Method for testing a CPOE system in the medication process in a cardiology ward

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Abstract

Medication errors are of major concern in most countries. The European PSIP project aims to identify and prevent medication errors by enabling data mining and designing contextualized decision support functionalities using a human factors engineering approach. To create a basic understanding of the work practice in the medication process members of the staff in a cardiology department in a Danish hospital were asked to take pictures of their workplace. The pictures were used as a memory trigger in a subsequent interview. Furthermore a video based observation of a full day of work was carried out. In this paper the methodological considerations and experiences are presented and discussed.

Keywords:

Adverse drug events, Human computer interaction, Video analysis, CPOE.

Introduction

Adverse Drug Events (ADE) due to medication errors and human factors are a major public health issue. They endanger patient safety and cause considerable extra healthcare costs. Decision support should assist in reducing the incidence of preventable ADE, by providing health care professionals and patients with relevant information and knowledge. The efficiency of the relevant feedback is however impeded by two major drawbacks:

- Lack of reliable knowledge about ADE
- Poor ability of IT solutions to deliver contextualized knowledge focused on the problem at hand, aggravated by a poor consideration of causative human factors

The European project PSIP (Patient Safety through Intelligent Procedures in medication) aims to identify and prevent ADE [1]. Data mining and semantic mining of structured hospital data bases in France and Denmark will give a list of observed ADE with frequencies and probabilities, thereby giving a better understanding of potential risks. The main objective of the project is to develop innovative knowledge based on the mining results and to deliver to professionals and patients contextualized knowledge fitting the local risk parameters in the form of alerts and decision support functions.

To enable the design of alerts and decision support functions in a contextualized form it is essential to have a deep understanding of the medication process as it is performed in daily clinical work. The present study surveys the medication process in a cardiology department in a mid size hospital in the Capital Region in Denmark.

Methods

In earlier work practice analysis it has been shown that there is a fundamental difference between what people say they do, what they think they do, and what they actually do [2]. What the users say and think they do to perform their work tasks can be investigated by interviews [3], but to explore what they really do and how they do it can best be revealed by close observation of their work over a period of time. The combination of interviews and observation studies is a good means of identifying how work tasks are adapted to fit the particular contextual setting [4].

In this study a nurse and a physician were interviewed to investigate how they performed the three stages of the medication process: prescription, dispensing, and administration. Two weeks prior to the interviews the two staff members received a disposable camera and were asked to take pictures of situations from daily works practice they felt important. The semi-structured interviews started with open questions about each phase of the medication process, prescription, dispensing and administration. The two staff members were asked to explain which devices and artifacts they used in each phase, what knowledge they applied, and how the tasks are organized.

Their response (the light post-it notes in Figure 1) were categorized and validated during the interview. These categories correspond to a general technology concept [5]. When they could not think of any further issues under the mentioned categories they were presented with the pictures they had taken with the camera.

The pictures triggered their memory with additional issues (the dark post-it notes in Figure 1). Apart from identifying the elements included in the medication process the nurse and the physician were also asked to explain the actions taken in performing the tasks. Hence the interviews provided a description of how the staff perceives their work practice in the medication process.

To get information on how the medication processes really are performed and the technology involved in the contextual setting we observed two nurses and the physician during a full days work. The observations were recorded on three video cameras.
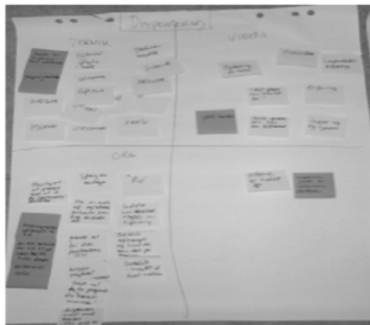

Figure 1 - Categorizing issues mentioned during interview

As a pragmatic validity and reliability check the approximately 18 hours of video was subsequently reduced to 20 minutes representing the most important situations in the prescription, dispensing and administration phases. The 20 minutes video recording has been approved by the staff, as representing this particular day at the cardiology department.

The full length video recordings were organized according to what phase of the medication process it concerned. In particular the physician work practice in the prescription phase was coded using a grounded theory approach. A first attempt to detect situations where decisions were made was given up, because it was impossible to detect precisely when single decisions were made. Instead we could identify when new information was obtained, from what source, and where it happened. Hence the physician's round with seven patients was coded with respect to when information was obtained from:

- a digital artifact
- a paper artifact
- a nurse
- the patient
- another source

The information obtained from coding was used to create a graphical representation to model the health professional's information seeking and processing. This representation graphically depicts over time the location of the health professional, the artifacts involved and the conversions that took place. An excerpt representing the interaction of the physician with a patient on a round is shown in Figure 2.

Results

The photo supplemented interview method and the video observation method for studying work practice in the medication process has been carried out without practical complications. They both produced very rich data as explained in the following.

The summarized results of the interview with the staff nurse are shown in Table 1. Each of the three phases in the medication process--prescription, dispensing and administration are listed in columns. The general technology framework is used to categorize all the issues and elements that came up. The elements that were mentioned during the conversation in the first part of the interview are printed in regular font; whereas the elements that were added after the nurses were presented with the photos they previously had taken with the disposable cameras are printed in italics. In the bottom row of Table 1 the actions taken during each medication phase are described.

The video recordings from the three cameras added up to more than 18 hours and give a very rich picture of what is really happening during a normal day at the department. The raw material has been edited and reduced to 20 minutes that can be used for presentation to external audiences, which has been approved by the staff at the cardiology department.

The video recording has been coded and graphically represented using the diagramming method described above in the Methods (see Figure 2). All the video for the physician has been coded and the video for the nurses in its full length will also be coded to detect and investigate important variables of context determinants. The aim of this analysis is to guide the design of decision support functionalities and their contextualization.

Discussion

When interviews are used as the data collection method voices are typically audio recorded for later transcription. Later the respondents validate the transcriptions, which subsequently are analyzed with respect to specific aspects. In the present study the analysis was performed simultaneously with the dialogue with the respondent, and the validation of the categorization was done at the end of the interview. This allowed us to correct potential misinterpretations during the interview. However, a potential disadvantage is that the respondent starts to respond according to the categories instead of just answering the questions.

The respondents own photos proved to add value to the interview. Nine new elements came up after the pictures were presented to the nurse, and in the description of how they performed in the medication process were remarkably enriched by the presence of the pictures.

The use of video recording for observing work practice differs from other uses of this media in a number of ways [6]:

1) The activity filmed does not happen for the sake of the recording. It has similarities with surveillance, but differs from test situations such as traditional usability evaluation.

2) The actors are aware that they are being filmed. In most cases the actors has been involved in the preparation of the recordings and have agreed to participate, which distinguishes it clearly from surveillance.

3) The actors are not paid or in any way bound to a particular obligation during the recording.

4) The recording happens as a part of a change process to the actors' work practice. In the present case the staff has an obvious interest in contributing to improvement in patient safety and the reduction of ADE's.

The greatest advantage of using video for observations is that this media can catch work practice situations visually as well as recording sound. The video document enables deep analysis because repetitive playbacks facilitate the study of essential details in the work practice – details that were imperceptible at first sight. The video recording is, however, not identical to the authentic situation. It will always be a reduction of the real, and not a completely accurate reproduction. Firstly the video media has a selective view limiting what is possible to observe, and secondly the sound quality can be reduced which means that pieces of information can be lost. Thirdly the space of experience is reduced from 3-D to 2-D. The most significant reduction however is the total absence of smell and atmosphere in the location, which can have significant influence on the interpretation of a communication process.

Table 1 - Result of the interview with the staff nurse

	Prescription	**Dispensing**	**Administration**
Technique	• Paper record • Note in pocket • Telephone • Acute sheet • *ECG curve* • *White board*	• Trolley • Cup • Medicine catalogue • Printer • Computer • Toxin cabinet • Exhaust device • IV-mix equipment • Bar code • PDA's • *Plastic bags* • *Paper record*	• Trolley • Medicine cup • PDA • Patient wristband • IV-rack
Qualification	• Basic nursing • Knowledge from errors • Experience • Older nurses • *CPOE-course*	• Locally acquired skills • Experience • Alert with toxins • Wonder and double check • *CPOE training*	• Locally acquired skills • Experience • *CPOE training*
Organization	• Patient • Other nurses • Physician • Lab technicians • Pathology lab • X-ray • Blood bank	• Asking colleagues • Quietness in medicine room • Dispensing for the whole day depending on time available • *Check off with the mouse instead of bar code*	• Independent work • Planning as the day pass • One patient at a time • Watch the patient take medicine
Outcome	• Information sheet to patients • *Health status improvement for patient*	• Medicine in the cup • Medicine in accordance with prescription	• Medicine administered • Changes recorded in CPOE
Action	Decisions on prescriptions made during • Discussing patients during board round • Collaboration with physician using the CPOE system and other information systems in the office • Communicating with the patient, the physician and other colleagues	• Find the patient in the system • Print out label with patient ID • Identify the medicine • Find it on the shelf • Identify it by the barcode • Dispense the prescribed dose • Check for dispense • Put the glass on trolley	• Log in on PDA • Drive the trolley to the bed room • Find the patient • Read the bar code • Check the identity • Explain the medicine • Watch the patient take the medicine

Figure 2-Graphic representation of information seeking with a patient and processing during a round

One of the perils of using video for analyzing work practice is that it can have a seductive effect. This seems to appear in at least three different forms [6]:

1) In the illusion that what you see is objective data.
2) In the risk of viewing it as entertainment.
3) In the temptation to ascribe the actors' motives and feelings.

The seductive effect in terms of objectivity often happens when hours of real time recordings of every day work practice seen through a particular lens are fragmented and analyzed by several independent researchers. They can identify typical work actions, quantify them and compare results. In this situation it is often forgotten that the data has already been edited: positioning of the camera has been determined, timing of the recording and equally important, those who are behind the camera often come out of the same community of practice as the staff being observed.It can sometimes be difficult to yield to the temptation to let unintentionally funny situations slip through the editing process or to focus on such situations in the analysis. It is often the unexpected, the disconfirmation of expected patterns that attracts attention. Particular consideration of ethics is essential to maintain video recording as a scientifically sound methodology [7].

In the present study we asked the physician and the nurses we primarily followed to think aloud. We did not want them to talk to the camera, or explain what they did, but just to say what they were considering in their work. This seemed to work very well, and it appeared to be very easy for them to do because they are used to collaborating in their work tasks (i.e. during the prescription phase the nurse and the physician constantly communicate about diagnoses, development in health condition, observations of patient behavior and things that must be done).

A question often discussed is the degree to which people are influenced by the presence of a camera, and if it makes any difference if there is an operator behind the camera [8]. After all it boils down to an empirical question that must be investigated on each occasion. From viewing the recordings it is clear that we can distinguish when the work performed is influenced by the presence of the camera. Often the observed person starts to talk directly to the camera, when he/she discovers it or abruptly changes behavior. In general however it is our experience that the observed staff members very quickly habituate to the camera, and the presence of the camera does not bias the observations in any significant way.

In the present study it has been clearly demonstrated that the interviews – supported by the respondents' own photos resulted in a clear and detailed description of how the medication process is performed. The descriptions obviously follow the rules for how medication processes are supposed to happen. The nurse describes the process as it is taught at the nursing school. However, from the video recordings of a single day in the department it is clearly shown that the formal medication process is often over-ruled by shortcuts and workarounds. But it is also clearly documented that every case

of over ruling is accompanied by a rational argument in terms of efficiency or considerations about quality of care for an individual patient.

Conclusion

Analysis of work practice of medication processes using video in combination with interviews supported by pictures taken by the respondents has proven to be a very powerful tool to obtain an understanding of what is really happening during the medication process. The methodological discussion has also exposed how important it is to be critical in the detailed analysis of the rich and comprehensive data collected.

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