback of acceptance. Finally, we made discussion and reflection to identify how it might be further developed as a better support.

4   Results

4.1   Results of the User Study

According to contextual design process, three different work models set by us to represent the work of the medical professionals of MDTMs. The flow model showed the

situation of roles and responsibilities of it is concluded that usually an oncologist is in charge of each case, there is no clear structure in the meeting. The communication between multidisciplinary team members is not so effective and interactive in this relaxed and informal atmosphere due to the lack of a hierarchy of the meeting and information need to be organized. It is imperative (Fig. 1).
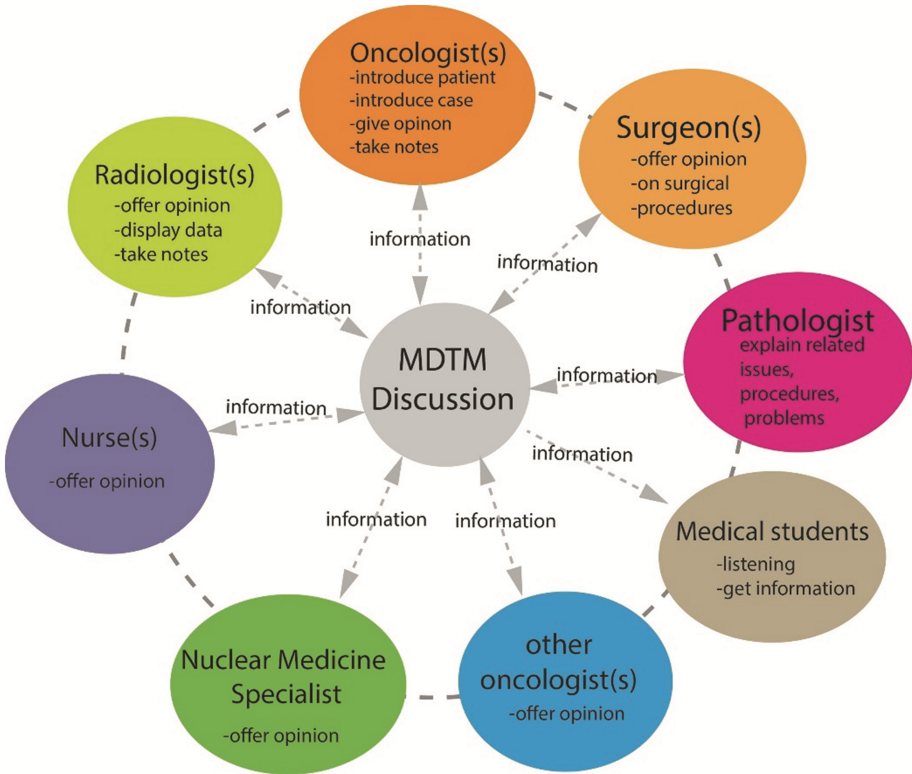

Fig. 1. The flow model

The sequence model (see Fig. 2) indicated the general structure of a MDTM. It is usually followed a linear structure, however, there was no specific steps into sequence to summarize the draw final conclusions. There was also some discussion not included in the list making the meeting chaotic and hard to be followed by people who were late or joined in half-way. During the meeting, oncologists might make presentation, review patient cases, pose a problem for discussion. Others took part in the discussion, contributed their points of view or relevant information. Then decisions were made for future further care and treatment. Sometimes a teleconference was needed to involve external specialists in. MDTMs Provide opportunities for multidiscipline team members to discuss recommendations and get help.
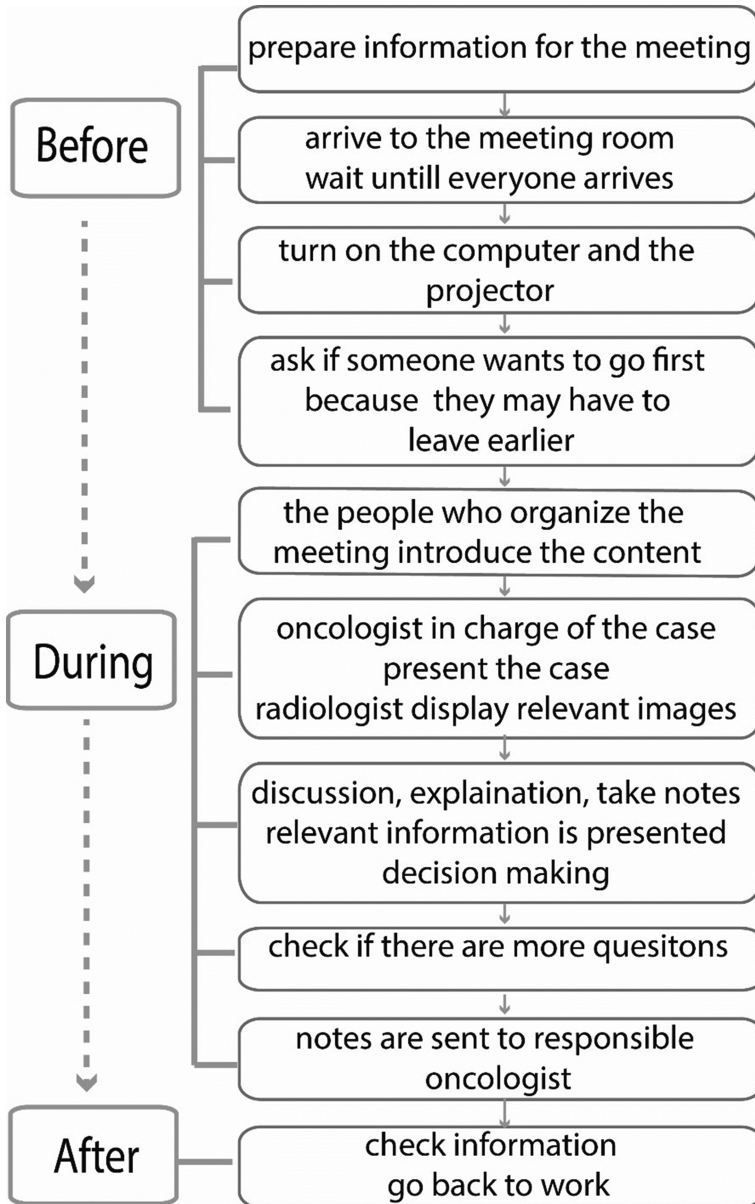
Fig. 2. The sequence model

The artefact model (shown in Fig. 3) offered insights into what documents and what information were needed for MDTMs. Except the meeting room environment, useful devices for the meeting, the agenda is the most important one. Usually, an agenda is

printed out with patient's names on it. The responsible oncologists can add any patient to the agenda. However, it was not completely followed during the meeting due to the dynamic changing order. There was a note-taker particularly, and every oncologist took note if needed. Then the notes were shared around. It may be not timely and not everyone can figure out as the notes are made by hand-writing. From this artefact model, it is concluded that if there is a design can help oncologists to organize, recorded and share the meeting documents, quickly, the efficiency of meetings can be improved greatly.
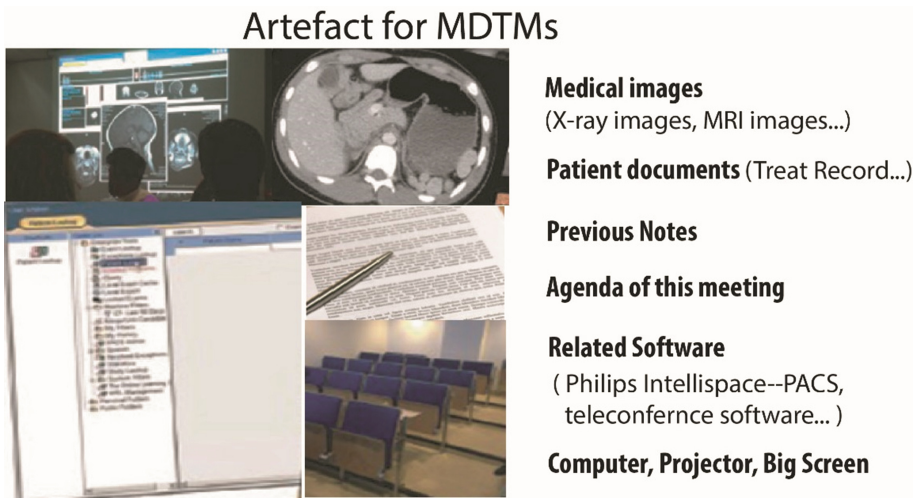

Fig. 3. The artefact model

These three work models indicated that all the activities like communication, discussion and decision-making happened before, during and after MDTMs is based on information. For most of the medical professional who work for long hours per day, free time is such a luxury. The MDTMs usually last for one hour and much cases or documents are needed to reviewed. Hence, in such a long time, how to make the meeting more effective, and how to better support the related MDT members especially like the oncologists for their work are the issues needed to solved. Information (including the physical medical documents, images, notes etc. and the talks, discussion) management seems to play an important role to improve the efficiency MDTMs.

Besides the work models, the records of observation and interviews were transcribed and analysed. Quotes about information of MDTMs were selected and categorized by researchers. The concerns about both the information and the meetings were identified and categorized into the three phases: pre-meeting, in meeting and post-meeting (shown in Fig. 4). In pre-meeting phase, the activities and concerns indicated that information management should focus on preparation for the meeting, which includes meeting arrangement, preparation of patients' information to discuss and collection of related information, etc. During the meeting, the dynamic information should be managed effectively and efficiently with the consideration of the meeting context and the possible issues which would happen during the meeting process. After the meeting, oncologists

would go back to work based on the information at hand. Thus, checking and updating information is very important.
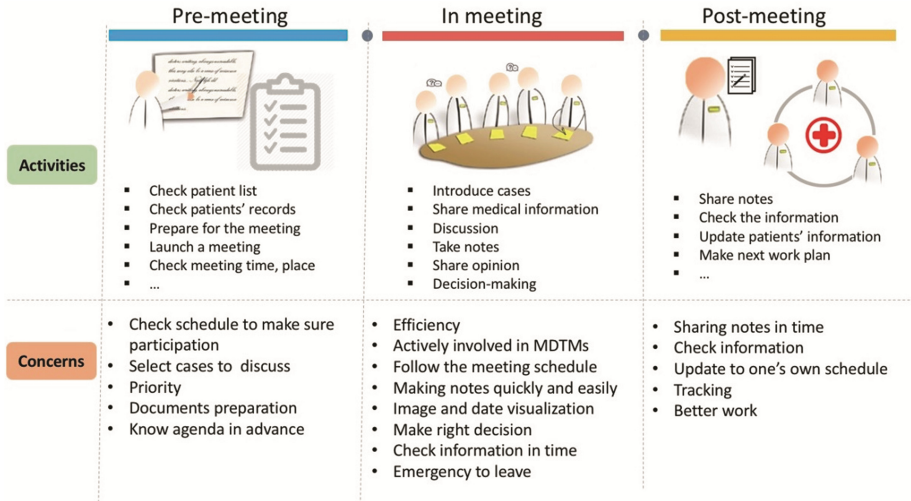

Fig. 4. Analysis of the three phases with activities and concerns

4.2 Prototyping Development

A m-Health app for information management was proposed as the possible solution (shown in Fig. 5). It was developed based on the three phases and pay attention to the dynamic characteristics of the information. Taking the using context into account, it was based on iPad because compared with smart phones, iPad has bigger touch screen, powerful on board computing capability, capacious memories [11] and can be connected to a smart keyboard which potentially better supports the activities of information management like taking notes and making records digitally and making editions if necessary. Meanwhile, we used some bright colours for the interface design with the consideration that medical staffs are easy to get tired due to their busy work for a long time everyday, and the bright colours are potentially positive in adjusting working emotions.

There were four main functionalities: (1) Meeting agenda supports pre-arrangement of MDTMs, with which oncologists can updating the newest information, check related information and making a list for discussion. They can also add important information to the meeting agenda to share with other in advance so that others might have enough time for preparation. (2) My patients, is actually the management of daily work. Compared with the traditional notes-taking, oncologists can make record of each patient at any time any place digitally, and it is easy to edit and update information. It is very important for the meeting since oncologists can not only use it to prepare for the meeting, but also to check related information if needed during the meeting. (3) Taking note is a particular support for the meeting. The app based on iPad offered opportunity to use

finger input on interface or a keyboard. Digital notes are easy to store and share with others. (4) Account was a consideration of personal information security. One oncologists usually are in charge of several patients and each patient has his/her own treatment. In account, oncologists can log in and work in their own accounts. They can also customize in the account to set up their preferred styles for information management such as changing colours or list patterns, setting up priorities or reminders, storing information on cloud, etc.

Fig. 5. The prototyping design

4.3 Results of the Prototyping Test

However, only five oncologists participated in the prototyping test because they were too busy to make an appointment with. After they tried to use the prototype, questionnaires about the acceptance of the app were answered and an exit interview was used to get feedback. The collected record was analysed and the results were summarized as follows: All the five oncologists showed positive attitudes to use a mobile device and m-Health apps to support their daily work. As an intervention in their work, they believed that this app was useful to support their management in the information related to MDTMs with the provided functionalities. They also agreed that the app was easy to use with a clear architecture. However, the improvement was still needed since it was only a prototype with some interaction problems when using it.

5   Discussion

This paper introduced the research of the design of a m-health app for information management. It was based on contextual design methodology which emphasizing the importance of deeply understanding users. It indicated that it is promising to combine mobile technology and devices in healthcare and medical practice to support medical staff's work. Our exploration was in accordance with the trend, for instance, healthcare professional use m-Health apps as management [12] or electronic libraries [15] which support storing and sharing information.

However, there were some limitations in this research:

Firstly, this study was proposed based on the investigation in paediatric oncology department of children hospital and we focused on paediatric oncologist. However, there are many other medical staffs involved in multidisciplinary medical team meetings. The needs for information management exist broadly. It is necessary to take the related issues of other stakeholders into concern.

Secondly, there were limited participants involved in the test because of busy schedule of the paediatric oncologists. However, the collected feedback was beneficial for improvement. Prototyping is a highly valuable UX technique to help providing a clear vison of the interface and the user interaction [16].

Thirdly, the app was developed on iPad. Though iPad owns many benefits in interface and input, it is a little heavy to take around in oncologists' busy working routine. It indicated that the choice of platform is an issue needed to be taken into account because m-Health apps should be designed based on many factors including the using context and users' habits.

6   Conclusion

In this paper, we presented a research of a m-Health app design which was supposed to support information management for MDTMs. MDTM is a system that needs to maintain the integrity and effectiveness of the information in order to guarantee the medical activities like treatment. Based on contextual design methodology, a m-Health app was developed and tested with the conclusion that it can facilitate paediatric oncologists in information management before, during and after meetings. Both the positive feedback and suggestions for improvement built the confidence for further development. The goal of this research was not only to develop an app as support, but also to explore more possible solutions to better support medical activities by making full use of mobile and digital technologies. Our future work will be intended to address these challenges through further investigation.

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