The impacts of adopting large touch screens and tablets with access to electronic healthcare records

by

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Abstract
In the last decade modern information technology systems have been introduced to healthcare in order to improve it. The aim of this study is to present the impact of such information system’s adoption on patient safety and efficiency within healthcare.

Interviews, observations along with literature study were conducted in order to study the impact of the adoption on patient safety and efficiency at hospital’s wards where a new information system is implemented.

The conclusion of this study is that such information technology systems can improve patient safety. However it is believed that the information technology system can improve efficiency in some aspects such as the communication among medical care personnel while other aspects within efficiency can be achieved if some improvements are made. Moreover the ability to access Electronic Healthcare Records is considered to be important to improve the medical care, which can increase patient safety.
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Contents

Abstract ......................................................................................................................... iii
Acknowledgments ........................................................................................................ iv
Contents ....................................................................................................................... v

Chapter 1 Introduction ............................................................................................... 1
  1.1 Aim of Study ........................................................................................................ 2
  1.2 Problem Definition ............................................................................................. 2
  1.3 Demarcation ........................................................................................................ 2
  1.4 Disposition of the Report .................................................................................. 2

Chapter 2 Background ............................................................................................... 4
  2.1 The Hospital ........................................................................................................ 4
    2.1.1 Ward’s Structure and Information Flow ....................................................... 4
    2.1.2 Electronic Patient Record System, COSMIC ........................................... 5
  2.2 COSMIC Nova Ward .......................................................................................... 5
    2.2.1 COSMIC Nova Ward Board ..................................................................... 5
    2.2.2 COSMIC Nova Ward tablet ..................................................................... 5
  2.3 Introduction of COSMIC Nova Ward ................................................................. 6

Chapter 3 Theoretical Background .......................................................................... 8
  3.1 Electronic Healthcare Records .......................................................................... 8
  3.2 Mobile Computing in Healthcare ...................................................................... 9
  3.3 Work Evaluation Methodologies .................................................................... 10
  3.4 Data Collection ................................................................................................ 10
    3.4.1 Observation ............................................................................................... 11
    3.4.2 Interview .................................................................................................. 11
    3.4.3 Document Analysis .................................................................................. 12
  3.5 Data Analysis ..................................................................................................... 12

Chapter 4 Method ..................................................................................................... 14
  4.1 Pre-Study .......................................................................................................... 14
    4.1.1 User research ............................................................................................ 14
    4.1.2 Stakeholder Research ............................................................................... 17
    4.1.3 First Draft of Impact Mapping ................................................................. 17
  4.2 Post-Study ......................................................................................................... 21
    4.2.1 User Research .......................................................................................... 21
    4.2.2 Second Draft of Impact Mapping ............................................................. 21
  4.3 Data Analysis .................................................................................................... 22
  4.4 Validity .............................................................................................................. 22

Chapter 5 Result ......................................................................................................... 23
  5.1 Pre-Study .......................................................................................................... 23
    5.1.3 First draft of Impact Mapping ................................................................... 23
  5.2 Post-Study ......................................................................................................... 26
    5.2.2 Second draft of Impact Mapping ............................................................... 27

Chapter 6 Discussion .................................................................................................. 30
  Result ...................................................................................................................... 30
  Method Critiques ................................................................................................... 32
    Internal validity .................................................................................................. 32
    Reliability .......................................................................................................... 32
  Future improvements .............................................................................................. 33
  The study in a wider context .................................................................................. 33
# Chapter 7 Conclusion

References

Appendix A

A.1 User Research Interview Questions

A.2 Stakeholder Research Interview Questions

Appendix B

Tina, sjuksköterska

Appendix C

Avdelningsarbete: Tina, Sjuksköterska

Appendix D

Post-study

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 7 Conclusion</td>
<td>35</td>
</tr>
<tr>
<td>References</td>
<td>36</td>
</tr>
<tr>
<td>Appendix A</td>
<td>38</td>
</tr>
<tr>
<td>A.1 User Research Interview Questions</td>
<td>38</td>
</tr>
<tr>
<td>A.2 Stakeholder Research Interview Questions</td>
<td>38</td>
</tr>
<tr>
<td>Appendix B</td>
<td>40</td>
</tr>
<tr>
<td>Tina, sjuksköterska</td>
<td>40</td>
</tr>
<tr>
<td>Appendix C</td>
<td>41</td>
</tr>
<tr>
<td>Avdelningsarbete: Tina, Sjuksköterska</td>
<td>41</td>
</tr>
<tr>
<td>Appendix D</td>
<td>43</td>
</tr>
<tr>
<td>Post-study</td>
<td>43</td>
</tr>
</tbody>
</table>
Chapter 1 Introduction

Modern information technologies (IT) nowadays have great potential in improving health care systems. It is believed that IT systems are presented to increase the quality and the efficiency of patient care and to support healthcare personnel in their daily workflow [5].

Electronic Healthcare Records (EHR) are increasingly implemented within healthcare organizations in order to improve safety of patient care, facilitate information access and improve communication. In spite of the difference in practices within healthcare, the need to access information at point of care can be beneficial. Wide adoption of mobile computing technology can possibly improve information access and workflow, which in turn can reduce medical errors and provide support for healthcare personnel in making decisions [1].

It is out of interest to investigate if those modern information technologies combined with the access to EHR at point of care can improve patient safety and increase efficiency in the daily workflow at hospital’s wards.

In order to cover these issues a study has been conducted at Cambio Healthcare Systems, which will be referred to as Cambio hereafter in the report. The study consisted of two parts: user and stakeholder research, and development of an impact map.

The study was conducted according to a well-known approach, impact mapping (explained in section 3.3), which has been used to develop the impact map when adoption of COSMIC Nova Ward at Enköping hospital, one of Cambios customer. The project focused on the impact of adopting the new product on efficiency, patient safety and mobility in the daily workflow of the medical care personnel at the hospital.
1.1 Aim of Study
To investigate and study the changes in the working procedure and patient safety caused by implementing and starting to use COSMIC Nova Ward. The answers to the question of the research found in section 1.2 are used as a basis; a framework is to be developed.

1.2 Problem Definition
The aim of the study is to answer the following question:

"What is the impact of adopting large touch screens and tablets with access to electronic healthcare records at a hospital ward?"

1.3 Demarcation
Only one approach for impact mapping (impact-map) has been tested as one of the demarcations of this study. However, it could be other approaches that are more suitable to be used.

The time limit of 20 weeks meant that the adoption of the new product did not last long before the post-study was performed. In this case the impacts on the different aspects may not be achieved fully by this stage.

1.4 Disposition of the Report
The report is divided into six chapters:
Chapter 1 – The introduction presents the background and purpose of the study as well as the question of the research and the demarcation.

Chapter 2 – The background describes the system to be used and the information flow at the hospital, to make it easy to understand the context of where the system is used.

Chapter 3 - Theoretical Background introduces the relevant theory of the related work such as the adoption of personal computer assistants in healthcare, and impact mapping.

Chapter 4 – The method describes the data collection, data analysis and validity, then the chosen approach for impact mapping is presented.

Chapter 5 – It presents the result of the study.
Chapter 6 - Discussion introduces the meaning of the results for Cambio, the customer and for this study.

Chapter 7 - Conclusion
Chapter 2 Background

Cambio Healthcare Systems is an e-health company with around 370 employees that deliver the healthcare system Cambio COSMIC [2].

Enköping hospital is located in Uppsala County Council. The hospital is using Cambio COSMIC nowadays and soon it will start to use a new system developed by Cambio, COSMIC Nova Ward, in order to increase effectiveness and patient safety [3].

2.1 The Hospital

The Hospital of Enköping is an emergency hospital for the southern part of the county. The Hospital community works in close cooperation with the University Hospital, Håbo and Enköping’s municipalities. The hospital provides clinical training for future doctors, nurses and other healthcare professionals [4].

2.1.1 Ward’s Structure and Information Flow

The ward, where the study is conducted, is divided into three teams, where each team may consist of a doctor, a nurse and one or two nurse assistants where every team is responsible for a number of patients. In the ward there is a coordinator as well who is responsible for the administrative work, such as booking transportation for patients. Moreover there are physiotherapists, pharmacists, and therapists who are part of the medical team.

The medical care personnel use different sources of information and communication to meet their needs for information. They use verbal communication, paper-based systems and computer-based systems.

In addition a white board is located in the team’s room; it contains each patient’s bed number, different tests and vital parameters that should be taken for a certain patient. Where vital parameters include blood pressure, body temperature, pulse, and breathing rate; which help the medical care personnel in providing healthcare. Besides, there are two different files for each patient, which may contain different sheets used by nurses and doctors. There is also a station computer where the COSMIC has been installed. In the nurses’ reception, there is one more white board
that is designed almost in the same way as the one in the team’s room but it contains
different information such as the healthcare’s weight.

2.1.2 Electronic Patient Record System, COSMIC
COSMIC, or "Compliant Open Solutions for Modern Integrated Care," developed by
Cambio Healthcare Systems, is an IT system for health care. This IT system is an
electronic health record, EHR systems, enabling different care units to share medical
records digitally.

COSMIC is a common platform where there are numbers of different modules. These
modules can be installed independently of each other and all need not be installed for
the system to work. Features found in COSMIC line include healthcare
documentation, referral and response, drugs, surgery and care administration. There
are also modules for statistics, resource planning and psychiatry. The hospital medical
care personnel need the credentials in order to log in and use the system.

2.2 COSMIC Nova Ward
This section describes the new system COSMIC Nova Ward that is to be used in the
hospital by the target group, nurses and assistants.

COSMIC Nova Ward consists of two applications: COSMIC Nova Ward board and
COSMIC Nova Ward Tablet. The COSMIC Nova Ward board is designed for touch-
screens and it can be used for scheduling, ward planning, and assigning tasks etcetera.
While COSMIC Nova Ward Tablet is designed for running on tablet devices assisting
users in performing tasks during their daily work.

2.2.1 COSMIC Nova Ward Board
COSMIC Nova Ward Board consists of a number of views providing patient and
personnel information displayed on a big screen. In addition to viewing information,
ward personnel can tap different objects on the screen in order to add, update or
remove information regarding patients, schedules, task assignments etcetera.

2.2.2 COSMIC Nova Ward tablet
COSMIC Nova Ward tablet complements COSMIC Nova Ward board in presenting
information about admitted patients at a hospital ward, it is integrated and
synchronized with COSMIC. This means that changes will be updated simultaneously in COSMIC, in COSMIC Nova Ward board and COSMIC Nova Ward Tablet.

A summary of patient information is displayed on a touch screen operated tablet. The target group within hospital medical care personnel can bring the tablet and use a number of different views to gain quick access to checklists, patient's medical records, orders and list of medications. The tablet can also be used for entering patient information, activities and values to the Medical record table window in COSMIC.

![Nova Ward Tablet used by a nurse](image)

**2.3 Introduction of COSMIC Nova Ward**

Cambio has provided training and education to the hospital personnel so they can become familiar with the system. A project group was created, which included super user from each ward where the system will be used.

Super users had the chance to practice to use the system for few months before it was installed. During this time they helped to apply the configuration by identifying what information is needed based on each ward’s needs and different exercises to be applied with help of COSMIC Nova Ward. Moreover they helped to identify the new routines to be used after the implementation.
In this way the super users become familiar with how the system works and its different functions. The super users held seminars for the medical care personnel within the ward; the groups consisted of a few nurses and/or assistants. This is in order to explain how the system works and the new routines created by the use of the new system. During the seminars the medical care personnel had the chance to perform different tasks provided by Cambio that is derived from real situations that may occur. In this way they could test the system and the different functions provided.

Moreover personnel from Cambio were available at the ward during the first days of the implementation.
Chapter 3 Theoretical Background

This chapter presents the theoretical background including the use of information systems within healthcare, electronic healthcare records and related methods to the case study.

3.1 Electronic Healthcare Records

As read in [7], Electronic Healthcare Record (EHR) can be defined as a digital collection of patient health information collected at one or more meetings in any care delivery occasion. A patient’s record typically includes patient demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory and radiology reports. The term EHR is often used to refer to the software platform that manages patient records maintained by a hospital or medical practice.

EHR has increasingly been used in healthcare to improve the safety and patient care but clinicians must use EHR in order to achieve these goals. Therefore it is important to consider the use of EHR in clinical workflow during the early phases of planning for the sake of improving the integration of the system into routine clinical use. Clinicians spend the majority of their time providing direct care to patients and the main objective is that HER access could increase this patient-interaction time and consequently the quality of care delivered [8].

As mentioned above in [8], time efficiency is one of the many benefits of using EHR, but equally inefficiency is the main barrier of a successful implementation of EHR. It’s unlikely that such implementation would decrease the documentation time, though it can lead to time saving in other activities such as access to patients’ charts or maintaining report form. Hence, evaluating the impact of EHR on a set of work processes and outputs. Such as the efficiency of communication among healthcare personnel, and measured by patient outcomes such as reduction in medication errors, and lower readmission rates. It could potentially result in motivations to the physicians; meaning that, shifting from the user’s efficiency to the organizations’ or even the system’s efficiency is needed [8].
3.2 Mobile Computing in Healthcare

The need to access information at the point of care is universal among the healthcare professionals in spite of the differences in practice environments. Most clinicians would benefit from mobile computing resources, such as evidence based guidelines, medical reference, drug reference and patient information in order to meet their need to access information. Mobile computing adds usefulness to clinical practice in many ways, such as giving clinicians access to clinical information at the time information is needed, and by improving the exchange of information. This can result in reducing medical errors resulting from insufficient access to clinical data, and by providing clinical decision support to give clinicians feedback at the point of care [5].

In the last few years Personal Digital Assistants (PDAs) have been used in healthcare, PDAs can be defined as handheld minicomputers that can be used to perform different tasks such as referencing, documentation, and data storage and retrieval [5].

Numbers of systems started to appear for all types of PDAs that enable recording and tracking the information of the patient. PDAs allow information to be both entered and accessed at the point of care, they also provide the possibility to enter the information independently from a central repository by allowing "synced" data through the use of a wireless or wired connection [6].

Mobile computing allowed by PDAs is becoming an important tool in healthcare and has grown in popularity among healthcare professionals during the last few years. The aim of using a wide range of mobile devices by healthcare professionals is to improve efficiency and effectiveness in the delivery of patient care [5].

According to [5], there are many benefits of using PDAs in healthcare, for example it includes offering clinicians mobility, providing real-time access to data and information, reducing medical errors, saving time, supporting evidence-based practice, enhancing productivity and quality of care, and providing a tool for communication.

However, according to [5], there are other factors to be considered necessary to increase acceptance and use of PDAs. Better designed PDA hardware and software applications, more institutional support, seamless integration of PDA technology with hospital information systems, and satisfactory security measures are examples of such
Despite the different benefits of using PDAs in healthcare, as read in [5] which found that there are still a number of barriers that can discourage healthcare personnel to adopt PDA usage. Small size, battery time, memory storage, and uneasy data access are examples of such barriers that may result in less adoption of PDAs. Some of those obstacles can be solved organizationally, by providing a necessary infrastructure for the handheld, technical support, and more education and training.

As mentioned earlier in [6] the handheld technology has much to offer to the improvement of the electronic healthcare record by allowing users to access the information at the point of care. Synchronous data with the hospital system is a necessary component of a successful implementation.

3.3 Work Evaluation Methodologies
As mentioned in [9], there are many questions to be considered during evaluating the impact of computers on work patterns, including:

1) How and by whom the system was used?

2) How much time was spent using the system?

3) What was the effect on the other work-related activities?

4) How long should it take to use the system?

5) How can the work patterns, environment, and/or the computer (i.e., the input/output devices, placement and/or numbers of devices, software options and/or data entry flow, and etcetera) be improved to utilize the knowledge of each member of the healthcare team and training to its fullest extent? [9].

In this study the focus will be on the first and the fifth question mentioned above.

3.4 Data Collection
The collection of data during a study can be quantitative or qualitative. Quantitative means that data collected in terms of numerical values that is analysed by using statistical methods. Qualitative data involves descriptions, words and feelings etc. [12].
Qualitative data analysis usually derives from fieldwork where three types of data collection can be used: interviews, direct observations, and written documents [13].

Aforementioned in [12], there are different sources of information and it is recommended to use more than one source of collecting data in the case study. In this way the conclusion based on few sources is stronger than the one based on one source.

Above mentioned in [12], there are different levels of techniques used to collect data. The first level is direct method where a direct interaction with the subject exists and the data is collected in actual time. The second level is where the researcher collects data without actual contact with the subject. The last level involves independent analysis where data is already available and compiled.

3.4.1 Observation
Observations are used to investigate how the persons of interest perform the task. They are considered as a first or second level technique for data collection [12]. When the researcher does not interfere or interact with the subjects to study during the observation, it is then considered a second level technique. It is considered as a first level technique when the researcher interacts with the subjects to study, for example by asking questions about what the observant is thinking. A benefit from observations is that they may provide a deeper understanding of the situation to be studied [12].

3.4.2 Interview
According to [13] the fact is that not everything can be observed. For instance thoughts and intentions are hard to observe. Thus, the aim of the interviews is to allow observing the others’ opinions from their own perspectives.

As [13] mentions, there are three different types of interviews. Interviews can be informal conversational interviews, the general interview guide approach or the standardized open-ended interview. The first type is also called unstructured interviews, where the questions are formulated during the interview. Further the standardized open-ended requires preparation of the questions before the interview. The general interview guide approach lists the questions or issues that are to be
explored in the course of an interview. This provides topics to be discussed during the interview but is free to explore. Thus the interviewer is free to create a conversation within a certain topic.

3.4.3 Document Analysis
This can been considered as implementation of a third level technique, where it means to study available documents which serves a certain purpose. Such as requirements specification or failure reports from an organization that can be analysed. Where the researcher can not control the quality of the documents and can base the analysis only on the available information [12]. Such documents that were analysed under this case study are personas¹ and storyline² that were developed by Cambio. The researcher analysed the documents in order to gather information needed. For further details, see section 5.1.3.4 Usage goals.

3.5 Data Analysis
There are different ways of analysing data depending on if the collected data is quantitative or qualitative. Quantitative data can be analysed by descriptive statistics analysis, correlation analysis and hypothesis analysis. The basic objective in analysing qualitative data is to derive conclusions from the data through maintaining a clear chain of evidence. It is also recommended to conduct the analysis during the process of collecting the data though this approach is flexible and new insights may appear during the process [12].

Unstructured data from a field study cannot be beneficial in any project. If the observations and ideas can be compiled and a theme can be found that connect all the collected data, this can result in that the design team can find insights to build the project on. The first step in data composition and analysis is to create an affinity diagram [10].

¹ Personas are prototypes that describe the various goals and observed behaviour patterns among potential users and customers.
² Storyline is a description of the future based on set of assumptions, focusing on ideal system behaviour in situations that will happen.
Affinity Diagram is a method of categorization or a thematization of data, which is considered a common method to analyse qualitative data. Affinity means kinship where the different facts are gathered and extracted from the notes to be classified in groups that seem to belong together [10].
**Chapter 4 Method**

This chapter presents the method used throughout the project. The first step was to identify the goals of this project; therefore a user and stakeholder’s research was performed in order to gather the information needed. This was followed by a summarization of the goals to be gained from the adoption of the new system from both the users of the system and the stakeholders; in addition impact mapping methodology was used. The research helped to develop the method used in this project as followed below in details.

4.1 Pre-Study

The pre-study consisted of a user’s research, and a stakeholder’s research. A combination of interviews and observations is used in the user’s research; moreover time-motion analysis is also applied. The stakeholder’s research included interviews, which was followed by data analysis in order to analyse the gathered data. Among the existing methods, an impact mapping method is used to conduct this study.

4.1.1 User research

A qualitative approach is applied through interviews and observations in order to gain understanding of the user. The combinations of interviews and observations will allow rich, useful information to be gathered quickly while minimizing self-reporting errors [16].

4.1.1.1 Interview

In order to really understand the interviewee and not only to get answers on the questions asked, some principles are considered during the interview. First, it is important to ask open questions to make the interview more like a conversation and not an interrogation. Furthermore, it is vital to be a concerned and receptive listener, taking into account nonverbal cues. The interviewer should also preferably not ask leading questions or ask about solutions if this is not found to be absolutely necessary. It is recommended to ask these questions at the end of the interview in order to let the interviewee react naturally and spontaneously with the subject [16].

The standardized open-ended approach is used in the user’s research, where the main topics and relative questions were decided in advance; however the possibility of exploring new questions exited based on the conversation. The user’s interviews are conducted in the environment where the product is to be used. The context and the
items in it help the interviewee to remember correctly and to be more specified and
detailed when answering questions.

Four interviews were held with the users of the system who had different roles in the
adoption process of the new system. Two of them are nurses who have the position of
deputy director at the departments where the system will be used. The third interview
was conducted with the project leader at the hospital, and the last one was conducted
with the contact person at Uppsala County. The choice of those different roles was to
gain a broader understanding and to capture the different effects that are expected
from different perspectives.

Three of the interviews were conducted in person at the hospital, while the fourth was
held through the phone due to the location of the interviewee. All interviews were
held in Swedish and took half an hour to complete depending on the answers and the
complementing questions. The interviews were documented by recording equipment.
This made it easier to go through the interviews afterwards and transcribe them for
further analysis.

This type of interview is considered suitable in order to gain an understanding of the
users’ situation and thoughts, by having a dialog while focusing on predetermined
topics. The English version of the questions can be found in appendix A.

4.1.1.2 Observation and Time-Motion Analysis
As read in [17] the “Shadowing” technique is presented, where the observer goes to a
location and observes the subjects through their routines, what actions are taken
without disturbing the process. It is important to assimilate in the environment where
the subject is being observed, in order for the subject to behave as normal as possible.

Time-motion analysis is considered one of the work sampling methodologies where it
enables management to observe the time spent by the staff on the different tasks,
which in its turn can help to improve the quality of the medical care provided. It
involves a direct observation of a task by taking time that is needed to accomplish the
task [9]. Where an observer who takes time spent on each activity carries out this
analysis [7]. Such a method involves a small size sample but has a possibility to
capture a large amount of data [14]. Moreover it is used to compare two different work patterns that generate the same result, which is considered appropriate for recurring tasks [9].

The researcher had no experience of healthcare that is why two occasions were used to observe and understand the context of the daily workflow. The researcher had matching clothes to nurses in order to blend in and be a part of the natural context. This is to minimize the Hawthorne\(^3\) effect and to capture the activities in the natural context.

In total six observations were conducted in the pre-study. One nurse was observed twice, since it was not possible to arrange another observation because of time limitation.

The observations were performed during the day shift which starts early in the morning and ends in the afternoon. Everything was documented in paper during the observation by using a small notebook. The notes were analysed according to affinity diagram, in this way it was easier to capture all possible patterns.

The five different nurses were observed according to time-motion methodology. Each activity within the daily work has a starting and ending time point. If the activity was interrupted then it was noted as a separate activity with its own starting and ending time point [15].

The main categories are:

- Direct Care, which may include communication with the patients, medical activities and reading patient’s records.
- Indirect Care involves all tasks related to patient care indirectly.
- Personal, personal time such as lunch or breaks.
- Unit-Related are activities related to general maintenance of the nursing unit.

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\(^3\) Hawthorne effect concerns research participation, the consequent awareness of being studied, and possible impact on behaviour. [15]
An *excel* document as well as a *word* document were created and tables were generated for each nurse with the four major categories.

“Shadowing” technique was used during the observations in order to capture all the possible moments that were considered significant and may affect the impact goals.

### 4.1.2 Stakeholder Research

Interviews with stakeholders can be conducted to gain a better understanding of the user research. This gives the interviewee an overview of the goals and objectives for the product [16].

Four stakeholder interviews were conducted with different people at Cambio who were involved in the COSMIC Nova Ward development. Three of the interviews were performed through conferencing due to the location of the interviewee. All interviews were held in Swedish and took from half an hour to one hour to complete depending on the answers and the additional questions. All interviews were audio recorded to facilitate transcribing and coding. An analysis according to affinity diagram was performed to extract the impact goals.

### 4.1.3 First Draft of Impact Mapping

Impact mapping is an effective method for strategic planning that supports organizations to make an impact with software. When there is a list of impact goals, project goals and user experience goals, then it is an advantage to draw the relationship between them. By using goal tree analysis the relationship between the different goals can be identified as seen in figure 1 below [10].

The impact map is a specific type of goal tree to achieve impact mapping. In this approach the focus lies on conducting interviews with the stakeholders and decision makers about what could be improved after the product is used [10].

According to [11], an impact map describes the desired effects from the product and how those effects could be achieved. The purpose of this method is to answer the questions below:

- *Why are we developing this product?*
- *Who can create the desired impact?*
• What do the target groups want and need?
• How are the product and operation to be designed?

Figure 1: The different questions to be used while developing the impact map

3.3.1 Impact Goals

The goal is formulated in one sentence and must be connected to one or more of the commercial goals. A number of measurement points are to be linked and should describe how the desired effects are to be measured [11]. This part of the method is connected to the why part seen in figure 1 and can be answered by the question why are we developing this product?

In order to identify the impact goals that are to be achieved from the adoption of the new system, interviews with the developers of the product, decision makers and possible users were held. The interviews were then analysed according to affinity diagram to extract the desired effects.
3.3.2 Measurement points
The measurement points describe how the aim and usage goals have been achieved. Usage goals provide the greatest contribution to the desired effects arising and they should have one or more measurement points. Three criteria must be met in the measurement points; a parameter deemed relevant to indicate that the operation is about to fulfil the goal. A numerical value for the parameter and a way of measuring, i.e. a plan for how the measurement is to be implemented [11].

A qualitative approach was used to measure the impact goals. The main measurement point consisted of interviews with the users after starting using the product.

3.3.3 Target group
The definition of target groups is; people with similar needs and expectations in relation to a product. In order to identify these groups, an analysis is carried out in order to answer the question: which user can create the desired effects? [11] This is linked to who part in figure 1, which can be answered with help of the question who can create the desired impacts?

This step of the process was not conducted throughout the project. The main target group for this product is nurses at a hospital ward. Cambio has already created personas for the developing of the product, which resulted in that personas were not developed during the project. Personas are presented in Swedish and can be found in appendix B.

3.3.4 Usage goals
Usage goals describe the different targets the groups need or should expect, and what should happen in order to attain anticipated effects. Usage goals should contain the keywords “Must”, “Need”, and “Want” and it is significant that the target group has one or more usage goals [11]. This is linked to what part in figure 1 above, and the different usage goals can be identified with the help of the question what do the target groups want and need?

The usage goals were developed with the help of storyline, based on the questions below:

- Which needs do the users have in their current usage situations?
• What is their motivation for carrying out the work?
• What are the expectations of the users to achieve from an operational perspective?

Those questions facilitated to extract the different usage goals from the storyline, where affinity diagram was used to analyse the document and find the answers to the questions mentioned above. The storyline is written in Swedish and can be found in appendix C. Moreover the gathered information during the observations was used to complete the analysis.

3.3.5 Actions
Actions define what needs to be done in order for a certain usage goal to be achieved [11]. This is linked to the how part in figure 1 and can be answered by the question, how the product and operation to be designed?

The different actions, that support the achievement of the various usage goals, were identified by analysing the design of the system and the different functions the system provides. The actions were grouped and connected to the different usage goals. Each action supported one or several usage goals to support.

3.3.6 Verifying the model
As mentioned in [11], regardless of the aim of the impact map, a verification must be performed to ensure that desired effects, usage goals, and actions etcetera are on the right track. There are several questions that can be used to verify the aim, usage goal and actions are leading in the right direction. A good way to verify the model is by asking oneself, for example do the measurement points describe the expected effects? Or is this usage goal really a description of a function?

The author asked the questions below throughout the project, the first question was asked to the product manager at Cambio where the study was performed.
• Does this goal describe what the users and stakeholders want to achieve?
• Do the measurement points describe the expected effect?
• Is this usage goal really a description of a function?
• Are there other actions that make better contributions to the usage goal?

The impact mapping method is used to extract the effects of using the new system at the hospital, where the impact map describes the link between the desired effects and
the selected product design. This link is built on the resulted effects during usage; the target groups and their needs are therefore to be met [11].

4.2 Post-Study
The post-study was conducted after the system was adopted at the hospital. It consisted of user research where interviews were performed. In addition the second draft of impact mapping was generated, by modifying the first draft.

4.2.1 User Research
Interviews with the users of the system were held during the post-study. The interviews were held after the interviewees had used the system in their daily work for a period of three months. The system was used for adding the different task to be performed by the medical personnel. In addition it was used to report the daily work and exchange of information among nurses and medical care personnel within the ward.

The choice of the participant in user research should be varied, in order to cover all the possible users’ rolls. That is why the interviews were held both with the super users who received more training and regular users who were not as familiar with the system as the super users. Three of the interviewees were involved in the adoption phase from the beginning, and are using the system nowadays. The other two interviewees were regular users of the system; this is in order to capture all the possible aspects from both the regular and the super users.

In order to register further reflections on how the system affected their daily workflow; the standardized open-ended methodology was used. It was decided to hold five interviews within different wards in order to analyse the different factors that may affect the usage of the system. These factors could influence the acceptance of the system and might lead to a different achievement grade of the impact goals that were earlier extracted in the pre-study. The questions can be found in appendix D.

4.2.2 Second Draft of Impact Mapping
The first draft of impact mapping that was developed in the pre-study was modified. This was done by analysing the gathered information from the user research and interviews, which helped to modify the different parts in the impact map. Most of the
methodology’s phases were not modified such as target group, measurement points, and usage goals as it was already decided in the pre-study. However the impact goals were modified based on what was achieved from the adoption of the system.

4.3 Data Analysis

All the interviews were recorded and transcribed in order to make it easier to analyse and find possible patterns. Affinity diagram is used to conduct the analysis on the data that was collected during the research.

The different categories of tasks performed by the nurses as well as the time they needed to fulfil those tasks was used as a method of data analysis during the observations [15].

4.4 Validity

The validity indicates the reliability of the results; to what degree the results are true and subjective. The validity must be considered during the whole process of the project but it can finally be evaluated in the analysis phase [12].

As mentioned in [12], there are four aspects of validity; construct validity, internal validity, external validity and reliability. Construct validity reflects to which extent the operational measures really represent what the researcher has in mind and what is investigated according to study questions.

Internal validity includes the aspects of whether the results reflect reality. External validity defines to what extent the results are generalizable and how interesting the findings are for people outside the studied case. Finally, reliability concerns the impact the researcher has on the result [12].

One way to achieve high internal validity is by using the triangulation method, which is well suited for qualitative study [12].
Chapter 5 Result

This chapter presents the results of the conducted study, which includes the process of developing impact mapping. It also presents the final impact map that was developed for answering the aim of the study.

5.1 Pre-Study

This part of the study case consisted of observations, interviews with both the users of the system and the stakeholders responsible for the development of the system. This resulted in the first draft of the impact map, which will be presented below.

5.1.3 First draft of Impact Mapping

5.1.3.1 Impact Goals

The two main objectives according to both Cambio and the users were that the new system should lead to increased patient safety and efficiency in the daily work. Moreover the system should also increase the mobility.

All the interviewees considered that patient safety was the most important goal to achieve from the adoption. As one nurse said “It will become more visible for everyone that this task is not completed yet”.

Efficiency in the daily workflow is considered important as well, thus by having effective communication and easier access to information, the medical care personnel can focus on the patients and their needs. As one interviewee said “it will be easier to find information for all medical care personnel just by logging in to the new system and retrieve specific information for each patient and the different medical care needs and treatments”.

Whereas mobility means that the access to information can be reached at the point of care with the help of the mobile devices. The mobility goal is important according to Cambio, where the possibility to access the EHR in order to provide help for the clinicians during medical decision-making. As one interviewee said “We work with post-treatment documentation, the medical care staff examines the patient and the documentation takes a place at a later stage. Why not examine and document at point of care?”
Additional detailed sub goals to the first two impact goals follow below:

<table>
<thead>
<tr>
<th><strong>Increased patient safety</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Less risk that activities/assignments are being forgotten</td>
</tr>
<tr>
<td>Information is visible for everyone and up to date</td>
</tr>
<tr>
<td>Less risk that activities/assignments get deleted from the white boards</td>
</tr>
<tr>
<td>Less risk that patches get lost and unauthorized person gets sensitive information</td>
</tr>
</tbody>
</table>

Table 1: The first impact goal

<table>
<thead>
<tr>
<th><strong>Increased efficiency in the daily workflow</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Less time on updating patches and white boards</td>
</tr>
<tr>
<td>Better communication and information exchange</td>
</tr>
<tr>
<td>Vital parameters reporting directly in the system</td>
</tr>
<tr>
<td>Easy access to information when needed</td>
</tr>
<tr>
<td>Patient related information</td>
</tr>
<tr>
<td>Information about patient’s state or relevant information in general recently added by others in the medical care personnel.</td>
</tr>
</tbody>
</table>

Table 2: The second impact goal

### 5.1.3.2 Measurement points

This part consisted of interviews with the users in order to measure whether the main impact goals were achieved after the implementation of the system. Where the three main impact goals are considered as key topics during the interviews:

- Increased patient safety
- Increased efficiency in the daily workflow
- Provide mobility

### 5.1.3.3 Target groups’ analysis

As mentioned before, see section 4.5.3.3, the target group’s analysis was already conducted by Cambio and thus it was not developed throughout the study.

### 5.1.3.4 Usage goals

A usage goal describes what the different groups need or expect, and what should occur so the desired effects are achieved. With the help of personas and the interviews the usage goals have been identified. The affinity diagram was used in grouping the different needs and a title is created for each group of needs that were connected to
each other. The usage goals were identified within three different areas, as seen below:

1. **Information access**: medical care personnel need access to the information at care point without the need to move to the computer or to the white board to study information about the patients.

2. **Patient communication**: more communication with the patients is needed; by having good communication and direct access to information they can spare time and focus on the patients. The oral communication between the nurses and patients is used, where the patients ask the nurses about their medical condition, moreover the nurses may provide the patients support and special care.

3. **Reporting**
   1. The medical care personnel must report their work; by passing needed information to the next shift or to other members in the medical care personnel.
   2. Easier to detect the uncompleted tasks
   3. Easier to find reports from other members
   4. The need to quickly report treatment, for example an assistant must report to the nurse about the vital parameters if they were taken or not and the results.

### 5.1.3.5 Actions

How the system functions in order for the users to succeed in performing their work in a way, which creates the desired effects. Thus the different functions that the system provides in order to facilitate for the users to achieve their needs and expectations. By having this in mind, the different actions were derived from the design of the system.

**Usage goal 1: Information access**

**Action 1**: The ability to view relevant information about the patient by providing electronic healthcare records.

**Action 2**: Synchronized to the hospital system and the board in the nurses’ expedition.

**Usage goal 2: Patient communication**

**Action 1**: Access to the electronic healthcare record
Action 1.1: ability to view test results and other information about the patient.

Usage goal 3: Reporting

Action 1: Make it possible to see one’s own assignments.

Action 1.1: Can be used, as one's own checklist.

Action 2: Possibility to see others’ assignments connected to a certain patient

Action 2.1: Providing different views such as ward’s view, patient’s view, team’s view, staffing’s view, bed management’s view.

Action 3: The possibility of inheriting undone task from the day before.

5.1.3.6 Verifying the model

See section 5.2.2.6 for further details, thus this part of the impact mapping is performed in the post-study.

Figure 2: First draft of the impact map developed under the pre-study

5.2 Post-Study

This part of the case study consisted of interviews, which helped in modifying the first draft of the impact map that was developed earlier; see section 5.1 for further details. Interviews were performed in order to capture the user’s experience of the adoption and its impacts on the main goals that were extracted during the pre-study.
5.2.2 Second draft of Impact Mapping

5.2.2.1 Impact Goals

According to the interviewees the increased patient safety was the main goal achieved among the wards. As one of the interviewee said “I can make a to-do list in Nova, where I can add the different tasks for the day, I can check them when they are completed. Moreover the risk of a task being missed between the shifts or during communication between medical care personnel is less when the list is visible to everyone. This helps to increase the quality and the safety of the patient care”.

Thus the system provided the possibility to add the different activities that can be seen by the medical care team within the ward. Moreover the possibility of activities getting erased from the white board has disappeared. Hence Nova Ward tablet is a digital screen that contains the same information as the old white boards. However the usage of paper patches has not disappeared completely as was desired.

The second impact goal, efficiency, was not fully achieved. As one of the interviewee said that “we can add the different tasks during the round with the doctor and they can be noted by the nurse sitting in the expedition. Compared with before the adoption of the new system, when we had to report to the rest of the medical care personnel after the round with the doctor”. And as another interviewee said “it is faster to spread information to others, when you add a task everyone can see it directly”.

“It takes long time to upload the EHR which creates frustration among the medical care personnel”. This was mainly because of the performance issues related to the PDA where the system is installed on.

Moreover mobility impact goal is not applicable because of the technical problems that resulted in the difficulty of accessing needed information at the point of care. Moreover the medical care personnel across the various wards need to access different parts of the EHR based on the nature of medical care provided.

The modified impact goals that were extracted in the post-study are presented below:

<table>
<thead>
<tr>
<th>Increased patient safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less risk that activities/assignments are being forgotten</td>
</tr>
</tbody>
</table>
Information is visible for everyone and up to date
Less risk that activities/assignments get rubbed from the white boards

Table 3: The first impact goal

<table>
<thead>
<tr>
<th>Increased efficiency in the daily workflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Better communication and information exchange</td>
</tr>
<tr>
<td>Information about patient’s state or relevant information in general recently added by others in the medical care personnel.</td>
</tr>
</tbody>
</table>

Table 4: The second impact goal

5.2.2.2 Measurement points
This part consisted of interviews with the users, which resulted in modifying the impact map. See figure 3 for more details.

5.2.2.3 Target groups’ analysis
As mentioned before, see section 4.5.3.3 the target group was already conducted by Cambio and thus it was not developed during the study case.

5.2.2.4 Usage goals
There were no new usage goals to extract during the post-study, see section 5.1.3.4.

5.2.2.5 Actions
This part of impact map was already developed during the pre-study. Because there are no new actions, this part was not modified; see section 5.1.3.5 for further details.

5.2.2.6 Verifying the model
This is done in the post-study when the users start to use the product in their daily work. As the researcher was the only author in this study, the question was asked both to the author herself and the product manager at Cambio throughout the study, see below:

- Does this goal describe what the users and stakeholders want to achieve?
- Do the measurement points describe the expected effect?
- Is this usage goal really a description of a function?
- Are there other actions that make better contributions to the usage goal?

The questions above facilitate in checking the model and the different parts of the impact map. The first question was asked to the supervisor at the company while the second and third question were asked by the author in order to be self-critical.
Where the last question helped in providing improvements that was extracted from the interviews, which can be seen in section 6, future improvements. The second draft of the impact map follows bellow.

**Figure 3**: Second draft of the impact map modified after the post-study
Chapter 6 Discussion
The discussion section is divided in four parts; the first part discusses the result, the second part reviews the method that was used during the study and the third part presents the future improvements, and at last the fourth part discusses the study in a wider context.

Result
As mentioned earlier, the system consisted of a touch screen that is placed in the nurses’ expedition and a tablet that the nurses carry with them. The medical care personnel across the wards interact with these two parts of the system differently. For example, in the surgical ward, the interaction with the tablet is more than the touch screen; in another ward they use both of them. That is due to the variety in the medical care provided in the ward as well as the size of the ward.

As the interaction’s degree with the system differs among the wards where the system was implemented, the benefit of the different system’s parts also varies within the same hospital.

Increasing the patient safety and the quality of the medical care are the common goal among those wards. The ability to see the activities attached to a certain patient is essential for the medical care personnel. In this way, the misunderstanding in communication is decreased, as one of the interviewee said: “I thought that you understood that this should be done”. Such situation of lack of communication experienced could be avoided when the activities are visible and everyone can see what is has to be done.

The system helps to view the uncompleted activities by providing the inheritance possibility, which reduces the risk that an activity might be missed or forgotten. Such activities are considered essential to take care of the patients and to provide better medical care.

The existing system provides the ability to access the EHR, test results and enter the vital parameters at the point of care. As mentioned in [7], the access to EHR and
relevant information increase the quality of medical care provided which in its turn increase the patient safety, however it doesn’t decrease the time spent on documentation. The EHR is viewed in a chorological order, which is not practical for those wards where the system is implemented. Thus the medical care personnel wants access to a different view of EHR in addition to the current view provided.

As mentioned in [18] “In addition, some of these information systems have made routine tasks very difficult for users, while staff could do their job much easier using manual methods. As a result, staff may resist using them and this resistance may lead to the failure of the systems.” It takes time to download EHR, which caused some resistance among the medical care members and using the paper patches still exists to register the needed information instead for retrieving it with the help of the tablet.

The system facilities avoiding activity duplication, thus it is visible when an activity is done and checked off from the list. In comparison to the previous working method, when everyone had their own paper patch, in which they choose to write the various activities. Even if you check off your activities, no one else but you can be able to note that. In addition the staff need to report to others in order to keep them updated.

As one of the interviewee mentioned “I want to access the same information that everybody else has”. Thus the daily work consists of exchanging relevant medical care information about the patient. The ability to note the different activities leads to spare time spent on searching for each other in order to report and check whether they have completed a specific task.

An example is if the tablet is used during the round with doctors, the need to report to others is reduced, thus those recently added activities can be viewed on the touch screen in the expedition. In addition if the different activities are entered from the beginning, it can spare time in the end even though entering those activities take time in the start. But this is not suitable for all the wards, for example in the surgical ward the round is very short and there is no time to enter the activities while participating in the round.
Method Critiques

Internal validity

• Due to the limited time of the case study, the number of interviews was decided to be five in total. In the user research, more interviews with the users of the system would be preferable. That is due to the diversity in the activities performed within the medical care, which can lead to the result not reflecting reality in this project. But due to time constraints this couldn’t be accomplished.

• Time-Motion analysis would also be applied in post-study part of the study but due to complications in the adoption, it was not possible to apply this approach. This is why only interviews were performed, in order to capture the user’s experience of the adoption and its impact on the main objectives that were extracted during the pre-study.

• The method impact mapping should be used before the implementation of the system, thus this method is used as a management tool in order to ensure that projects are on the right path. In addition it can be used to see if the project achieved the desired outcome, and how different mistakes could be avoided in the future. But due to the fact that the system was already developed when this study was conducted, few modifications were performed in order to be able to use the method. The method was used to study the adoption phase of the system and whether the purpose of the system was fulfilled.

• Moreover the change in how the medical care personnel work, by using a new system and stop using paper patches, could take some time. All that can lead to the grade of usage acceptance of information systems taking time before achieving the expected effects. This could be considered essential, that the post-study should be conducted after more than one month of the implementation and usage of the system.

Reliability

While using interviews, there is always a risk that inexperienced interviewer can affect the result of interviews. The standardized open-ended approach with predetermined topics was used and leading questions were avoided, but still there was a risk that the interviews were not performed optimally. All interviews and observations were performed in Swedish. The author was focused to keep the
intention of the statement translated to them.

Being a single author in this case study resulted in getting familiar with the situation and the information, being objective during the process was difficult.

**Future improvements**

Some future improvements are presented below, which were derived from the qualitative research and the author observation.

The first improvement is to spend more time on the adoption of the new system, where training of the medical care members can be provided before the adoption phase starts. The training can be arranged differently, for example by having the possibility for super users to use the system in real situations. In this way they can build an understanding about how the new system can be used. Moreover providing real situations where the system was used in other wards during the training sessions can help in better understanding the system.

In addition the medical care members should be encouraged to use the tablet instead of pen and paper when receiving information about the patient. This can result in learning the system more thoroughly and become a part of the daily routines, which may decrease the resistance among the medical care personnel.

**The study in a wider context**

The ability to use a handheld device in the ward, which contains the needed medical care information, seems like as a convenient way to retrieve information about a patient, in comparison to the current systems, using a stationary computer and papers to register information, where medical care staff needs to run back and forth in order to retrieve information. For example if a patient asks about a blood result or if he needs to be scheduled for radiographs or any other treatment. The medical care staff may need to retrieve information by going to the expedition in case they didn’t register the information earlier.

A risk in using such IT systems is that information about the patient can be spread to unauthorised persons resulting in violation of integrity of the patient.
The current development within technology may resolve this issue; in the same time using security mechanisms should not affect the ease and availability of the product. Moreover the human factor is one of the biggest threats to such mechanisms that cannot be controlled, as the system is to be used in the daily work, where the possibility of irresponsible use of the system may result in spreading information to unauthorized persons.

Another risk with the system is that the contact with patients may decrease when medical care personnel retrieve information during the examination. This can be considered as unpleasant experience both by the patient and the nurse, where the handheld device could function as an obstacle while fetching the needed information. As one of the interviewee said “It feels like disrespect to the patient that I hold the PDA while I speak to him, it comes in the way of the eye contact.” It is a risk that the use of PDAs could worsen the medical care in that the contact with the patient decreases.
Chapter 7 Conclusion

The conclusion of this report is the adoption of the Nova Ward affected three different aspects: patient safety, efficiency and mobility in different degrees. In addition there are different factors that resulted in different grades of interaction with the new system.

The different factors, such as variety in the task characteristics and the context where the system is used can affect the acceptance and the usage of the new-implemented system. Increasing the patient safety by the possibility to see other’s activities and have shared activities’ lists is considered the main advantage of the new-implemented system. Providing mobility and access to EHR are to be achieved if modifications are made to the current system. This is by providing an extra view of the EHR that matches the need of the different wards. Patient safety was achieved from the adoption of the system and the other two impact goals, namely efficiency and mobility are probably to be achieved if improvements are made to the current system; however further investigation will be needed to explore this possibility.

In order to be able to generalize this study, a larger study is required by performing the qualitative research approach with more users, which can be performed after a longer period of time than one month.
References


Appendix A

A.1 User Research Interview Questions

Presentation

• My name is Allaa Al-Omaishe and I am writing my master thesis for Cambio. The study is about Nova Ward adoption and I am interested in knowing what are the impacts of the adoption according to you. I will use this information in the further development of the impact map.

• Is it OK if I record the interview? I am the only one that will listen to it and you will be anonymous in the report.

Background

• Personal information

  (a) What is your role in the hospital?

  (b) What are you responsible for?

Nova Ward Project

  o What is your roll in this project?
  o In which department the product will be used?
  o What are the reasons of purchasing the product?
  o What is the goal of implementing Nova?
  o Is there anything you want to change with the help of Nova, what is it in this case?
  o What impacts do you expect the system will have?
  o Who are the people affected by the implementation?

A.2 Stakeholder Research Interview Questions

Presentation

• My name is Allaa Al-Omaishe and I am writing my master thesis for Cambio. The study is about Nova Ward adoption and I am interested in knowing what are the impacts of the adoption according to you. I will use this information in
the further development of the impact map.

• Is it OK if I record the interview? I am the only one that will listen to it and you will be anonymous in the report.

Background

• Personal information

(a) What is your role in the company?

(b) What are you responsible for?

Nova Ward Project

• What is you role in this project?
• Who is this product for?
• What is the goal of this product?
  o How will you, personally, define success of this product? (That you achieved your goal/goals)
• What are the impacts that the product will have, in your opinion?
  o Is there anything you want to change with the help of Nova, what is it in this case?
• What values are you looking for from the product?
Appendix B

Tina, sjuksköterska

Tina har jobbat på avdelningen som sjuksköterska i flera år. Tidigare var hon på en kirurgisk vårdavdelning men trivs bättre nu. Hon tycker att kliniken tar ett bättre helhetsperspektiv på patienten och det stämmer bättre överens med hennes egna värderingar.

Tina arbetsuppgifter går ut på att se till att de beslut som fattas på ronden genomförs, dela läkemedel och ge patienterna sina cytostatikabehandlingar. Det är mycket att hålla i ordning på under ett arbetspass.

Tongivande egenskaper

- Gillar arbetet på onkologen för det finns ett helhetsperspektiv på vården av patienten.
- Gillar när det är mycket att göra, bara man hinner klart en patient i taget.

Mål

- Utföra de aktiviteter som ordinerats på ronden.
  - Rätt mediciner ska delas
  - Prover ska tas
  - Behandlingar ska startas
- Ha koll på patienterna så att hon kan rapportera på ronden.
Appendix C

Avdelningsarbete: Tina, Sjuksköterska


När avrapporteringen är klar markerar Tina Arne i sal 2 för rondning. Hon gör så för att läkarna ska se att det hänt någonting med patienten sedan förra ronden eller att det finns någonting att prata om.

Alla i rummet deltar aktivit i ronden och sköter sina egna anteckningar om vad de ska göra med patienten. Whiteboarden uppdateras allt eftersom nya aktiviteter eller undersökningar läggs till.

Tina uppdaterar sjuksköterskans ansvarslista med nya prover som ska tas under förmiddagen. Dessa prover finns redan skapade i systemet så att lägga till dem till ansvarslistan är enkelt, det krävs bara ett par tryckningar med ett finger, sen är det klart.
Eftersom aktiviteterna läggs på sjuksköterskans ansvarslista så är risken liten att något faller mellan stolarna, även om dagen skulle köra ihop sig totalt och Tina inte hinner göra allt som planerat. Nästa sköterska tar över listan när hon går på och fortsätter att beta av aktiviteterna på den.

Appendix D

Post-study Presentation

- My name is Allaa Al-Omaishe and I am writing my master thesis for Cambio. The study is about Nova Ward adoption and I am interested in knowing what are the impacts of the adoption according to you. I will use this information in the further development of the impact map.

- Is it OK if I record the interview? I am the only one that will listen to it and you will be anonymous in the report.

Background

- Task characteristics
  - How an ordinarily task look like for you?
- Information needs
  - Which information you need in your work?
  - How do you get the information you need?

- What did you think that you could use Nova for?
- What do use Nova for?
- Why do you think the reason that led to start using Nova in this ward?
  - What are the differences or the different factors that affect the usage?

The difference between now and before

  a. What do you think about patient safety before and after you start using Nova?
    i. How do use Nova to get access to patient information? In comparison with before?
    ii. How do use Nova in reporting patient information? In comparison with before?
    iii. How do you use Nova in answering questions from patients? In comparison with before?
b. What do you think about efficiency before and after you start using Nova?
   i. How much time do you feel that you spend on reporting patient information? In comparison with before?
   ii. How much time do you feel that you spend on communicating with others? In comparison with before?
   iii. How much time do you feel that you spend on accessing information? In comparison with before?

c. What do you think that has changed, if there is any, in the daily workflow after the system was implemented?

d. What do you think about mobility, accessing information at the point of care?

2. How did you experience the system during and after the training?
3. What are the benefits of using such a system?
4. Do you want to change anything? What is that in this case?
På svenska

Detta dokument hålls tillgängligt på Internet – eller dess framtida ersättare – under en längre tid från publiceringsdatum under förutsättning att inga extraordinära omständigheter uppstår.

Tillgång till dokumentet innebär tillstånd för var och en att läsa, ladda ner, skriva ut enstaka kopior för enskilt bruk och att använda det oförändrat för ickekommersiell forskning och för undervisning. Överföring av upphovsrätten vid en senare tidpunkt kan inte upphäva detta tillstånd. All annan användning av dokumentet kräver upphovsmannens medgivande. För att garantera äktheten, säkerheten och tillgängligheten finns det lösningar av teknisk och administrativ art.

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