From user needs to system specifications: Multi-disciplinary thematic seminars as a collaborative design method for development of health information systems

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Abstract

This paper presents a new multi-disciplinary method for user needs analysis and requirements specification in the context of health information systems based on established theories from the fields of participatory design and computer supported cooperative work (CSCW). Whereas conventional methods imply a separate, sequential needs analysis for each profession, the “multi-disciplinary thematic seminar” (MdTS) method uses a collaborative design process. Application of the method in elderly homecare resulted in prototypes that were well adapted to the intended user groups. Vital information in the points of intersection between different care professions was elicited and a holistic view of the entire care process was obtained. Health informatics-usability specialists and clinical domain experts are necessary to apply the method. Although user needs acquisition can be time-consuming, MdTS was perceived to efficiently identify in-context user needs, and transformed these directly into requirements specifications. Consequently the method was perceived to expedite the entire ICT implementation process.

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1. Introduction

Healthcare professionals work in an increasingly team-oriented environment, creating a need for development of computer supported cooperative work (CSCW) [1]. Although most work is collaborative, large-scale information and communication technology (ICT) systems are often poor at supporting the collaborative dimensions of work [2] and a large number of health information systems (HIS) developed actually fail in supporting the healthcare professionals in their work [3–5]. Development of HIS, assuring that healthcare professionals of all disciplines involved are provided with information they actually need in their various work situations, requires, as a first step, establishment of a common understanding, or common ground, within the work team. The common ground [6] needed among ICT developers and healthcare professionals includes work routines, information demands, and other central preconditions at the clinical level [7]. This is especially important when developing systems to support complex cooperative work processes, where staff with different professions and different objectives should ensure continuity of care for the patient.

A basic premise for successfully introducing HIS is to consider a multitude of social, organizational and cultural factors relating to the work process [8]. Moreover, real users have to be involved in the development process as they alone have the relevant knowledge and understanding of the actions, and the consequences, of their work [3,9]. Further, achieving close collaboration and mutual understanding between system developers and involved care pro-

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providers has been found to be a good investment [10]. However, involving real users in development of HIS is often complicated, especially when these users have limited computer skills, or collaborate in a non-computerized environment; they neither know the requirements, nor can they articulate them. Involving users from the integrated care domain accentuates the difficulties in eliciting correct requirements; representatives from many different care professions often focus only on their particular part of the work, and have difficulties in reaching the essential holistic overview of the entire work process.

In addition, requirements eliciting is still often performed according to conventional system development processes [11–14] reducing user involvement to user questionnaires and the like rather than effectively analyzing the user needs in the context of social and organizational issues. Moreover, the fact that introducing ICT always forms according to conventional system development procedures that bring an understanding of practice into correct technical requirements specifications. This viewpoint is encouraged by Kaplan, Jungk and Mullert [39]. This method has mainly been used in social sciences as a tool for change management. The technique was proposed to be used in system development by Kensing and Halskov Madsen [42] and was the inspiration for the MdTS method.

However, socio-technical approaches are perspectives on system development and do seldom deliver answers on how to apply the approaches. Future workshops, as other socio-technical methods, focus primarily on a higher analytical level and do not include the actual design of future ICT. The methods described in Johnson et al. [29] neither comprise the multi-disciplinary perspective needed to design HIS for cooperative healthcare work, nor is their framework designed to support development of new systems, but to re-design old ones. Therefore, the MdTS method presented in this paper focused on the initial part of development, elicitation of users’ needs in cooperative interdisciplinary work, and on transforming these needs into detailed requirements specifications for development of new HIS. More specifically, in a pre-seminar period we used contextual inquiry-methods [43] to gather raw data from interviews and observations in the field. The data was further analyzed during the MdTSs. Initially we used a context of use-questionnaire [44] to collect all users’ present work practices and environment. Data from the field studies and the questionnaire were later analyzed in cooperation with the participants.

2. Methods

The research was based on the theories of action research, a qualitative research method that associates research and practice. Action research encourages researchers to experiment through intervention and to reflect on the effects of their intervention and the implication of their theories [36].

In action research, activity theory is often chosen as the theoretical background to study work practices and routines [37]. We initially applied the first steps of Checkland’s activity theory-based soft systems methodology (SSM) [38]: (1) finding problem situations in an unstructured way and (2) expressing the problem situations. However, our description was not limited to rich pictures and system definitions as suggested by Checkland. Instead of continuing the activity analysis following SSM’s seven steps to reach an activity specification, our work was continued in a MdTS series composed of 12 seminars, to create the basis for system development.

One reason for not continuing on SSM was that in activity analyses, many resources are spent on interviewing users about current work; few or no resources are used in helping users generate alternative ideas about future work. Considering the common problems such as users being unaware of their needs or unable to formulate their requirements, future workshops [39] together with PD were better techniques to use. Denvall’s and Salonen’s future workshops [40], as well as vision seminars described by Johansson et al [41] are based on future workshops by Jungk and Mullert [39]. This method has mainly been used in social sciences as a tool for change management. The technique was proposed to be used in system development by Kensing and Halskov Madsen [42] and was the inspiration for the MdTS method.

The methodological review by Johnson et al. [29] also advocates a variety of user-centred methods to conduct the analyses needed, with each method providing different but necessary components in order to design an initial prototype [29]. This viewpoint is encouraged by Kaplan, proposing methodological pluralism to increase understanding of many influences concerning development and deployment [16]. In order to perform a user needs analysis and to write requirements specifications for integrated care, we therefore proposed a multi-disciplinary thematic seminar (MdTS) method based on established theories from the fields of participatory design (PD) [30–33] and of user centred systems design (UCSD) [29,34]. This method is collaborative in that it involved all actors during user needs analysis [35] to acquire all possible needs. At the same time it supported the prioritization and transition of the needs into correct technical requirements specifications. This paper describes the method in detail, presents a case study where the method was applied, and explains the impact of the method on both implementation and participating staff.
Detailed task analysis [45] served to categorize information and communication flows within and between different organizations. The tasks formed the basis for discussions of current and future work [42] and the creation of scenarios [46,47]. Detailed scenarios were translated into technical specifications (use cases) for development of prototypes.

### 2.1. Participants

Establishment of multi-disciplinary working groups is a requirement for conducting the thematic seminars. End users from different care professions as well as other stakeholders (buyers/owners, operational services and designers/users from different care professions as well as other stakeholders [35] should be engaged throughout the development process. It is especially important that all stakeholders are present at project start-up, to agree on common goals and strategies in order to establish a good working environment for future project work. Subsequent seminars involve different participants exploring diverse issues. Progress reports from the working groups’ collaborating process are continuously handed over to all other stakeholders.

As it is important for all care professions to be assisted in finding more efficient work practices, this method recommends use of external expertise with a “birds-eye view” of the actual domain or work process. This external role must be capable of balancing requests from all stakeholders: different care organizations and different user groups, always keeping focus on usability. Samaras and Horst [48] describe this specialist as an “ergonomist”, Gulliksen et al. [49] use the term of a “User Centered Design facilitator” intermediating between users and designers/developers.

It is also beneficial to include competence from the health informatics (HI) area [50,51]. The ultimate external participant would therefore be an HI specialist with a sound knowledge of work processes and other usability issues. Here, the interpreter is referred to as a health informatics and usability (HI-U) specialist. The HI-U specialist plays an important role, directly impacting work of the design team and the final design of the product [48]. Being fluent in the languages of both healthcare professionals and system engineers, the HI-U specialist converts clinical and organizational needs into requirements specifications for system implementation. The HI-U specialist also works with the users to verify the requirements specification against the user needs. More specifically, this means the HI-U specialist iteratively explores how work environment can impact the use and reliability of the proposed design and vice versa. To support the developers, the HI-U specialist also conducts usability tests and formative assessments of the prototypes.

### 2.2. Conducting the multi-disciplinary thematic seminars

The method is based on a series of 12 seminars with set themes (Table 1). Although, the themes are not necessarily held in consecutive order, the complete MdTS series aims to encompass the necessary knowledge of work situations in integrated care for development of a flexible and “future-aware” HIS.

To strengthen the results of the MdTS, it should be preceded by pre-seminar work and consists of multi-disciplinary work in inter- and intra-professional groups. The seminars can be performed in an iterative way and contain both a holistic and a detailed perspective.

#### 2.2.1. Pre-seminar work

Pre-seminar work consists of field studies, observations and interviews, conducted by HI-U specialists, to understand current work situations and to capture users’ tacit knowledge. This is particularly important in situations where different care professions are, or should be, cooperating.

#### 2.2.2. Two types of multi-disciplinary seminars: inter- and intra-care professional groups

Most healthcare professionals only focus on their particular role of the healthcare process and have little insight into the work of their colleagues. Using conventional methods that only work with one user group at a time can therefore lead to a fragmented picture of the work processes. Moreover, specific profession-based ICT needs analysis often lacks the depth of understanding for true cooperative work. On the other hand, if representatives of several professions are present at all seminars, it is difficult to reach the necessary level of detail in all issues. Therefore two types of seminars are held: (1) intra-care professional seminars where focus is on one healthcare profession’s work, and; (2) inter-care professional seminars where the cooperative aspects of work are handled. As the HI-U specialists

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**Table 1**

<table>
<thead>
<tr>
<th>Multi-disciplinary thematic seminar series (MdTS)</th>
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<tbody>
<tr>
<td><strong>Holistic perspective</strong></td>
</tr>
<tr>
<td>1. Project start-up—introduction</td>
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<tr>
<td>3. Organization</td>
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<tr>
<td>5. Technical workshop</td>
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</table>

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<thead>
<tr>
<th>Detailed perspective</th>
<th>Feedback on iterative sketching and prototyping</th>
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<tbody>
<tr>
<td>7. Current work scenarios—intra-care professional</td>
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<tr>
<td>8. Current work scenarios—inter-care professional</td>
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<tr>
<td>9. Detailed analysis of information needs</td>
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<tr>
<td>10. Future work scenarios—intra-care professional</td>
<td></td>
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<tr>
<td>11. Future work scenarios—inter-care professional</td>
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<tr>
<td>12. Visualization of future work scenarios</td>
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</table>
are present leading the MdTSs all seminars are still considered multi-disciplinary. Other stakeholders, apart from end users, are not present during this work as they are generally considered to be receivers of information and therefore not part of the working process.

2.2.3. Two perspectives of multi-disciplinary work: holistic and detailed perspectives

Both holistic and detailed perspectives are covered in the MdTSs. The holistic perspective aims to create a platform from which the participants can gather an overview of each others’ work processes and obtain an understanding of the entire cooperative framework, a common ground [6]. In the detailed perspective results from the holistic perspective are further analyzed, examining points of intersection and specific details for each profession, items that are necessary for the development of a HIS supporting integrated care. The detailed perspective also includes hands-on multi-profession workshops in which participants from the range of professions take advantage of each others’ ideas of how to improve work practices.

2.2.4. An iterative, reflective work process

To fully understand a theme it may be necessary to repeat the theme’s seminar. A repeat seminar may also be necessary in cases where new information has emerged, and particularly when this new information influences previous results. Both the iterations of themes and time between seminars allow all participants to reflect on the seminars’ outcomes. After each seminar, healthcare participants also complete different assignments or “homework” (examples provided in Table 2). Analyses of the users’ needs and translations into more technical specifications are performed by the HI-U specialists after every theme and iteratively fed back to the working groups. Paper sketching is used in early stages to facilitate communication and to minimise the risk for misunderstanding between working group participants with different backgrounds. Paper sketching also provides a means for documenting ideas during and between the holistic perspective seminars. As the requirements evolve, prototypes are continuously provided. Digital prototypes and hands-on testing of ICT devices assist healthcare professionals to envision and describe their exact needs. These needs are then fed into the system specification using use case descriptions. Validation of the prototypes takes place in parallel with the use case documentation.

3. Results and discussion

The method outlined in this paper was developed in the 3-year action research project OLD@HOME [52] and applied as an explorative study during the first 6 months of the development process. In this chapter, application of the method and its impact on both implementation and participating staff are discussed.

3.1. The OLD@HOME case

The main purpose of the project was to provide a reliable information and communication flow between home healthcare and primary healthcare professionals involved in the care of elderly patients in their own homes. Based on the results of the MdTS, a virtual health record (VHR) was implemented which allowed for information access and documentation at the point of need. Three groups of care professionals from different care provider organizations were involved: general practitioners (GP), district nurses (DN) and home help service personnel (HHS). Using PDAs and tablet PCs each care professional was able to access relevant patient information from an integrated platform. This integrated platform incorporated a number of underlying feeder systems such as the DN’s and GP’s electronic health records. The tools used (PDA’s and tablet PCs) and their user interfaces were adapted to the specific needs of the different user groups during work situations at the patient’s home. Regardless of organizational affiliation, the role-based VHR distributes secure and reliable patient data to the professional in need. Examples of the patient data provided include: a modified prescription list for the HHS; an integrated care plan for HHS and DN; daily notes; risk factors; and status updates from all feeder systems [53,54].

Two teams of healthcare professionals validated the results of the MdTS and tested the prototypes in daily practice over a 5-month period. The home help service group consisted of 14 assistant nurses employed by the municipality of Hudiksvall, a town in northern Sweden. Of these assistant nurses, three participated in the MdTS series and all 14 participated in the test phases. The primary care group consisted of seven members, employed by the county council of Gävleborg. Of these, one GP and two DN participated in the MdTS series while an additional four others (two DN and two GP) assisted in testing the prototypes.

A technical group was involved in coordinating technical infrastructure, architectural design, software development, technical implementation and support. A scientific group, focusing on evaluation of the project from different perspectives, is still engaged in a longitudinal study at the test site.

3.1.1. Application of the method in OLD@HOME

The pre-seminar work lasted for 3 months and consisted of 17 days of field observations using the master-apprentice, or contextual design, method [43,55,56]. As apprentices, the HI-U specialists worked together with three professional groups (GPs, DNs and HHS) in order to grasp their different work processes and to reach a common ground to facilitate further communication. Following the field observations, the HI-U specialists performed first-step analyses of users, environment and tasks performed in integrated care, to form the basis of the MdTS series. The HI-U specialists also interviewed staff to
Table 2
Thematic seminars: holistic perspective: structured activities assisted to elicit the users’ needs in cooperative care, and analyses afterwards (in italic) to approach a system specification

<table>
<thead>
<tr>
<th>Seminar theme</th>
<th>Activities/User-centred design methods</th>
<th>Case results</th>
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<tbody>
<tr>
<td><strong>Holistic perspective</strong></td>
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<tr>
<td>1. Project start-up—intro (All stakeholders, e.g. users, HI-U specialists, buyers/owners, operational services and developers)</td>
<td>Get-together activities: project model, work descriptions, aim and ideas are presented</td>
<td>Establishment of a good working environment: project rules, regulations and guidelines are agreed on and a commitment contract is signed</td>
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<tr>
<td>2. Current work situation (Inter-care profession group and HI-U specialists)</td>
<td>A “context of use”-questionnaire completed by all users [44]: users evaluate present work practices and environment</td>
<td>Reflection on present work e.g. how medication changes are handled; HHS need information about the medication they give to a patient, but the way it is stored in the GPs’ health record, they have neither access nor use of the GPs entire list</td>
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<tr>
<td>2. Homework: “Describe a day at work”</td>
<td>Ethical issues [58] are discussed</td>
<td>Information is gathered about different roles’ perspectives on the organization in which they work [61]. Common insight in how people feel about their jobs/carry out their work: how HHS and DN create work-arounds (oral information and paper-based notes) to solve lack of information regarding prescription changes</td>
</tr>
<tr>
<td>3. Organization in practice (Inter-care profession group and HI-U specialists)</td>
<td>Contextual inquiry [43,59,60] Analysis of current work in groups; HI-U guides a summarization of problems, difficulties, need for change etc noticed during field work Managers/politicians are invited to explain their point of view of change management and in particular changes in their own organization</td>
<td>Information is gathered about different roles’ perspectives on the organization in which they work [61]. Common insight in how people feel about their jobs/carry out their work: how HHS and DN create work-arounds (oral information and paper-based notes) to solve lack of information regarding prescription changes</td>
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<tr>
<td>3. Homework: “Describe your organization”</td>
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<tr>
<td>4. Information and communication handling (Inter-care profession group and HI-U specialists)</td>
<td>Categorizing of information Gathering of current documents. A detailed task analysis serves to understand the current system and the information flows within it [45] (why/when/where/how and by whom documents are used, and in certain cases NOT used)</td>
<td>Example of a single task in a cooperative environment and its implications: when giving the drug, HHS signs a list that does not contain information about the drug, they only sign that “drug is given”. When a patient or relative asks about the medication, HHS needs to contact DN to be able to answer. DN often feels she is being interrupted by HHS, while working with other patients and HHS feel insecure in their work and at the same time impolite and inefficient by letting the patient/relative wait for answer</td>
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<td>4. Homework: “Describe your desire for improved communication”</td>
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<tr>
<td>4. HI-U analyzes the results → overall/general description of information and communication flows</td>
<td>Full-day workshops: selected presentations, hands-on working sessions, guided discussions containing critical evaluations combined with lectures in HCI</td>
<td>Innovative and fruitful discussions about new technology and the environment where it is to be implemented. Where are the current IT limits? What is good/bad design/functionality for your role in dispensing medication?</td>
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<tr>
<td>5. Technical workshop (Inter-care profession group and HI-U specialists)</td>
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<tr>
<td>5. HI-U: knowledge about preferred hard- and software/functions. Non-functional requirements specification in close cooperation with solution- and enterprise architects</td>
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<tr>
<td>6. Future work perspective (Inter-care profession group and HI-U specialists)</td>
<td>Future workshops [42] envisioning future work practices: development of a vision, ideas and action plan among the participants. Obstacles to get there?</td>
<td>Specification of goals for future cooperative work, e.g. important aspects of future handling of change in medication: when GP changes the prescription list, HHS and DN should instantly receive a message. DN will add orders about how/when to give the drug, and HHS will document on handhelds when it is done. Information is electronically fed back to DN and GP Goal: less interruptions and less loss of information in the flow</td>
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<tr>
<td>6. Homework: “If you were the boss...?” and “Describe a day at work in the future”</td>
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<tr>
<td>6. HI-U analysis: task analysis (iteration 2) → general task description of future work</td>
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<tr>
<td><strong>Detailed perspective</strong></td>
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<tr>
<td>7. Current work scenarios (Intra-care professional)</td>
<td>Scenario descriptions [22,46,47] contain detailed work situations for and by every profession contributing to integrated care. Preliminary prototypes are used to verify the requirements</td>
<td>Specific details are collected within each profession, e.g. change in medication affects GPs, DNs and HHS differently. Each activity and cooperation is taken care of within the intra-care professional groups</td>
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<tr>
<td>7. Homework: “What would your profession need, if you consider today’s work?”</td>
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<tr>
<td>7. HI-U results: detailed scenario descriptions for each profession and work situation functional specification: use case modeling and use case specification work begins</td>
<td>(continued on next page)</td>
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incorporate non-observable aspects of work practices as well as an understanding of professionals’ thinking during their daily work. The pre-seminar work increased the HI-U’s understanding of the professionals’ current work situations, problems and difficulties in cooperative care. Specifically, the HI-Us noted the limited access to information when working at a patient’s home as well as the lack of coordination and communication between care providers. They further observed that documentation in homecare was frequently incorrect, incomplete, unavailable or that a significant amount of time had to be spent retrieving it creating frustration and stress in the staff groups.

To illustrate the findings, we here describe how some observations by the HI-U specialists were handled and further elaborated in the MdTSs (Table 2). We chose to present the workflow around a change in medication as it affected all user groups. The actual outcome of the development process is illustrated by scenarios (Table 3) and design solutions (Figs. 2 and 3). Overall, the system supported the work process of the professionals and decreased the problems found in current work situations.

During the MdTSs structured activities or user-centred design methods (Table 2) were used to reach the objectives of each seminar. The multi-disciplinary seminars brought the participants closer together and created a common understanding of the entire work process and a common picture of the system to be. The MdTSs also provided
HI-U specialists with a range of information about user needs. This information was gradually translated into technical requirements and basic system specifications.

The MdTSs were held approximately every 2 weeks for a period of 6 months. The holistic seminars were held as a one day workshop (one day per theme) and the technical workshops lasted two days. The detailed seminars required 4 h per theme.

Inspiration for the workshop topics was initially provided by internal or external lecturers. The topics encouraged participants to thinking creatively and to propose new solutions to problems in their work place. To broaden the involvement of care professionals, a number of “homework” tasks were assigned. These tasks were to be completed in cooperation with other colleagues from the professionals’ various work environments. During the following seminar, the “homework” was discussed and previous work by the HI-U specialist was presented the participants.

A repeat session of a seminar was held in two situations—firstly, when the theme handled extremely complicated issues regarding the topic of cooperative care planning and secondly, when the development of the prototypes required exact details (Theme No. 9). Moreover, theme numbers 7 (current work scenarios), number 9 (detailed analysis of information needs) and number 10

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Table 3

Example of future work scenario from OLD@HOME

**Future work scenario: change in medication**

**Goal: immediate updates of all staff involved, less interruptions and improved assessment**

1. Receive change in medication: when GP changes the medication, HHS receive an instant message in their handheld devices and DN is notified in his/her virtual health record (VHR)

   Medical and pharmaceutical descriptions are stored for GP and DN with HHS only needing limited access: name of drug, form, dose, potency, GP-sign and date. Only current medications are displayed to HHS.

2. Add complementary information: If further information is required, DN updates the VHR system by adding a specific instruction for treatment.

   Instructions for treatment contain information about when the drug is preferably taken and descriptions of the drug: active substance, physical appearance, “nota bene” and the DN signature. DN’s information is clearly separated from the GP medication, by colour coding.

3. Dissemination: updated information reaches the entire HHS team instantly and is re-accessible later.

4. Documentation: HHS document on their handelds every time the drug is given.

5. Follow-up: DN controls that the medication is given as per directions and performs assessments of the patient’s medication whenever appropriate.

As information is accessible via the Internet, documentation and follow-up can be performed either via mobile device or at the health centre/office.

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Fig. 1. The prescription list as in the GP's stationary EPR, one of the feeder systems for the VHR.

Fig. 2. The PDA shows the details needed for the HHS when giving the medication.

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(future work scenarios) were held separately for each care profession, i.e. the HI-U specialists carried out those seminars once for each working group.

3.1.2. Reflection on current case study

Regarding change in medication, HHS perceived problems that the primary care participants (GP and DN) had not considered: (1) the actual drug arrives at a patient’s home but descriptions of changes seldom arrive at the same time, (2) HHS cannot answer questions on medication they give to a patient, (3) lack of information makes HHS insecure in performing their work, as they do not know what drugs they give to the patient, and for what reason. Initially, some DNs did not think that HHS should read the prescription list at all; “HHS delegation is only about giving the drug to the patient, they should not need to know anything else”. “That works fine,” replied the HHS, “as long as no changes are performed and patients and relatives do not ask about the medication given.”

Current EHRs are primarily designed to document patient information for one profession, either e.g. GPs or DNs, not to distribute and display information to other staff categories. HHS therefore needed to explain exactly which information they needed from the primary care EHRs and how they would use it. Once the primary care group understood that their contribution of specific medical information could benefit the work flow as a whole, they started to formulate information differently. They also used this knowledge to improve other inter-disciplinary work flows, e.g. the care planning process or that GPs benefit from HHS’ notes regarding for example risk factors. Unexpected needs like these would never have been elicited if not the inter-care professional seminars had been held.

The future possibilities of the work scenarios were further explored in future work scenarios. In these scenarios, the healthcare professionals outlined their thoughts on the best way to perform their work with the aid of different types of technology (Table 3). This resulted in a prescription list that was not only shared, but also enhanced with information from DN to HHS. The benefit for the DN in this case, was a decrease in interruptions caused by HHS or relatives. Furthermore, they could get immediate feedback on whether the medication was taken, and if HHS had noted any changes in the patient or other abnormalities. As the information was on the Internet, DN could perform follow-ups from the office, instead of collecting the paper lists once a month at the patients’ home.

Finally, these changes in the professionals’ work process better provided for the patient’s needs, ensuring that the patient was given the right medication at the right time. It also further improved the continuity of care; when a patient was sent to hospital directly from home, HHS forwarded their knowledge about his medication. Often, a patient does not know what medication he/she is currently taking. Thus, staff at the hospital, ambulance, emergency ward or alternative care centre immediately received an updated prescription list from the HHS, even though primary care originally stored the information.

3.2. Impact of the method on healthcare staff

In the MdTS method, personnel were quick to realize their own part of the entire integrated work process and
better understood how their work contributed to the optimized work flow. More specifically, the following was achieved.

3.2.1. Overview of the entire work process—today and tomorrow

Different work practices use different terminology. Therefore, to minimise the risk of misunderstandings, the important terms, definitions, and objectives of one practice was explained to other professions. In seminars 2 and 3, these differences were described on a personal and organizational level respectively. A more detailed analysis was also undertaken in seminars 8 and 11. This work increased the professionals’ insight in, and understanding of, the complex care they are providing. Future work perspectives were discussed in inter-care profession groups and later in the seminars, future work scenarios were tested by the cooperating staff. Iterative prototypes, illustrating the proposed work scenarios, were used as communication tools and helped to ensure a common picture of new work practices, possible chain-reactions, and consequences for other professions.

3.2.2. Triggering innovative thinking

Currently, information is distributed among many different information systems and healthcare professionals are often unaware of their actual information needs [57]. Seminars 6, 10 and 11 increased staff awareness of their own (and mutual) desirable information and work processes. New insights, gathered from for example the technical workshop (seminar 5), inspired staff to consider both information content and presentation format, combining them into innovative solutions. An example of this was the development of new search structures for patient status, new feedback systems, and display of information irrespective of which profession originally stored the information, as explained in the case of change in medication (Figs. 2 and 3).

3.2.3. Improved coordination of work

Coordination of care requires high quality information processing capacity and efficiency of communication between involved healthcare professionals. In the OLD@HOME project, scenarios and prototypes were developed to enhance integration of different care practices into a collaborative work process. The prototypes were also used to clarify the complex, integrated work processes and the workflow in practice. Integrated views were developed and these views were discussed in multi-disciplinary seminars. Presentations of jointly planned activities resulted in a holistic view of the work process, achieved gradually through the MdTSs. Documentation at the point of care provided new ways to feed back information and to follow up performed work.

3.2.4. Improved cooperation through increased competence in documentation

In many situations, professionals did not understand why, and in which occasions, other professions needed specific documented information. The understanding of other professionals’ needs of documentation, professionally and legally, increased during the seminars (especially seminar 9). While testing the prototypes, the staff understood what particular information was needed from their own documentation, in order to improve other healthcare professions’ work practices. This provided incentives for the professionals involved to write notes more thoroughly, knowing that they were useful to, and read by, other professions. For example, integrated care planning between nurses and assistant nurses in HHS increased, when a reliable prescription list and daily notes were accessible to all.

3.3. Impact of the method on system implementation

The MdTS in OLD@HOME led to the development of technical specifications, which prioritized information for the different care professions when working on the field. PDAs were provided for HHS and web applications for GPs and DNs. Thus, while all healthcare professionals could view a complete patient summary (displaying risk factors, latest progress notes and ongoing medication), this information was displayed on profession-specific user interfaces. Innovative thinking inspired staff to consider information access as well as user interfaces. The cognitive workload was diminished through new search structures and new user interfaces. The origin of information, (i.e. from which feeder system data had been gathered) was identified by colour coding, tabs were arranged in a way that supported the actual work processes and the “number of clicks” had been reduced throughout the system [57]. Documentation at the point of care was reduced to only inserting important new information and/or ticking performed actions according to the care plan.

3.3.1. Holistic overview of the patient

Analysis of the integrated care process using the discussed method demonstrated that a range of information which had previously been stored in different feeder systems needed to be displayed. In the early stages of the project, as participants discovered the benefits of the idea of the VHR, discussion leaders had to ensure that the professionals focused on the holistic work processes. Details, no matter how important, were postponed to be explored later, when the process had been clarified to all participants. During the detailed seminars, participants reflected upon the fact that it now was easier to agree on for instance which key words to collect from different records to provide a quick and correct overview (e.g. patient status or history). Redundant risk factors, previously documented in respective feeder system, were found, controlled, and if necessary, corrected, as an immediate quality control of the documentation.

3.3.2. Profession-based design

In the inter-care professional seminars, the staff identified and agreed on information that was crucial to all care
providers, i.e. common information needs. However, inevitably, each profession had specific information needs and therefore results of the intra-care professional seminars consequently affected the design of the prototypes. More specifically, common information needs as up to date practical information about the patient and his/her risk factors were also adjusted according to each profession’s demands. In the OLD@HOME VHR prescription lists and care plans were organized, displayed, and queried differently for each profession (Figs. 1–3). This led to enhanced participation in the joint work processes.

3.3.3. Individualized design

When patient care is shared, a major challenge is keeping up to date with new documentation. To ensure continuity of care between different care providers, an important requirement was to highlight unread information to individual users. A high priority messaging system was another requirement to ensure that information of high importance was read by relevant personnel [57,53].

4. Conclusions

We developed a new method for collaborative system design and applied it to a real setting. We combined a number of known HCI methods to utilize the advantages of each of them, to respond effectively to user needs, and to transform these needs directly into requirements specifications and ultimately usable IT systems.

Common objections against user requirements analyses are that they are time-consuming and thereby cost-intensive. Moreover, they require active participation of real users what in healthcare might be difficult to achieve. Following, we discuss our method in the context of these objections, compare it to other user requirements methods and list the necessary pre-requisites for using the MdTS method.

4.1. Is the method generally applicable?

The MdTS method was specifically adapted for cooperative work. It supports gathering of requirements from different perspectives involving a range of work practices. Despite this, we consider the method to be generally applicable. It can, for example, be used for single profession analysis if the inter-care professional seminars 8 and 11 are removed. It can also be applied to domains other than healthcare.

While the seminar themes covered all the important aspects of work in an integrated care environment, they remained sufficiently general to be applied in any ICT development where stakeholders’ and/or users’ work differ from the practice of the developers.

The MdTS resulted in prototypes that were well adapted to the user groups and organizations they were designed for. However, a known effect from action research is that results can not be directly transferred to other settings. The prototypes are not applicable to any new user group or domain without a process for communicating and applying the results to the new organization.

4.2. How time-consuming is the method?

User needs analyses are considered to be time-consuming. Aware of this fact, we quickly provided sketches and mock-ups of the participants’ ideas to the developers, while still in the user needs elicitation process. As a consequence, developers were quickly involved, and, assisted by health informatics-usability (HI-U) specialists, they gradually transformed requirements into various prototypes that were immediately verified and validated by the users. By using HI-U specialists as mediators between users and developers, the user needs analysis and the early development phases merged, leading to a more accurate description of the final system and therefore a compressed coding phase. Results from the MdTSs, users’ future work scenarios and prototypes, can be either transformed into traditional requirements specifications or preferably, directly documented in use cases as technical specifications for implementation. Choosing the latter, the MDTS method was perceived to expedite the entire ICT implementation process. As the method also was perceived to efficiently identify in-context user needs, and transformed these needs directly into requirements specifications, our industrial collaborators later on adopted this method. It is now being used in other industrial development projects.

In the OLD@HOME project, the MdTS series was spread over a period of 6 months. The effective time allocated during this period was not explicitly measured. However, the work load was heavy for HI-U specialists and developers, less demanding for the clinical domain experts. Approximately 2 days were spent per decision maker/manager, divided into a number of meetings. During these 6 months, each clinical participant spent approximately 14 days working in the MdTS and performing assigned tasks. However, as they got engaged in creating their own work process, work continued outside the seminars and spread to other colleagues not directly participating in the seminars.

We found the iteratively improved prototypes to result in few errors once the final version was released. In a heuristic evaluation [65] of the prototype there were only 44 identified potential usability problems found. In the severity ratings, none of them was categorized as catastrophic; the majority consisted of cosmetic or minor problems [66]. The changes needed to improve this version before implementation in daily practice were neither many nor costly. This could justify the time spent by the domain experts, but it is difficult to measure in practice.

4.3. How to attract clinicians?

Involving real users from the integrated care domain in eliciting correct requirements was not an easy task.
Representatives from many different care professions often focus only on their particular part of the work, and it can be both difficult and time-consuming to reach the desired holistic overview of the work process. Here, HI-U specialists played an important role; their understanding of when clinical work practically differs from theoretical models aided in reaching consensus among staff in changing work processes and implementing new support systems [67]. In general, we experienced that the participants in the working groups were engaged and enthusiastic. All of our participants were interested in improving their work situations, even though not all were interested in technology they all contributed greatly to the results.

Due to the well known problem of access to domain experts, experienced professionals were contracted to the project. This also ensured their continuous participation during the seminars. Meanwhile, substitutes to perform the domain experts’ ordinary tasks were required.

4.4. What makes the method worth using?

“Useworthiness” regards the importance of a product’s functionality in a user’s life (or work) situation and comprises usability as a response to the individual user’s high priority needs” [68]. Questions like “Can this method fulfill the most important needs in order to develop ICT systems for cooperative care?” and “Is the system worth using?” are answered by all stakeholders in various assessments during the development stages. Follow-up interviews with the staff after testing the prototypes in practice revealed that, as well as less paper work, safer documentation, and access to information, staff felt safe and secure. Furthermore, usage of the virtual health record (VHR) was expected to further improve cooperation and job satisfaction. “All professionals now understand how to contribute to the team” and “acceptance of the VHR and the new work processes were reached through jointly iterated and validated scenarios using these prototypes” were some statements from a user. Once the method was inserted in a change management process and the outcome became clearer, all stakeholders in the homecare domain, including managers, agreed that the method was worth using, as the VHR benefit to the care process. The difficulty lied in creating an understanding of the benefits of this method at buyer/owner side, prior to start using it. Final assessments exposed that inter-care professional working groups correctly focused on the information that was needed within the interdisciplinary team. Moreover, most of the fears expressed before the deployment of the VHR did not become real problems once the system was operational [69]. Positive outcomes outweighed the fears and the personnel adopted the VHR into daily practice.

4.5. In how far differs this method from other methods?

This method consists of a structured way to combine a number of known methods, and is specifically adapted for cooperative work. The method consists of a holistic and a detailed part to allow for direct implementation of the requirements specifications into an information system. For other purposes, e.g. activity and information needs analyses or normative studies, application of the holistic part is sufficient. Here for example vision seminars [41] or activity analyses [38,37,70,71] can be applied.

4.6. What were the difficulties in using the method?

The process of user needs acquisition can be time-consuming and the engagement of clinical domain experts is mandatory yet not always easy to achieve. Therefore, we contracted replacement staff prior to initiating the MdTS work. This allowed the clinical domain experts to participate in the working groups during the 6-month period. None of the clinical domain experts left the project during that time. However, during the implementation phase we had to replace two clinical domain experts. Therefore, it is important to choose “the right” domain experts, domain experts that represent their work group. They should be experienced in their work, not necessarily be interested in technology but open and willing to improve their work situation. This could be done using technology when applicable, or by reorganizing work.

Application of the method demands working groups containing clinical domain experts and health informatics-usability specialists. The role of HI-U specialists was crucial for performing the MdTSs successfully. Most difficult in this respect was to keep to the subject during the half-day seminars and to conclude them with an agreement.

In conclusion, we learned that a cooperative design process is needed to gain insight into the entire work process and that the ICT system implementation process can be expedited by accurate user needs elicitation. However, it took some time to get to know each other within the working groups, but once acquaintance was done, the work was effective, efficient and performed with great enthusiasm.

5. Future work

Although we consider our method generally applicable, its results cannot be directly transferred to other settings. We therefore want to explore a process for communicating and applying the results to the new organization. Moreover, we aim to optimize the method and will in future projects examine the time spent for each stakeholder and how far the number of seminars could be reduced.

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