

## Publication I

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## **Redesigning digital dictation for physicians: A user-centred approach**

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The user-centred approach has proven its success in software and product development. However, in the healthcare domain, user-centred research methodology has been applied less widely. This article reports a study that employs a contextual inquiry method to study the prevailing dictation procedures and solutions in a hospital from the physician's perspective. The goal was to empirically evaluate digital dictation and the other three currently used methods for making dictations, thereby eliciting information for supporting the hospital administration in their decisions concerning the further development of a dictation solution. The research indicated a number of user requirements for a dictation solution. The main conclusions were: (1) the currently used information systems need extensive improvements and redesign; (2) the observed process of digital dictation does not seem applicable for its intended context of use; (3) for future solutions, it is important to understand that the dictation user interface cannot be standardized.

### **Keywords**

contextual inquiry, dictation, healthcare information system, physician, user-centred design

### **Introduction**

Over the last few decades, the user-centric approach has proven its success in the development of services and products. In recent years, the focus of user involvement in design has shifted from evaluation and design activities towards those occurring in the early stages of development. In industry, user-centred design methods are generally thought to improve product usefulness and usability, despite the uneven adoption of user-centred methods across different organizations [1].

The user-centred research approach is quite new in the health informatics domain. It has been argued that one of the main challenges for healthcare information system development is the design of successful user interfaces [2]. Recently published literature reviews [3, 4] reveal some examples of studies that have involved real users in the design and development of healthcare technology. The reviews concluded that users were mainly involved during testing and design activities, rather than in the early phases of development [3], and that the involvement generally provided significant benefits [4].

In order to design effective and efficient user interfaces, we need to identify the actual needs and desires of the users to specify the context of use – the actual conditions under which a given product, system or service is used. This article reports a study that employs a user-centred design approach and related methodology to research both the dictation procedures and the context of their use in a hospital from the perspective of the physician.

The remainder of this article is structured as follows. The next section briefly outlines the backgrounds and the overall goals of the dictation study, gives an overview of the research approach, and describes how the study was carried out. In the following section, the results of the study are presented within three themes: user requirements for dictation, evaluation of dictation procedures, and future visions. The final section highlights the main findings and suggests areas of improvement for further developing a dictation solution.

## Dictation study

The dictation study was carried out in spring 2008 in a large hospital in Finland. It was conducted in cooperation with two researchers from the usability research domain and the hospital administration responsible for hospital-wide development activities. The study focused on the user perspective – the physicians, who daily dictate notes, reports and other patient information and therefore play a vital role in clinical documentation. Together with other related studies, the reported dictation study constituted a larger dictation research project aiming to support future decision-making and investments.

At that time, various dictation techniques, procedures and equipment were used in the hospital, including cassette dictation, digital dictation and voice-recognition dictation.

*Cassette dictation*, utilizing a recorder and analogue cassette tapes, was the prevailing method. However, the disadvantages of cassette dictation and the underlying process had already been recognized: transformation of physical cassettes and papers back and forth between physicians, transcriptionists and other related parties not only takes time and money but also is vulnerable to different kinds of oversights and errors. It was obvious that the cassette method was outmoded in a digital age and that emerging technology could be used to make the dictation process more efficient.

In the hospital, three pilot units had already been using a *digital dictation* solution for several years. Digital dictation and cassette dictation processes resemble each other closely: the dictation is first recorded and then converted from voice to text. The main disparity between these two methods is the format in which the signal is recorded and transmitted: compared to analogue cassettes, the digital dictation procedure records all the information in digital format. From the administration's viewpoint the digital dictation method was seen as the most promising solution for replacing traditional cassette dictation in the near future.

The hospital also had experience in using the *voice-recognition technique for dictation*. In the radiology unit, voice-recognition technology and dictation systems had been developed

and tested together with the physicians and the software provider for about 3 years. This emerging technology seemed well suited to the radiology context. However, experience had indicated that there were many challenges to overcome before the voice-recognition solution could be utilized in other healthcare fields and contexts.

Similarly, a variety of techniques and procedures had been applied for *typing dictations*. At this point, the hospital administration felt that it was time to launch an extensive dictation project to renew and unify the prevailing procedures and practices.

### ***Objectives of the study***

Physicians play a central role in the clinical documentation process, as they are the direct source of the most comprehensive and accurate information about the patient. The goal of the dictation study was to research and empirically evaluate currently used dictation methods in their context of use from the physician's perspective. The objectives of the study were the following:

- To gain an understanding of the dictation process from the physician's perspective. What is the dictation procedure like in practice? What kinds of needs do the users have?
- To compare and evaluate four dictation procedures in the hospital context of use; to outline the possible drawbacks and challenges to be encountered when moving from cassette dictation to a digital procedure.
- To determine physicians' opinions concerning a new dictation concept that exploits a mobile phone.

Because the study focused on examining the dictation procedures, attempting to determine or model the diversity of surrounding workflows was beyond the scope of this study. Although special attention was given to digital dictation, other methods and a new idea for a mobile phone dictation concept were included in the study to obtain a more comprehensive and richer view of the researched subject. The idea of a mobile concept came from the hospital project members and was seen as a potential new solution for organizing the dictation transcription as an outsourced service.

### ***Research approach and methods***

A critical aspect of developing and integrating successful applications is to understand who the potential users are, how they behave, and what they need. 'Early user involvement' is one of the key principles of user-centred design [5, 6]. User-centred processes try to include the actual users in the development process at the earliest possible time in an effort to produce products that correspond to the needs of the users and the restrictions of the context of use.

User research refers to a process and associated activities that aim to understand the impact of design on an audience [7]. Observing real or potential users acting in a specific context of use can provide information about the overall product offering and how it can be extended. These observations will not only reveal problem areas to product designers but often provide clues to addressing the problems. When conducting user research, it is recommended that several methods be used in order to obtain rich qualitative data and

to build a holistic view of the studied user group [8]. The most common methods used include interviews, observations and questionnaires [9], with other methods such as cultural probes [10] or artefact analyses [8] being applied less frequently.

In the dictation study, the research method used was contextual inquiry [8]. Contextual inquiry is a user research method combining observation and interview in a specific context of use. In the contextual inquiry method, a researcher typically conducts field interviews with four to eight users one at a time in the working environment and, while observing the user at work, asks about the user's actions in order to understand their motivation and strategy [11]. The reported advantages of the contextual inquiry method are manifold [11]. The contextual inquiry (a) reveals the details and motivations implicit in users' work, (b) makes the users' work and their needs real to the researchers, (c) introduces user data as the basis for decision-making and (d) helps to create a shared understanding of the data throughout the research team. Like other qualitative user research methods, contextual inquiry generates a large amount of data. The collected data are typically shared with other team members in a sharing session using an affinity diagram method suitable for organizing and analysing the observations and findings [8].

### *Research procedure*

Dictation interviews were conducted in February 2008 with seven physicians working in the target hospital. Suitable physicians were recruited in cooperation with the hospital project members. The main criterion for selecting physicians was that the physicians should have had previous experience in using different types of dictation methods, thus ensuring that all the prevailing dictating methods would be represented.

The selected users represented a heterogeneous group of physicians working in the hospital. All seven physicians were accustomed to using a variety of dictating methods and tools. Two of the physicians used cassette dictation as their primary method. Three of the physicians had previously used cassette dictation but thereafter participated in the digital dictation pilot study and used a newer method for differing lengths of time. Two physicians working in the radiology unit had experience in using voice recognition technology. In addition, all seven had experience in typing dictations using various tools and techniques. The backgrounds and experiences of the participating users are presented in Table 1.

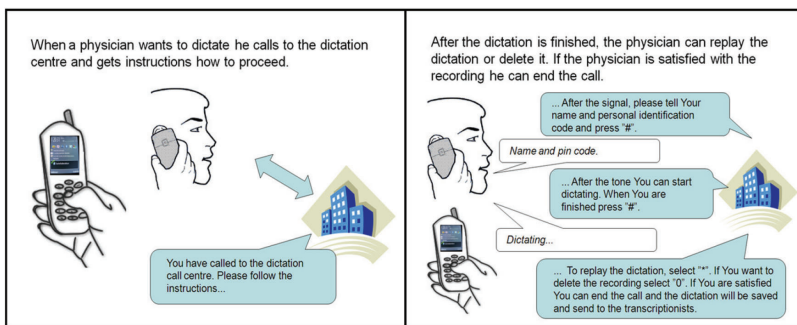
The inquiry was performed as a semi-structured interview, since a flexible structure would allow the researcher to generate new questions during the interview based on what the interviewee had said. The framework to be explored consisted of three themes:

- 1 background including education and current job description, information technology skills and enthusiasm, dictation methods and experiences
- 2 a dictation walkthrough in practice: the beginning of the dictation, dictating, ending of the dictation, and a discussion of performed activities
- 3 futuristic views: evaluating and discussing the mobile phone dictation concepts.

The mobile phone dictation concepts were created in cooperation with hospital project members. The reason for including the concepts in the inquiry was to discuss the new type of dictation method in general and to evaluate the conceptualized ideas with the users. Figure 1 shows an example of an evaluated scenario.

**Table 1** Summary of physicians' backgrounds and experience

| User | Gender | Work experience (years) | Speciality         | Information technology enthusiasm                  | Dictation methods used  |
|------|--------|-------------------------|--------------------|--|---|
| 1    | Female | 6                       | Surgery            | "I do not like computers"                          | Typing, cassette dictation  |
| 2    | Male   | 6                       | Orthopaedics       | "I'll get along"                                   | Typing, cassette dictation  |
| 3    | Female | 4                       | Paediatrics        | "I'm not interested"                               | Typing, cassette dictation, digital dictation (6 months)          |
| 4    | Female | 5                       | Paediatrics        | "You cannot avoid even if you would like to"       | Typing, cassette dictation, digital dictation (3 years)           |
| 5    | Female | 2                       | Neurology          | "Not very interested"                              | Typing, cassette dictation, digital dictation (2 months)          |
| 6    | Female | 10                      | Radiology          | "I'm interested"                                   | Typing, cassette dictation, voice-recognition dictation (3 years) |
| 7    | Male   | 12                      | Radiology, surgery | "Compared to colleagues I'm enthusiastic about IT" | Typing, cassette dictation, voice-recognition dictation (3 years) |



**Figure 1** An example of a mobile phone dictation concept

There were two main sets of functionalities underlying the concepts: (1) recording the dictation using a mobile phone and sending the recording to the dictation call centre, and (2) calling to the dictation centre and dictating online. Altogether, five concept candidates were created and visualized using storyboards.

Each of the seven inquiries lasted about one and a half hours. A recorder and a digital camera were used to record interviews for later analysis. All the data gathered, including transcribed inquiries and pictures taken during the interviews, were analysed using the affinity diagram method and interpreted together with the hospital project members in a team sharing session.

## Results

This section presents the main findings of the digital dictation study. The results are divided based on the objectives of the study into three themes: (1) user requirements for dictation, (2) evaluation of dictation procedures and (3) future visions.

### *User requirements for dictation*

The objective of the study was to gain an understanding of the dictation process from the physician's viewpoint. To describe the process and the context of use at a general level, the identified needs, wants, desires and constraints are expressed as user requirements for a dictation solution.

*Requirement 1: physicians should be able to dictate at any opportune moment.* Physicians want to dictate patient information as soon as they have enough time, in order to remember all the important aspects of the patient's care and treatment. Sometimes, physicians write notes during their visiting rounds. The later the information is dictated, the more difficult it is to recall all necessary details.

*Requirement 2: while dictating, physicians need to have access to various patient information resources.* Before dictating, physicians usually become familiar with the prior patient documentation. The documentation can be in digital format as an electronic patient record or printed papers included in a patient folder. Often, dictation involves such information as laboratory results found from various databases and applications.

*Requirement 3: the dictation solution should be simple and easy to use.* Physicians, who work in a hectic environment, do not have time to study how to use devices, applications or systems. They expect the technical environment to support their main tasks in patient care and make the processes more efficient. The simplicity of the dictation solution is related to the following activities: initial preparation, identifying the patient, recording, editing the recorded dictation, ending and saving the dictation.

*Requirement 4: the dictation solution should tolerate prolonged pauses.* According to physicians, pauses and interruptions are common. During dictation, physicians often pause to consider how to continue the dictation. Interruptions can also be caused by phone calls or questions asked by nurses or colleagues. Sometimes, the physician may even need to suspend the dictation and return to it later on.

*Requirement 5: the physician should be able to perceive the dictation as a whole.* The length of a dictation may vary greatly, as does the time required to complete one. In particular, lengthy dictations enhanced with complex content can be difficult to outline. When the dictation is performed using a recorder, the physician has to piece together the dictated message in her mind. To facilitate the process, physicians sometimes sketch lengthy dictations using a pen and paper.

*Requirement 6: the dictation solution should support silent, individualized operation.* Dictation involves personal information about the patient and must therefore adhere to privacy and security control. Often dictations are conducted in public places where other people are present. In other contexts, speak-aloud dictation procedures may also disturb

the surrounding environment. In places lacking private space, the dictation solution should enable the physician to utilize other types of procedures.

*Requirement 7: the dictation process and solution should suit the intended context of use.* Dictation contexts vary greatly. In hospital wards, physicians usually dictate in their rooms mainly in the afternoon, whereas in clinics the dictations are conducted immediately after visiting the patient. Often, the hospital emergency department is characterized as being stressful and noisy. The hectic atmosphere raises challenges for dictation solutions. The dictation solution should be easily accessible, support mobile use and tolerate a noisy environment.

### **Evaluation of dictation procedures**

An empirical evaluation of the dictation procedures was conducted to elicit practical user information on the currently applied methods. The four evaluated methods were cassette dictation, digital dictation, typing dictation and voice-recognition dictation. The evaluation focused on the digital dictation method, since it was seen as the most promising solution for replacing the traditional cassette method. The typing method proved difficult to evaluate, since the procedures used for typing can vary greatly.

The results indicated a number of arguments for and against the evaluated dictation methods. The user requirements presented in the previous section were used as a framework for representing the results. The results are summarized in Table 2 and described in greater detail in the following paragraphs.

Simplicity and familiarity were considered the main advantages of cassette dictation. Physicians also appreciated the concreteness of the procedure. Cassette recorders, both tabletop and portable devices, are easy to find and access. In addition, it takes little time to

**Table 2** Summary of evaluation results

| <i>Criteria (identified user requirements for dictation solution)</i>                    | <i>Cassette dictation</i> | <i>Digital dictation</i> | <i>Typing dictation</i> | <i>Voice-recognition dictation</i> |
|--|---------------------------|--------------------------|-------------------------|------------------------------------|
| Physicians should be able to dictate at any opportune moment                             | +                         | –                        | ?                       | +                                  |
| While dictating, physicians need to have access to various patient information resources | –                         | –                        | ?                       | +/-                                |
| The dictation solution should be simple and easy to use                                  | +                         | –                        | ?                       | +                                  |
| The dictation solution should tolerate prolonged pauses                                  | –                         | –                        | +                       | +                                  |
| The physician should be able to perceive the dictation as a whole                        | –                         | –                        | +                       | +                                  |
| The dictation solution should support silent, individualized operation                   | +/-                       | +/-                      | +                       | +/-                                |
| The dictation process and solution should suit the intended context of use               | +/-                       | +/-                      | ?                       | +                                  |



carry out the preparatory actions: before the physician can start dictating, she only needs to fill in a dictation form and stick a note indicating the patient's social security number onto a cassette before inserting the cassette into a recorder.

Cassette and digital dictation share the same primary problems. It is difficult to perceive the dictation as a whole when recording the dictation in audio format. After an interruption, the physician usually has to rewind the tape to listen to the previous part of the dictation. If the dictation has a complex content and the interruption is lengthy, it is even more challenging to summon up thoughts and continue. Theoretically, both cassette and digital dictation allow physicians to suspend the dictation and return to it later; however, for practical reasons, physicians favoured recording dictation anew rather than pausing and continuing at a later time.

Whereas cassette dictation was appreciated for being concrete and simple, the digital dictation procedure involved several complicated steps. In brief, the dictation procedure consists of the following steps (see Figure 2):

- 1 Start up the computer, log in and open the electronic patient record system.
- 2 Find the target patient information from the system using the social security number.
- 3 Open up and become familiar with previous patient information documentation.
- 4 Carry out dictation including identification information and dictated message.
- 5 End and save the dictation.

After the finished dictation is saved, the voice file is automatically sent to a dictation centre and converted from voice to text by transcriptionists. Usually, the dictation is returned to the physician for approval within a few days. The approval process includes the following activities:

- 6 Find the notification about the transcribed dictation.
- 7 Search the dictation from the electronic patient system.
- 8 Review and possibly rectify.
- 9 Save the approved dictation.



**Figure 2** Digital dictation procedure in brief. The physician first seeks the right patient and related information from the electronic patient record systems and then, while dictating, searches relevant information from different sources

When reviewing and confirming the dictation, physicians need to recall the patient in order to check the transcribed dictation and make any necessary corrections. The sooner the transcribed text is returned to the physician, the easier it is to recall the patient and other related information. This lengthy dictation process was also perceived to be a problem for the cassette dictation procedure.

The observed digital dictation was closely integrated into the electronic patient record system. Thus, any problems related to the patient record system were also attributed to the digital dictation process. The study revealed dozens of usability problems, including unnecessary codes and verifications, ambiguous terminology and failed error prevention, to mention but a few.

A striking example of the fragmented digital dictation process was the technical implementation of a notification informing physicians about transcribed dictations. The notification of a transcribed dictation waiting for confirmation did not appear in the electronic patient record system or the desktop, but instead compelled the physicians daily to open the 'personal checklist' application and check for possible notifications. Although the notification informed the physician about written dictation, it did not include a link to the dictation text. Therefore, physicians needed to use the notified social security number when seeking the dictation text for that patient from the electronic patient record system. It was estimated that a simplified digital dictation procedure would consist of over 60 interaction steps. The number of steps indicates the complexity of the prevailing digital dictation procedure.

The voice-recognition dictation procedure observed in this study had several advantages over cassette and digital dictation. The radiology unit provided dictating physicians with several rooms, enhanced with a sufficient number of computers and other equipment. Dictated text, which appears on a screen almost in real time, enables the physicians to structure the dictation while dictating and to make necessary changes using text editing. The overall dictation process, including the radiology information system, had been developed together with the software provider and the physicians. A simple, effective process enhanced with tailored user interfaces paralleled the main activities of the radiology physicians.

All the dictation methods shared the same problem when searching for relevant patient information from a number of sources. The large number of disparate information systems and the non-integrated information technology infrastructure make the dictation procedure inefficient and frustrating from the physician's point of view.

Dictations are often recorded in places where other people, such as patients and relatives, nurses, or other physicians, might be present. The requirement that the dictation solution should support silent, individualized operation is partially satisfied by all of the four evaluated methods. The most challenging environment for silent, private operation is the emergency department, where it can be difficult to find privacy.

### *Future visions*

Physicians made a number of requests for improvements to prevailing dictation practices, as well as the information technology environment in general. They found inconsistent practices and multiple disintegrated systems to be frustrating. In particular, those physicians using the digital dictation solution argued that the electronic patient record systems needed extensive redevelopment. Currently, physicians may have to type the patient's social security number many times throughout the dictation in order to search for information from different databases and applications.

Some of the interviewed physicians hungered for portable dictation solutions that would enable them to dictate in the intervals between visiting the patients on the ward. All the physicians emphasized the importance of finishing the dictations as rapidly as possible without the need for gratuitous approvals. In general, the voice-recognition technique and mobility were seen as key features for future dictation solutions. Nevertheless, the physicians expressed critical opinions about utilizing a mobile phone for dictation. They argued that the phone cannot be fully allocated for dictation in the case of emergency calls. As indicated in the user requirements, the solution should be simple and easy to use, and the key functionalities should be easy to access. The physicians speculated whether a sufficient amount of call centre resources could be made available for hospital-wide simultaneous dictation calls.

## Conclusions

Hospitals strive to adapt higher technology in an effort to create more efficient dictation processes and improve the quality of clinical documentation. However, it has been argued that the increasing complexity of the language used in medicine, the diversity of the healthcare working environment, and the sophistication of the dictation procedures and systems present a challenge for dictating physicians [12]. This digital dictation study supports that argument. The results indicate that from the physician's viewpoint, it is essential that the following areas concerning dictation be improved and developed.

*The currently used information systems need considerable improvements and redesign at both user interface and system-wide levels.* The digital dictation study revealed dozens of usability problems. Most of the problems were related to the electronic patient record system and could have been quite easily improved. Integrating disparate information systems generally seems to be a major challenge in the health informatics domain [13, 14]. Instead of having to search for patient care information from separate applications and databases, physicians should have easy access to patient-centric healthcare information through an integrated interface.

*The process of digital dictation is not applicable to the intended context of use.* From the physician's point of view, the observed digital dictation procedure failed to support them in their work, and did not meet the presented user requirements. The study indicated that digital dictation lacks many of the main advantages of the cassette dictation procedure: a dictation process and associated preparatory actions that are simple and easy to perform. The observed dictation process, which utilizes a voice-recognition system, seemed well suited to the context of use in radiology. It was concluded that instead of the digital dictation solution as such being improved, the dictation process itself needed to be reconsidered. Many questions remain valid: What would an alternative procedure for conducting digital dictation be like? How could the advantages of the radiology dictation process be exploited when developing digital dictation? Would it be possible to extend the use of voice recognition into other healthcare domains?

In summary, the technology environment should support the physician's work – make the daily tasks more efficient and easier to perform, as well as more appropriate for the hospital context of use. However, the dictation contexts of use in hospitals can vary considerably, thus presenting divergent requirements for the solutions used. The main conclusion of the digital dictation study was that *the dictation user interface cannot be standardized:*

*the same solution is not suitable for all hospital contexts.* In hospitals, a variety of context-specific dictation solutions and procedures should be considered instead of forcing the physicians to adapt their practices and procedures to the prevailing technical environment or to hospital-wide comprehensive dictation solutions.

## Discussion

Patient care information can be used for many purposes: treatment and care, coding, and compliance. Clinical documentation, including notes, reports and other patient care information, dictated by physicians plays a fundamental role in healthcare delivery and decision-making. Complete and accurate documentation is a central focus in current efforts to improve patient safety and healthcare quality [12]. It is obvious that the dictated message, as well as the dictation procedure and equipment used, have an influence on the quality of documentation. However, few references can be found in the scientific literature reporting on clinical documentation. Most of these studies share concern about the quality of healthcare documentation [12, 15, 16] but do not consider the procedures from the physician's perspective.

This article reported a study that used contextual inquiry method to elicit practical user information for hospital administration. These experiences in applying user-centred design methodology to the health informatics domain were promising yet thought-provoking. The applied methodology seemed suitable for its intended purpose; interviews conducted in a real working environment made it possible to make insightful observations and to enquire about the users' actions. These inquiries revealed needs that could not be articulated by the users. The huge number of interactions in a single digital dictation procedure surprised not only the hospital administration but also the physicians daily using the current digital dictation solution. Due to time constraints and limited resources, the contextual inquiry method was challenging to apply. However, other research methods, such as observation or questionnaires, were found inadequate for gathering a large amount of qualitative data.

Although user involvement and user-centred design methods have become a more pervasive part of product development in healthcare, there is still a great deal of work to be done before the practice can be considered to have reached full maturity. Venturi and Troost [17] have argued that if organizations want to benefit from the user-centric approach, they should seriously take into account the factors related to management, infrastructure and communication described in the user-centred design process. The user-centred research domain is still quite unfamiliar with the idea of including user involvement and user research methodology in decision-making and management. Although verifying the identified impacts on decision-making was beyond the scope of this research, the dictation study can be considered an example of a study that elicited user information to support the further development of a dictation solution and practice.

Within the health informatics domain, conventional user-centred design and evaluation methods have been criticized as being insufficient for safety critical system design [18]. Along with this argument, earlier studies have established the need for cost-effective research methods, as well as investigation into the benefits and obstacles associated with user involvement [4, 14]. Future research should focus on applying the user-centred methodology to information system development and should seek to find a roadmap for involving users in service and system design within the health informatics domain.

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