Exploring HCI-issues within error-sensitive intensive healthcare systems

An Ethnographic case study

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Abstract

People are used to working routines that are taught and transferred from one to another, routines such as how to interact with an information system and how to use it in a specific context. While user experience and usability have been two issues of interest within the field of HCI, there is a lack of research exploring usage and behavior while interacting with complex error-sensitive systems, in so much as an action that couldn't be undone once performed. This thesis explores the error-sensitive aspects of complexity within interactions of the administering of medical prescription activities at an intensive healthcare unit. The aim is to investigate the interactions of computer-supported cooperative work environments used for information transformation activities for medical prescriptions. The results reveal a number of HCI-related issues in which clinicians socially bypass system interactions by making incomplete data inputs while assuming a given level of understanding of other employees.

Keywords: CSCW, complexity, interaction, activities, routines, error-sensitivity

1. Introduction

Information systems (IS) used by healthcare organizations today are often complex systems handling and processing a large amount of shared information for human communication and interaction. These are sociotechnical information systems (STS) found and used everywhere in the world where users have or could have the need for information transformation (Whitworth and Ahmad, 2013). STS is an approach that combines the traditional human-computer interaction (HCI) with the community level of communication where the user applies information technology (IT) (see fig.10, app. 1). HCI in a broad sense includes fields such as interaction design, computer-supported cooperative work (CSCW), pervasive computing and ubiquitous computing. This is a combination that has grown in the recent years, two examples are Wikipedia and Facebook where the user becomes one with the IS to communicate and transform information, information from one user to another via a organizational IS (Vicente, 1999; Whitworth and Ahmad, 2013). The common factors for all these IS’s are streamlined working routines and technology interactions related to the needs and the social requirements of peoples’ natural behaviors in networking contexts (Gonzalez-Rivas and Larsson, 2010; Vicente and Rasmussen, 1992; Vicente, 1999, 2002; Westergren and Holmström, 2012). No matter if it is a social media interaction or a nuclear power plant operation, the natural behaviors and their context of use are of the highest interest to successfully understand their specific case and to design a system (Janlert and Stolterman, 1997; Kaptelinin and Bannon, 2012; Kaptelinin and Nardi, 2012; Vicente, 2002). We rely on our routines to get the job done the “right” way; the question is how these IS’s are affecting the human-computer interactions.

It is a known fact by now that IS’s have an influence on our behaviors and routines in terms of HCI as we interact with different types of systems (and the users within the STS) of interest, but also on skills, rules and knowledge in the term of usability (Rasmussen, 1983;
Thomas and Kellogg, 1989; Vicente, 2002). An intensive care unit (ICU) context could however be seen as rather unique as it consists of error-sensitive routines and interactions that are non-alterable once performed. To clarify, these are direct actions such as injections that could cause death if processed inaccurately.

The importance of understanding the impact of technology influence has always been a key feature in discretionary decision-making in HCI research to prevent errors and malfunction, but also what separates traditional HCI concerns from the focus of consumer products of today, as elaborated by Grudin, (2012, 2005). This is an issue of HCI-research in complex error-sensitive environments where little research has been done in relation to IS’s (as the focus of research moved towards customer products) (Albrechtsen et al., 2001). It is a field that partly has been abandoned by researchers. This is an issue to investigate and study in terms of traditional HCI-perspectives. The traditional HCI-concerns to speak of are usability, user experience and tool empowerment of people. It could potentially reveal some important issues about how user skills and knowledge may change the behaviors and design of events whereby the possible outcomes could have devastating consequences (Mchome et al., 2010; Rasmussen, 2009; Thomas and Kellogg, 1989; Vicente, 1999; Vicente et al., 1995). It is also a perspective of how our products are being designed in relation to their intended purpose of the technology-enhanced environment, and the relation to the user experience (Janlert and Stolterman, 2010; Kaptelinin and Bannon, 2012). The ambition of this thesis is to investigate and re-establish the links between the fields of traditional HCI-concerns and IS’s that have been abandoned, in this case by exploring people’s relations and behaviors of routines in a sociotechnical system within an error-sensitive intensive healthcare context.

A reason for this lack of research is found within the difficulties of practically engaging the theories for testing purposes with non-routine and unanticipated activities in exposed contexts as elaborated by Vicente and Rasmussen (1992) and Darke et al., (1998) in their work on ecological interface design frameworks and the existing definition of HCI. The general issue being discussed is; what should be considered as HCI and what are parts of HCI? (Cockton, 2004; Grudin, 2005, 2012). The phenomena of interest are how the increased amount of data input and complexity of the routines are affected by a STS approach. Systems in which the user depends on the usability and user experience of the supportive and empowering system to perform their activities, but also on how the system itself could be affected by the possible events occurring during the possible situations (Christensen and Bardram, 2002; Janlert and Stolterman, 2010; Liu and Stasko, 2010). These types of systems are often experienced as supportive to various degrees based to its complexity, about how well it handles and matches the user interactions along with the available information and the HCI-relations of the system (Winograd and Flores, 1986). The issue to address, however, is where and how this complexity is experienced and empowered in relation to the outcome. Important aspects of interest are the perspective of intrinsic and extrinsic (mental and physical) practice in transformation of complexity when operating in an error-sensitive environment. Cases where all actions are un-alterable once executed. How does the user experience affect and influence the user’s behaviors and routines in practice?

These cases of un-alterable interactions are to be found in many industries around the world where the ICU only is an example of a context where errors and mistakes occur on a
daily basis. It is also an environment that is exposed and sensitive to errors as the objects of treatment are human beings. These are just some of the reasons why this type of context is of interest for HCI-related research, as well as an opportunity to further investigate the previous mentioned HCI-concerns (Vicente, 2002).

The intensive healthcare is a context where established actions are impossible to alter or undo once processed. This thesis contains a case study to reveal and explore the extent that system interactions could be affected and influenced by the system’s design for the IS mobilized by the activity of medical prescriptions.

The research question for the case study is poised as follows: *How are traditional HCI-issues of importance when analyzing complex error-sensitive IT-systems in hospitals?* This question will be elaborated in relation to a number of sub-questions to explicitly investigate whether or not users actually have encountered these issues in their everyday work, whether or not they consider them important, and how they can relate to the traditional HCI-concerns earlier mentioned.

### 2. Related Research

This section presents existing research investigating related fields and concepts of interest in relation to HCI-issues of the error-sensitive health context. The areas of interest found are activity-centered design (ACD), interaction complexity, ecological interface design (EID) and artificial intelligence (AI) in relation to interaction complexity within the field.

**Activity-Centered Design**

Researchers around the globe have over the past years been elaborating and exploring different types of theories, methods and principles from various angles of both the perspective of the user and the activity, as well from the perspective of the organization (Bertelsen and Bødker, 2002; Beyer and Holtzblatt, 1998; Fitzpatrick and Ellingsen, 2012; Grudin, 2012; Sachs, 1995). This is a question about logic versus use and how activities and routines could be enhanced by the collaboration between ACD and user-centered design (UCD) as elaborated by Norman (2006), a question about how we interpret our use of design (Gay and Hembrooke, 2004; Nielsen, 2003; Norman, 2006, 2010).

Various studies that are particularly related to the healthcare and learning that focus on the supportive activities in pervasive computing and how these activities can be assisted and merged in digital workspaces as a framework for enhanced interaction, play a central role (Bardram and Hansen, 2010; Bardram, 1998; Doryab and Bardram, 2011; Fitzpatrick and Ellingsen, 2012; Grudin, 2004; Uden, 2007). A series of conducted studies by Jacob E. Bardram in collaboration with others have been investigating and testing a number of concepts within the particular area of healthcare and digital workspaces of activity-based computing (ABC) in pervasive computing. In other words “tool empowerment” and the empowering of individuals, the vision to use or not to use a technology in a certain context as elaborated by Grudin (2005, 2012). These studies focus on context-awareness of the computational activities, resulting in a number of findings within the field of ABC-frameworks. A significant outcome is the improved transition-possibilities between activities
of natural behaviors of the context when parallel and interruptive sessions (pause and resume) were made possible. The research in relation to the outcome emphasizes the support for understanding and conceptualizing coordinated, co-operative, and co-constructive collaborative activities in terms of breakdowns and “routinization” within the healthcare context, when implementing technology-enhanced interactions (Bardram, 1998). Managing the future collaboration within pervasive computing is however an addressed issue of complexity in Bardram’s previous research, as computational support moves from the physical objects towards the tasks and goal of the user for an improved user experience (Bardram, 1998; Gothelf, 2013; Nielsen, 1994). “User experience’ encompasses all aspects of the end-user’s interaction with the company, its services, and its products” (Nielsen, 2003).

**Interaction Complexity**

Interaction design has since its early days been about conceptual and empirical exploration with an interest of the context and the understanding of cognitive needs and technology-based requirements for the users (Hutchins, 1987, 1995; Janlert and Stolterman, 1997, 2010). The studies however are vague due to that the principles and definitions of routines and interactions may change over time, in relation to the different types of complexity of the existing needs and types of cognitive distributions within a given context (Cockton, 2004; Fitzpatrick and Ellingsen, 2012; Grudin, 2005; Huang and Stolterman, 2012; Hutchins, 1987, 1995). These are arguments and theories closely related to the distributed cognition theory introduced by E. Hutchins in the mid 80’s, in which he emphasizes the coordination of social aspects in cognition of the complex sociotechnical world we live in (Hutchins, 1987, 1995). There have however been many attempts to decrease the level of interaction complexity, making the theoretical framing of benign complexity in the modern information age (Gonzalez-Rivas and Larsson, 2010; Janlert and Stolterman, 2010). However, the observed fact is that modern information technology seems to have a tendency of increasing the complexity of the artifacts when packed with more functionality (Huang and Stolterman, 2012; Janlert and Stolterman, 2010). Complexity however, is often seen and experienced as a problem for the overall range of users.

Generally speaking, HCI has to date had a coherent approach towards technologically integrated workspaces and the resources to support the activities and workflows. Rather than the complexity of the interaction (and processing) of the available information that is creating the human routines in the first place (Cockton, 2004; Grudin, 2004, 2005; Sachs, 1995). The researchers Kaptelinin and Bannon (2012) and Cockton (2004) address a challenge about information processing and transformation between intrinsic and extrinsic practice, as well-designed artifacts are beneficial and adds a value to both the industry as well as the users. The issue has been elaborated on for years by researchers about how to determine and define the needs of the individual users and the possible opportunities that could be brought be the use of customized IT interactions (Cockton, 2004; Grudin, 2004, 2005, 2012; Hutchins, 1987, 1995). Recent research by Kaptelinin and Bannon (2012) and Janlert and Stolterman (2010) have been illustrating the effect that the digital artifacts and different types of expressed or experienced complexity have on its users, and why in particular we should consider or even re-think the “the object of design”. The product is not just a product you buy off the shelf for personal consumption anymore; “Undoubtedly, well-
designed artifacts are of benefit to both the industry and users” (Kaptelinin and Bannon, 2012).

**Ecological Interface Design**
(Vicente and Rasmussen, 1992), among others, have directly and indirectly been studying usability and user experience in error-sensitive and error-sensitive environments while investigating existing theoretical frameworks of ecological interface design (EID) in complex human-machine systems, and how these errors (gaps) could be studied on a cognitive level. A user error that could for example be seen as a system HCI issue as well as information transformation in the form of distributed cognition where the user of a system acts on the behalf of the physical environment causing the space for user error to become substantial (Rasmussen, 1983, 2009). Their work of the EID-approach was developed from the perspective of complex systems, as these issues were a key focus of HCI-research at the time. This is a focus that unfortunately was abandoned by HCI-researchers (Grudin, 2012). These existing studies have focused on physical operations and how to design interfaces for complex contexts, rather than the complexity of the interactions. The case for complexity being described as an obstacle whereas the highly distributed work in the domains is not as detailed or robust as the physical attributes working with (Vicente and Rasmussen, 1992; Vicente, 2002). This is an issue that has been discussed by Nielsen (2003) in terms of usability in digital services where he argues that; “If users get lost on a website, they leave”, leaving the interactions uncompleted or aborted. Their research shows that EID adds value to the less-experienced users (Vicente, 2002).

**Artificial Intelligence and Interaction Complexity**
To engage the gaps between the context and the interaction complexity of the context, lately researcher at IBM have been developing an artificial intelligence (AI) system concept where HCI- and AI-research meet, the IBM Watson (Ferrucci et al., 2013; Grudin, 2009; Thomas and Kellogg, 1989; Wagle, 2013). The AI Watson is a complex computational system that operates with algorithms to gather hypothesis and shape a number of outcomes presented as confidence levels on a scale for answers or possible suggestions. Communication, as of today, is only done through plain text. Watson was however initially designed by IBM to participate on the quiz show “Jeopardy!”, but been introduced to the healthcare as a concept to exploit its capabilities in other environments and augment problem-based learning methods in 2013. Watson’s natural language processing (NLP) of hypothesis generation and evidence-based learning system is being tested as clinical decision support system to aid medical professionals. Their “MD pilot study” claims to “help physicians identify appropriate and individualized options for patients” and “Provides evidence-based insights to help researchers understand effects of therapies on certain patient cohorts” as well as “Can help shorten time from research to practice” (IBM Research, 2014).

The area of interest is the gap between the multiple areas where error-sensitive interactions and routines hasn’t been studied, even though it is important field of issues within traditional HCI-research. These practice gaps are specifically investigated in this current study by investigating the relations and behaviors of routines in a IS within an ICU.
3. Method

To investigate the research question and the cultural phenomena of the error-sensitive context, ethnographical study techniques and methods were used as described in section 3.2.

3.1 Study Object

The field study focuses on the complex activity of medical prescription administration within an intensive care unit (ICU) ward context at the North Star University Hospital. North Star University Hospital (NSUH) is a fictional name used to protect and ensure the organizational and the integrity of their employees (Yin, 2013). The ICU ward within NSUH is one of the most exposed wards within the hospital when it comes to error-sensitivity, as they only treat patients suffering from critical conditions in need of intense health care to survive. The ICU found at NSUH is the largest ICU ward of its kind in Sweden at the time of writing, capable of treating up to 15 patients at once in a single ward when fully staffed. The doctors carry out around 100 prescriptions per patient on a daily basis, resulting in a stunning number of at least approximately 300,000 prescriptions a year.

Patients located at this ward could be patients suffering from critical injuries, traumas or large-scale surgeries in need for constant monitoring. To monitor and treat these patients at the ward, a complex sociotechnical critical care management system (CCM) is being used. The critical care manager is an IS software that is designed to interlace all different sources for information in the context that is of relevance for the patient condition and current location. The IS operates as an IS-node for the different sources of information, some examples of information that is interlaced within the IS are; the staff, medical artifacts, external medical databases, an internal medical database and external services that is related to the patient. External resources could be x-rays represented as illustrations as well as diagrams for blood levels of interest. Each of the clinicians have their own user credentials to access the system as all the actions of the individual user and artifact are systemically important. Further these actions and activities have to be traceable according the regulations of the hospital and are therefore being logged for safety reasons. The IS software is represented as a graphical user interface (GUI) on workstation monitors to manage and display the network mapping of information in order to gather and store patient related information issued with the intense treatment (see fig.6, app. 1). In order to administer a medical prescription within the tool doctors utilize and manipulate the information gathered within the IS to make decisions, evaluate and diagnose the current condition of the patient. The tool is the only way to create, shape and register a medical prescription that is traceable through the digital journal of the patient.

The node system can be summarized as a comprehensive clinical documentation tool that is designed to support and manage the workflow at an intensive health care ward, connecting the medical artifacts and embedded sensors to log and trace vital diagnostics to provide the system users with a rich picture of the patients’ current condition.

There are multiple reasons why the ICU ward at NSUH was chosen for this ethnographical study. Firstly, the ICU ward is an exposed error-sensitive area where all decisions and medical prescription activities could cause life-changing events. Secondly, the environmental context where the medical personnel are interacting with critical care is a
work environment that is handling interruptions and unforeseen activities. Lastly, there is a high level of medical personnel turnover. Interns are required to learn the system while serving their internship at the hospital, as a medical prescription has to be made by system interactions.

These characteristics open possibilities to explore human-computer interaction (and errors) of the critical care manager system in use to accomplish medical prescriptions within an error-sensitive context. These include the activities that are emerging under organizational forms of a hospital, the collective experience and the possible phenomena that might occur while interacting with the IS on a daily basis.

3.2 Research methods

The conduct of this study is based on an in-depth ethnographic case study technique in order to both explore and acquire a deeper understanding of how the work environment of the sociotechnical IS and its elements are active within the health context (Vicente and Rasmussen, 1992; Yin, 2013). This study method was chosen to take advantage of both unexpected opportunities and HCI-related activities as the context for the object of interest is an exposed activity that could be interrupted at any time, occasionally impossible to iterate (Darke et al., 1998). The ethnographic study was planned and conducted with the operative personnel as a part of the fieldwork to explore the organizational nature, human actions and interpretations of the object of study. It was designed as a qualitative methodology consisting of: non-participatory observations in the intensive health care context, semi-structured contextual inquiries relying on open-ended questions, as well as open-ended interviews to gain understanding for the interaction activities and HCI-issues related to the IS case of an error-sensitive context (Grudin, 2012; Walsham, 1995). The data collection strategies were ethnographically performed with the least amount of distortion and bias as possible. This in comparison to other methods such as fully structured interviews that have broader tendencies for bias due to their non-narrative and sequential structure (Yin, 2013).

The study was conducted with a distinct focus on the creation and elaboration of activities whereby the doctor utilizes the information of the IS to make decisions, evaluate and diagnose the current condition of the patient. However, to encapsulate the activities and to gain an understanding of the importance of and collaboration with the IS, the whole process of a medical prescription was investigated to gain a better understanding the unfamiliar context as a researcher from the point of view of a clinician (Lee and Baskerville, 2003).

3.2.1 Observations

As a starting point, to get to know the contextual environment as a non-participatory observer, the fieldwork was initiated in the form of a grand tour to avoid any unforeseen bias. The grand tour observations were conducted during two days to revamp the possibilities of finding out what types of artifacts, objects, personnel and professions that were interacting in the environment, seen as human activities in their nature. A non-participatory observation with an emphasis on the nature of the social phenomena to explore and identify the elements related to the environment, as well as possible HCI-related influences and conflicts with the sociotechnical IS (Hammersley and Atkinson, 2007).
The data gathered during the grand tour were used as a foundation to construct the layout and framework for the questions of the contextual inquiries, as well as identifying specific interactions of interest that were to be observed in collaboration with the contextual inquiries. The method was chosen to give validity and reliability to the case study’s material as elaborated by Yin (2013), by ensuring that the observer understood what was happening and preventing own conclusions to be drawn.

The observer was introduced to the staff members as a researcher under ethical principles of confidentiality to avoid any questions regarding confidentiality issues or unauthorized access to the ICU ward due to its exposed vulnerability. The first impression was made during a morning conference in the beginning of a shift where the observer was introduced to the staff by the manager in charge. The interviewee was verbally presented during the morning conference as a student within the fields of HCI with an interest of the behaviors and interactions with their critical care management tool. The staff was informed that they were going to be observed (on a safe distance to the clinicians and integrity of the patient) and interviewed as a part of a master thesis case study with the orientation of an exposed and error-sensitive healthcare context. No formal handshakes were initiated during the presentation process as the morning conference had to proceed on a tight schedule.

### 3.2.2 Contextual inquiries

Semi-structured contextual inquiries were conducted in an un-altered environment with a strong emphasis on exploring the nature of the HCI-relations and the understanding about how these interaction behaviors are or could be conflicting, based on the environment and the artifacts of the IS elements (Beyer and Holtzblatt, 1998; Uden, 2007). The general prevailing understanding is the exposed context and understanding for the likeliness of not having the possibility of asking or answering questions in an accommodative accomplishment. This would cause the duration of the contextual inquiry to be undeterminable and possible to extend over multiple shifts, causing the interview to proceed on a later occasion when the participant becomes available. This is however an inevitable drawback of the chosen method for this context. While the participants were unreachable for questioning their complete activities were instead observed as a whole picture.

The interviewer was assigned a staff member to follow and with whom to conduct the contextual inquiry. In practice, the staff manager informed the clinician of interest that the interviewee was to join the clinician during a shift for the purpose of this study. Before the contextual inquiry was initiated, the staff manager asked the clinician of interest if there were any problems with doing this at the particular occasion whereby a positive answer of the question was followed by a formal handshake-presentation.

The questions constructed were based on the grand tour observation and designed according to cognitive work analysis and on the four of elements; mean/ends, environment, learning and development of the activity checklist. In this way, the question enlighten the importance of understanding the HCI-context and to explore relevant contextual factors to evaluate limitations, as well as conflicts and vital interactions with the IS (Kaptelinin et al., 1999; Vicente, 1999). Fifty-two open-ended questions in total were constructed in the fashion of an ethnographic exploration of the cultural phenomena of the interactions and the human
nature on which these interactions are based. The contextual inquiries were conducted in their native language, Swedish, below are an example of four translated questions; (see app. 2 for complete list).

- What type information is transferred in the system?
- What type of information and peripherals is needed for the activity?
- How do you experience the error-sensitivity of your activities?
- How do you interact with the IS?

The questions were carefully designed to be overlapping and fluent to prevent and hinder any type of important data that could “fall between the cracks” of the interruptive interview. This type of open-ended design could cause the participant to answer multiple questions, even though the questions haven’t been put (Darke et al., 1998; Hammersley and Atkinson, 2007).

Two types of users were chosen for interviews, doctors- having the authorization to prescribe a medical prescription- and nurses performing the medical prescriptions. Together shaping the whole picture of the activity of a medical prescription with the possibility of studying both the inputs and outputs as a source for interactions causing errors of the IS (Darke et al., 1998).

3.2.3 Open-ended Interviews

To encompass all possible aspects of the IS, open-ended interviews were conducted with the possibility of having the participants describe their personal everyday use of the system in the workspace and how it operates from both an architectural perspective as well as an organizational perspective. The interviews were conducted at the end of the study with an orientation of exploring without asking the interviewed in plain language whether they agreed on the gathered data (Yin, 2013). The participant’s chosen were IT-administrational personnel and managers in charge of the doctors and nurses at the ward. The open-ended interviews were designed with the interests of the administrative perspective of the IS in mind in order to attain a better understanding of how the technical and informational levels are operating within the critical care managing system. In these interviews, the gathered data was discussed and used as a common base for discussing findings related to the field of HCI in collaboration with the use of the natural science model (Darke et al., 1998).

3.3 Data collection and analysis

Data was collected throughout using pen and paper as the media for information mediation. Voice recordings were not an applicable option due to the duration and noisy environment of the data collection, as well as exposed integrity issues.

Thirteen participating personnel in total were interviewed over a 3-week period of approximate 100 hours for this study; the interviewed participants were 5 doctors, 5 nurses, 1 IT-administrator and 2 managers in charge. The interviews were anonymously performed in order to protect the individual identity. The language used in the interviews was Swedish, the native language of both the interviewer and the participants. The quotes found in the thesis have been translated to English by the author.

The qualitative data were analyzed by comparing the conducted interviews with the observation in order to explore routines and patterns in relation to HCI-concerns (Yin, 2013)
4. Results

This section presents the gathered data from the conducted study. The results are divided into four sections to illustrate the natural routines and patterns of the context in the perspective of an ethnographic researcher, unfamiliar to the specific context.

4.1 A focus on activity

The data collected can be described as a collaborative activity lifecycle divided into three activities phases seen in (fig. 8, app. 1), each activity consisting of the actions: information gathering, processing and presenting. Together, these complete the medical prescription. These three activities are equally important as a component of the lifecycle, as well as a source for interaction errors. One statement from a doctor on site was that “a flaw or an error in the process that isn’t noticed can cause a total failure and a life-threatening situation.” For each activity, the user interactions were identified in relation to their authorization and the goals of the activities. The interactions were studied as a part of the environmental context and the activity as whole being distributed among the IS, as well as the different users. The different types of interactions can be described from the perspective of the user groups doctors and nurses, but also the mediating IS tool as seen in table 1. The table illustrates the three different activities and how the lifecycle is a part of the cognitive and physical operations within the context of the users’ nature. Before the activity of medication can be initiated relevant information has to be transferred and communicated from a doctor through the IS. This was exemplified by one of users as: “Information and prescriptions that aren’t available in the IS, doesn’t exist as it isn’t available for preview for others than the one who having the thought. It isn’t possible to do whatever you feel like” – Department manager.

<table>
<thead>
<tr>
<th>Phase (when)</th>
<th>Actor (who)</th>
<th>Actions (what)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding</td>
<td>Doctor(s)</td>
<td>Analyzing the current condition, prescriptions and records of the patient. Making prescription</td>
</tr>
<tr>
<td>(Medical prescription)</td>
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<tr>
<td>Presenting medication</td>
<td>IS</td>
<td>Visualizes the given prescriptions</td>
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<tr>
<td>Medicating</td>
<td>Nurses</td>
<td>Reads the given prescriptions and medicates patient</td>
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**Table 1 - Medical prescription activities**

The data collected during the observations shows that the context of the object of study is a complex entanglement of the two principles digitalization (how people use IT to produce and process digitalized material) and virtualization (how people use IT to collaborate across time, space and organization boundaries). The entanglement seen in figure 1 is based on a hybrid-organized environment, surrounding a patient in need for medical treatment.

The environment, as depicted in figure 1 and 2 shows a sociotechnical cluster-system that involves multiple levels of networked computing. Together, shaping the context of an organizational ward with an activity process centered towards the treatment of a patient. The
system cluster consists of various medical IT-artifacts that transmit information to the CCM-IS-node. These are medical artifacts that independently measure and monitor vital parameters such as pulse and blood pressure, as well as medical artifacts that inject the patient with medical substances. Visual information about the current status is available through the IS GUI as well as information displayed on the GUI of the artifact itself. Any user inputs have to be done through direct physical interaction with the artifacts. That is, remote control actions are not possible. Connecting the medical artifacts are two sets of workstations. One assigned to be a shared computer, and the other one dedicated to the patient found in the bed located next to the computer (fig. 2). The dedicated workstation is customized to only access the present patients records, the shared workstation can access all the patients hospitalized at the ward (fig. 5). Both of the workstations are designed as office workstations with keyboard and mouse as the only user interaction medium, full Internet access is available for external sources of information.

The IS GUI incorporates a session-based system in which each user has their own credentials. The sessions are then shared on the specific computer through which the login authorization adjusts the privileges of the GUI for its current user as well as traces all the different actions made by the specific user. The credentials consist of a username and a password. During an activity where a user is inactive for five minutes, they are signed out according to automated principles. When signed out from the system (manual or automated), another user can continue with the same activity that the previous user left on the workstation without any conflicts. However, a nurse cannot finalize a doctor-related activity due to authorization restrictions.

Aside from human-computer interactions and computer-computer system interactions, interactions and the exchange information are done by human-human interactions. The next section will illustrate the workflow of the human-computer interactions as well as the human-human interactions of the contextual environment.

4.2 Human actions and interactions
During the process of contextual inquiries the clinicians acted in an alert manner to keep the continuous monitoring process active while engaging in a wide range of clinical activities. The study showed that clinicians never let their guard down regardless of their authorization or positions, causing the response time for the contextual inquiries to be diverse. There was however a clear distribution of what goals their attention had in focus as a part of the various
actions. The next section will elaborate the collaborative activity lifecycle workflow and the different user-related activities. The complete lifecycle is briefly described to illustrate an overview of the complete workflow for a medical prescription to present an understanding for the course of event.

To begin a shift at the ICU ward all clinicians are updated through a verbal *morning conference*, held by the manager in charge of the previous shift in order to know which patient(s) that they will be responsible for. All clinicians are responsible to make notes regarding information of specific interest. The clinicians are then mobilized to their specified patient to begin treatment. This is where the clinicians’ different authorization initiates engagement and the lifecycle of medical prescription initializes.

The first of the three activities of the prescription lifecycle process starts with the *doctor’s information gathering activity*. This is a digitalization activity where the doctor signs in and interacts with the IS to get an overview of the patients current health status as well as medical status, information which are available through the system GUI. The local critical care manager monitors the cluster of the medical artifact network to shape and present a record chart of the vital parameters, as well as the current patient-specific medication records of the wards treatment. To get access to “out-of-ward” information such as X-ray and laboratory specific data, the doctor has to actively make use of “external-in-house” IS’s, information that is not integrated in the CCM and yet is available as ad-hoc component hotlinks for read-only purposes upon request. Excessive information is also available through communication with other clinicians. The *information gathering activity* is then merged and followed by a *mental processing activity*. This is an activity whereby the doctor themselves has to process all the gathered information as a mental activity to make a decision about how the patient should be treated.

“There won’t be anyone else doing the diagnostics for you, we have to do it ourselves until we have a super computer to help us with the diagnostics.” – ICU Specialist

This complex interaction activity is being processed with the possibility of verbally consulting other specialists and their input of the case. Each of the specialists has access to the same GUI and information without any alterations except for personal experience and knowledge. These mental diagnostics are then transformed into IT-terminologies and medical prescriptions through the IS GUI. The system interaction transforms both the *information gathering activity* as well as the *mental processing activity* into data that is stored (fig. 7, app. 1). We will return to these activities in the analysis section.

Once the doctor has created a medical prescription, the IS *gathers the information inputs* made by the doctors and *processes the information*. The information is then *presented as a list of medical prescriptions* containing guidelines, PM’s and restrictions made by the doctor.

The third activity in the lifecycle is the *nurse information gathering activity* where the nurse interacts with the system to access the processed information of the medical prescriptions. The nurse then *physically processes the gathered information* instructions found in the medical prescriptions as medical treatment. When the medical treatment is finalized, the medical prescription is *presented and confirmed* as executed in the GUI. The language used at the ward, during the time of the observations, can be described as a
complex language with a complex medical terminology that is adjusted for the specific context and the level of knowledge of the ones communicating. According to the interviewees, the same principles do apply to text-based communication through the IS.

To be able to analyze all the activities of the collaborative activity lifecycle, all activities have to be seen as a part of the lifecycle. The activities are however influencing different degrees that will affect the outcome of the collaborative medical prescription activity. Excluding or failing one of the activities would, by natural causes, break the chain and terminate the medical prescription. The interactions of interest will be discussed in the discussion section.

4.3 Routines and system experience

The present study shows a situation at the ICU where a day at work is built upon routines. The routines are a relation between the clinicians and the context that collaborates to reach a goal of treating a patient. The routines however are circulating around the IS containing most of the information needed for them to do their work at the ward. Two users describe the situation as follows;

“The system controls our decisions! That is something that you don’t like as it becomes an administrative burden. A small and simple activity takes the same amount of time as a huge and complex activity. It happens that I rather send my decisions in a direct and verbal fashion as the system doesn’t support my activities.” – ICU Physician

“We are absolutely dependent on the system, it would be impossible to have all that data in our minds. However, It’s the best designed system of the systems we at the hospital” – ICU Specialist

The data gathering shows that an activity regardless of its proportion, will take a similar amount of administrative time. The IS acts as a referral and encyclopedia where the users have two types of routines, the routine of being a doctor in the specific context and the routine of a system user.

“The system is like a huge patchwork quilt, I have to actively and manually browse for information of interest in the modules. It becomes a daily circle where you have to access the modules and the databases over and over again to get the information that is related to the case and of my interest. It would be so simple for the system to just generate a report with available information, but it doesn’t, I have to browse for what is and could be available…” – Associate specialist

The routines of a doctor’s roles are related to the profession, but the routines of a system user is individually fashioned and developed by their use of the IS. The society of the ICU is built on a hierarchy in which the new intern clinician are taught to teach each other before starting to work on their own. As the routines and actions performed could cause life-changing events, these routines are carefully studied and learnt over an extensive period of time to success with the routines and interaction as its instructing mentor. The learning curve is however experienced as problematic;
“You hesitate to do a medical prescription over a longer period of time in the system as it just relocates the responsibility, the duration of a continuously given prescription is only informed in a message. The system only allows medical prescriptions of a single instance or a continuous schedule without a given day to finalize, besides in a message.” – ICU Specialist

The approximate time spent on computer interaction and office work were expressed at a various degree of 20-70% of the time spent on a shift. The interviewees experienced the IS as a “time-thief” stealing their precious attention on simple activities such as manual information gathering of the different systems. The one reappearing comment was that the system should act as an active help for decision-making, not as a “time-thief”, a comment that was always complemented by the impression of dejection. In relation to the use of pen and paper as on other wards, the system was nonetheless described as something that they rather stick with than going back to pen and paper due to the availability of digital information that previously had been accessible in a binder in a specific location.

4.3.1 An emergency call

During the time of the study there was an emergency call where a patient was airlifted to the facility in a critical condition. This event caused the whole ward to operate with full attention in order to treat this life-threatening condition. This occasion displayed a situation in which the majority of the staff acted cooperatively under the instructions of the doctors in charge. What is of particular interest is how the routines of the staff were changed in relation to a “standardized-routine” of a prescription and treatment. Instead of physically examining the patient and diagnosing the patient at a workstation, the interactions and medical prescriptions are kept under the circumstances of a “closed-loop” where the doctors cooperated (physically and verbally) to diagnose the patient in a working condition (fig. 3). The “closed-loop” principle is an interaction of response and feedback where all verbal communication and directions are to be confirmed in a direct manner, an example of the principle could be:

- Direction by doctor: “intubate the patient with tube 6”
- Response by nurse: “intubating patient”, “Patient intubated with hose 6”

![Figure 3 - Closed-loop communication](image)

The medical prescriptions are carried out in a direct manner where the activities have to be put in the records on a later occasion, this is called a verbal prescription.

As the condition of the patient became stabilized, the number of clinicians was reduced and the routines declined back to normal. When the situation was assigned as stabilized by
the clinicians at the ward, there was an explanation of how the different types of prescriptions were possible and practiced at the ward;

“[...] all medical prescriptions are made in collaboration with clinicians of interest or with information regarding the patient to make the best possible treatment, we adapt our behaviors according to the situation.” – ICU Specialist

The routines that follows when the diagnostics are finalized are however diverse as explained by a clinician;

“It is possible to make a medical prescription in a verbal manner, something which only is practiced under critical circumstances or when the prescription is a simple routine. A medical prescription has to be done in the critical care manager to have it stored in the records, and verbal ones have to be listed afterwards. Medical prescriptions that are based on routines and are carried out on daily bases are often constructed in the system, but are not made with details of the action as we know that the nurses knows the routines.” – ICU Specialist

The routines and their different types of relations will be discussed in the discussion section.

5. Analysis and Discussion

This study shows that the activities of the doctors is the most vital in the collaborative activity cycle as its main orientation is about finding the accurate and valid information in the IS, to diagnose the patient by collaborating and processing the available information (fig. 9, app 1). The interviews do however indicate that the activities and actions carried out to determine a goal, and then trying to reach it, are hard to define. What should be included, what is relevant, what is irrelevant, what are exceptional cases and what are standard procedures that are carried out by routine?

In this section I will discuss the results and findings made accessible through the empirical study in terms of the stated research question. It will be emphasized on the routines related to usability, user experience, tool empowerment and the complexity of the activities of the doctors’ interactions throughout a medical assignment in relation to error-sensitivity. The following list illustrates a number of identified HCI-issues to be discussed;

- Difficult to reach established goals due to system architecture and GUI
- Distribution of complexity and cognition
- Performance and efficiency

The identified issues are elaborated in different sections in various degrees of interest to elaborate the poised research question; how are traditional HCI-issues of importance when analyzing complex error-sensitive IT-systems in hospitals?

5.1 Interaction issues and usability

The expressions gathered and experienced are a principle of iterated IS-interactions that causes frustration and lack of awareness. The generalization is based on the routines of a doctor, routines that follows an explicit pattern when interacting with the IS for diagnosis.
5.1.1 Information gathering
When a doctor begins gathering information for understanding the current condition of the patient, the doctor needs to actively browse and search for information of interest by exploring and accessing external ad-hoc IS’s. This action causes a developmental interaction of multiple subtasks where the doctor needs to create an internalized and mental awareness of the given information in one system to another by actively externalizing the gathered information in to relevant information of the representational mediums of the IS’s (Bardram, 2009; Jonson et al., n.d.; Kaptelinin and Nardi, 1997). The reaction and anatomical response of the users are the consistent expression of dejection, resulting in the need for a second iteration to interact with the system. The process is repeated by accessing the external ad-hoc IS’s to double-check whether the externalization of the mental activity is likely to be adequate. This is a routine consisting of subtasks that has to be iterated with an undefined number of external systems based on the need to reach a determined goal. The behavioral outcome of the interaction is a behavioral pattern causing the doctors to bypass the system. This is because it is occasionally difficult to access and express the given information, as well as uncertainty of up-to-date expressed by the doctors on site. The bypass action is distinct in that the system interaction complexity creates a behavior where the doctor just walks up to the medical artifacts of the cluster and read the data manually (or makes a verbal request to another clinician to get a quicker access to the relevant information). However, when the externalization process is being engaged, the information has to be virtualized to collaborate and visualize the information within the organizational boundaries (Jonson et al., n.d.).

5.1.2 Diagnostics and decision-making
The virtualization of the medical prescription diagnosis is a fashion of digital paperwork and external complexity. This is, the doctor is interacting with the GUI of the IS. To initiate the creation of the medical prescription, the doctor has to evaluate the type of medical prescription that is of interest to be able to choose from a variety of medical terminology groups available in the information architecture (IA) (fig. 7, app. 1). This is an action that in turn requires the fullest attention of the user among the thousands of possible options, combinations and collaborations.

The obvious issue of an HCI-perspective is that the IS neither merges nor collaborates to take earlier or even active information of medical prescriptions in consideration in relation the current condition of the patient. This is an issue causing the user itself to actively look for potential PM’s to make sure that they don’t miss out on any vital information or recommendations that could cause a conflict in either the system interaction or in the medical treatments of interest. The incapability of delivering a supportive system causes the users to act on social level in order to bypass the difficult system interaction complexity where the doctors assume a level of knowledge and understanding for the recipient nurse (Whitworth and Ahmad, 2013). Medical prescriptions of common knowledge were the system interactions interrupt the user for a longer period of time are often passed on with the least effort possible. This is the causation of medical prescriptions lacking or even missing out on information or recommendations as it often is seen as common knowledge. The behavior implies that the doctor add an incomplete prescription which relies on the
knowledge and experience of the nurses to externalize and physically process. The information that is supposed to be digitalized in the IS is taken for granted due to the difficulties of the HCI of the system. It is seen as a standard procedure. The conflict is however a common and shared issue of mediation complexity, how do they know who the recipient may be if the medical prescription is scheduled for the future of an unknown shift?

“You have to adjust and customize your behavior to use the system, there are not any other alternatives for making a medical prescription.” – ICU Physician

The user implies that they use the available possibilities to make their work as smooth as possible. This is because their intention is to spend as much time as possible with their patient rather than with the IS. This is a case that was illustrated as the doctors partially and occasionally while practicing the same possibilities of a verbal prescription to bypass the extrinsic virtualization conflicts with system interactions, as described in the emergency call in result section.

5.1.3 Scheduling

The interactions do however express signs of a design that is causing user complication when digitalizing the externalized information. It seems that the GUI confuses the users internalization process when scheduling the activity. The users expressed dejection when it comes to system characteristics of usability as illustrated in the quote below;

“The system doesn’t allow me to prescribe the medical substance for a given number of days; it only gives me the possibility of choosing single instances or until further notice. If prescribed until further notice, I need to leave a PM to inform the nurses when to finalize and end the treatment, the system doesn’t automatically inform the nurses when to stop.” – ICU Specialist

The two bypass behaviors of the IS are acknowledged issues in the organization due to the inconvenience of the human-computer interactions (Liu and Stasko, 2010). It is also acknowledged that the behaviors are undeniable and that the difficulties of HCI-related issues is causing a gap in traceability and the possibility of further referrals for further reasoning. The complications of the IS interactions are compliant to confirm as they are causing deviation reports on a daily basis.

5.2 User experience

5.2.1 The Emergency call

The emergency call that occurred during the study did illustrate some interesting types of interactivity between the clinicians. It a case whereby all interaction routines within the IS were breached and compromised. The observed behavior was bypassing the whole IS interaction due to the emergency to treat the patient as intense and quick as possible. This is a highlighted behavior and expresses the possibility that could occasionally influence their normal activities. As the clinicians are acutely about of their legal possibilities to act during an emergency call, they seem to have an attraction to practice the gaps and the workarounds of the sociotechnical system due to the various interaction difficulties of the IS. I argue this to
be one of the interaction-related concerns in relation to the design of the system and its supportive behavior. Even though the IS may have been perfectly designed according their routines when introduced, the routines, technology, information and terminology will change. The error-sensitive context has developed requirements and needs of a sociotechnical system involving data gathering and shared activities that has to be supported to generate hypotheses.

5.2.2 Ecological Interface Design

In relation to existing studies which show that an EID-approach adds value to the less-experienced users, (which in this case would be interns and doctors new in the ICU ward), this present study illustrates a distribution of complexity in which users of the IS seem to have a shared perspective among the various activities. The question however is whether the system studied should be seen as a solid system to study or plainly just too unsupportive and “un-empowering” as the findings show similar user experience-related problems at the personal level of the system interaction. This statement is highly contestable in this particular case, due to the difficulty of defining the significance of the level of user adoption as an innovated behavior to use the IS.

I argue that the experiences gained during the study have to be seen as information processing and transformation between intrinsic and extrinsic practice beyond the product and the IS itself, but also how the distributed complexity of the systems affects the behaviors of its users (Janlert and Stolterman, 2010; Kaptelinin and Bannon, 2012). This is a case where it could be argued that the complications of the human-computer interactions are initiated before even reaching the relevant information. With questions like: “which information is available?” “What information is of interest?” and “How do I access it?”, in where the study shows that the distribution of complexity in the activity space of use is causing complications. Complications that affect the whole user experience due to the obstacles of usability experienced within the given error-sensitive context. The addressed problems are however difficult to encapsulate, as there are arguable too many elements giving indications of conflicts in where the system is claimed to be unsupportive and a “time-stealing thief”. This is in turn causing an innovative user behavior in where the interactions are transformed from a personal level into a community (social) based level of the sociotechnical IS (Whitworth and Ahmad, 2013; Winograd and Flores, 1986).

5.3 Ethical issues and the empowering of people

The outcome experienced and described within the organization is a question that has to be argued. The provoked actions of the activities imply that the users have to act upon laws and streamlined work routines of their profession (in terms of medical treatment), a statement that is unique and true. The counterfactual sense of this statement is that the users innovates and adapts their human-computer interactions by transforming their interactions to a social interaction to master the artifacts. Which in turn makes it possible to maintain their professional activities of treating patients while bypassing the complexity complications caused by the system. This is a context in the need of a supportive and empowering system that could operate to generate relevant data on the behalf of the users and the mental
processes. The clinicians are aware of what they are able to do and what information they are in need of, but they are experiencing difficulties in reaching their desires due to the interaction complexities. Even though if a concept such as “Watson MD” was introduced, the judgment call still has to be made by the clinician in charge to sign and execute the desired prescription and treatment. Supportive AI’s are though in the position of supporting and empower the users hypothesis generation based on instant data collection, besides the facts that examination of physical and visual appearance or attributed has to be evaluated along with the gut feeling and experience of a clinician. I argue that complexity is causing problems in the context of the case, not because that the complexity is too high, but because it is being distributed and mediated incorrectly in relation to the contextual requirements of tool empowerment. “It’s about living with complexity” (Norman, 2010). It is important to remember that these types of systems are supposed to empower people as tools.

5.4 Real-life systems and HCI-research

Complex real-life systems such as the one found in the ICU are associated with a number of issues that current HCI-research doesn’t specifically address. I would like to argue that we should bring in and re-introduce the HCI-perspective to analyze these types of systems and continue to investigate the where change of focus in existing HCI-research left of (Albrechtsen et al., 2001). The issues of usability, user experience and the tool empowering of people with tools are just some of the specific concerns illustrated as a motivation for future research in this particular study.

5.5 Limitation and reflections

When looking back at the choice of methods and principles for analysis in relation to the research question, there are some issues and conflicts that need to be taken in to consideration, both as critique and assets for future research. The adaption of the combined method of semi-constructed interviews and contextual inquiries could sound like the perfect combination to both observe and interact with the user while working, but it is also a source of error seen from the perspective of a researcher. It could be difficult to know what’s accurate and what is of importance, routine or deviation. The exposed context of error-sensitive and classified data along with user opinions could also cause an uncomfortable situation for the user, in where the user acts with an emphasized or altered behavior that could cause openings for bias or inaccuracy affecting the final results. This is also an issue that is related to the ethical issues of integrity and to the context itself that cannot be altered for specific research purposes. The drawback is that there are no possibilities to design such real-life user scenarios for testing, which is one of the drawbacks mentioned earlier for such contexts. One can never know if this has a neutral or negative impact on the results. These issues could have been diverted by methods such as indirect observation, video recordings or equivalent where the researcher isn’t interacting or interfering with the user. This would however disfigure the key properties of an ethnographic study and the benefits of understanding ethics and participation in the context. In short, resulting in a different type of study that would have changed the outcome and results.
6. Conclusion

I have presented the results of an ethnographic study relating to the use and interactions of a sociotechnical healthcare system. The studied context shows a technology-enhanced environment consisting of various artifacts and information systems collaborated in an activity space where clinicians share their activities in collaboration to treat patients. The gathered data illustrate a relationship between the different users and artifacts where the users have to reach beyond the existing limitations of the ecological attributes and the existing distribution of complexity. It reveals a context in need for supportive and interactive systems that can assist and empower the clinicians and make it possible for them to spend more time with their patient and diagnosing their patients, rather than spending valuable time on complex interactions. I have been arguing that complexity is causing complications in the user experience of the routines within the context, but not because the complexity is too high, but rather because it is distributed and mediated incorrectly in relation to the contextual requirements. The complexity distribution is causing a conflict between the routines and the profession of the clinicians, which in turn creates a behavior where the clinicians exclude important information in faith of knowledge and routines of others.

Clinicians are a user group that is in need of a high level of complexity due to their complex profession, but not necessarily in terms of external complexity when talking about information gathering. The overall experience is characterized by time-consuming interactions while collaborating relevant data before the mental processes of diagnosis can be initiated. Related research has however been elaborating with the possibilities of artificial intelligence systems to support the clinicians in terms of information gathering and diagnosis. The conclusions to be made are in relation to this case, highly valuable in terms of information gathering and diagnosis, as the complexity of the existing HCI may cause complications and data loss. What needs to be added to future research are the physical and visual interactions of gut feelings and the overall picture created by a clinician.

Even though a medical diagnosis has successfully been finalized, the activity of presentation was seen as an issue due to the external complexity of the information transformation.

The questions to put for further research are more related to the ethical issues rather than technical and HCI-related issues of interaction. The reliability and trustworthiness seen to existing experience, the hospital isn’t a quiz-game such as “Jeopardy!” where you lose money when the answer is incorrect, the outcome could cause irreversible death.

This thesis is my contribution to the field of HCI-research as an explicit case study where I claim that HCI-research should pay more attention and focus on error-critical and complex clinical systems. Traditional HCI-concerns and concepts can be fruitfully utilized in analyzing these types of systems and work to reveal some important aspects that need to be improved in terms of research. The findings are specific for clinical systems, but could share some similarities with process control systems in factories or within the military. The contribution to this field from an HCI-perspective is aligned with the traditional HCI-research performed by researcher Jacob E. Bardram and could be seen as an alternative and complementary case study to his current work.
7. Acknowledgement

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References


Appendix 1: Illustrations and Pictures

The environment

Figure 4 - Location of treatment

Figure 5 - Hospital bed with surrounding
Appendix 1: Illustrations and Pictures

GUI

Figure 6 – Record chart

Figure 7 – Medical options
Collaborative activity cycles

**Doctor – Prescription activity**

- **Gathering**
  - Visual examination of patient
  - Information gathering from IS systems (internal + external)

- **Processing**
  - Mental processing activity
  - Social collaboration with other clinicians

- **Presentation**
  - Prescription creation in critical care manager GUI

**Figure 8 - Activity flowchart**

**Figure 9 - Doctoral activity**
Appendix 1: Illustrations and Pictures

Figure 10 - Computer system levels (Whitworth and Ahmad, 2013)
Appendix 2: Interview Questions

Interview questions (Swedish)

1. Hur står det till?

2. Hur går det i arbetet?
   
   Jag är mycket tacksam för att Ni tog er tid för mig idag.

3. Som jag har förstått så arbetar du som Läkare, då måste du ha mycket erfarenhet inom området av ordinationer?

4. Hur kom det sig att du började jobba just här?

5. Annan bakgrund än sjukvård?
   
   Jag har ju själv varit på sjukhuset flera gånger, men då befinner man ju sig på andra sidan. Låt mig förklara vad jag har av intresse;

   Jag har av intresse att försöka förstå hur det är att arbeta som läkare och vad som händer på Intensivsjukvården (IVA) här på NSUH, vad som är viktigt att kunna, förstå och kunna hantera för att göra ett bra jobb. Som jag har förstått så är IVAn en mycket utsatt avdelning

   a. Skulle ni kunna berätta hur en typisk dag skulle kunna se ut på IVAn?
   b. Okej, skulle ni kunna ta ett exempel från ett typiskt händelseförlopp om det således finns ett?
   c. Tex under en förmiddag/annat pass

6. Ev. följdfrågor..

   a. Finns det andra exempel på vad ni använder system/datorer till för?
   b. kan du förklara/visa ett exempel?
   c. Ev. Mer ingående på varje del, systemdel

7. Hur upplever du fel-säkerheten (av de du gör)?

   a. Är det lätt att göra fel?

   Intervjun försätter på IVAn i korrekt kontext om möjligt.

8. När du ska börja behandla/ordinera och medicinera en patient, hur skiljer sig Ert/Era beteende i förhållande till patientens tillstånd?
Appendix 2: Interview Questions

9. Hur kommunicerar ni verbalt er sins emellan? Likvärdig "grad" och högre/lägre grad?
   a. Olika sätt/termer? Korta/långa?
   b. Skulle du kunna ge ett exempel på en "mening" /Konversation?
   c. Gäller detsamma när ni kommunicerar via systemet?
   d. Vilken typ av information skulle du säga att ni förmedlar ni er sins emellan? Vad till vad?

10. Vid en ordination mer specifikt, hur går Ni tillväga?
   a. Flera personer, en osv?
   b. Vem är det som bestämmer vad, kan Ni ordinera något på "egen" hand?
   c. Hur lång tid tar vanligtvis en ordination uppskattningsvis?
   d. Hur lång tid tar en konversations uppskattningsvis?
   e. Hur lång tid tar det uppskattningsvis innan ni kan börja ordina när ni satt er vid en dator? Dvs. inloggning osv som krävs.

11. Vad skulle du säga att det finns för olika aktiviteter?

SYSTEMET

12. Systemet ni använder er utav, kan du beskriva hur de ser ut?

13. Skulle du med "förbundna" ögon kunna navigera mig fram genom systemet om jag skulle behöva göra ordenationen?


14. Har ni något mer att tillägga?

Ni får gärna fundera igenom huruvida det är flera frågor, funderingar, åsikter eller värdefull information som Ni har inför nästa samtal.

DEL 2 – MILJÖ OCH KONTEXT

15. De uttryck som ni använder er utav vid ordination och kommentarer, är de konsekventa (likvärdiga för samtliga i teamet?)?

16. Dessa uttryck, hur håller de sig inom ramen för sjukvården?

17. Vilken typ av information förmedlar du/ni via systemet?

18. Finns det några regelverk på vad eller hur ni egentligen får skriva i systemet?
   a. Låt säga, ha en bra kväll, kaffet var gott osv?
19. Vilka typer av "prylar/verktyg" använder ni i samband med en ordination?

20. Datorsystemet och dess tillhörande teknik, hur är de enligt din uppfattning en viktig del som stöd i arbetet för att utföra en ordination?

21. Hur upplever du datorns resurser i arbetet sett till det stöd/underlag som behövs?

22. Hur upplever du teknikens integration/helhet i arbetsprocessen och aktiviteten av ordination?

23. Tycker du att det sättet som ni ordinerar läkemedel idag är ett "naturligt" sätt att utföra aktiviteten sett till miljön ni arbetar i?

24. Hur upplever du fel-säkerheten (av de du gör) i systemet?
   
   a. Upplever du att de lätt blir fel?
   b. Hur ofta uppstår ev. fel?
   c. Vad skulle du säga att ett fel beror på/orsakas av?
   d. Är det möjligt att upptäcka dessa?
   e. Är det möjligt att förhindra/korrigera?

25. Arbetar ni och era kollegor (av olika behörighetsgrad) i samma utsträckning med systemet?
   
   a. Utför ni samma uppgifter?
   b. Kan ni utföra samma uppgifter? Sett till behörighet i systemen inte till personen i fråga, doktor vs. Sköterska

26. Hur ser arbetsfördelningen ut?
   
   a. Är det alltid samma person som gör en specifik uppgift?
   b. Finns det någon anledning till fördelningen?
      i. Sett till medicinsk eller organisationsmässigt sett

27. Hur skulle du säga att arbetsbördan/användandet av systemet ser ut över ett arbetspass?

28. Finns det någon typ av "akut avbryts-knapp"?

INLÄRNING

29. Systemet som helhet, hur anser du att det fyller sin uppgift genom hela arbetsdagen?

30. Hur lång tid skulle du uppskatta att det tog för dig att lära dig systemet? Om du ens anser dig kunna det?

31. Tycker du att du kan systemet?

32. Tycker du att du kan använda systemet fullt ut (som behövs för din roll)?
Appendix 2: Interview Questions

33. Hur upplever du systemet?

34. Känner du dig bekväm i användandet?

35. Hur upplever du förmedlingen av information i systemet?

36. Externa resurser/uthopp och liknande, lätt att tillgodose?

37. Hur anser du att systemet filtrerar ut intressant information?
   a. Är detta något som hamnar i er roll?

38. Anser du att systemet representerar användarnas aktiviteter så att den själv kan ge ett gott stöd, sett till att det istället skulle vara en mänsklig ”maskin”?
   a. Eller är systemet endast ett uppslagsverk/journal?

MEAN / ENDS

39. Sett till system från ditt perspektiv, finns det någon typ av händelse/aktivitet som du upplever INTE går att utföra i systemet?

40. Finns det någon funktionalitet i systemet som inte används eller upplevs som ett hinder?
   a. Om ja, (varför finns dessa och) vad är dess tillsänkta funktionalitet?
   b. Om ja, när och varför används dessa isåfall om ens görs?

41. Finns det aktiviteter eller händelser/åtgärder/ordinationer som det inte finns stöd för, men som det uppenbart behövs stöd för?

42. Finns det några konflikter/hinder i systemet där dina handlingar ger konflikter och behov av ett ”tummande” (justering av) på rutiner för att få det att fungera?
   (Tänker på ordinerade paket vs. allergier och redan orderade läkemedel)

43. Hur upplevs/finns det några begränsningar sett till tekniken som används på i miljön på IVA?

44. Hur upplever du bytet mellan de olika modulerna/uthoppen som stöd för din ordination?
   a. Är det nödvändigt att kontinuerligt göra dessa byten för att skapa en ordination?
   b. Finns det någon hjälp för er att underlätta denna typen av hantering?
   c. Egen quickfix?
Appendix 2: Interview Questions

UTVECKLING

45. När ni använder ett ordinationspaket, tillgodoser ni/det då möjligheterna eller skulle ni lika gärna kunna ha gjort det personligen?
   a. Hastighet vs. bekvämlighet och kompetens?

46. Anser du att du har tillräcklig kunskap/erfarenhet av systemet för att utföra ett fullgott och säkert arbete?

47. Hur upplevde du "upplärnings-processen" av systemet?
48. Var det något som bara kändes naturligt och assisterande eller som ett mörkt hinder?

49. Vad anser du om systemet i sin helhet sett till effektivitet?
   a. hade papper och penna gått fortare?

50. Hur är din inställning till systemet och allmänna åsikt?
   a. Hur upplever du andras åsikter?

51. Som läkare, skulle de gå att helt undvika att arbeta med systemet under en dag om ni tog hjälp av era medarbetare för att dölja eventuell O-Kunskap?
   a. Skulle ni notera detta och erkänna eventuell brist?

52. Slutligen, har du något personligen att tillägga?
   a. Angående hur något fungerar eller som ni anser att man bör kika närmare på?