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A checklist-based guideline system

- For implementing clinical guidelines into practice

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A Master's thesis in
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Synopsis:

Clinical knowledge is ever growing and evidence based clinical guidelines have started to play an increasingly bigger role in today's standardized care. For many years, guidelines have helped to both improve the quality of patient-care and -safety. However, implementation of guidelines has shown limited success, and methods of implementation do highly vary between regions, which results in high variation in quality of treatment as well. In recent years, clinical checklists have been gaining more attention, as their use in clinical practice, to help ensure compliance with clinical guidelines, has shown promising results. Nevertheless, there is still lack of coherence between the checklists being used and the clinical-knowledge they are complying with. It is clear that if guidelines are to comply with the future state of healthcare their use in a clinical setting needs to be reconsidered, preferably with the use of an IT based solution. The project's objective was therefore set on defining, and evaluating, requirements which could enable prediction of such a clinical-information-system. A proof of concept, called CliniCheck, was developed and implemented into a functioning web-application, which exemplifies how guidelines and checklists can be implemented and used within a surgery pathway in a hospital setting. CliniCheck served to fulfill the requirements identified, while also taking into account the seven characteristics of healthcare described by Garde and Knaup [2006]. Although CliniCheck serves to only exemplify the requirements within a surgery pathway, the model still manages to illustrate how a checklist-based guideline systems could function in practice. Nevertheless, if the requirements are to be used for predicting a clinical guideline system, more extensive evaluation and design-input is needed from its end-users.

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Synopsis:

Mængden af kliniske viden vokser fortsat, med stigende fokus på forskning. I daglig praksis er evidensbaserede kliniske retningslinjer begyndt at spille en større rolle, hvor kliniske retningslinjer har i mange år bidraget til at både forbedre kvaliteten af patient-pleje og -sikkerhed. Imidlertid har implementering af retningslinier vist begrænset succes, og metoder for implementering varierer meget i mellem regionerne, som resulterer også i en høj variation i kvaliteten af behandling. I de senere år har kliniske-tjeklister påkaldt sig særlig opmærksomhed, da deres anvendelse i klinisk-praksis har vist lovende resultater, for at sikre overholdelse af klinisk-retningslinjer. Dog er der stadig mangel på sammenhæng mellem de tjeklister, der anvendes, og den kliniske-viden, de skal overholde. Det er klart, at hvis evidensbaseret behandling skal fortsætte med at være standard i det fremtidige tilstand af klinisk-praksis, skal implementeringsprocessen af retningslinjer gøres mere strømlinet; gerne med brug af et it-baseret løsning. Projektets problemstilling blev derfor at identificere krav, som kunne muliggøre udvikling af et klinisk-informationssystem, som overvinder de udfordringer med, implementering og overholdelse af kliniske retningslinjer, i praksis. Et proof of concept, kaldet CliniCheck, blev udviklet og implementeret som et web-applikation, der eksemplificerer, hvordan retningslinjer og tjeklister kan implementeres og anvendes under et operativt-forløb på et sygehus. CliniCheck opfyldte de identificerede krav, samtidig med at tage hensyn til de syv karakteristika, der beskrives af Garde and Knaup [2006]. Selvom CliniCheck har kun eksemplificeret hvordan kravene kan blive opfyldt indenfor et operativt-forløb, vil modellen stadig illustrere, hvordan et tjekliste-baseret retningslinjesystem kunne fungere i praksis. Dog hvis kravene skal kunne anvendes til at udvikle et system, kræver det mere omfattende evaluering og design-input fra selve slutbrugerne.

Preface

This master's thesis, in Biomedical Engineering and Informatics, was written by Jón Ingi Bergsteinsson during the period from February to June 2013.

The thesis is intended to give healthcare professionals, and other interested, insight into how clinical guidelines can be implemented into the future hospital setting, with the help of digital clinical checklists.
I gained interest in the subject of clinical checklists while working on a prototype-application for the World Health Organization Safe Surgery Checklist, where the idea of incorporating digital checklists into clinical practice originated.

The project lead me through an interesting field within the healthcare sector, where I soon came to realize that evidence based practice isn't necessarily as standardized as I had previously thought.
As a result of this project, requirements were identified for a clinical-information-system which could help overcome the issues of implementing clinical guidelines into practice, while also developing a functioning proof of concept application for evaluating these requirements.

I would like to give special thanks Pia B. Elberg, Teaching Associate Professor at Aalborg University, for her inspiring supervision during the project work period.

Jón Ingi Bergsteinsson

Danish abstract

Mængden af kliniske viden vokser fortsat, med stigende fokus på forskning. I daglig praksis er evidensbaserede kliniske retningslinjer også begyndt at spille en større rolle. Kliniske retningslinjer har i mange år bidraget til at både forbedre kvaliteten af patient-pleje, -sikkerhed og nedsat omkostninger [Cabana et al. 1999, Woolf et al. 1999, Grimshaw and Russell 1993, Grol et al. 2003, Faul et al. 2007]. Imidlertid har implementering af retningslinier vist begrænset succes [Cabana et al. 1999, Grol et al. 2003, Michie and Lester 2005, Grol et al. 2006], og metoder for implementering varierer meget i mellem regionerne [Sundhedsstyrelsen 2009], som resulterer også i en høj variation i kvaliteten af behandling.

Kliniske miljøer er komplekse og kræver svære beslutninger, der foretages dagligt af forskellige fagfolk. I de kommende år, kan man kun forvente større kompleksitet, hvor flere patienter lever med kroniske sygdomme og nye måder af behandling bliver indført [Rabøl et al. 2011]. På grund af dette, er tjeklister set som et værktøj til at hjælpe med at sikre overholdelse af kliniske retningslinjer og nye behandlingsmetoder. Den stigende betydning og brug af kliniske retningslinjer i sundhedssektoren, og i øvrigt, de nylige drøftelser til udvikling af nationale kliniske retningslinjer i Danmark [Finansministeriet - Danish Ministry of Finance 2012], gør emnet for kliniske retningslinjer interessante at undersøge nærmere.

I de senere år har kliniske-tjeklister påkaldt sig særlig opmærksomhed, da deres anvendelse i klinisk-praksis har vist lovende resultater, for at sikre overholdelse af klinisk-retningslinjer [Savel et al. 2009, Haynes et al. 2009, Robbins 2011]. Dog er der stadig mangel på sammenhæng mellem de tjeklister, der anvendes, og den kliniske-viden, de skal overholde. Det er klart, at hvis evidensbaseret behandling skal fortsætte med at være standard i det fremtidige tilstand af klinisk-praksis, skal implementeringsprocessen af retningslinjer gøres mere strømlinet; gerne med brug af et it-baseret løsning.
Projektets problemstilling blev derfor at identificere krav, som kunne muliggøre udvikling af et klinisk-informationssystem, som overvinder de udfordringer med, implementering og overholdelse af kliniske retningslinjer, i praksis.

En kombination af videnskabelige metoder, indenfor klinisk information systemer og software-ingenørvidenskab, blev brugt til at identificere krav for et system som vil kunne overvinde de problemer identificeret i problem domænet. Derudover, blev fokus også sæt på at imødekomme forskellige udfordringer og barrierer, der blev introduceret i et interview sammen med en projekt-sygeplejerske på Aalborg Universitet Sygehus, som omfatter brug af kliniske-retningslinjer og tjeklister i praksis.

Et proof of concept, kaldet CliniCheck [1], blev udviklet og implementeret som et web-applikation, der eksemplificerer, hvordan retningslinjer og tjeklister kan implementeres og anvendes under et operative-forløb på et sygehus. CliniCheck opfyldte de identificerede krav, samtidig med at tage hensyn til de syv karakteristika, der beskrives af Garde and Knaup [2006]. Selvom CliniCheck har kun eksemplificeret hvordan kravene kan blive opfyldt indenfor et operative-forløb, vil modellen stadig kunne illustrere, hvordan et tjekliste-baseret retningslinje-system kunne fungere i praksis. CliniCheck er blot et eksempel på, hvordan en simpel model kan bidrage til en endnu større løsning og er ikke et konkluderende resultat, hvor systemet har klart behov for en faglig vurdering, fra selve slutbrugerne i praksis. Det skal dog bemærkes, at hvis kravene skal kunne anvendes til at udvikle et system, kræver det også mere omfattende evaluering og design-input fra klinisk-praksis.

[1] `http://clinicheck.medei.dk`

Contents

CHAPTER

1 Introduction

Nowadays, guidelines and protocols are important factors in many organizations and projects, where they are used to recommend the management of specific actions or techniques.
In a clinical context, guidelines have been used for many years, with the aim of documenting and recommending, decisions and techniques, with the potential benefits of improving quality of patient care [Fervers et al. 2006]. The Institute of Medicine defines clinical guidelines as *"...statements that include recommendations intended to optimize patient care that are informed by a systematic review of evidence and an assessment of the benefits and harms of alternative care options."*[Graham et al. 2011].
As our clinical knowledge is ever growing, evidence based clinical guidelines have started to play an increasingly bigger role in today's standardized care, to help improve the quality of patient-care and -safety [Grol et al. 2006]. Medical associations or governmental bodies, such as the *American Heart Association* (AHA) or the US *Agency for Healthcare Research and Quality*, publish guidelines of recommendations for clinical care on a regular basis, by introducing and incorporating new knowledge and research into today's clinical practice.

Checklists have as well been used for many years in different industries to both enhance safety and improve process outcomes [Savel et al. 2009]. In recent years, hospital checklists have gained more momentum, especially after the World Health Organization introduced the Safe Surgery Checklist (WHO SSC) in the early 2009 [Savel et al. 2009, Robbins 2011].
Clinical environments are complex and require difficult decisions to be made daily by different clinical professionals. In the coming years, one can only expect greater complexity, as more patients are living with chronic diseases and new ways of treatment are being introduced [Rabøl et al. 2011]. Because of this, checklists are seen as a possible tool to help ensure compliance with clinical guidelines and new treatment methods.
The increasing importance and use of clinical guidelines in healthcare, and moreover, the recent discussions of implementing national clinical guidelines in Denmark [Finansministeriet - Danish Ministry of Finance 2012], makes the subject of clinical guidelines interesting to investigate further.
In order to identify the project's main objective and the possible problems/challenges within the subject of interest, the following questions where formalized to initiate the working processes.

- What are the main pros and cons of using clinical guidelines?
- How does legislation and regulations affect clinical guidelines?
- How are clinical guidelines implemented into practice?
- How are clinical guidelines used, and their compliance ensured, in practice?

Part I

Problem Analysis

CHAPTER

2 Clinical guidelines

The following chapter is set on analyzing the domain of clinical guidelines. This part will be based upon research within the area of interest and thereby, establish a ground for defining the project's problem statement.

To initiate the project's problem analysis, publications and research related to clinical guidelines and their use within a clinical-context in a hospital setting will be considered. The problem analysis will however not cover the area of guidelines related to healthcare administration, general practitioners or other (private) clinical settings.
Hereafter, clinical practitioners (doctors/surgeons), clinical professionals (nurses and etc.) and healthcare professionals (doctors,nurses and other healthcare staff), will be used to cover those professions in a hospital setting which are the primary consumers of clinical guidelines.

2.1 The benefits and limitations of clinical guidelines

In today's society we are constantly trying to improve our general quality of care, despite a constant aging and growing world population [World Health Organization 2011, Google Inc. 2013]. With clinical guidelines, healthcare professionals have been given a chance to provide standardized care and treatment, based upon evidence based knowledge, to all patients.
For the past decades an increased interest has been show in the use of clinical guidelines in western countries and moreover, for quality healthcare systems, clinical guidelines are regarded as indispensable [Francke et al. 2008]. Although its hard to determine whether these interests are strictly administration influenced, or influenced by the clinicians themselves, researchers do agree of the importance of using them, as they have proven not only to help improve clinical outcomes and safety, but also shown benefits of lowering and controlling cost expenditure [Cabana et al. 1999, Woolf et al. 1999, Grimshaw and Russell 1993, Grol et al. 2003, Faul et al. 2007].
Apart from benefiting patient care, guidelines can also improve the quality of clinical decision making, by recommending uncertain clinicians on how to proceed with their ways of treatment [Woolf et al. 1999].
However, implementing guidelines into healthcare, and encouraging healthcare professionals to utilize them, has shown limited success [Cabana et al. 1999, Michie and Lester 2005, Grol et al. 2006]. In addition, differences in culture and organizations between countries, influences variation on the structure and use of guidelines, even though the evidence they are based upon is the same [Fervers et al. 2006]. Due to this, defining a successful clinical guideline in reality can compose a challenge and guidelines are often ”lost in translation”[Lenfant 2003, Grol et al. 2006].

Researchers have discussed the usage of clinical guidelines where e.g. Woolf et al. [1999] points out that evidence based guidelines can have their limitations with potential harm as well. The most commonly recognized bias, which limits the quality of guidelines being used today, is financial [Shaneyfelt and Centor 2009]. As Shaneyfelt and Centor [2009] state: *"too many current guidelines have become marketing and more opinion-based pieces, rather than assistive statements"* - where guidelines are used to market devices and pharmaceutical products. It appears as clinical guidelines are shifting focus from standardizing and improving patient care. Most guideline committees have their own values and goals to protect, which can lead to subconscious bias and affect their recommendations[Shaneyfelt and Centor 2009].
Guideline consumers could adjust for these biases, but only if those goals and values are explicit; and usually this is not the case [Shaneyfelt and Centor 2009]. These various biases can lead to flawed guidelines, which can affect not only the quality of patient care, but also harm all actors involved, i.e. healthcare professionals and the healthcare system as a whole [Shaneyfelt and Centor 2009, Woolf et al. 1999].

2.2 National visions for clinical guidelines

Recently, the Danish government earmarked *60 million DKK*, for the period of 2012 to 2015 to focus on developing national clinical guidelines [Finansministeriet - Danish Ministry of Finance 2012]. Clinical guidelines are believed to be the corner-stone of the Danish healthcare system and should be funded to ensure uniform and high quality of diagnosis, treatment, care and rehabilitation for all citizens [Finansministeriet - Danish Ministry of Finance 2012]. The Danish government wants to make sure that all citizens will be able to receive the same quality of care, regardless of where in Denmark they are being treated. Therefore, during the next two years, a committee of clinicians and consultants within Danish healthcare are to continue developing national clinical guidelines to improve the general patient care in Denmark.
One can argue that such a project will prove to be effective, as noted previously, such committees are usually influenced, in one or another way, by finance, private companies or subconscious bias; which can affect the quality of the guidelines [Shaneyfelt and Centor 2009].

In 2001, the Danish Society for Patient Safety (Dansk Selskab for Patientsikkerhed) was established, with the focus of improving the general patient safety in Denmark. The organization's primary objective is to share knowledge, influence decision makers and initiate projects that together work to increase the safety of Danish patients [Dansk Selskab for Patientsikkerhed 2013a]. Their goal is to reduce the risk for patient harm during their visit in Danish healthcare settings. Together with the Danish Health and Medicines Authority (Sundhedsstyrelsen), national visions have been defined by incorporating new methods, guidelines and recommendations, which can help to improve the quality of general patient care, and safety, in Denmark.
One of the biggest ongoing projects is called "A Patient safe hospital" (Patientsikkert Sygehus). Currently there are five Danish hospitals involved in the project where they focus on providing the highest quality of care and safety for each patient. By participating in the project, these hospitals accept to incorporate new methods and guidelines into their daily routine, by implementing different "patient-care-packages". The packages focus on implementing "best practice" guidelines and work protocols, which have already proven to benefit patient's safety and care. Some packages aim directly at the individual patient's care and treatment, while others focus on improving the organizational, and/or clinical work processes [Dansk Selskab for Patientsikkerhed 2013b].

The most common elements implemented with these packages are so called ”pocket cards”, which are essentially, clinical guidelines in the form of checklists or flow diagrams. Such ”pocket cards” are to help clinicians to remember and follow strict guidelines or protocols, to help improve their quality of care.
The ”Patient safe hospital” project has shown promising results, where e.g. Hillerød hospital has managed to exclude any central venous catheter infections for over 500 days and counting, and Hvidovre hospital has managed to lower the mortality rate for all types of operations from 1.5% to 1.1% between the years of 2010 and 2012; which corresponds to preventing 50 deaths each year [Patientsikkert sygehus 2013a; 2012].
Although the project has shown positive results for the currently participating hospitals, one might ask, why aren't the larger hospitals in Denmark participating as well? Non of the four largest hospitals in Denmark, i.e. Rigshospitalet, Odense University Hospital, Aarhus University Hospital or Aalborg University Hospital, are on the list of participating hospitals [Patientsikkert sygehus 2013b].
No specific factors can be identified as a reason for this, however, the cost of implementing such projects in a large hospital could have large influences.

2.3 Methods of implementation

Methods of implementing clinical guidelines do highly vary between countries and continents, nevertheless, as stated by Grol et al. [1998], it is important to define clinical guidelines precisely and clearly for the user, to have a higher chance of them being implemented and used correctly in practice.
In Denmark, hospitals utilize independent web-based systems to implement and withhold clinical guidelines or work protocols (see table 2.1). An example of these is PRI[1], or the e-Dok[2]; which are used respectively at Aalborg University Hospital and Århus Hospital. These guideline systems are very

Region	Documentation system
Region Nordjylland	PRI
Region MidtJylland	E-Dok
Region Syddanmark	Infonet and VisInfoSyd
Region Sjælland	Infonet
Capital Region	VIPportalen, SundViden, VIPbasen, PVI og Kvalitetshåndbogen

Table 2.1: *The table shows all the clinical documentation systems being used in danish hospitals [Sundhedsstyrelsen 2009]*

different from each other, regarding looks and use, however, they do all share the same important functionality, i.e. providing healthcare professionals, and others, ease access to clinical guidelines and work-protocols. Each region is responsible for withholding clinical-guidelines and -work-protocols for each of their hospitals, within their own documentation systems. All documentation must be approved by relevant professionals, or the hospital/ward management, responsible for quality development while also being consistent with national regulations [Sundhedsstyrelsen 2009].
Almost all documents and guidelines within these documentation systems are available to both healthcare professionals and the public through the Internet; which allows both for easy access and updating of the documents.

[1] `https://pri.rn.dk`
[2] `http://e-dok.rm.dk`

One can argue that these systems are serving the purpose of encouraging correct implementation and use of clinical guidelines in practice. On the other hand, they are providing healthcare professionals and administrations a platform to share information of recommendations in a flexible manner. Even though updated guidelines and work-protocols are always available through these systems, there is nothing that indicates the actual (or correct) use of these guidelines in practice. In other words, guidelines or work protocols are only accessed from these systems if needed and are never "actively" incorporated into daily practice. Therefore, clinical guidelines implemented in this way can be classified as "passive" information.
Inside the e-Dok system used at Århus Hospital, more precisely dokument 2.5.1 "Anvendelse af kliniske retningslinjer" (Use of clinical guidelines)[Aarhus-Hospital 2013], a document defines how each hospital ward should handle clinical guidelines within their area of care. It is stated that each ward should be responsible for defining specific ward-guidelines for use in their clinical practice. Such guidelines should be defined for each of the "most common patient groups" where diagnosis, treatment, rehabilitation, etc. should be defined, with support from evidence based recommendations from national centers for clinical guidelines or other national legislation related to clinical guidelines.
As a result, these systems withhold thousands of clinical-guidelines and -work-protocols which are composed by local hospital wards.

2.4 Preliminary conclusion

According to the literature, clinical guidelines are to ensure that healthcare professionals are up to date with latest evidence based treatment to offer the best possible care to all patients.
Different methods are being used to implement clinical guidelines into a hospital setting and in Denmark the trend seems to be using web-based documentation systems, like PRI or e-dok. Despite the fact that these systems seem to be updated continually and withhold thousands of updated guidelines and work-protocols, it can be difficult see if guidelines are actually being used to withhold the latest evidence based knowledge among healthcare professionals, i.e. implemented successfully. In addition, no monitoring seems to be done in these systems and no clear measurable indication of their use, or their guidelines, is available in a standardized format. One might ask, are these systems safe or effective enough, for both clinicians and patients, if no monitoring or measurable indicators are available?
Currently, the Danish legislation is focusing on developing national clinical guidelines for the most common patient groups. One can argue that such a project will manage to improve the general patient care and safety in Denmark, as the current problem in hospital healthcare is not necessarily related to the quality, or the amount, of clinical guidelines, but rather to their implementation and compliance [Michie and Lester 2005, Grol et al. 2006, Grau 2010]. The "Patient Safe Hospital" project has managed to incorporate checklists and flowcharts into practice with promising results, but if national clinical guidelines are to be implemented in Denmark, are these guidelines only to be added to the guidelines already available in the clinical guideline documentation systems, or will they be implemented differently in order to gain increased compliance?
The problem is clear, hospitals are risking high variability in quality of clinical-care and -safety, when different clinical guidelines are being implemented using different methods. If the clinical evidence behind a certain procedure is always the same, regardless of locality, shouldn't the clinical guideline supporting the knowledge be implemented in a similar manner to achieve the same results everywhere?

CHAPTER

3 Clinical checklists

A new trend has risen in healthcare, where the the use of checklists to comply with guidelines in clinical practice has shown promising results. This chapter will therefore focus on investigating the subject of clinical checklists.

Checklists can provide an ideal way of complying with standards of evidence-based care, while also supporting structured communication between healthcare professionals [Robbins 2011].
Two of the most noticeable hospital checklists, which have already been implemented in many hospitals worldwide, are the WHO's Surgical Safety Checklist (WHO SSC) and the Central venous catheters checklist (CVC-checklist) [Rabøl et al. 2011].

3.1 WHO's Surgical Safety Checklist

The WHO Surgical Safety Checklist was first presented in 2009. Its objective is to improve the general safety of surgical care, by ensuring that healthcare professionals follow evidence based standards. The checklist has already demonstrated its value to reduce the rate of morbidity and post surgical complications significantly in eight different hospitals around the world [Haynes et al. 2009].
The checklist consists of a total 19 check-items which should be reviewed during three different phases of a surgery: (1)before induction of anesthesia, (2)before skin incision, and (3)before patient leaves operating room (see figure 3.1). These items include elements in form of questions, to e.g. ensure correct identity of a patient, correct operation is taking place, medication, sterility, equipment, diagnostic imaging, etc.
A designated checklist coordinator, often a circulating nurse, is responsible for performing all the checks on the list. During each phase, the checklist coordinator must confirm with the team that the specific tasks have been completed on the list before proceeding. All steps of the checklist will have to be verbally reviewed with the appropriate surgery team member [WHO 2009].

The checklist itself is not conclusive and can be adjusted to local clinical-settings if needed - e.g. with information about clinicians participating in the surgery.
As illustrated on figure 3.1, every question is standardized with a specific answer in order to minimize erroneous spellings and inputs. Nevertheless, researches have concluded that some of these questions might be to general and sometimes not applicable in simple surgeries, and therefore too time consuming [Fourcade et al. 2012, Vats et al. 2010].

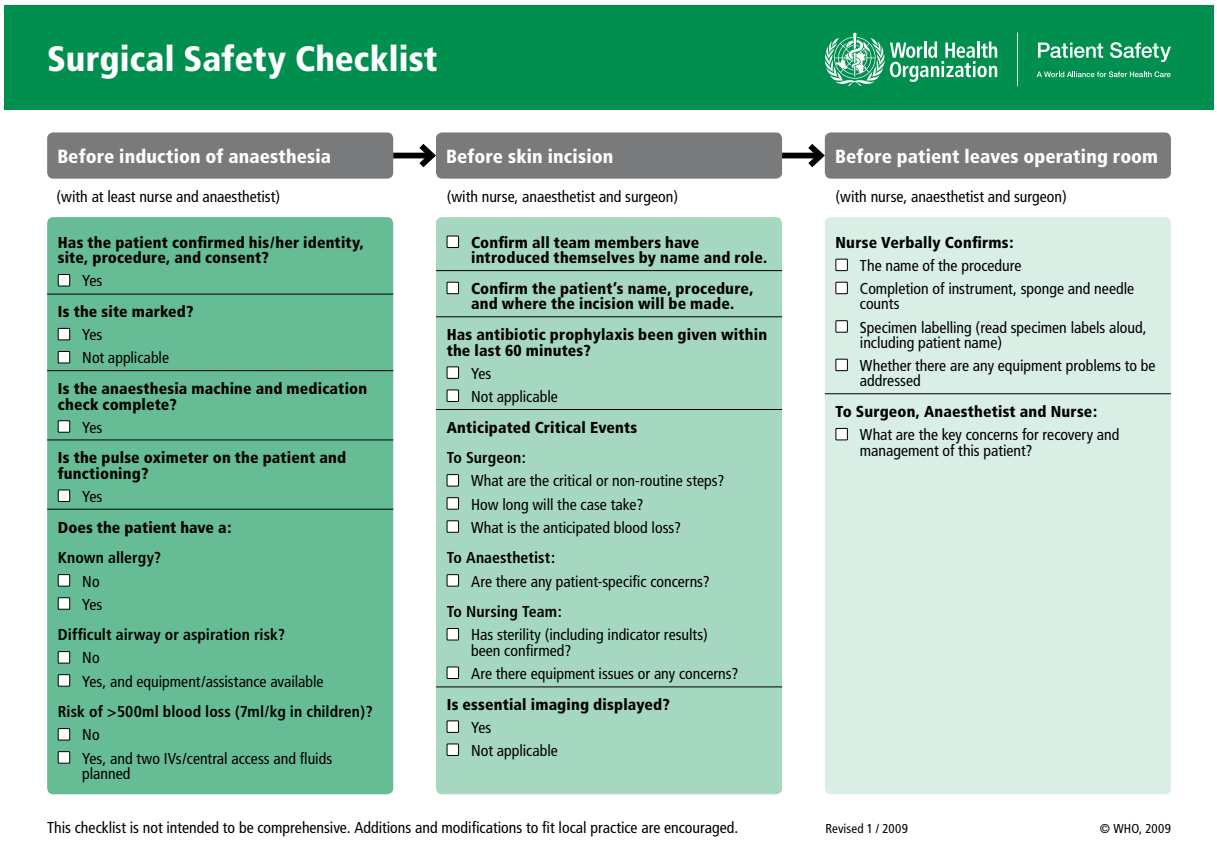

Figure 3.1: *The World Health Organization Surgical Safety checklist.*

3.2 Central Venous Catheter Checklist

Central venous catheters can provide patients with life-saving medicine and fluids. Nevertheless, central line-associated bloodstream infections (CLABSI) cause thousands of deaths in the United States alone each year, apart from additional billions of dollars in costs to the United States healthcare system [CDC.org 2010].

Despite the fact that CLABSI can be life-threatening, it can be prevented by ensuring adherence to proper practices, by e.g. implementing a Central Venous Catheter Checklist into standard care [O'Grady et al. 2011, Marschall et al. 2008]. The use of CVC checklists in ICUs have shown to significantly reduce CLABSI and thereby morbidity as well [Berenholtz et al. 2004].

An example can be taken from the previously named Hillerød hospital as well, where the CVC checklist has helped eliminate CLABSI for over 500 days and still counting [Patientsikkert sygehus 2013a].

3.3 Structured communication

It is clear that the use of these checklists inside the healthcare field has shown to be successful and have the potential to improve general patient care and safety. Not only can they help clinicians to comply with clinical guidelines in practice, but they can also be used to structure communication and improve cooperation between clinical professionals [Rabøl et al. 2011, Nagpal et al. 2010]. In

a systematic review by Nagpal et al. [2010], the importance of clinical checklists is highlighted even more, where their use has shown positive results in information transfer and communication during surgery. Communication and information transfer breakdowns between healthcare professionals are one of the most common causes of surgical errors and adverse events [Nagpal et al. 2010, Rabøl et al. 2011]. By standardizing communication among clinicians, e.g. by using checklists like the WHO's SSC or ISBAR [1], the information transfer and communication process can be improved and thereby help improve patient care and safety [Nagpal et al. 2010, Fudickar et al. 2012, Rabøl et al. 2011].

3.4 Challenges of implementing hospital-checklists

When introducing new clinical checklists into the practical work-flow in a hospital setting, one can only assume that challenges arise. In a study by Fourcade et al. [2012], implementation of the WHO's SSC was investigated in 18 different cancer centers in France, in order to identify barriers to effective implementation of the WHO SSC. 80 random surgical procedures where analyzed and eleven different barriers where identified. A. Vats and colleagues also published their experiences of potential challenges, and barriers, with implementation of the WHO SSC in the UK [Vats et al. 2010]. The most common barrier identified to effective implementation of the checklist was duplication with existing processes, i.e. the items being questioned in the checklist had already been covered in a previous process [Fourcade et al. 2012, Vats et al. 2010]. Another common barrier identified was related to questions/items not fitting with the customary operating room practices or inappropriate timing. The clinicians felt that these checklist might be too general and not fitted for different operations or patients [Fourcade et al. 2012, Vats et al. 2010]. This is also in coherence to what Rabøl et al. [2011] states, that patient treatment and care, can be extremely complex and two patients with the same diagnosis do not necessarily needed to be treated alike. Clinical-checklists or -guidelines, may be too general and not fitted to each patient. As pointed out by Fourcade et al. [2012], consideration should be given into tailoring checklists to service and areas with different needs.
Additionally, experience has shown that clinical checklists can also be used incorrectly, i.e. healthcare professionals forget to use it, use it to late or do not complete the checklist procedure [Rabøl et al. 2011, Vats et al. 2010].
To be able to successfully implement clinical checklists into a hospital setting, for transforming evidence-based care and safety protocols into best and actual routine practice, one will have to focus on incorporating the checklist into the work-flow itself and encourage clinicians to use it consistently and durably [Robbins 2011, Rabøl et al. 2011]. In addition, local measurements of effectiveness are needed to follow both compliance of checklists and their influence on patient care and outcome [Vats et al. 2010].

3.5 SURPASS - A checklist-based system

A checklist-based surgical safety system, developed by De Vries et al. [2009], named SURPASS (SURgical PAtient Safety System) Digital , was introduced in 2010. SURPASS Digital, was developed with the focus of preventing errors and adverse events during the whole surgery pathway (i.e. during pre-, peri-, and post-op). The system has the ability to be incorporated into clinical practice and enabling management of how checklists are presented and used. Healthcare professionals use

[1] A checklist used to structure information transfer between healthcare professionals, and healthcare professionals and patients. ISBAR stands for Introduction, Situation, Background, Assessment, and Recommendation

SURPASS to access the clinical checklists to be completed during each phase of the pathway, to ensure compliance with clinical guidelines. The SURPASS system can provide an environment for managing checklists, while also providing a standardize platform to comply with them in practice. The effects of using a checklist-based system, like SURPASS, during the whole surgery pathway are promising - where SURPASS has shown to be associated with a significant reduction in the number of complications and in-hospital mortality rates [De Vries et al. 2010].

3.6 Preliminary conclusion

Researches have long discussed how implementation of clinical guidelines in a Hospital setting has shown limited success [Cabana et al. 1999, Grol et al. 2003, Michie and Lester 2005, Grol et al. 2006]. In Denmark, and many other western countries, hospitals have tried to implement clinical-checklists and -flowcharts, with the objective of improving compliance with the clinical guidelines. This relatively new way of complying with guidelines in practice has shown positive results worldwide, where they have managed to lower mortality rates and improve the general patient care and safety [Haynes et al. 2009, Savel et al. 2009, De Vries et al. 2010]. It seems as hospital-checklists and -flowcharts are gaining more popularity as they are relatively easy to use. However, few international standardized hospital-checklists, like the WHO SSC, have been implemented into the practical work-flow. The fact that many clinical guidelines are still being developed and customized locally, could explain why not so many standardized hospital-checklists are being used in practice.
In Denmark, all clinical-guidelines, -checklists and -work-protocols are documented inside their local hospital documentation system. This proposes a challenge for the use of these "implemented" clinical guidelines in practice, as they aren't fully incorporated into the everyday work-flow processes. The documents are stored away and only accessed if needed, for initial learning, or revision purposes (passive information access). On the other hand, clinical checklists could provide a way to "actively" incorporate guidelines into practice and improve their compliance.
It is clear that there is a lack of structure for implementing and using clinical guidelines in a hospital setting - where checklists and flowcharts are being used to somehow improve the situation. Although standardized clinical checklists, and a checklist-based system like SURPASS, have shown a possible way of improving the situation, they still haven't managed to incorporate clinical guidelines fully into the practical work-flow as the evidence based knowledge is still documented independently, e.g. in a separate documentation system.

CHAPTER

4 Clinical guidelines in practice

The following chapter is written as a summary from an interview with a project nurse at the heart- and lung-surgery ward at Aalborg University Hospital. A transcription is available in Appendix B.2 and an audio recording of the interview is available from the project's author [1]

The interview was conducted at Aalborg Universtiy Hospital the 8th of march 2013. The interviewee has been a project nurse at the heart- and lung-surgery ward for almost 25 years and is highly experienced with treating thorax-surgery patients, and has taken a large part in developing many of the clinical guidelines currently being used at the ward.
The primary objective of the interview was to acquire more insight into how healthcare professionals in a hospital setting, comply with, and use, clinical-guidelines and -checklists in practice.
This summary should not be read as a description of how the situation is in every hospital setting, as only one interview was conducted in relation to the project. However, as the interviewee has almost 25 years of clinical experience as a project- and attending-nurse, from one of the largest hospital in Denmark (Aalborg University Hospital), the summery should provide enough information to understand some of the general challenges being faced with using clinical-guidelines and -checklists in practice. Even though much of the information provided by the interviewee is only in relation to work-processes at Aalborg University Hospital, one can assume that other hospitals in Denmark are experiencing similar challenges, as every regional-hospital in the country must follow the same standards, rules and legislation.

4.1 The patient's surgery pathway

The heart- and lung-surgery department primarily takes on patients who are to undergo surgery in the thorax area. Normally, a patient first meets with a surgeon at the hospital to decide if he needs to undergo a surgery or not; If so, a date for a surgery is scheduled. The patient arrives at the hospital ward one day before the surgery, for a complete pre-operative check (pre-op phase). Early morning, the following day, the patient is transferred down to the operation ward where he will then undergo the surgery itself.
After surgery, the patient is moved to the ICU/recovery where he is monitored for the first day/day's after the surgery, depending on the patient's state. Finally, the patient is moved back to the heart- and lung-surgery ward, where he is taken care of and monitored for a few days (post-op phase), before he can be discharged.
Figure 4.1 illustrates the whole surgery pathway for a typical thorax surgery patient, and the different

[1] `https://www.dropbox.com/s/hmv4gc3pgiru9y3/Interview.mp3`

elements that come into play during each phase. Checklists are used before and during operation, while flowcharts are primarily used during the post-operative treatment phase at the surgery ward. Information sharing between healthcare professionals, and the independent wards, is done both verbally and through the Electronic Patient Record system.
The pre-op checklist is an important tool during the pre-op process, where procedures will have to be completed and checked off. The list will also affect the final decision, if the patient should be operated on or not.

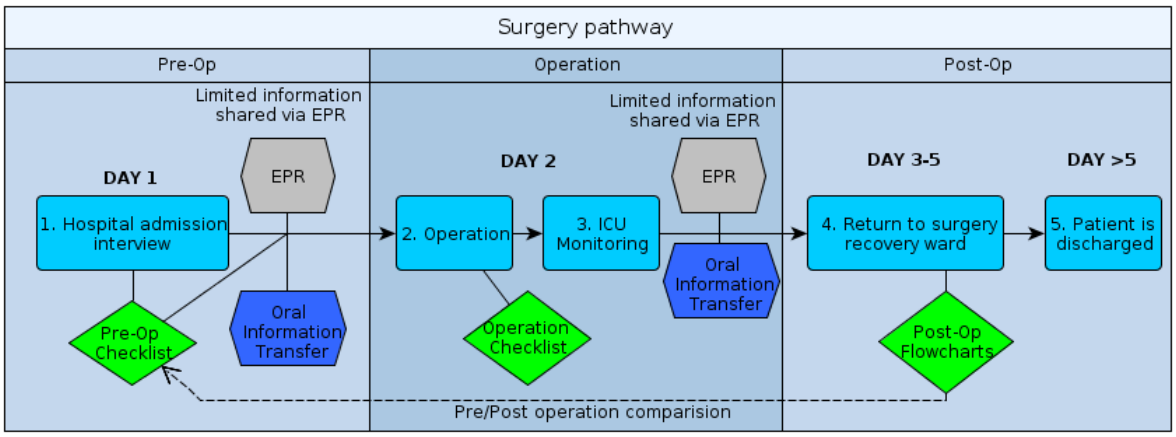

Figure 4.1: *The figure illustrates the whole surgery pathway for a typical thorax surgery patient, and the different elements that come into play during each phase.*

During the operation, a safe surgery checklist (WHO) is used, and after the operation, the ICU also uses their own flowcharts and checklists to monitor the patient. Before the patient is moved back to the recovery ward a report is given verbally to an attending nurse at the recovery ward, while other clinical information is also noted in the EPR.
Lastly, during the post-op process, nurses rely on flowcharts while treating the patient until he is discharged. In addition, the post-op procedures do sometimes require revision of the pre-op checklist, to be able to compare the patient's state before and after the operation.

This surgery pathway is almost the same for all patients on this particular hospital ward, regardless of the type of operation. The pre- and post-operative care is however very different between operations, and different clinical guidelines will have to be followed depending upon the patient's diagnosis and operation type.

4.2 Compliance with guidelines in practice

This particular hospital ward has developed its own clinical guidelines (which is quite common - as described previously in section 2.3) which are then stored inside the PRI documentation system. These guidelines have primarily been produced by local project nurses and clinicians at the ward, where experience has played a big role. However, in recent years, evidence based research has affected the development of new clinical guidelines a lot more, and will continue to do so.

All healthcare professionals at the ward must learn how to comply with these clinical guidelines in practice, which is usually done by reading through the guideline-documentation in PRI.

The interviewee has been active in developing guideline tools, i.e. checklists and flowcharts, which are used by the nurses at the ward to help ensure their quality of patient care - as defined and documented in PRI. In routine practice, a physical checklist in a paper format follows the patient throughout the surgery pathway. During the post-operative process, the checklist is then replaced with a standardized flowchart, which illustrates which treatment processes need to be done by a nurse during the post-operative process.
Both the checklist and the flowcharts are important for the whole surgery process itself. The checklists ensure standard quality of care prior to the operation by helping with compliance of certain pre-op procedures, while also providing documentation of important physiological parameters needed by the anesthesiologist for the surgery. The post-op flowcharts serve as a to-do list for the nurses, which have to complete certain procedures for each patient every day.
The checklists and flowcharts are different for each type of operation but are not personalized for each patient. Therefore, certain procedures on the checklists or the flowcharts, will have to be changed, adjusted, or left undone, if some aspects of the surgery process, or the patient's state, changes.
All healthcare professionals at the ward will have to follow these strict work protocols of using the checklists and flowcharts. However, only the lowest quality of compliance is ensured by using these checklists/flowcharts, as they are only available in paper format and each nurse is responsible of filling it out and storing it correctly. The checklists/flowcharts, and their results, are not documented other then on a paper sheet within the individual physical-patient-journal-folder.

4.3 Challenges with checklists and flowcharts in practice

The pre-op checklist, and the post-op flowcharts, are carried out during the course of 1 to 10 days before and after surgery, as a result, procedures and checks are accomplished at different times by different healthcare professionals. In many cases, nurses at the ward find it difficult to oversee who, and when, someone had carried out procedures (or checks), which can have dramatic effects, especially if a certain procedure affects the clinical outcome.

The whole process of operating a patient can be very complex and highly variable, and complications can easily arise before, during, and after operation. Therefore, especially during post-op, the patient care processes is critical and must be highly adjustable to changes, whereas the standardized flowcharts being used are not. Due to some physiological parameters that are measured during post-op (e.g. blood pressure, temperature, oxygen-saturation, etc.), the decided treatment of care can change, which the flowcharts being used do not necessarily account for. The interviewee says, that many of these changes and adjustments could be made decision based and implemented into checklists and flowcharts, which could then again, help healthcare professionals to ensure the best clinical-guided care for the patient.
For now, changes in care or treatment, will have to be made as described in the clinical-guidelines available in PRI, which are not always available at hand.

Cases have come up during the pre-op phase, where attending physicians on call, had to be contacted to see if a surgery should be canceled, or not, because some checks/procedures had not been documented on the checklists/flowcharts, or had not been completed. This can have critical affects on the clinical outcome for the patient and can induce decreased quality of care - where healthcare

professionals spend more time in figuring out which procedures haven't been completed, instead of treating the patient.

Only few (measurable) parameters on the checklist/flowcharts are documented in the Electronic Patient Record (EPR), such as weight, blood pressure and height. Otherwise, the checklists are stored in a physical folder which follows the patient around the hospital. The flowcharts do not document how procedures are carried out for each patient but are rather used as guidance tools for healthcare professionals.
The pre-op checklist does however play an important role for the surgery itself, as the anesthesiologist needs to review and sign them before surgery. In relation to that, all pre-op checklists must be completed the day before the surgery, where the anesthesiologist arrives at the ward to collect the needed information from them. The data is then used to decide medicine doses for the patient to be taken before the operation, and to decide the amount of anesthesia medicine needed for the operation itself.
One can argue if this is the safest way of sharing important clinical data. Nevertheless, it is clear that this is not the most efficient way for neither the nurse or the anesthesiologist to work.

One of the most challenging problems the interviewee described, was the lack of knowledge for *why*, procedures on the checklists or flowcharts should be completed. In a complex and busy environment, like a hospital setting, it is not enough to only implement clinical guidelines once and then not revise them regularly; or else we can risk that the evidence based reason for their usage will be forgotten.
At this particular ward, attending nurses are sometimes not completely aware of the reason for *why* the procedures should be completed. If the evidence based knowledge behind each procedure is not available at hand, it can be difficult for attending healthcare professionals to understand, or recall, *why* certain procedures cannot be skipped, or how it can affect the surgery process and the clinical outcome, if the procedures aren't completed satisfactory. Additionally, in most of the pre-op checklists used at the ward, different parameters will have to be measured and noted. If some of these parameters aren't within a certain range, the surgery might have to be canceled, i.e. if not the correct clinical decisions are taken according to those measurements.

The interviewee highly emphasizes on the importance of providing attending nurses information and knowledge needed to understand *why* they are performing the checks/procedures on the checklists and flowcharts. Such information can clearly not be fitted on a single page of paper with the checklist, and is therefore only stored inside the clinical guideline documentation system, PRI.

4.4 Improving compliance with clinical guidelines

The interviewee was asked if he had any thoughts about how the usage of clinical guidelines during the whole surgery process could be improved.
First he described a previously failed project conducted at the ward, where attending nurses were asked to exchange their note papers, with hand-held computers, which ought to ease their documentation work. The project was a short success, which was though not resulted by the hand-held computers themselves, as the nurses were actually happy to use them, but rather by the extra work in documenting everything from the hand-held computers into the EPR manually. With this example, the interviewee wanted to make it clear that if a solution is to be designed to improve their environment, it has to be compatible with other systems and thereby eliminate any "double documentation work" as described in the previously failed project.

The interviewee believes that the usage of clinical guidelines in the surgery process can be improved, by implementing a new solution together with the checklists and flowcharts being used today. Such a solution will have to be able to help attending nurses to understand the evidence based knowledge behind each procedure (and check), while at the same time providing them with guided clinical decision making. In addition, such a solution would also have to function as an "alarm" system, i.e. a system which could notify attending nurses if a procedure hasn't been completed, or if documented results aren't satisfactory. A system like this, could make a tremendous improvement in the quality of care for each patient, as it could help minimize misunderstanding with completed and uncompleted procedures, both during pre- and post-op, while also saving time; which then again, comes out in favor for the patients.

Lastly the interviewee concluded, that although the hospital sector has moved closer to using computer based EPR systems, there are still too many elements and processes documented in paper format.
It is clear that new solutions will have to be design and incorporated with the current hospital systems, which not only can improve the clinical challenges at hand, but also help with transferring documentation from paper into computer based systems and databases.

4.5 Preliminary conclusion

Clinical practice seems to lack the structure and coherence with clinical guidelines. Checklists are being used to ensure compliance with certain guidelines, but there seem to be minimal or no coherence at all with the independent guideline-systems.
The ability to review *why* a certain procedure has to be done, while e.g. filling out a checklist, and the ability to provide healthcare professionals assistance in clinical-decision making related to the specific procedure(or check), is currently not available through standard physical checklists. To ensure compliance with clinical-guidelines, it is crucial for a healthcare professional to understand *why* they are to complete each procedure/check, and how they are to react if a procedure/check isn't satisfactory to the standards(the guidelines).
In addition, there doesn't seem to be a structured way of using checklists in clinical practice. There is either minimal or no documentation and at all, in relation to filling out these checklists - which can result in confusion between healthcare staff at the hospital ward and therefore have an affect on the quality of patient-care. There is a clear need for reminding attending professionals of the status of certain checklist/flowchart, by monitoring the process status; which could help save time and minimize misunderstanding in clinical practice.

CHAPTER

5 Problem formulation

The primary objective of using clinical guidelines in practice is to ensure high quality treatment and safety to all patients, regardless of the locality. Nevertheless, implementation of guidelines has shown limited success [Cabana et al. 1999, Grol et al. 2003, Michie and Lester 2005, Grol et al. 2006], and methods of implementation do highly vary between regions [Sundhedsstyrelsen 2009].
Currently in Denmark, clinical guidelines are developed locally and implemented within different documentation systems, and to ensure their compliance, clinical-checklists and -flowcharts are sometimes used in daily practice.
After reviewing the literature, and the interview conducted, the following issues have been highlighted:

1. Clinical guidelines are developed locally and implemented using various methods - Adjusting guidelines to local environment can be positive, but this can also result in high variation in ways of treatment between hospital-settings. There is a clear lack of structure and standardization in how clinical guidelines are implemented
2. There is a lack of coherence between evidence based knowledge(clinical guidelines) and checklists used in clinical practice - clinical checklists are used to comply with certain procedures, but their coexistence is not reflecting the specific knowledge from the guidelines they are complying with

These issues can not only affect patients and the quality of every day patient care, but also clinicians and and the healthcare system as a whole. In order to acquire safer environment for both clinicians and patients, successful implementation and compliance with clinical guidelines must be fulfilled [Cabana et al. 1999, Grol et al. 2003].

It is clear that if guidelines are to comply with the future state of healthcare their use in a clinical setting needs to be reconsidered, preferably with the use of an IT based solution.
In the light of this discussion, the following problem statement was therefore set forth:

Which requirements must a system fulfill to overcome the issues raised above?

The project's objective was therefore set on identifying requirements which could enable prediction of such a clinical-information-system.

Part II

Problem Solution

CHAPTER

6 Methods

The following chapter describes the scientific methods used to compose a possible answer to the problem statement.

6.1 Overview

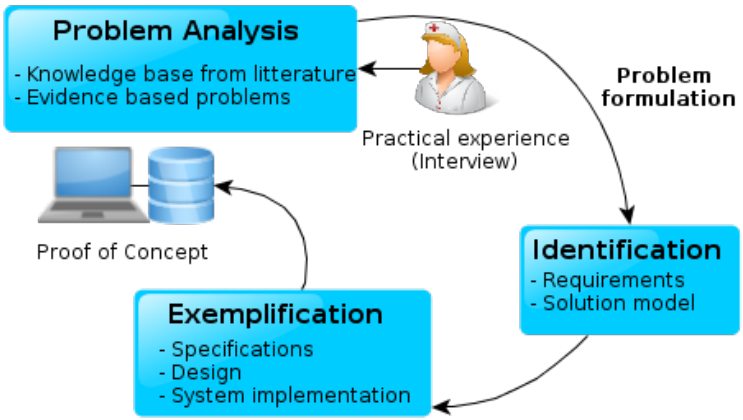

Figure 6.1: *The figure illustrates the three main processes carried out within the project.*

The figure above (fig 6.1) shows an overview of the processes carried out within the project. The first phase - problem analysis, provided the research base for the problem domain by analyzing the issues and challenges within the field of clinical-guidelines and -checklists. In addition, the interview conducted (see summary in chapter 4 on page 13) supplied the project with a practical example of how clinical guidelines are used in practice, i.e. in a hospital setting. After analyzing the subject's domain of interest, a problem formulation was composed which highlighted the issues and challenges within. The objective of the project was therefore to compose a possible solution to the problem statement defined in chapter 5.

To answer the problem statement, scientific methods within the area of clinical-information systems and software engineering were applied. The problem solving process was initiated by identifying the solution-requirements by utilizing a well established clinical-requirements methodology (see further in chapter 6.2), while also taking references from the problem analysis into consideration as well.

Thereafter a vision for a possible solution model was presented, which illustrated how the requirements could be structured into a model to function in clinical practice. A suitable and efficient model structure had to be designed which corresponded to the needs, and overcame the barriers at hand, in today's hospital practice, while also enabling simple use and implementation.

In order to evaluate the sustainability of the solution-requirements and -model, an exemplification process was carried out by developing a functioning proof-of-concept system which fulfilled the requirements set forth, and implemented the solution model into a functioning system.

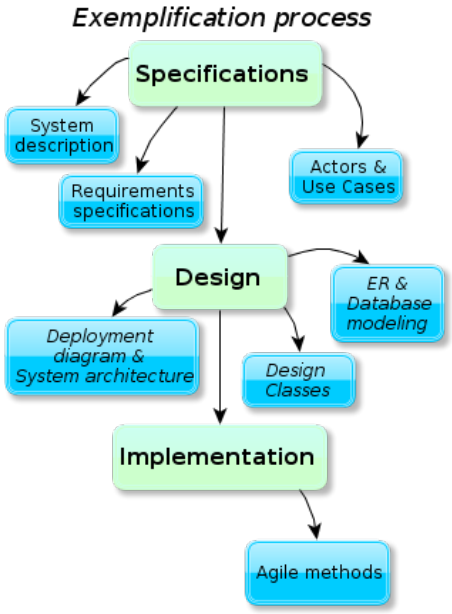

Figure 6.2: *The figure illustrates the project's exemplification processes.*

As illustrated on figure 6.2, the exemplification process was divided up into three phases, i.e. specification, design and implementation. The specification and design were documented with the help of UML (The Unified Modeling Language) while the software implementation phase was conducted with the help of an agile software development method. UML was used as a visual syntax for modeling the solution from requirements and specifications, to its implementation into software. It should be noted that the implementation phase covers only realization of the modeled solution, i.e. its implementation into a functioning software, and did not cover implementation of the solution into a clinical-setting, as it would have exceeded the project's main objective and time horizon.

Design science research methodology

When developing a clinical-information system, standardized scientific methods will have to be applied to the process. As a result, the method for answering the problem statement was highly influenced by the Design Science Research Theory introduced by Hevner et al. [2004].
Design science research and behavioral science research live symbiotically, as one always tries to improve the other. Behavioral science focuses on developing theories and explanations for both human and organizational behaviors, while design science research tries to incorporate those theories and explanations into artifacts, which are then provided as utilities to again, improve behavioral science research. As the focus of this project was on developing a solution artifact, the

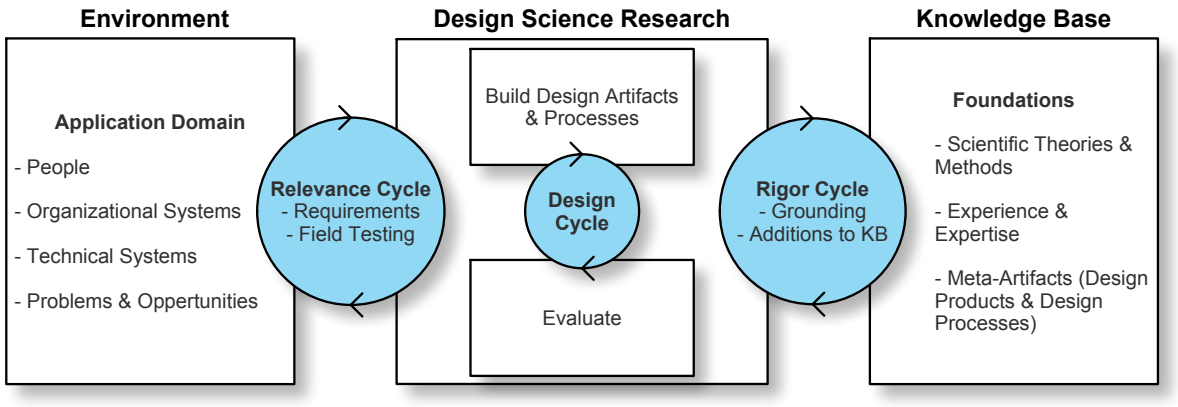

Figure 6.3: *Information systems design science research cycles [Hevner and Chatterjee 2010].*

design science research methodology should be incorporated into the process to ensure a rigid design and evaluation of the artifact.
Figure 6.3 illustrates well how the project relates to the design science research methodology. The problem analysis and interview provided an information base from the environment and identified problems and challenges to be solved. Requirements and specifications were then identified from the problems and challenges (Rigor Cycle) which cause a stimulus towards the Design Cycle. Software engineering theories and clinical-information system knowledge will play a big role in providing the project with the knowledge base to acquire rigor and a stable ground to design and develop from.
When developing a solution artefact to be used in a clinical environment, it is important to ensure that the artifact contributes with solving a problem or overcoming barriers identified from the environment; otherwise, its existence will be unproductive.

6.2 Requirements identification methodology

As described by Garde and Knaup [2006], requirements engineering in healthcare can be highly complex and challenging. In order to overcome this complexity, one must understand the different aspects of the healthcare environment.
In relation to that, Garde and Knaup have identified seven different characteristics of the healthcare domain, which will be reflected upon when identifying requirements to the solution. Table 6.1 on the following page will list the seven characteristics and describe how they influence specification of the requirements.
The first three characteristics describe how flexibility is important to a clinical-information system. It is therefore crucial that the solution model to be designed provides flexibility for its actors. Characteristics five and six specify that healthcare information should be patient centric and that a solution must be able to adjust to changes in regulations, and reporting requirements, both locally and globally. Lastly, characteristic four and seven discuss the importance of storing patient information over time and ensuring the patient's safety at all times.

Characteristic	Definition	Influence on requirements
1. The complexity of clinical knowledge	Clinical knowledge for best treatment (guidelines) is constantly changing and more finer-grained details are being discovered. In addition new relationships between drugs, adverse events and treatments are also being discovered.	It is clear that the solution must allow for flexibility, i.e. when new knowledge/relations are discovered, it should be easily implemented into the solution model.
2. The complexity of clinical information	Sharing health information can be a complex task where various types of information is being shared in various formats between various actors. The current state if information sharing is changing constantly.	The solution must take reference in how information is formatted/shared between two actors and how it can quickly change.
3. The variability in healthcare	Each patient is different, and is treated accordingly. The variability in how one procedure/treatment can be different from one patient to another is enormous.	The solution must take reference in how patients can be handled differently. Adverse events can e.g. occur for one patient, while not for others.
4. Relevance of health information over time	Healthcare information can be of relevance for a long period of time. Regulations can require information to be safely stored for almost 100 years.	The ability to store information for a longer period of time must be available for both research and quality assurance processes.
5. Patient-centric health information	Healthcare information should be able to follow the patient across institutional bounderies. This can be a huge challenge as many countries have a heterogeneous healthcare system landscape.	The patient should be centric in the solution. His information should be accessible beyond only one EPR system.
6. The complexity of the healthcare domain and stakeholders	The Healthcare sector is controlled by different actors, which varies from country to country. Different stakeholders are at play where both national and private regulations and reporting requirements change constantly.	The solution must be able to adjust to change in regulations and reporting requirements. The ability to balance local and global requirements is important.
7. Patient safety and automation	The patient's safety should be of top priority in all healthcare sectors. Errors, misunderstanding and other inaccuracies cannot be accepted in healthcare.	The solution must not risk the patient's safety. It should focus on not giving the actor the ability to provide/process erroneous information, which could compromise the patient's safety.

Table 6.1: *The table describes the seven characteristics of healthcare and how they influence requirement specifications of the solution model [Garde and Knaup 2006].*

6.3 Methods of exemplification

As described by Hevner et al. [2004], an artifact must be evaluated in order to ensure its utility for a specified problem. In order to achieve an acceptable evaluation of the solution-requirements, a proof-of-concept was chosen as a method to illustrate a functioning system which would fulfill the requirements identified. As an interactive evaluation usually helps to acquire a more realistic evaluation of an artifact, a functioning proof-of-concept was thought to be a sufficient method for evaluation.
Before the solution-requirements could be implemented into a functioning system, it had to be designed and modeled. This was done with the help of UML by composing a deployment-, a class-, and an ER-diagram (entity-relationship diagrams). Not only did this allow for structured implementation of the solution into software-code, but also a presentable model of the system itself.

The system design and structure was influenced by the checklists currently in use at the heart- and lung- surgery ward at Aalborg University Hospital, while also taking reference from standardized clinical checklists as well, like the WHO Surgical Safety Checklist. A copy of these can be found in Annex (see page 91).
An agile software development was chosen to be the method of development and implementation. This was mainly due to the fact that agile methods focus on implementing small working segments of a bigger solution. This allowed specific requirements to be identified, and then implemented, into a functioning module. With the help of agile methods, implementation was therefore set to produce a realization of the solution model; which could then be used to evaluate the solution-requirements in perspective to the project's main problem statement.

CHAPTER

7 Identification

This chapter documents the process of identifying the solution-requirements along with a possible solution-model which could be implemented into practice.

7.1 Requirements

The process of identifying requirements is a critical success factor in requirements engineering, as a set of requirements should enable prediction of a final software system [Arlow and Neustadt 2005]. In order to identify the solution requirements, to both answer the problem statement and overcome the complexity of the healthcare domain, references were taken from the seven characteristics defined by Garde and Knaup [Garde and Knaup 2006].

As Arlow and Neustadt [2005] state: "Requirements tell us what we should build, not how we should build it.". Therefore the following chapter will focus in identifying the functioning-requirements of a system, i.e. what behavior a system should offer to overcome the challenges described in chapter 5:

1. Clinical guidelines are developed locally and implemented using various methods.
2. There is a lack of coherence between evidence based knowledge(clinical guidelines) and checklists used in clinical practice.

Firstly, the requirements must specify how clinical guidelines can implemented into practice in order to minimize the variation between different hospital-settings.
Secondly, the requirements must specify how evidence based knowledge can be joined together with clinical checklists in practice, to minimize the gap between the two.

7.1.1 The 7 characteristics of healthcare

If a system is to allow for guidelines to be implemented and updated freely, the requirements should focus on flexibility, e.g. each time new guidelines are implemented, or if information sharing processes change, a system should not have to be re-coded, or re-modeled. This means that the requirements model must define a standard for implementing and presenting guidelines in the clinical-work flow, which can easily allow for changes of the guidelines themselves, in addition to how they are presented and shared.

Depending on countries and states, healthcare information must be archived for varying periods of time, for both research and quality assurance. The requirements model must be able to provide a stable environment for information to be stored, and later accessed if needed. A database could be a sufficient solution, as they can provide a highly structured way of storing clinical information.

A model which favors patient's information sharing, is of higher importance than a solutions which provides added functionality. The requirements model must be able to share information between actors in an accessible manner, while also allowing for adjustments of the system if regulations or requirements for reporting change.

If the system model is to be patient centric, healthcare-actors must be able to access patient's information whenever needed, without being dependent upon specific settings or equipment. Otherwise, if a solution is designed to be only incorporated with a specific system or work-methods, we will encourage heterogeneity; which can highly affect the safety and efficiency of information sharing in healthcare [Garde and Knaup 2006]. The patient is, and will always be, the center of a clinical work-flow, therefore, if the model is to integrate guidelines into it, they must somehow be induced to be centered around the patient himself as well.

Lastly, if system is to work within a clinical environment, the patient's safety must be of top priority. Healthcare professionals must not be able to harm the patient, or induce harm, by using the system. The usage of a checklist based solution to comply with clinical guidelines has already shown to be successful in minimizing errors, adverse events and misunderstanding [De Vries et al. 2010]. It would therefore be suitable for a system to utilize a similar method, to fulfill such safety requirements.

7.1.2 List of requirements

The following lists the possible solution-requirements to the problem statement.

- A system must allow for implementing and updating of clinical guidelines
- A system must utilize a standardized way for implementing/updating guidelines
- A system must utilize checklists to comply with clinical guidelines
- A system must allow for implementing and updating checklists
- A system must utilize a standardized way for implementing/updating checklists
- A system must be completely integrated into the standard clinical work-flow, i.e. a part of all clinical processes should be to use the system as well
- A system must be centered around the patient, i.e. checklists and guidelines must be presented differently, dependent upon a patient's diagnosis
- A system must be able to classify patients in a standardized way in order to illustrate different guidelines/checklists
- A system must be able to link a guideline together with every checklist
- A system must allow any clinician to review a guideline while filling out a specific checklist in practice
- A system must allow for monitoring of clinician's compliance with guidelines and/or checklists
- A system must allow for clinicians to monitor each others compliance of guidelines and/or checklists
- A system must be able to store all checklists being filled out together with all necessary information - preferably in a database
- A system must be able to function as a separate module
- A system must be ready to function together with an EPR system

7.1.2.1 Requirements justification

A system must allow for implementing and updating of clinical guidelines
The system must provide a way of implementing both old, and new, clinical guidelines to be followed in a hospital practice.

A system must utilize a standardized, and flexible, way for implementing/updating guidelines
To minimize the variation in methods of implementing clinical guidelines, a standardized way will have to be defined. In addition, flexibility of an IT-based clinical guideline system is a key, as local clinicians will have to be able to adjust guidelines to local standards and changes in work-flow [Quaglini et al. 2001].

A system must utilize checklists to comply with clinical guidelines
Utilizing checklists to comply with guidelines has shown to be effective in practice, and must therefore be utilized [Haynes et al. 2009, Savel et al. 2009, De Vries et al. 2010].

A system must allow for implementing and updating checklists
A system should allow for flexibility, as different clinical settings can adjust checklists to either global or local standards[Garde and Knaup 2006].

A system must utilize a standardized way for implementing/updating checklists
Even though checklists can be freely implemented/updated, it must be done in a standardized way, in order to present both checklists and guidelines in a standardized format.

A system must be completely integrated into the standard clinical work-flow, i.e. a part of all clinical processes will be to use the system as well
Robbins [2011] has already discussed the importance of incorporating checklists completely into the standard practice, in order to achieve successful implementation.

A system must be centered around the patient, i.e. checklists and guidelines must be presented differently, dependent upon a patient's diagnosis/type
This is one of the most important requirements and serves to overcome the complexity of the healthcare system as discussed by Garde and Knaup [2006].

A system must be able to classify patients in a standardized way in order to illustrate different guidelines/checklists
In order to present different guidelines/checklists, a classification standard will have to be implemented which serves to classify patients into different groups.

A system must be able to link a guideline together with every checklist
In order to achieve a closer coherence between guidelines and clinical checklists, the ability to link those two must be possible.

A system must allow any clinician to review a guideline while filling out a specific checklist in practice
A clinician must be able to access specific clinical guidelines whenever needed, while serving to comply with them through the use of checklists. This is gives clinicians the access to understand the reasons for *why* they must perform specific procedures.

A system must allow for monitoring of clinician's compliance with guidelines and/or checklists
By enabling monitoring of clinician's compliance with guidelines and/or checklists, we might be able to encourage the use of guidelines in practice. Monitoring of non-compliance can also assist

in identifying weak points of clinical guidelines [Quaglini et al. 2001].

A system must allow for clinicians to monitor each others compliance of guidelines and/or checklists
While being able to monitor compliance with each clinician, they should also be able to monitor each other, as it could serve to encourage teamwork and better structured communication in practice.

A system must be able to store the usage of every guideline and checklists
This serves to archive all information about the use of the system, and thereby acquire information about compliance.

A system must be able to function as a separate module
A system should be able to function independently, to allow for implementation in any clinical-setting possible, without being dependent upon a specific equipment or already available systems.

A system must be ready to function together with an EPR system
A system should however be able to function together with an EPR system if needed, as some information gathered from the system could be of importance inside a patient record system.

7.2 Solution model

7.2.1 Limitation of scope

A proof of concept is a feasible way of demonstrating how an idea or a theory can function, however, it does not resemble a fully completed ”end product”. Therefore, a limitation of scope will have to be defined for the project
Due to complexity and the enormous variability of the problem domain, the project will not be able to document a complete solution model to function in every clinical work-flow inside a hospital-setting. In stead, the project will focus describing a model which could function within a surgery pathway. This was mainly due to the fact that a surgery pathway incorporates different patient types, different hospital surgery wards and clinical staff, and does therefore serve as an example of how guidelines and checklists can be implemented and presented to be used in different phases for different processes in a hospital setting.
In addition, as the interview conducted was with a project nurse at a surgery ward, it provided a sufficient example of how a typical surgery pathway is organized.

7.2.2 Vision

An illustration of a patient centric model can be seen on figure 7.1 on the next page. The model is to closely incorporate clinical guidelines into the standard clinical work-flow with the help of checklists, while also providing healthcare professionals the advantage of accessing evidence based knowledge underway. The advantages of using checklists to comply with clinical guidelines has already been discussed in chapter 3, but methods of implementing guidelines do still vary. The solution model should therefore offer a common platform where clinical guidelines can both be implemented and complied with in a standardized way.

In order to visualize the appropriate guidelines and checklists to a user, related to each specific patient, a classification standard will have to be implemented with the solution model.
Each patient who is to undergo an operation will have an operation type identified. For each operation type, there can be many different procedures which have to be completed during different

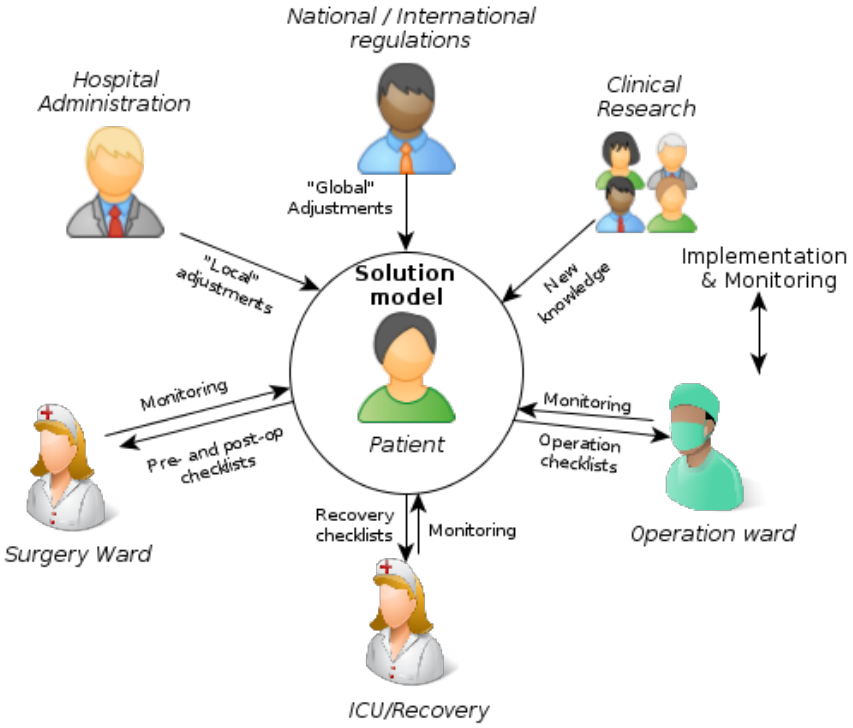

Figure 7.1: *The figure illustrates a vision for a patient centric solution model.*

phases of the operation pathway.
Therefore, a method to identify the surgery type for each patient is needed for the model to be able to present specific guidelines and checklists, for specific procedures, for each patient.
The Danish SKS-code system (The Danish healthcare classification system) is a collection of international, Nordic and Danish clinical classifications which are continuously developed and maintained by the Danish National Board of E-Health (NSI). Not only is the SKS-code systems well known and in use in Danish clinical practice, but it also provides a sufficient standard to be used to classify the type of an operation a patient is to undergo. The SKS-code system was therefore chosen to be used in the model to map patients with different operation types.

The model is to provide a way for both managing and complying with clinical guidelines, therefore, its main structure can be divided in two: (1) implementation and monitoring of guidelines/checklists, and (2) usage of guidelines/checklists in practice. In order to acquire a coherent relationship between the two, the SKS-code system was used as a tool to map guidelines and checklists to a specific surgery. Illustration of the model structure can be seen on figure 7.2 on the following page.

Implementation and monitoring -teams are responsible for defining how, where and which guidelines/checklists are implemented within the system, while also being able to monitor the compliance if the guidelines/checklists implemented. Healthcare professionals (clinicians) are responsible for complying with guidelines, i.e. completing specific clinical procedures, during different phases of the patient's operation pathway, according to the checklists defined by implementation teams.

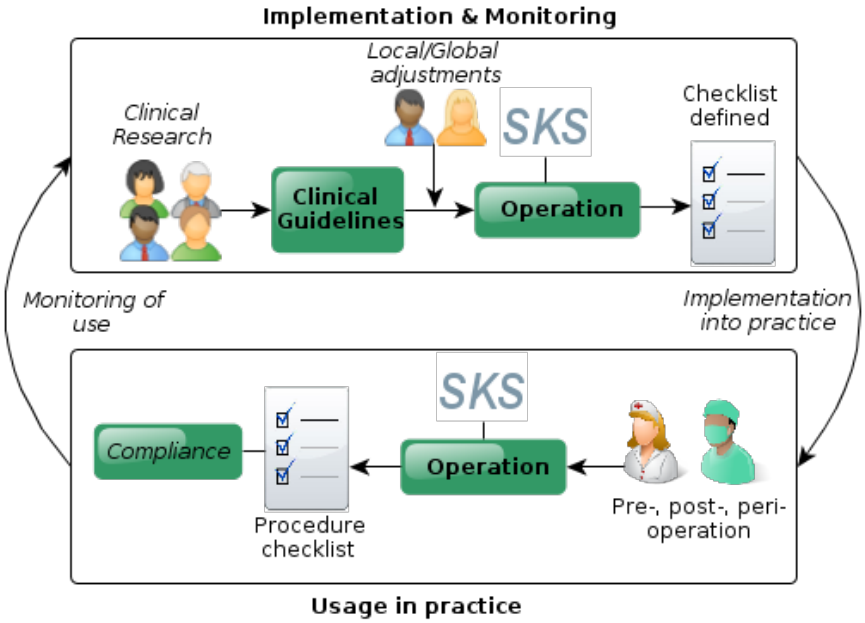

Figure 7.2: *The model can be supported by the SKS-classification system to both implement and use clinical guidelines in practice.*

CHAPTER

8 Exemplification

The following chapter documents the exemplification process of the requirements previously identified. The process is divided up into specifications, design and finally implementation.

8.1 Solution specifications

This section documents the system specifications, i.e. system-requirements, system description, actors and use cases.

8.1.1 System description

From the requirements specified in the previous chapter a system description was formalized to illustrate how the system should function. As noted before, the exemplification of the requirements is limited to function within a surgery pathway work-flow in a hospital setting.

Each actor which participates in a surgery pathway, should have access to the system, where he can access specific checklists related to the guidelines he is to comply with during different phases of the pathway (work-flow). Dependent on which type of operation a patient is to undergo, different ”versions” of checklists are presented during different phases of the pathway. For example, during the pre- and post-op phases, different clinical professionals will be able to access and complete specific clinical checklists for each patient, where procedures/checks are specified from the clinical guidelines. In addition, the evidence based knowledge behind each procedure/check will be available for each checklist as short informative text or by linking to the specific guideline.

The solution does not only function as a checklist-based system to be followed in practice, but also as a platform to monitor and implement clinical guidelines. It combines the functions of a clinical documentation system like PRI or E-Dok and a clinical checklist system like SURPASS[De Vries et al. 2009] into a coherent platform. This means that, adjustments can be made to both guidelines and checklists directly within the system, which corresponds to both ”local” and ”global” requirements. Also, if clinical guidelines are to be updated with new evidence based knowledge, such adjustments can be done directly as well.

The most efficient way of using this system would be to implement it on a tablet, or other hand-held device, which can replace the paper-format checklists currently being used. In addition, the hand-held device should be able to continuously update the current progress of a checklist into the main system, or possibly a different EPR system, where healthcare professionals will not need to retype

their checklist results into a desktop computer - the platform should always be at hand. However, regarding management of the platform itself, a desktop version should be provided where clinical-guidelines and -checklists can be monitored, implemented, or updated, to comply with the newest evidence based knowledge and standards.
By implementing such a solution into the standard clinical work-flow, where checklists within the platform are to be followed for each procedure, we are not only providing a standardize way of implementing/updating guidelines, but also a standardized way of ensuring compliance with them; and thereby ensuring the highest quality of care.

8.1.2 Functional requirements

The following is a more detailed list of functional requirements which are needed to be defined before implementing the system into a functioning software within a surgery pathway in a hospital setting.

- The system must allow a user to add a new patient profile to the system - *If the patient isn't found in the system*
- The system must function with a patient identifier - *This can be a CPR number.*
- The system must be able to classify patients according to operation types - *This distinguish which guidelines/checklists can be presented*
- The system must be able to show all patients currently registered in the system - *This allows clinicians to quickly access a patient profile, to which they are treating*
- The system must allow an actor to access the status of all checklists for each patient - *This helps clinicians to monitor compliance with every checklist*
- The system must enable a user to define which guideline/checklists are linked with each operation type - *This is needed to allow for flexible implementation of guidelines/checklists to be followed with each operation type*

8.1.3 Non-functional requirements

The following non-functional requirements are defined solely for the purpose of this project and should not be taken as final design choices.

- The system must must be a web based application solution - *This allows for implementation both on a desktop computer and a tablet*
- The system must must be built up from two main components, an application server and a MySQL database server - *One to run the web application itself, the other to run the DBMS*
- The system must be accessed from a local-web site, i.e. a local web-server-address which can be accessed from every ward in a hospital setting - *This should allow users to access the application whenever and wherever in a hospital setting*
- The system must require a log-in for hospital staff to access its clinical-functions - *Unauthorized users should not be able to fill out checklists*
- The system must make all guidelines publicly available, without the need to log-in - *The public should be able to review all clinical guidelines available*
- Each healthcare professional should have his own username and pin code to log in, and to confirm procedures/checks in a checklist, or when updating a clinical-guideline or -checklist
- The system must be role based, i.e. some actors will not be able to access and perform some actions

8.1.4 Actors

Three actors are defined for the solution model.

1. A practicing healthcare professional in a hospital setting (HP)
2. An administrative professional (AP)
3. A healthy citizen or patient (P)

A HP is used to describe those who will be using the solution on a daily basis in clinical practice. These are the clinicians, nurses and other healthcare professionals who are to follow certain clinical guidelines in their practical work-flow.
An administrative professional can be categorized as an HP as well, but has different responsibilities compared to an HP. APs are responsible for implementing/updating guidelines and checklists within the system, while also having the responsibility to adjust guidelines to the local environment, or work-procedures. This can be a hospital-administrative, a head physician, head nurse, or a professional responsible for clinical guidelines in a hospital setting.
A patient or a healthy citizen are users to the system who should only be able to read through and understand the clinical guidelines available.

8.1.5 Use Cases

The following 12 use cases were defined for the solution model's proof of concept:

- Log-in
- Log-out
- Add guideline
- Find guideline
- Edit guideline
- Add checklist
- Find checklist
- Edit checklist
- Add patient
- Find patient
- Edit patient
- Fill out checklist

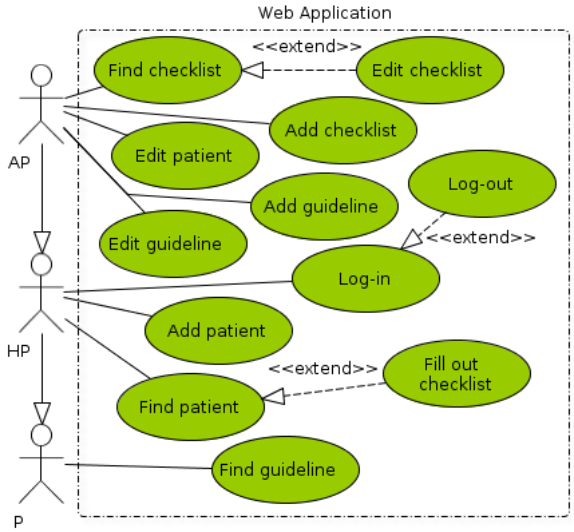

Figure 8.1: *The Use case diagram for the solution.*

Detailed specifications for each use case are listed in Appendix, chapter C on page 83. Figure 8.1 illustrates the Use Case diagram for the solution. The administrative professional has the most "rights" within the application, i.e. he both extends the use cases from the HP and the P. The UCs for the AP are mostly management UCs where he is able to add, edit and adjust how guidelines and checklists are presented to the HP. The HP is able to log-in and find/add patients and to fill out their corresponding checklists. Lastly, every actor is able to find and view clinical guidelines within the system without having to log-in.

8.2 Design

The following section documents the design phase of the exemplification process. It covers the system deployment diagram and architecture, together with modeling of classes, ER model and the database.

8.2.1 Deployment diagram

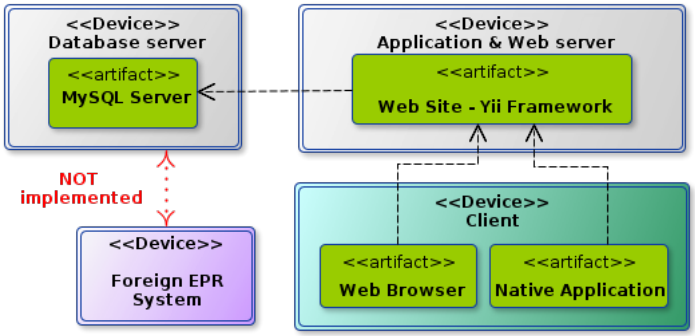

Figure 8.2: *The system is deployed in three different components. A client device, the web application server and a database server. Foreign EPR systems will have to be incorporated separately.*

Figure 8.2 illustrates how the solution model was deployed into a complete system. A client device, which represents the end user's device, accesses a web application server through a local net. The web application server utilizes a database server to manage and store all data, which is implemented using a database management system (DBMS). Although the MySQL server, and the application and web server are illustrated as two separate devices, they can be deployed into the same computer. Any linkage with a foreign Electronic Patient Record (EPR) system will have to be manually designed for each specific case, as the systems being used in today's hospital settings do highly vary in structure and function; it will therefore not be documented in this report. Nevertheless, as MySQL is a common DBMS, it should be feasible to design a solution which can transfer data between the database and an foreign EPR system if needed.
The client device component can either be a web browser on a standard computer, or a native application on a tablet or a smartphone. Currently, both tablets and smartphones, provide stable web browsers which can be used to access the web application, however, a native tablet/smartphone application can also be developed to access the same web application.
The web application itself was deployed with an Open Source web application framework - called the Yii-Framework [1]. The framework itself is built upon PHP and provides a secure, fast and professional base to deploy the solution in. Not only does it fully support SQL DBMS, but does also allow for a complete customization in the framework environment, in order to develop complex and tailored web based application solutions.

8.2.2 System architecture

The Yii-framework fully implements the the Model-View-Controller design pattern which enables organized development of code and a simple application methodology. Figure 8.3 shows how an

[1] `http://www.yiiframework.com/`

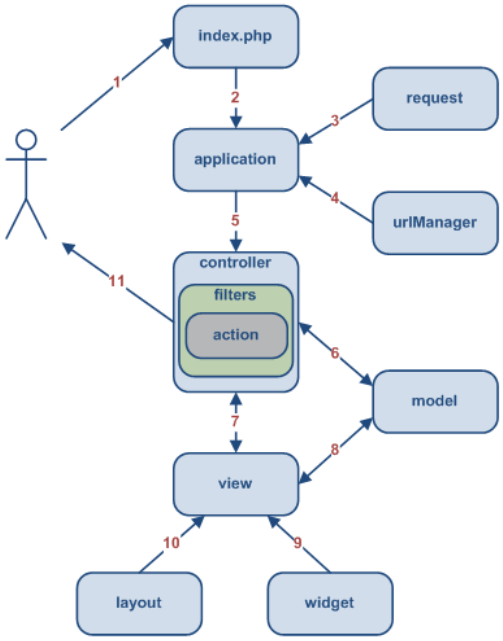

Figure 8.3: *The figure illustrates the typical work-flow of a Yii based web application [Yii Framework 2013].*

Yii based web application handles a typical user work-flow. An actor gains access to the specific index.php (web page) on a specific website address, which then activates the web application to fetch a specific controller class linked with the web page (index.php). The controller then uses models, filters and different actions to illustrate and update a view for the actor - which is displayed on the website.

8.2.3 Database

In order to handle data and information storage within the system, while also allowing for information sharing between healthcare professionals (or possibly other EPR systems), a database will be implemented with the solution.
Data handling, and storage, can be very delicate in the healthcare sector, where inconsistencies and distorted data can make the difference between life and death. In order to design a suitable database to be used with a clinical information system, a relational database model will be used. Relational databases focus on ensuring atomicity, consistency, isolation and durability (ACID properties) of data [Silberschatz et al. 2011], which is important to withhold in a database to be used in clinical practice.

8.2.3.1 E-R model

Relational databases can be designed with an entity-relationship (E-R) model, which is often used to directly model work flows of an enterprise [Silberschatz et al. 2011]. An E-R model represents entities, the relationships between them and attributes. Each entity usually represents a *thing* or an *object* in the real world that is distinguishable from other objects and has attributes which are used to describe it. Relationships are then used to associate several entities with each other. To illustrate the solution model and to design the corresponding database, an ER-diagram was drawn - see figure 8.4 on the following page. In this model, entities are illustrated in blue, relationships as purple and attributes as

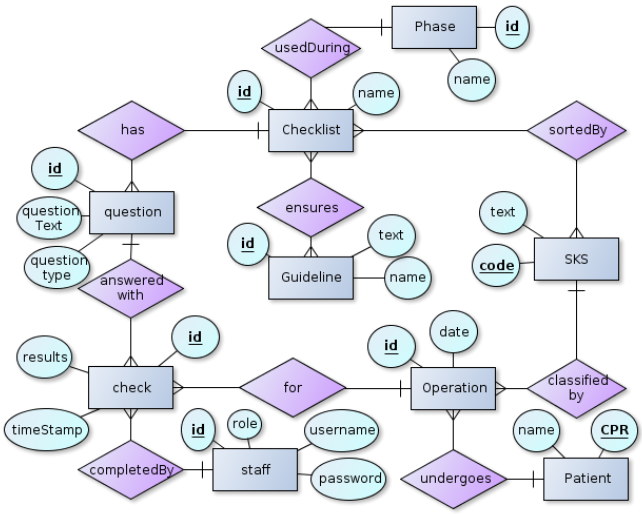

Figure 8.4: *The figure illustrates E-R model of the solution, which was implemented into a DBMS.*

light-blue. The model is focused on being highly structured and normalized to minimize unnecessary redundancy and to retrieve information easily.

ER model description

The **patient** entity will have to be defined with his own personal identity number (CPR) and a name. A **patient** can undergo one or more **operations**, however, each **operation** can only be linked to one **patient** and does therefore have an one-to-many relationship. An **operation** can only be *classified* with a one specific operation type from the **SKS** code system, while a **SKS** code can be linked with multiple **operations**, thereby a many-to-one relationship.
Because the same **checklist** can be used with different operation types while different **operations** can have multiple **checklists** assigned with them, there is a many-to-many relationship defined between them where a **checklist** can be *sorted by* **SKS**. A **checklist** is used to *ensure* that clinicians follow different **guidelines** in practice, while one **guideline** can be followed by different **checklists**, we have a many-to-many relationship between **guideline** and **checklist**.
An **operation** commonly follows three different phases, i.e. pre-, peri- and post-operation. Each phase can have multiple **checklists**, while one **checklist** can only be *used during* one **phase**, therefore an one-to-many relationship. A **checklist** has multiple **questions** which a clinician will have to answer or check-for, but each **question** can only be linked to its **checklist**, therefore an one-to-many relationship. Each **question** in a **checklist** has a **check** which has to be *completed by* a clinical professional. Each **check** is only related to one question, but one **question** can have multiple **checks** *completed by* different clinical **staff**. Each **check** is also only linked to a specific **operation** at a time, therefore, the relationships to/from the **check** entity are all one-to-many.

ER model design choices

The ER model was designed to support both implementation, and monitoring of compliance, with clinical guidelines. In the ER model, both guidelines and checklists are represented as independent entities, which allows for simple implementation and retrieval to and from the system. However, monitoring of their compliance requires the solution to be able to combine archived data from

more than one entity at any given time. This means that monitoring of compliance does not have to be defined as a specific parameter for each clinician, checklist or guideline, but rather a combined result from different entities. This is due to the fact that various hospital settings might symbolize compliance in different ways. As the solution focuses on flexibility, to be able to fulfill the various requirements between different hospital-settings, the model should be able to present various combinations of data which can be used to evaluate compliance in different ways.
Another design choice supporting this methodology was the placement of the staff entity. The only relation to/from staff is from the check entity, where each check/answer can be directly linked to a clinical staff member. As each check can directly be linked to a checklist (through question),an operation, a patient (through operation), or a SKS (through operation), through different many-to-one relationships, a clinicians compliance with these different identities can be found by joining different entities together. By doing so, the ER model is not placing a general constrain onto the design, but rather allowing for flexible use of the model, depending upon the clinical-setting it is to be used in.

During the design of the ER model, guidelines and checklists from the Aalborg University Hospital heart- and -lung surgery ward were used as reference (see Annex on page 91). Due to the fact that a question from a checklist could be answered with a simple check, a text, or a pre-defined answer, the questions had to be sorted into types. A question-type attribute was therefore defined in the question entity which could classify the type of check/answer to be completed in a checklist.

8.2.3.2 Database schema

Before the ER model could be implemented into a DBMS, it had to be transposed into a database schema Figure 8.5 on the next page illustrates the full database schema which was implemented.
Each table represents an **Entity** defined in the previous ER model and naming of entities and relationships have been changed for convenience. All one-to-many relationships are represented with a foreign key in the ”child” table, e.g. the one-to-many relationship from **checklist** to **question**, the **question** table has a *checklist_id* attribute which is a foreign key of *id* from the **checklist** table.
Many-to-many relationships are represented with their own relationship-table, where e.g. the table **checklist_guideline** links a *checklist_id* together with different *guideline_ids*.
As the question entity required a classification of the question type, a simple many to one relationship was defined with a question-type table, where a foreign question_ type key was added into the question table. As one question could be classified in at least three different ways, the answer would have to be able to store (at least) three possible question types. This was achieved by defining the answer attribute itself as a VARCHAR.
Three additional tables where defined as well, in order to manage user roles, those are: authItem, authAssignment and authItemChild. The only objective of these tables was to be able to store the roles of different users within the database.

8.2.4 Design classes

In order to complete the design specifications for the solution, design classes had to be identified. Table 8.1 on the following page illustrates all the models, view and controller classes. Each model class was defined from a non-relationship-table in the database schema, with its corresponding attributes. The Yii framework allows models to be linked through different relationships defined in the database, which means that no relationship-model classes were needed to be defined for any of the relationship

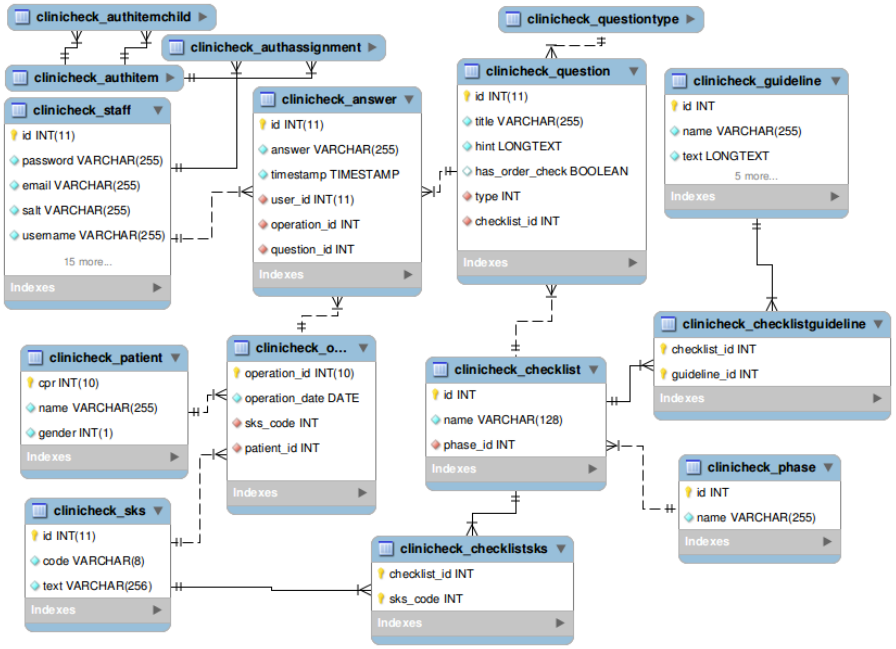

Figure 8.5: *The figure illustrates the fully implemented database schema of the original ER model.*

Model	View	Control
M:Answer	V:Checklist	C:ChecklistController
M:AuthItem	V:Guideline	C:GuidelineController
M:Checklist	V:Patient	C:PatientController
M:Guideline	V:Site	C:SiteController
M:Operation	V:Staff	C:StaffController
M:Patient		
M:Phase		
M:Question		
M:QuestionType		
M:Sks		
M:Staff		

Table 8.1: *The system's identified design classes, divided into Model (M:), View (V:) and Controller (C:) classes.*

tables. Four different main-view classes were defined for each of the controller classes where each view class could illustrate different views needed for a specific model. Controller classes were defined to handle different CRUD (Create, Remove, Update and Delete) operations, along with different specific UC operations. The design class diagram (see figure 8.6 on the next page) also illustrates which methods(operations) were defined in each class.

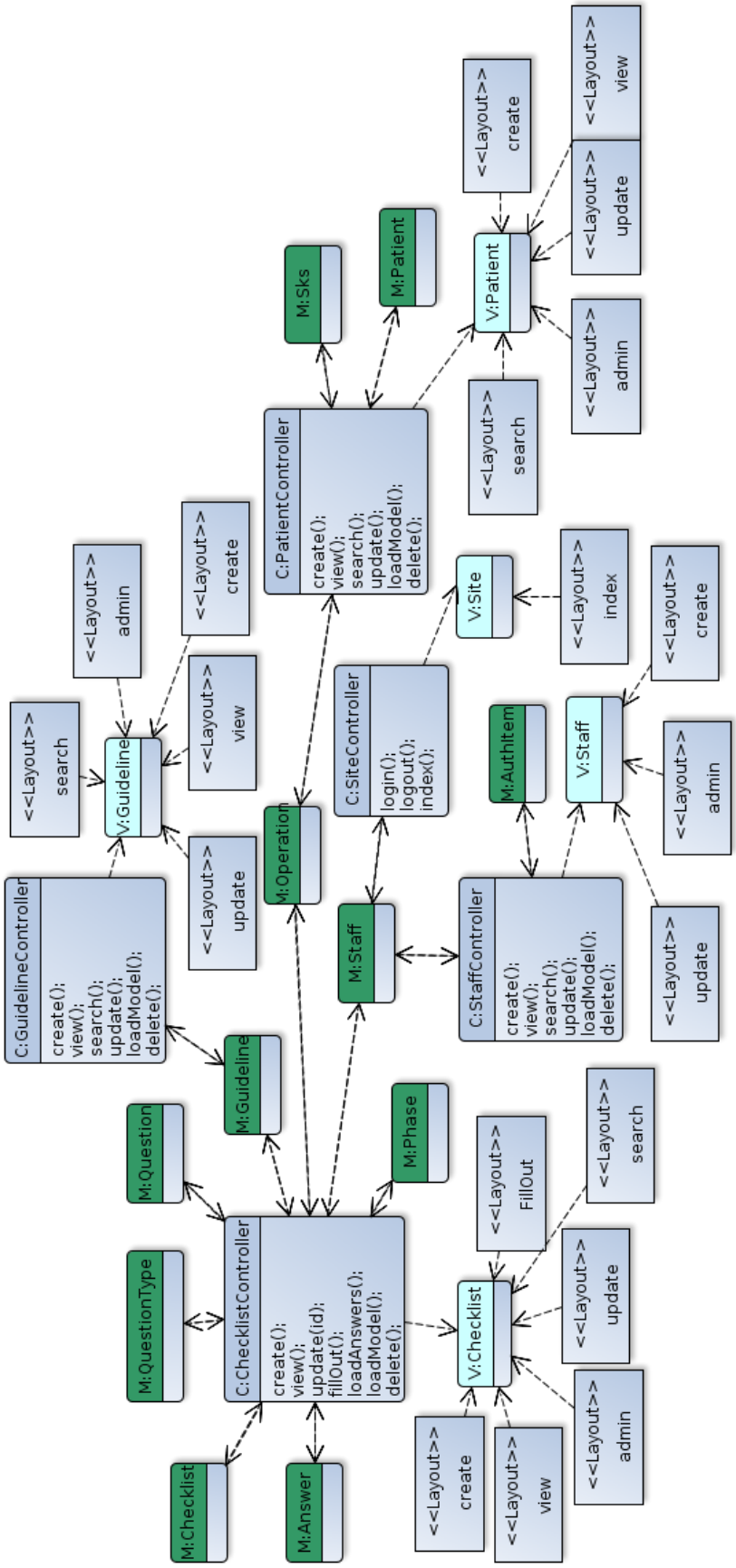

Figure 8.6: *The picture illustrates the design class diagram for the application solution.*

8.3 Implementation

The following chapter documents the realization process, or implementation of the solution model into a proof of concept application.

During implementation of the solution model, the structure and design of both guidelines and checklists being used at the surgery ward at Aalborg University Hospital, were used as a reference. However, as neither the guidelines or checklists were designed to be used in a solution such as this, their structure had minimum influence on the final results. Instead, focus was set on fulfilling all the specifications and requirements by utilizing standardized structure and design from the Yii-framework.

While following an agile development method, the implementation was divided up into two "sprints". Each sprint lasted a week, and focused on implementing specific use-cases and fulfilling specific requirements. The use cases were divided up into two, where in the first sprint, use cases related to implementation and management of guidelines and checklists were implemented. The later sprint, covered the rest of the use cases, which focused on the HP specific use cases and the general usability of the system.

8.3.1 Sprint 1: Management of guidelines and checklists

The first part to be implemented of the solution model were the functions which could allow users to implement clinical-guidelines and -checklists into the system. As specified in the requirements, only an administrative professional (AP) is able to log-in to create/update guidelines and checklists. Each guideline created within the system is visible to everyone, but can only be edited by an AP. Figure 8.7

Displaying 1-7 of 7 results.

ID	Name	Create Time	Update Time	Update	
1	CABG/klap eller anden hjerteoperation, Klargøring af patient til operation.	2013-04-29 09:15:17	2013-04-29 09:34:17	1	
2	Postoperativ sygepleje til den hjerteopererede patient	2013-04-29 09:40:15	2013-04-29 09:40:15	1	
3	Lungeoperation, klargøring af patient til operation	2013-04-29 09:58:53	2013-04-29 09:58:53	1	
4	Lungeoperation, postoperative standardordinationer - sygeplejeinstruks for Hjerte– Lungekirurgisk Afdeling	2013-04-29 10:02:04	2013-04-29 10:02:04	1	
5	Præoperativ klipning - thoraxkirurgiske operationer	2013-05-01 09:11:17	2013-05-01 09:11:17	2	

Figure 8.7: *The guidelines can be accessed through a list-view for both reviewing and updating.*

illustrates how each guideline is listed in the application, where they can be filtered or searched for by name. When defining/creating a guideline, the user only needs to specify a name, and a descriptive text or images; similar to those guidelines being developed and presented in documentation systems like PRI. Any linkage to a specific operation is done through the checklists.
Managing checklists within the system is similar to that of guidelines, the creation of a checklist does however require a more specific input from the user. A checklist must be linked with certain SKS

codes, i.e. which operation types it is to be used with, along with a specific relation to a guideline or guidelines the checklist is to ensure compliance with. Only SKS operation classification codes related to operations in the thorax area were implemented into the system as they would suffice to prove the concept. Figure 8.8 and 8.9 illustrate the inputs needed from the user when defining a checklist.

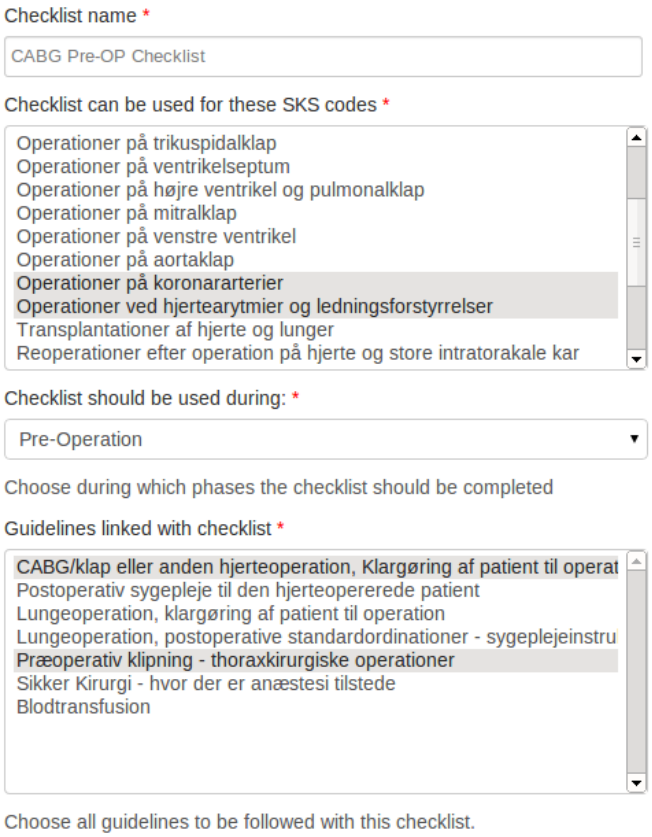

Figure 8.8: *When defining a checklist the user needs to specify a name, operation type to be linked with it, the operation phase and which guidelines its supporting.*

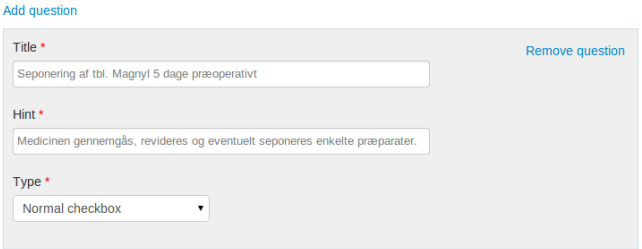

Figure 8.9: *Questions for each checklist will have to be defined. A user can add/remove as many questions as needed.*

A checklist can withhold as many questions as needed. Each question must have (1) a title (the question itself), (2) a ”hint” which is a short justification (preferably a text from one of the guidelines) of *why* this specific question is being asked, and (3) a question type - which specifies if it’s a normal checkbox, multiple answer, or a text input question (e.g. to receive text input about blood pressure).

Each checklist can then be reviewed or updated by an AP if needed, by accessing the checklist management, which is a similar view to the guideline list on figure 8.7 on page 44.

8.3.2 Sprint 2: Use in practice

As mentioned before, all guidelines previously created by an AP are publicly available through the application. This means that both clinicians and citizens can search and access guidelines through the application. However, only healthcare professionals(HP) can access checklists to be filled out for each patient.
When a HP is to treat a patient who is to undergo an operation, the HP should preferably use the application on a tablet, to allow him to fill out the specific checklists needed for that particular operation. The application was however only implemented efficiently to be used in a desktop computer browser. A HP can search for a patient through the patient-management list, and if the patient has never been involved in an operation before, a patient profile can be created. Each patient will have to be identified with his CPR number, name and gender. By using the patient's CPR number the system could allow foreign EPR systems ease access to specific patient data within the application, if needed; e.g. checklist results for a specific patient.
As one patient can undergo numerous operations throughout his lifetime, the possibility to "add" an operation to his profile is available for all HPs. Each time a patient is to undergo a new operation, the patient profile will have to be updated by linking a new operation to it. When caring for a patient throughout the operation pathway, each attending HP must follow the checklists assigned to the patient at any given time to ensure compliance with the predefined guidelines. Therefore, a HP must be able to quickly find a patient's profile inside the application and the specific checklist to be filled out. To achieve this, different methods can be used, however, as the application is only a proof of concept, the method implemented was a simple way of filtering patients by CPR number, name or gender in a list-view. When a HP chooses to view a specific patient profile

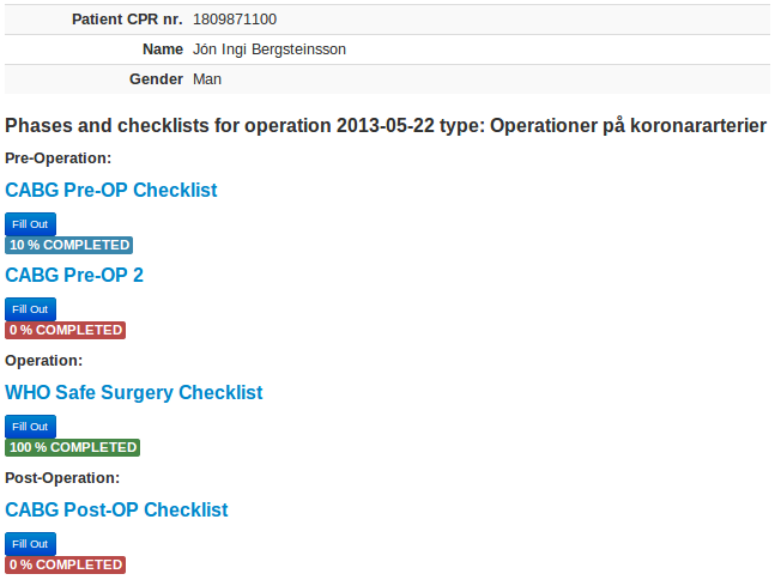

Figure 8.10: *When viewing a patient's profile, an overview of the patient specific checklists for each operation, along with the status of each checklist, is shown.*

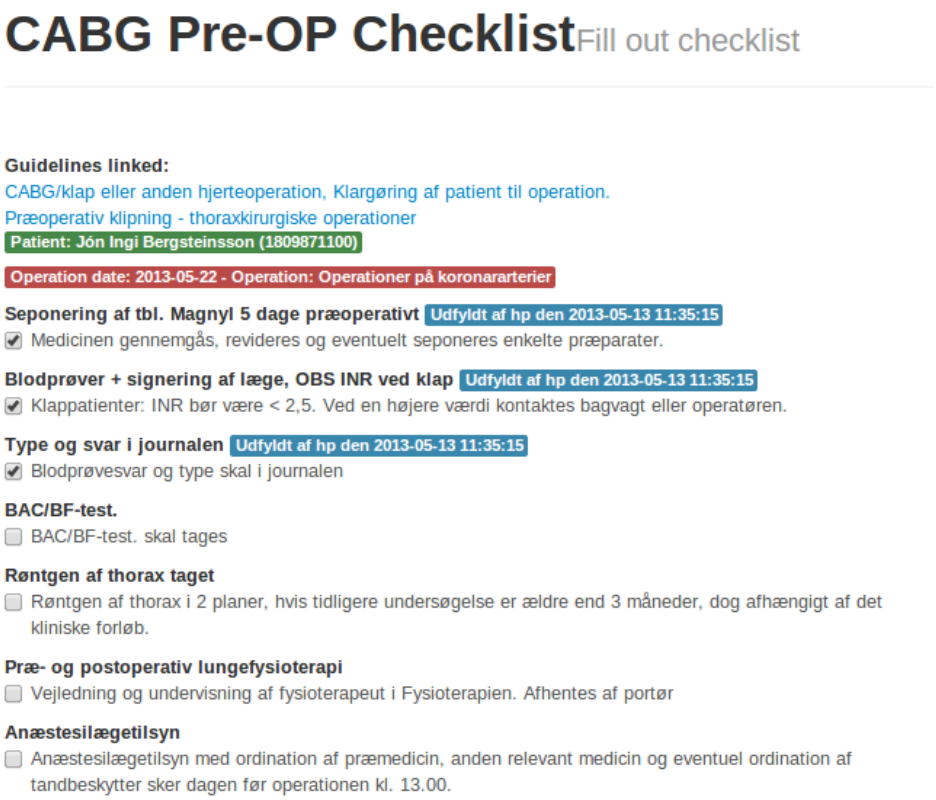

Figure 8.11: *The figure illustrates how a checklist can be filled out. Each question has an information text under it, which should describe why the procedure is being done, and if needed, a link can be made to a particular guideline.*

he is presented with an overview of the checklists specified for only that patient. A HP can then choose which checklist he needs to fill out, depending on where in the operation pathway the patient is situated. Figure 8.10 on the facing page illustrates the patient-view a HP is presented with. The status of each checklist is presented in percentages and color. While a checklist is currently being filled out, it is listed in blue. If it has not been completed already, it is listed in red, however, if a checklist is completed, it is listed in green. By using colors and percentage to illustrate the status of each checklist, a HP can quickly review the status for each patient. When a HP is to treat a patient, e.g. during the pre-op phase, the "fill out" button is to be used to complete a particular checklist. An example of the checklist-view is shown on figure 8.11. The example illustrates the first questions to be completed from a CABG (Coronary Artery Bypass Graft) Pre-OP checklist. The guidelines linked with the checklist are listed in the top where a HP can quickly access them if needed. Each question has an information text linked with it, which should describe *why* the procedure is being done, and if needed, a link can be made to the guideline which the question complies with.

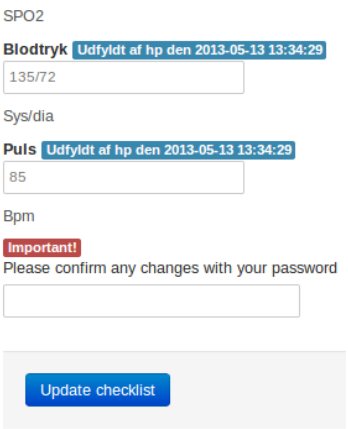

Figure 8.12: *A HP must confirm his checks with his password.*

A HP is able to check for each question and finally confirming his checks/answers at the very end of the checklist by typing his password (see figure 8.12 on the preceding page). When a checklist has been filled out, or updated, the checklist-status will be visible to other HPs within the patient's profile.

8.3.3 Evaluation

Evaluation and testing of a solution artifact is a vital part of the design science research methodology. The process of testing an artifact in its environment is important to both design and development, in order to adjust the artifact to its user needs. However, due to the projects time-limitations and lack of resources, the developed solution could not be implemented into a hospital setting for end-user testing. Such a test would require increased development time in adjusting the proof of concept to a real life setting. The application was therefore only evaluated on the use cases implemented, and its functionality as a proof of concept application.

All requirements previously set forth in chapter 7.1.2, 8.1.2 and 8.1.3 were fulfilled. Every use case listed in chapter 8.1.5 on page 37 was implemented into the Yii-framework web application and their functionality accepted. However, as the system developed is only a proof of concept, the level of design and general sophistication can be discussed.
For further evaluation, the system has been made available for public evaluation through the website `http://clinicheck.medei.dk` where it is possible to evaluate the Administrative- and the healthcare-professional functions, by logging in with the information listed in the following table.

Username	Password	Role
ap	1234	Administrative Professional
hp	1234	Healthcare Professional

Table 8.2: *It is possible to evaluate the proof of concept by logging in with the information in this table*

Part III

Synthesis

CHAPTER

9 Discussion

The objective of this project was to define requirements for a system which could overcome the issues and challenges analyzed from the problem domain.
It has widely been shown that requirements are the most fragile part of a system development, and incorrectly defined requirements can easily cause a whole project to fail [Garde and Knaup 2006, Arlow and Neustadt 2005]. The healthcare environment is highly complex and it can be difficult to apply general requirement engineering methods in development of clinical information systems. Clinical environment is highly sensitive and the smallest errors can make the decision between life and death. It was therefore important to utilize an accepted requirement engineering method within the domain of clinical information systems, to define the solution-requirements to the problem statement.

IT solutions within healthcare are becoming more complex to use, which is probably due to overflow of functions, complex decision support algorithms or highly structured documentation standards. It is becoming more clear that if a system is to function effectively in practice, healthcare professionals must be able to understand how to correctly use it. Therefore, instead of constantly focusing on developing new systems which require complex learning plans, one should try to focus on developing solutions that serve to solve the user's problem, in a simple - yet effective way. This does not mean that a whole new technology must be developed each time a problem is to be solved, but rather try to combine simple components together, which also, might already be in use.

With that in mind, and in order to evaluate the requirements identified, a proof of concept of the solution model was developed, which could present, a simple, yet a standardized method, for implementing clinical guidelines into practice, while also allowing clinicians to use clinical-checklists to comply with them.
The proof of concept was developed to function only within a surgery pathway in a hospital setting. This was mainly due to the fact that much of the checklists available in practice are used in relation to surgeries performed in a hospital settings. A different scenario could have been chosen, but as a surgery pathways incorporate various patient types, hospital surgery wards and clinical staff, it serves as the perfect example of how guidelines and checklists can be implemented and presented to be used in various phases and processes in a hospital setting.
Although the system only provides an example of how guidelines can be implemented together with checklists for surgery related processes, it still illustrates how the possible future guideline-systems could function in practice.

A fully functioning proof of concept system was implemented as an Yii-Framework web application

and is accessible for temporary evaluation via `http://clinicheck.medei.dk`. A different method could have been chosen for implementation of the system, e.g. with the use of java on a desktop computer, or a native Android or iOS application to be run on a tablet. Nevertheless, as this was only a proof of concept, the PHP framework sufficed for exemplification of the model.
It is clear that security is also an important factor of a clinical information system, which hasn't been discussed previously in this project. Both patient and clinical-compliance -information within the system are sensitive, and future versions of the concept must be able to fulfill all the necessary standards related to encryption and access control of such information.

The design of the proof of concept underwent numerous changes underway where different diagrams and models were drawn up. Many of them served to be usable for this particular exemplification, but did however always end up in placing some constrain on its use as well - If not on its general usability, then on the way how guidelines, checklists or compliance was presented to its users.
The final implemented design focuses on being utmost flexible and not relying on specific version of guidelines or checklists, but rather enabling users to specify their own.

As Hevner et al. [2004] states, an artifact should be evaluated in its environment to acquire its correct usability. However, as the project primarily focused on identifying requirements, and exemplifying them into a functioning proof of concept, the evaluation of the system was solely dependent upon the author himself and his colleagues.
For future perspectives, it is clear that the system will have to be tested in a clinical environment by its end-users.

It can be argued that the solution-requirements identified in this project may be too general. On the other hand, they do manage to highlight some important factors a system should implement if it was to manage implementation and/or usage of clinical guidelines. It should however be noted that the list is not conclusive and additional non-functional requirements will have to be defined. For future work, the requirements could be extend to cover non-functional requirements of a system as well, and even more, develop a fully functional platform for complete evaluation.

CHAPTER

10 Conclusion

As described by Garde and Knaup [2006], developing solution to be used in healthcare can be highly challenging - the complexity in healthcare in general, and the clinical-processes there within, are enormous. Due to this, there cannot be only one way of performing certain clinical-procedures, but rather only best clinical practice to each given situation.
Clinical guidelines have been used for decades in order for clinicians to meet the same standard of best-clinical practice and to achieve the best possible care for every patient[Cabana et al. 1999, Fervers et al. 2006]. The use of clinical guidelines has been shown to have positive results on clinical-outcomes, patient safety and lowered costs [Cabana et al. 1999, Woolf et al. 1999, Grimshaw and Russell 1993, Grol et al. 2003, Faul et al. 2007]. Even though the importance of using clinical guidelines in practice is widely accepted, it has been difficult to encourage clinical professionals to follow them [Cabana et al. 1999, Grol et al. 2003, Michie and Lester 2005, Grol et al. 2006]. In addition, current methods of implementing clinical guidelines into standard practice do highly vary from one hospital setting to another [Sundhedsstyrelsen 2009], which results in high variation of patient-care as well.

In recent years, clinical checklists have been gaining more attention, as their use in practice, to help ensure compliance with clinical guidelines and to structure communication between clinicians, has shown positive results [Savel et al. 2009, Haynes et al. 2009, Robbins 2011]. The use of checklists as an assistive-tool in daily practice gives clinical-professionals the possibility to comply with guidelines in order to provide the same quality of care to all patients. The "patient safe hospital" project has also encouraged clinicians to utilize both checklists and flowcharts in practice, with some positive results [Patientsikkert sygehus 2013a; 2012]. In addition, De Vries et al. [2010] did also illustrate that it is possible to lower mortality rates and surgery complications by implementing clinical checklists into a highly structured IT-system. However, much knowledge is still kept away from the standard practice, within guideline documentation systems, which cannot be fitted into a clinical checklist.

Similar to the system developed and presented by De Vries and colleagues [De Vries et al. 2009; 2010], CliniCheck serves to incorporate clinical checklists into practice in a standardized way. As noted by the interviewee from Aalborg University Hospital, clinical checklists are being more commonly used in daily hospital-practice, but only in paper format. However, as the need to update clinicians with the newest evidence for patient care is ever growing, it can be difficult to maintain, adjust or update these current paper formatted checklists/flowcharts accordingly. Therefore, a computerized solution like the one presented in this report might help with simplifying the process.

While CliniCheck can serve as a computerized way of using clinical checklists, its method of implementation into a clinical-setting must be made efficient. Today, healthcare professionals

are able to carry checklists around, and fill them out wherever and whenever needed. Therefore, CliniCheck must allow healthcare professionals to carry out the same work in a similar manner. In order to achieve this, the application will have to be implemented on a portable computer, such as a tablet, where it can be used in the same way as a paper formatted checklist.

In the coming years, one only can assume that with new ways of treatments being introduced for various clinical processes, more complex guidelines will follow as well. It is clear that if the future healthcare-setting is to be able to adjust to the speedy evolution of clinical treatment, more robust solutions will have to be applied. If evidence-based treatment is to continue to be the standard in clinical practice, the implementation of guidelines into the clinical-work-flow will have to be made more streamlined.
The current process of sharing new knowledge among clinical professionals can be a difficult task, especially when our clinical-knowledge is constantly growing. A new way of informing clinicians of new evidence based knowledge is needed, as today's trend of implementing complex guidelines is not only time consuming, but can also be misinterpreted easily Lenfant [2003]. By standardizing the way how clinicians comply with clinical guidelines, we might be able to simplify the process of implementing new knowledge into practice.
However, if monitoring of compliance with guidelines in practice can be made possible, clinicians might want to impose themselves more into following them. On the other hand, some clinicians might feel as monitoring of their compliance is crossing their "decision-boundary" as clinical-professionals, which might result in even lowered compliance. Nevertheless, it can be agreed upon that a change is needed, and not only in methods of implementation, but also in the way how clinicians cope with change and new knowledge [Grol et al. 2003].

When the seven characteristics which Garde and Knaup [2006] identified are reflected upon, the requirements identified and CliniCheck serve to comply with all of them. Firstly, CliniCheck allows new evidence-based guidelines to be implemented/updated in a simple manner, in addition it allows for local/global environment adjustments to be made to guidelines, which is reflected in the structure of the checklists within the system. CliniCheck does also allow for different checklists to be presented to different operation types, i.e. it adjusts to the patient himself, while also being able to store information from the system for a longer periods of time. Lastly, CliniCheck can also be structured even further, to minimize error inputs from healthcare professionals to minimize the risk for affecting the patient's safety. This particular version of CliniCheck is able to run on its own and not being dependent upon other EPR systems, but the possibility to be combined as a module with another EPR system is an option.

CliniCheck does not focus on solving all the issues related to implementation or compliance with clinical guidelines. It does however, present an example of a simple model which fulfills all the requirement specified to overcome the issues raised from the problem domain. CliniCheck is merely an example of how a simple model can contribute to an even bigger solution, and more work is clearly needed to be able to professionally evaluate the solution-requirements in clinical practice.

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IV

Appendix

APPENDIX

A Litterature search-protocol

This search protocol should support the collection of the evidence based material used in this project.

A.1 Background and aim

The problem analysis was set on analyzing the area of interest and identifying issues within the domain of clinical-guidelines and -checklists, in order to define the project's problem formulation. A literature search was carried out in order to achieve sufficient amount of knowledge within the area.

A.2 Focus questions

- What are their main pros and cons of using clinical guidelines?
- How does legislation and regulations affect clinical guidelines?
- How are clinical guidelines implemented into healthcare and how is their compliance ensured?
- How are clinical guidelines used in practice? (practical example - Interview)

A.3 Criterias

Inclusions criteria
Language: English or Danish.
Age of references: Any.
Type of publications: Any.
Context: Hospital-settings

A.4 Databases

The literature search was conducted on Google Scholar, PubMed, and Embase. Furthermore, citations in relevant articles were followed, along with an unsystematic free text search on Google.

A.5 Database search strategy

A free-text search was to be done on the following keywords. As a rule, the abstracts from the first 10 publications, and only titles of the next 20 publications were read. Publications were then either accepted or discarded to be used in the project.

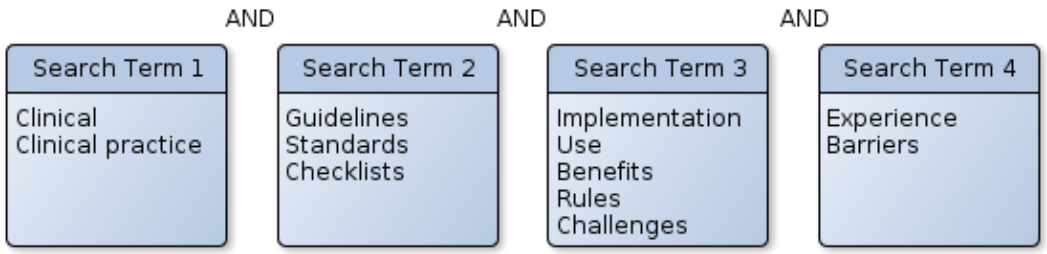


Figure A.1: *The figure illustrates how the different search terms were composed.*

Database	**Search term**	**Hits**	**Relevant hits**
Google Scholar	”Clinical + Practice + Guidelines”	> 1.000.000	1
Google Scholar	”Clinical + Practice + Guidelines + use”	> 1.000.000	2
Google Scholar	”Clinical + Practice + Guidelines + implementation”	> 200.000	5
Google Scholar	”Clinical + Practice + Guidelines + use + benefits”	> 1.000.000	3
Embase	clinical AND practice AND (’guidelines’/exp OR guidelines)	211.523	0
Embase	clinical AND practice AND (’guidelines’/exp OR guidelines) AND use AND benefits	3436	1
Embase	clinical AND practice AND (’guidelines’/exp OR guidelines) AND benefits	6144	0
Pubmed	((((Clinical) AND Practice) AND Guidelines))	46678	0
Pubmed	((((Clinical) AND Practice) AND Guidelines)) AND Implementation	4249	0
Pubmed	clinical AND practice AND (’guidelines’/exp OR guidelines) AND use AND benefits	182	0
Pubmed	(((Clinical) AND Guidelines) AND Implementation) AND Experience	518	0

Table A.1: *The table illustrates an example of the literature search and hits.*

The table shown above is only an example of the literature search done throughout the project period. The domain of clinical-guidelines and -checklists is very broad and it turned out to be challenging to acquire sufficient ”general” knowledge within the domain of interests, from the specific medical databases (Pubmed, Embase, etc.).

In addition to specific searches on the internet, the author managed to acquire most of his citations by reading through reference lists from other articles, and also, previous thesis projects within the subject of clinical guidelines, in Biomedical Engineering at Aalborg University.

In addition, systematic searches through Google Scholar showed to be more successful, compared to the other databases, as Scholar always serves to find the most citet articles within a given search term. Unsystematic searches via Google did also prove to be more successful in acquiring general knowledge about the use and implementation of clinical-guidelines and -checklists, which then lead to findings of specific articles and references used in this project.

APPENDIX

B Interview guide

The following chapter describes how the interview was carried out with a project nurse at the heart- and lung- surgery ward at Aalborg University Hospital.

The objective of the interview was to get an example of how clinical professionals develop and comply with clinical guidelines in practice.
Initially, surgical wards at both Aalborg- and Aarhus-Hospital where inquired about interviews in relation to the project. Unfortunately only one project-nurse from Aalborg University Hospital accepted to be interviewed. Preferably, two interviews from different hospital settings would have given a broader perspective of how guidelines are handled in practice. However, as the interviewee had over 25 years of experience working with clinical guidelines in practice, the interview was accepted to be sufficient for this particular project. Nevertheless, it should be noted that a broader investigation is needed, to further evaluate how guidelines and checklists are used in clinical practice in Denmark.

B.1 Interview design

The interview was setup as an *open interview*. Four main discussion questions were pre-defined to open up a conversation. Non of the questions asked could be answered with a yes, or no answer, but would rather lead to an open discussion about a particular subject.
Before the interview started, the interviewee accepted that all conversations would be recorded and transcribed, to be used as a reference in this project.

B.1.1 Questions

1. Kan du vise, eller fortælle mig hvordan i overholder kliniske retningslinjer i jeres dagligdag ?
    - Hvad synes du om PRI?
2. Kan du fortælle mig hvordan i deler information/data omkring patienter imellem personaler under selve operationsforløbet?
    - Hvilke typiske problemstillinger opstår i forhold til dokumentation og information overførsel imellem sundhedsprofessionelle når en patient skal opereres?
    - Hvilke information/data er vigtigt for jer at dele imellem de forskellige afdelinger under operationsforløbet.

- Hvordan foregår e.g. rapportering på jeres afdeling?

3. Er det noget du synes der kan forbedres i forhold til dokumentation og information overførsel under selve operationsforløbet?

B.2 Interview transcription

Date: 8th of march 2013
Time: 14.00 - 15.00
Location: Aalborg University Hospital at the heart- and lung- surgery ward
Notes: Chapter B on the preceding page
Audio recording: `https://www.dropbox.com/s/hmv4gc3pgiru9y3/Interview.mp3`

Due to technical difficulties the first 10 seconds of the interview are missing and therefore could not be transcribed.
***J:** stands for the author, while **I:** stands for the interviewee.*

J: Det vil sige, jeg kender godt til PRI og det der.

I: Ja, tjeklisten for det er jo... når der kommer en ny patient... Så har du enten, hvis det er en hjertepatient... vi har så både til klap- og til hjerte- og en stenklap og så til lunge. Så har vi den her tjekliste som vil jo gøre at mindste kvalitet skal være i orden, det vil sige alle de her ting, for patienten kan gå ned, skal jo være tjekket af. Du skal i hvert fald tage stilling til: ja men er de sukkersyg? Nej det har de ikke, så sætter du minus. Når alt det er gjort, så kommer narkoselægen og skriver her, jeg ordinere så meget medicin, de skal så meget faste. Og så om morgenen når patienten er klar til at gå ned på op og få pre, så skriver jeg under på at alt det her er i orden.

J: Og det er så kun pre-operativ det her

I: Ja det er pre-operativ. Så har vi... og der når vi laver indlæggelsessamtale så har vi den der. Post operativ, der har jeg været med til at lave standard.

J: Ok. Så man kan sige at det her, er jeres primære værktøjer til at overholde... eller til at hjælpe jer med at overholde...

I: Ja men det her er når vi tager imod patienten.

J: Ja, og i bruger den her samme tjekliste til alle forskellige hjerteoperationer?

I: Nej det er det jeg siger, den der er til hjerte-bypass... så skal jeg lige finde den standard. Så har vi jo til klap patienter, og stenklap patienter og så har vi til lunge, og så har vi til spiserør patienter. Så der er jo sådan en klargøring til forskellige kategorier af patienter.

J: Ja

[Pause]

I: Så har vi jo det her, det er jo post-operative når de er indlagt. Dag nul er den dag de kommer op fra intensiv dagen efter de er opereret. Så skal man gøre de her ting, det er for at mindste kvalitet er i

orden, så kan du altid put noget på for at øge kvaliteten, ikke også? Det er det du gør. Og alt det her, noget er jo erfaringsbaseret og noget er evidensbaseret.

J: OK

I: Ikke også? Jeg har selv været med til at udarbejde den, så nu ændrer det sig jo noget, fordi det er kommet noget med akkreditering og der skal man kunne TOKS patienterne, det vil sige, du vil vis antal gange kunne gå ind og tage puls, tage saturation, tælle respiration, mål blodtryk, temperatur og så skore ved at TOKS dem, så bliver de skoret i procenter og så hvis de er et hvis procente, så skal man gøre det igen, så er det simpelthen lavet retningslinjer på hvad man så skal gøre. Så det kan godt ske at det her så bliver ændret.

J: Ja, undervejs?

I: Ja det kunne jeg tænke mig måske. Det her, det er jo for at man i hvert fald kontrollere og dokumentere at man har været der.

J: Og hvis det skal ændres undervejs, hvem er det så som tager beslutning om det?

I: Jeg vil tro at hvis det bliver efter TOKS, så må det være en stående [?] hvis nu at de er 70

J: CVK, lægger i CVK herinde?

I: Nej, det er patienten som har CVK, så her står seponering. Det er noget vi har aftalt med lægerne, når nu første dagen der må vi seponere CVK . Det betyder at jeg behøver ikke at sige til lægen, må jeg tage det her CVK? Fordi det er en standard vi har, at det må gerne fjernes den dag, hvis det ikke skal bruges.

J: Ok

I: Og til hjertepatienter der har vi [...] på tredje dagen, hvis der ikke har været arytmier, og det kan jeg jo godt se det har der ikke været. Men det her er jo kun til lungepatienter.

J: Ja ok, fint nok. Men det er anderledes til hjerte-klap patienter... og til stenose og...?

I: Ja de er lidt anderledes.

J: Så du har forskellige flowcharts og tjeklister til hver type patient?

I: Ja, vi har til lungepatienter, og til hjertepatienter og der skiller man ikke af til hjerte-klap eller hjerte-patienter. Der står her, [?] det er også en lungepatient som har fået fjernet en del af lungen. Til hjertestandarden der står så, klap-opereret de skal få målt blodprøve og så noget. Så der er nogle andre, og der kan man så udbyt dem lidt.

J: Men der er ikke så stor forskel på dem at der kræves et helt andet flowchart til dem?

I: Jo, det er en som hedder lunge og en til hjerte.

J: Nej, jeg tænker på hjerte.

I: Nå nej, ikke til hjerte-klap patienterne. Klap og hjerte patient de går ind under en side.

J: Ja ok. [pause]

J: Men Laufey har også fortalt mig om stenklap-patienter. Der er der en mappe som skal hentes hver

gang de skal...

I: Ja men det skal der jo egentlig ikke.

J: Ok, men det er så bare for dem som ikke kender til dem?

I: Ja, men også fordi det er en ny ting vi har fået i afdelingen og kun opereret dem i 2 år. Altså, jeg har været her i 25 år og har været med til hjerteoperation og til lungeoperation i 25 år så det sidder jo på rygraden. Men de andre har jo kun haft dem i 2 år. Så der starter vi jo med ingen ting.

J: Så man kan sige at implementering af de nye type patienter har måske vist sig at det kræver at de nye sygeplejersker skal til at hente mappen hver gang...?

I: Ja men den gang vi startede med stenklap operationer. Så starter vi jo med at en anden sygeplejersker og jeg og en læge, først siger lægen: Sådan og sådan og sådan skal i gøre det. Så går vi så ind og kobler det sammen med vores sygepleje-viden, så læser vi lidt litteratur, og hvad vi så har hentet rundt omkring og så bygger vi jo op. Og så fordi, at for en del år siden da vi startede med spiserørs-patienter lavede jeg simpelthen sådan en standard, som sagde på dag nul skal man gøre sådan, på dag 1, 2, 3 ? så alle kunne tage den her retningslinje i hånden som egentlig er en standard, ikke? Og udføre plejen til den her kategori patienter og på den måde har vi egentlig også bygget det op med stenklap patienterne, fordi de skal have taget nogle andre blodprøver på nogen andre tider, og for at alle kan passe de her patienter. Selvfølgelig, jo bedre og jo længere tid man har passet de patienter, jo bedre bliver man og jo bedre individuelt kvalitet bliver man. Men når man er ny, kan man stadigvæk godt passe dem og tingerne er i orden hvis man følger den her og den standard.

J: Men for eksampel, de mest erfarede sygeplejersker, bruger de de her flowcharts?

I: Altså, jeg gør ikke. Men jeg tror at en gang i mellem er der nogle som lige tager dem frem.. Men jeg har selv været med til at lave dem. Men jeg vil tro... altså jeg anbefaler mange nye og siger, inden i går hjem så tager jeg lige og ser om det er dag 2 ikke...og har jeg gjort det her? Ja og det har jeg egentlig gjort. Og jeg kan jo godt sige en gang imellem, oh hvordan var det nu egentlig med blodprøver den 2. eller den 4. dag. Så, jeg vil tro at der er nogen...

J: Så der er sådan en personlig monitorering af det her dokumentation.

I: Jo det er jo den laveste kvalitet så sørger du for at du har ydet den laveste kvalitet. Du har sørget for at dokumentere, blodtryk er taget, temperatur er taget, saturation, du har læst drain af, du har vasket, alle de her ting.

J: Men så er det primært dig og nogle andre sygeplejerske og en læge som udarbejde de fleste retningslinjer som i bruger her på afdelingen?

I:... Ikke primært mig, det er meget forskelligt.

J: Ok det er forskelligt og det kommer egentlig ind på patient gruppen?

I: Nogle gange er det jo bare en instruks, så bliver det udarbejdet af lægen. Lige nu er vi ved at udarbejde en instruks til mundpleje af hjertepatienter. Fordi, jeg har taget en master og der læste jeg om mundpleje og hjertepatienter og så ...fand jeg ud af at man kan egentlig gøre det så patienter måske ikke fik så mange [...] og ikke fik svamp i munden, og det er der mange som får. Så har jeg interesseret mig for det. I mellemtiden er der så nogen som har lavet en klinisk retningslinje som ligger ind på centeret for kliniske retningslinjer. Det har jeg så taget og omsæt det til en instruks på

vores afdeling, som jeg skal så gennemgå med en læge på mandag. Fordi det er også noget med at patienterne skal faktisk få at vide at to dage før de skal opereres skal de få købt det her og begynde at skylle munden. Det er sådan nogen ting det gør jamen og.... i Skejby siger de at de skal gøre det fire gange. Men compliance, jo flere gange man beder patienten om at gøre noget, jo dårlige bliver compliance. Så hvis man siger to gang så kan de måske bedre overskue det fordi så er det morgen og aften ikke? Og det er så noget som man skal diskutere med lægen i forhold til hvad siger evidensen egentlig, den litteratur vi har, ikke også?. Så kan man diskutere det, og så få det lavet så man synes det er ok.

J: Ok, så lægger i dem op på PRI?

I: Så bliver de lagt i PRI.

J: Så laver i nogle flowcharts eller checklister til at understøtte det, og så kører det bare eller ?

I: Ja altså, der bliver lavet PRI dokument, så når vi har nogle kliniske konferencer, så laver vi nogle undervisning, det har vi jo gjort, men det gør vi løbende. Så det bliver implementeret.

J: Hvad synes du egentlig om PRI, selve systemet? Kan du fortælle mig lidt om din erfaring?

I: Det er bedre en det vi havde før.

J: Hvad havde i før?

I: Da havde vi noget der hedder...

J: Det var et eller andet med at samle...

I: Ja med at samle dokumenter, men jeg vil så sige at jeg synes PRI er ikke det bedste fordi... jeg har altså, det skal være sådan, at hvis man bliver opereret i Aalborg, eller på rigshospitalet, eller hvor. Så skul det gælde det samme...

J: for alle

I: Ja. Fordi det er jo kvalitet det gør at tingerne skal være i orden, og det er der hvor vi skal akkrediteres.

J: Så måske noget lignende med nationale retningslinjer..?

I: Ja, det vil jeg synes.

J: Ok. Det er fordi staten har faktisk sæt i gang et projekt, hvor de skal udarbejde nationale retningslinjer for de mest hyppigste patientgrupper i løbet af de næste 3 år. Har du hørt om det?

I: Nej desværre.

J: De har erstattet en 20 mands gruppe af læger og nogle projekt managers, og sundhedsfagligt personale som skal udarbejde nationale retningslinjer. Det er de så i gang med lige nu.

I: Altså det jeg tænker, når du bruger... i dag når vi arbejder som vi gør, altså da jeg blev uddannet så var det jo erfaring - min erfaring siger, ikke? Men det er det ikke i dag, der er det evidens. Og evidensen er jo ikke anderledes i Nordjylland end i København.

J: Det burde den ikke at være.

I: Nej. Og derfor tænker jeg der er jo kun en måde at gøre de her ting på. Så jeg synes det er ikke noget

til at diskutere.

J: Synes du ikke at det er lidt underligt at PRI findes jo kun i Aalborg, så har de e-dok i Aarhus for eksampel. Så aner jeg ikke hvad de bruger andre steder. Så det er lidt specialt.

I: Altså, nu har jeg været med... vi fik Elektronisk patient journal, altså nogen af de første i Danmark. Så havde de fået det på Rigshospitalet også, men så var der en læge fra Gentofte men han vil ikke bruge det de andre brugt han vil have noget andet, så han havde sit eget, ikke? Og det gør jo at i dag at når jeg sender en patient til Århus jeg kan ikke bare trykke ?send?, jeg skal print alt papir ud, og hvor er vi så hen? Ikke? Så er vi bare tilbage igen, ikke?

J: Og det er jo den største problemstilling som fleste virksomheder har å dag. De vil jo lave et fælles EPJ system... og det går jo ikke så hurtigt fremad.

I: Og det er det man skal, ikke?

J: Jaaa, måske.

I: Altså,alt ting skulle lægge derinde.

J: Ja men hvordan dokumentere i egentlig det her papirarbejde?

I: Ja men det kommer jo altså...

J: Det vil sige når i er færdig med at tjekke det hele af.

I: Ja så har vi den i vores [...], altså den har vi med i vores plastiklomme. Og... så går den med ned på... Det bliver ikke indtastet noget som helst på nær højde, og vægt måske men eller i hvert fald den vægt der kommer her...

J: Men stadigvæk anastæsilægen har brug for det her dokument ikke også?

I: Ja men den går med ned.

J: Ja den går med ned.

I: Ja men han har jo ikke brug for det for han har jo skrevet, så har han skrevet på sin eget papir.

J: Så han kommer her? **I:** Så han tager sin egen papir med ned og så har vi den her, men han kommer her på tilsyn og skriver: ?Du skal give X gram/mol...?

J: Så det er faktisk double arbejde som bliver lavet?

I: Ja, ja...

J: OK

I: I stedet for, man kan sige. Ok det ligger under halsen. Så jeg kan lige se hvad jeg skal give. Men problemet er jo hele hele tiden at vi ikke har komputer i hånden eller i lommen. Fordi når jeg så kommer ud i medicinrummet og skal til at hælde op, hvad var det nu? Jeg kan jo ikke gøre mere end jeg kan huske. Fordi hvad nu hvis jeg har 3 patienter? Så skal jeg enten print ud, eller træk det frem igen. Så kommer jeg ind til patienten, på vejen indtil patienten har jeg mødt nogle sygeplejersker som har spurgt mig om noget, så kommer jeg ind og jeg har stadigvæk 3 patienter som jeg skal sende ned på OP. Så siger en jo, hvad er det egentlig for noget piller jeg spiser? Så skal jeg igen til at træk det frem,

ikke? Så det er rigtig rigtig svært.

J: Nu er vi måske nået frem til næste spørgsmål. Hvilke typiske problemstillinger opstår, i forhold til dokumentation og information overførsel i mellem jer eller andre sundhedsprofessionelle ? når en patient skal oporeres. Det vil sige hvad for nogen problemstillinger har i forhold til den her dokumentation.

I: Altså, vi har lige ændret noget fordi faktisk på lunge... operationsfeltet markeret, hvis mangler bagvagt skal kontaktes. Det vil sige hvis de skal opereres på højre side så sætter man jo kryds på højre side. Så har vi været udsæt for at om morgenen når vi gør patienterne klar, så havde de ikke en kryds. Så ringer vi til bagvagten, han lå og sov, så han bliver skide sur over han skulle vækkes klokken halv syv for der ikke er sæt en kryds. Så snakkede vi om det i sygeplejegruppen, så siger vi så, at det er ikke vores ansvar, det er lægens ansvar og vide at sæt den kryds for det er faktisk Sundhedsstyrelsen som siger at det skal være markeret. Så det vi gør nu det er at hvis der ikke er sæt kryds på patienten så lader vi patient ligge på afdelingen og skriver på OP at patienten er ikke markeret. Så må lægen komme op og markere og så køre. Men det gør han ikke ret mange gang og glemmer det for så forhaver det processen og så er det nogen som bliver sur i den anden ende. Det er så noget. Noget andet er, at hvis nu der har været travlt og man har glemt at sætte vinge på noget, ikke? Og man ikke kan gå ind og tjekke det, altså har hun fået to protein dræk, det er faktisk evidens baseret at det skal man give dem for faste perioden. Men det kan jeg egentlig ikke vinge af, jeg aner ikke om hun har fået det. Jeg kan heller ikke sæt minus fordi det ved jeg faktisk heller ikke. Jeg kan spørge patienten men nu er det sådan....

J: Så enten så vinger i af eller bruger minus?

I: Ja det gør vi.

J: Hvad bruger i minus til?

I: Altså, hvis nu jeg har en patient som ikke er sukkersyg, så sætter jeg minus her.

J: Sker der nogle gange at der er vinget noget andet ind i feltet en minus eller?

I: Altså, vi vinger af og så skriver vi mine initiale. Hvis det var dig så var det J et eller andet. Det har vi aftalt for, egentlig fordi vi oplevede at det ikke altid er blevet udført OK. Og så skulle man kunne gå tilbage, men jeg har egentlig aldrig oplevet at gå tilbage og sige ved du hvad, du gjort det faktisk ikke OK, for det gør man ikke i sundhedsvæsenet.

J: Så i har også svært med at se hvem har egentlig gennemgået de andre ting?

I: Ja, hvis man ikke har fået sæt initiale på.

J: Ok. Men hvad så med informationsoverførsel i mellem jer, sker det under rapportering eller?

I: Altså, det vi gør, det er at vi går ind i den Elektroniske patient journal, den kender du eller hvad?

J: Ja.

I: Der går vi ind, for det første, så skriver vi under sygeplejenomnesen, der skriver du hvorfor er patienten kommen, hvad er helbredssituation, er de allergisk, hvad er deres livsstil og hvad er deres socialeforhold, det noterer du så. Så går du ind i STATUS, status er bygget op over VIPS, det ved du godt hvad er?

J: Jo

I: Og så, der skriver du så også kommentar i forhold til patienten, patienten har sår på venstre arm ikke, patienten er lettere dement, patienten er [?], altså der er sådan nogen ting som de så ned på OP kan gå ind og træk frem, hvis det er et eller andet de har brug for at vide. Jeg tror de går ind og kigger det der er rart for dem at vide selvfølgelig, måske knap så meget på OP der har de fået noget. Men på intensiv er patienten [?] dement og når de så vågner op og er konfuse, så kan man sige ok det kan være relateret til deres demens samtidig de har været bedøvet ikke? Så har man den der viden at det kan måske godt hænge sammen.

J: Kommer det nogen siden til at ske at det her et eller andet på de tjeklister her, eller den dokumentation som følger patienten, som påvirker noget af det...noget af det som patienten oplever efter operationen, eller herop på afdelingen efter OP. Det vil sige, at der mangler et eller andet som skal bruges derned (på OP), eller at der mangler et eller andet for jer som de glemte at få udfyldt derned.

I: Altså, det som er egentlig meget vigtig er at man får den vægt om morgenen når de skal opereres. Det er fordi vores væskeregnskab går efter den vægt, og så den vægt hvor de har tøj på passer aldrig sammen. Nu er de så bliver meget bedre til det men vi har også haft patienter som gik ned op fra S, dvs. hjertemedicinsk afdeling, og de ved jo ikke hvad vi bruger den vægt til, så de havde i et stykke tid ikke vejet dem. Nu underviser jeg på kardiologisk om eftermiddagen, så nu gør de det. Men så gør det jo så, at når man så vejer dem dagen efter, så går man jo så ud fra den vægt der som egentlig godt kan afvige et par kilo, for der står de i træsko og i tøj og bland andet de har på. Og så er det jo ikke den realvægt, det er småting, men det er ikke den realvægt.

J: Det kan jo godt være forskel på 1 til 2 kg.

I: Ja det kan det sagtens, og så er det jo den du kører efter hvis du ikke har den der... Altså førhen, så ver det også noget med at hvis patienter, kvinder, havde menstruation, de må de ikke have når de går derned. Så det skal man jo også notere, så kan operationen blive aflyst. Så det skal man også lige have viden om, men nu har vi jo ikke så mange i denne alder.

J: Nu tænker jeg lige, patienterne er jo meget forskellige og selvom de er hjertepatienter eller hjerteklap patienter, så har de jo forskellige baggrund og de kan jo have forskellige sygedommer udenfor hjertesygdomme, er det noget i de tilfælde som kan påvirke hvordan i tjekker de her ting af?

I: Nej det skriver vi i anamnesen, vis de mangler ben, eller har en dårlig hofte, eller...

J: Så det er egentlig kun operationstypen som...

I: Det er egentlig det, som er relevant for at man kan sige GO til operationen, ikke også? For det er egentlig lige meget om du har dårlig hofte hvis du skal have en hjerteoperation. Men det er ikke lige meget bagefter, men de kan operere patienten på hjertet selvom han har dårlig hofte. Men bagefter når vi skal have ham mobiliseret, er det vigtigt at vi har en rolletor eller, altså, ikke også? Og det er vigtigt på intensiv, at hvis han ømmer sig i søvn ikke også, det er jo mærkeligt, hvorfor gør han det? Så kan du jo går derind og se nå han har jo en dårlig hofte så prøver vi lige at lægge ham på den anden hofte. Så på den måde kan man jo bruge det der ting. Det er først her for nyligt på OP og på intensiv, nej intensiv har været med i lang tid, at man kan gå ind og se hvad vi skriver, eller så kunne man jo ikke se det. Så det var jo bare at elektronisk patient journal den var vores. Så printer vi lægens papiret ud, men sygeplejepapiret det blev bare jo herop, ind i computeren.

J: Nå ja, fordi de havde jo ikke det samme system.

I: Nej nej, de havde ikke det samme system.

J: Ja, men ok. [pause]

I: Det er jo egentlig ikke, nogle ting der går tabt, lige på den måde.

J: Nej, men er det egentlig noget, i forhold til den her dokumentation, under, før og efter operationsforløbet, eller hvad er det egentlig vigtigst i det her forløb, for patienten og for jer?

I: Hvad tænker du på?

J: Hvad for nogle parametre, for eksampel, er det vigtig at de der ned på operationsafdelingen kender inden patienten kommer derned? Og hvad er der for noget ting i skal få at vide inden patienten kommer igen op til jer for eksampel fra intensivafdelingen?

I: Altså jeg vil sige, ned på operationsgangen... jeg er ikke operationssygeplejerske, altså de vil jo gerne vide det hele, men det er jo minimal hvad de bruger. Fordi, kontakten er så kort, ikke? Det kan være, patienten bruger briller, men så normal har de brillerne på når de skal derned. Jeg skriver samtidig, bruger høreapparat, er i toilettasken, ikke? Fordi nu hvis man føler man ikke får kontakt til patienten, så er det fint, og de ser altid lige på den her at nu har han fået det han skal have ikke? Og så hvis jeg skriver med rødt herned, så undrer de sig over at der står med rødt. Det er sådan man tænker. Man kan også skrive, men det er jo også [?], man kan jo også skrive ?er meget bange?. Så har vi også den stående aftale, fordi det kunne jo også være at... alle vores overlæge at når de er færdig med at operere, så ringer de til hjertepatienterne pårørende. Så har vi skrevet ind i vores EPJ, hvem det er de skal ringe til, helt bestemt så skriver vi hvor de skal ringe hen. Så det er ikke noget de skal lede efter. Men på førhen, så var der nogen som blev ringet og nogle som blev ikke ringet. Så lavede vi sådan et aftale at alle bliver opringet, så skal man bare finde ud af hvem der skal ringes til. Vi er ved at få styr på mange sådan ting.

J: Men der er ikke noget information fra selve operationsafsnittet, eller intensafdelingen som i vil have brug for.

I: Jo, så kommer intensiv, da ringer de op om morgenen og gerne siger til os: Der er tre patienter der kommer op i dag, også den og den skal have almindelig ilt og den der skal have fugtig ilt. Det betyder for den måde vi stiller frem til patienten ikke også? Vi skal have en enkelt slange, eller vi skal have sådan et fugt apparat. Om de har drain, som regel har de ikke drain, men hvis de har nu har blødt for meget, så får de drain herop, så skal vi også have en holder til drainet. Det er egentlig det vi er interesseret i, og så er det jo så igen, er de forvirret og kræver fast vagt, så er det også noget vi har brug for at vide. Men det er jo ikke noget man ser før intensiv faktisk melder tilbage.

J: Alt sådan noget information i får fra intensiv, er det jo bare via telefonen eller hvad?

I: Nej de der ting det er via telefonen, ellers så har sygeplejersken skrevet en status ind i VIPS, ind i EPJ. Og lægen har også skrevet ind i EPJ når de går ud fra afdelingen derned.

J: Nu tænker jeg lidt bredt, nu er jeg ingeniør indenfor dette her område. Hvad tror du at jeg kan gøre, kunne gøre en forskel for jer? I forhold til dokumentation omkring operationsforløbet?

I: Hvis jeg havde vist det, så ville jeg nok have tjent nogle penge Jon, [griner]

J: Men nu vil jeg bare spørge. For tit kan man ikke finde på noget, for man tror jo altid at det man har lige nu er det bedste man har mulighed for, dvs. lige nu. For, jeg har nemlig fået en idé om et system som kan forhåbentlig hjælpe jer med at dokumentere dette her, og også monitorere dette, og på samme tidspunkt også have muligheden for at dynamisk ændre tjeklisterne hvis der er brug for det. Således at hvis for eksampel, der kommer en hjertepatient ind som skal opereres, som skal til en bestemt operation, så får i en tjekliste op som præcist fokuserer kun på den type operation, og hvis for eksampel han har diabetes eller noget andet, så kan det vinges af, ellers bliver det skjult. Så det er ikke for standardiseret, at det bliver mere personaliseret. Det vil sige, at i, operationsafdelingen og intensivafdelingen, kan tilgå et fælles system i hånden, for eksampel på en tablet, eller smartphone eller noget som helst, hvor i kan se status på alle tjeklisterne som denne patient skal gennemgå i hans forløb over de 2 eller 3 dage. Så for eksampel, de ikke behøver at komme herop for at hente nogle tjeklister, de kan jo bare se det igennem systemer, hvad for nogen tjeklister har være udfyld, er der noget vi mangler, har jeg adgang til alle information jeg har brug for, hende der sygeplejersken har udfyldt det hele, fint.

I: Altså, nu bliver jeg nu mere og mere til computere og hvad nu man bruge. Det eneste man skal tænke, det er at vi havde for en del år siden, nogen medico-ingeniør, eller hvad det nu var. De troede i hvert fald at de havde opfundet den vise sten, det havde de ikke, men jeg troede egentlig også, fordi vi skulle have en håndbar, sådan en håndcomputer, så skulle vi skrive blodtryk og sådan noget ind. Og det var rigtig fint fordi jeg går jo altid rundt med en blok og skriver det ned. Og så der jeg siger til dem, hvad så hvor er docken så hen siger jeg til dem hvor de bliver så ført over.... nej nej du skal ind og skrive det ind igen, nej det duer ikke, det er dobbelt arbejde, så kunne jeg godt glem det.

J: Ja men det er det faktisk også med det her.

I: Ja, men jeg vil så sige. Nej jeg ved ikke om det er dobbelt arbejde, for den følger jo patienten, så den gør jo egentlig det samme som du siger, ja altså. Men det kunne være rigtig smart som jeg tænker, det er jo at hvis man havde den, men det skal hele tiden være noget vi kan håndtere i hånden. Man kunne have den der computeren og så hvis man skrev, hjerteoperation et, eller klap, så kom der kun de ting frem der var relevant for det ikke? Når du så er i anamnesen og har skrevet ind diabetes, ja men så vil den automatisk komme med, blodfortyndende så vil den automatisk dukke op, altså alle de ting der var relateret. Men så skulle man også kunne tryk på hver eneste, magnyl felt der for pre-operativ, seponering, ja men hvis det er ikke seponeret, så skal du gøre, så må patienten aflyses, er den seponeret så er det jo OK. Og det er i henhold til den evidens så du skal simpelthen kunne gå tilbage og se hvad er begrundelsen for at vi har besluttet sådan og sådan, ikke? Men det er jo et stort arbejde. Men det tænker jeg altså, det er jo egentlig vejen frem, blodprøve, [?] fra læge... det skulle jo ikke være nødvendig. Lige så meget det er jo en huskeseddel, det vil så sige, ok så skal vi sige til lægen at nu skal du huske at skrive under på at du ser blodprøverne ikke, fordi vi er jo barnepier og det er jo lidt skørt ikke? Hvor man i stedet for skal sige OK, det er Jens Grønlund som står på den her patient, han skal klokken hvart i 3 hver dag gå ind og kigge, er det noget jeg skal signere inden jeg går hjem. Altså, jeg tænker, hvis man skal gøre arbejdsgangene smartere... og brugervenlige så vi får mere tid til patienterne, så bliver vi nødt til at gøre sådan at vi får en reminder på en eller anden måde. Så jeg ikke skal sige, du skal huske, også tænker jeg alligevel nå det hørt han ikke, så må jeg heller lige ringet til ham og sige det også. Jeg tænker, der skal være et eller andet som minder, og ligesom den der kommer op, når du så har patienter så skulle der komme en klokke, du er faktisk ikke færdig kl tre der mangler nogle ting der ikke er blevet udfyldt. Fordi så behøver aftenvagten ikke at undre sig over nå men har hun nu glemt det, eller har hun nu givet ham det, eller hvad gjorde hun nu ikke? Så skal vi

til at ringe til hende, men så er den... altså inden du går hjem har jeg nogle klokker eller har jeg nogle stjerner eller har jeg noget, forstå du hvad jeg mener?

J: Ja ja.

I: Altså det er noget jeg af det jeg tænker der vil øge kvaliteten og hjælpe sygeplejepersonalet, eller personalet i det hele taget og vi ikke behøver at være barnepier.

J: Så det kan godt være at nogen af de her tjeklister ikke bliver udfyldt inden aftenvagten tager imod patienten?

I: Ja ja, altså hvis der er nogle ting man også kan overlade, eller hvis patienten har kommet sendt så skal de jo udfylde den. Men kan også have glemt det for man har haft så travlt. Men de ved ikke om de er glemt eller der er udfyld og bare glemt at vinge det af. Og det er jo altid det der at man står i den der dilemma, er det gjort eller er det ikke gjort, at det er træls. Det er jo aldrig træls når man ved om det er gjort eller om det er ikke gjort ikke? Der for tænker jeg, hvis man skal have sådan noget væk så skal man mindes om inden man går hjem kl 3. Og de tjekker sine patienter, er der nogle symboler, eller er det et symbol som siger, hø jeg har ikke lige været omkring ham og det kan jo være i det hele, det kan jo være i sygepleje anamnesen, sommetider kommer man til at se at de har ikke fået skrevet noget om patienten ikke? Men når dagen går og man får travlt, så glemmer man det. Så derfor tænker jeg der må være et eller andet som, enten bliver bippet, eller en liste som man tjekker inden man går hjem, ok jeg er ikke færdig med han her. Det er sådan nogen ting jeg tænker at kunne være smart.

J: Men hvordan foregår rapportering her på afdelingen. I har rapportering hverdag kl 7, og så kl 3 og 20.

I: Ja men det foregår egentlig mundtlig men det skulle egentlig være sådan, at vi havde besluttet at når vi fik elektronisk patient journal så skulle man bare sætte sig ned og læse. Så skulle man spørge hvis for eksampel hvis det var nattevagt som skulle hjem kl 20 minutter over 7, så fra kl 7 til kl 20 min over syv skulle man egentlig bare gå rundt her. Så kunne jeg lige sige, ja men, den patient bar blødt meget i nat. Det er de der ting der er speciale, og alt andet kan man læse. Men det vi gør at vi sidder os stadigvæk på gammeldags måde og overlevere og det er alt for tidskrævende, så folk ofte overarbejder.

J: Men i kender så også ISBAR ikke?

I: Jo, men vi bruger den ikke. Det er heller ikke, det er lægen som har lært det. Men det er jo ikke det, det har noget med kultur at gøre. Sygeplejersker tro at... det de ved er noget særligt og de bliver nødt til at fortælle den næste og den næste og den næste og den næste og den næste, i stedet for at skrive det. Så skal de helst dokumentere det tre gang, tre forskellige steder så de har skrevet det en gang, men selvom en sygeplejerske ikke ser det to af stederne, så står det i hvert fald den tredje sted. Forstå du hvad jeg mener?

J: okay.

I: Jeg tror det er den der, jeg ved ikke om det er omsorgsgivende, men det er det der med at folk kan gå hjem og så ringe ind og sige... altså være gået hjem og i seng og så vågne op kl 2 og jeg glemte sgu at sige at han har 389 men er faktisk upåvirket. Men så, i hvert fald tænker jeg anderledes. Jeg tænker altid på hvor kan vi få frigivet tid til vores patienter, for det er den tid som bliver berøret med hele tiden.

J: Men typisk så følger den her tjekliste med patienten ned til OP.

I: Jo, den følger med under hovedpuden. Fordi du har givet pre og det har du herover, så bliver den lagt under hovedpuden og lagt ind i journalen. Så kører den ned på intensiv, så har de den der hvis de skal bruge den. Så tager jeg den altid frem, fordi jeg gør i hvert fald, så ved jeg altid hvad jeg skal sige hvis lægen siger hvad vejede han før operationen, ja men han vejede det der.

J: Har det nogensinde sket at det her bliver tabt?

I: Ja men det er ikke ret tit.

J: OK

I: Det er sjældent. Vi finder den næsten altid igen.

J: OK. Men ja ...[pause] lige nu tror jeg ikke at det er flere ting jeg vil spørge om.

I: Nej ok, jeg håber jeg kan hjælpe dig lidt.

J: Ja du har i hvert fald svaret på nogle spørgsmål. Det tror jeg. [pause] Men det er bare fordi jeg har læst så meget omkring kliniske retningslinjer og hvordan de bliver implementeret på sygehusene og det er så vidt forskelligt. Lige nu er de så begyndt at bruge tjeklister lidt mere.

I: Ja men det er stadigvæk... når jeg tænker kliniske retningslinjer, så er de jo evidens baseret. Men den eneste måde jeg tænker at tingerne bliver implementeret på, er at de bliver gentaget og gentaget og gentaget og det er håndterbart. Og derfor er den her utrolig populær, det er overskueligt og håndterbart. Det her er også populært. Hvis man skal have evidensen med i det, skal man kunne klikke på det, hvorfor er det så egentlig at vi gør det, og hvordan skal vi handle ud fra det. Nu har vi urinprøve...

J: Ja ok, hvis du for eksampel, hvis det her er vinget af og det betyder at operationen skal aflyses, så skal du få at vide hvorfor, eller hvad?

I: Ja, altså, hvad er grundet til at de skal stoppe med magnyl 5 dage før? Det er fordi a det hæmmer trombocytterne i at klokke sammen, det vil sige at hvis de fortsætter med at... så har de større blødningstendens under operationen, samtidig med at de får en masse af blodfortyndende. Men det kan jeg så sagtens sige fordi jeg har været her i 25 år og jeg ved. Men dem der har været her i 2 måneder, de kan ikke lige klik sig ind og sige og faktisk finde noget om det, vel?

J: Så hvis de vinger af, hvad betyder det så?

I: Altså de vinger af, at de har seponeret, patienten har ikke taget magnyl, men sygeplejersken ved ikke om hvilken betydning det har om han har taget dem eller ikke har taget dem. Det er det samme med urinen.

J: Det kan jo også påvirke hvordan patienten bliver behandlet, kan man sige.

I: Jo jo, nogen bliver aflyst fordi at han har ikke holdt den der pause. Men det kan jo ofte være patientens skyld. Oftest står det faktisk i brevet til dem men så har de ikke fået det læst, ikke også? Men jeg tænker tit, at hvis man skal implementere ting, så bliver man nødt til at vide hvorfor tingerne er som de er. Det vil sige, hvorfor skal jeg observere patienten når jeg har fjernet paceelektroder, fordi de får [...] og de kan stå og bløde herinde ikke? Man skal vide hvorfor det er man gør de ting man gør, hvorfor stikser vi til at se de her bakterier i urinen. Det er fordi hvis man skal have en hjerte-klap operation, så kunne man faktisk påvirke de bakterier i kroppen, og så får de infektion... og så koster

det ti gange så meget, ikke også? Altså, men det der sker er at når man ikke ved hvorfor det er så vigtig, så kan man også tænk, nå det er jo bare en lille plus det betyder jo ikke noget vel? Men så er der en som siger, bare fordi de får for lidt, der hvor jeg var før der havde det ikke nogen betydning. Men jeg vil så gerne få fundet ud af, hvornår har det betydning - har et plus betydning, to plus eller tre pluser? For lægerne siger, ah for sikkerheds, jamen det der for sikkerhedens skyld koster jo sundhedsvæsenet penge.

J:Ja hvis lægerne kunne tilføj noget som en informationsfelt, som kan fortælle sygeplejerskerne som udfylder det her hvorfor.... så vil det betyde mere for jer, ikke også?

I: Ja, Albumin der må være spor, eller der må være, hvis der er mere en spor, så skal den sendes til urindyrkning, i dag.

J: Og det står så ikke her på?

I: Nej! På grund af at det er farligt at have Albumin i urinen når man skal opereres, det er det nu ikke men altså. Eller det kan være tegn på at man har nyresygdomme ikke? For man udskylder proteiner og det gør man ikke normalt. Eller, altså, men den der læring har vi ikke i et stykke papir, og den læring gør jo at man får meget dygtigere sygeplejersker. Fordi når du så har gjort det fem gange så ved du hvorfor, ikke? Og det er den måde jeg tror på at man lærer bedst.

J: Ja, man kan jo også sige at de sygeplejersker som arbejder her på afdelingen bliver nok ikke her de næste 20-30 år, de går og kommer jo løbende

I: Nej nej, men tingerne kan jo altså ændres. Jo dygtigere du bliver jo bedre kan du gå og være alle steder, fordi du har simpelthen viden så du kan ikke sige det går da ikke... Så det er jo med at man får en viden da er evidens baseret på den højeste plan ikke? Og det kan godt være at det er erfaring, det ved man jo ikke altid, men det er den måde man dygtige-gør sig på. Og det er den måde at fejlene bliver reduceret på, ikke? Så det er sådan nogle tanker man skal have ind, tænker jeg.

J: Jo jo, det er præcist det jeg leder efter. Når man sidder ved computeren og skriver flere sider om kliniske retningslinjer, tjeklister og litteratur relateret til det, de giver ingen mening om hvordan det går i praktik

I: Nej, det er så svært at implementere tingerne... jeg får, det var nok i 2000. Vi har patienter der blev lungeopereret og de får lagt en lille kateter ind i ryggen hvor man giver nogle smertebehandling. Da jeg startede her i 85 da havde vi også patienter blev opereret i benen, i årene, der fik vi dem lagt herned. Det vil sige herned der ligger vandladningscenteret, centeret for vandladning, det vil sige de patienter var påvirket af nogen kunne ikke lade vand. Herop der ligger vandladningscenteret ikke, men de havde alligevel været der fra 88 til 2000 før jeg en dag så en 40 årige kvinde gå rundt herud med kateter pose og så et dropstativ havde hun, på 40 år og hun kørte med 1ml [?] og hvis man, viden det er at efter tre dage så begynder virkningen at falde, dvs. bivirkningen falder også. Hun havde stadigvæk kateter op i urinvejen og hun var 40 år og gik rundt med den der 1ml, og da tænkte jeg det kan ikke passe og det kan heller ikke passe at det har indvirkning herop, når kateten ligger herop. Det jeg gjorde var at jeg gik til min overlæge og så sagde, det her undrer mig simpelthen, det vil jeg altså kigge på. Så lavede vi kvalitetssikring på en undersøgelse hvor jeg simpelthen lavede retningslinjer hvor vi tog 50 patienter og seponerede kateter, og tog kateten ud dagen efter operationen og skrev hvornår de havde ladt vandet. Havde de ikke ladt vandet så efter 8 timer så lægger man kateter og så hvor meget der var og det gjorde man i op til 24 timer og så lægger man en kateter. Og så snakker vi

med narkoselægen, han havde undersøgt det når det lå herned, da var det 10

J: OK.

I: Men, så kommer der nogle nye sygeplejersker, og så begynder de gamle at blive lidt vanet og jeg kan ikke egentlig huske hvad jeg lavede i 2000, og hvorfor det egentlig var at gjorde det her. Jamen så har vi en gammel [...] og han tisser måske ikke så meget, så lader vi kateten ligge. Men kateter gør ikke at manden tisser mere, og han kan stadigvæk tisse i en flaske hvis du skal se hvor meget der kommer om måle det og du kan stadigvæk veje ham. Men det er igen, fordi folk har glemt hvad er til grundlæggende for den handling vil gøre og den beslutning der er taget. Så evidensen, hvis jeg ikke en gang imellem tager den der snak med folk, ud med kateter, så glemmer de det.

J: Ja, det er mærkeligt... men sådan er det bare....

I: Ja men sådan er det jo. Og derfor tænker jeg, at det man skal gøre, det du skal også lægge derinde, så klikker man lige... nå ja det var sgu det der projekt fra 2000 så det er derfor og det var kun 6

J: Ja i sådan plejeplan skal man kunne klikke på hvorfor.

I: Ja, fordi så ved man og hver gang du klikker så lærer du noget.

J: Må jeg tage billede af det er?

I: Ja det må du gerne, men jeg må lige se om jeg har nogle herover som du kan få med.

[?]

J: Jeg kan også bare nøjes med billede

I: [?] det er der hvor kliniske retningslinjer, kunne ikke hjælpe, om du kalder det PRI eller nu kan jeg simpelthen ikke huske hvad det hed før men det er lige meget hvad du kalder det. Plus implementering, altså da vi skulle akkrediteres første gang så blev der lige [?] hvor der ryg en sygeplejerske ud af klinisk sygepleje og i halvt år skulle hun sætte sig ned og lave de her ting og lægge dem ind i PRI og få dem lagt ind, men de blev jo ikke evidensbaseret, fordi der var der ikke tid til. Det vil sige, vores erfaringsbaseret og vores gamle ting, lægger vi bare ind i PRI.

J: Det er også derfor der lægger tusindvis af dokumenter derinde.

I: Ja men det er det der! Og det er ikke sådan at når vi skal til at lægge kateter så er linket bare til neurologisk, altså det bliver altså mere og mere ikke også, fordi sygeplejerskerne er opmærksom på det. Men der ligger jo stadigvæk masser af ting. På det samme må man tænke, jo hvis der er nogen som skal have lagt et [...] drain, altså et drain ind i munden, så er det jo vores evidens som er den bedste fordi det er vores speciale. Det er overhoved ikke lungemedicinsk eller neuromedicinsk eller nervekirurgisk, vel? Så evidens må vise selv hvor er den bedste kvalitet, ikke? Eller den bedste evidens, ikke? Jeg tænker, vi er gået helt galt i byen med det her. I vores papirløse samfund. Altså, vi er helt tøset.

J: Nu vil jeg heller ikke lave nyt tool eller værktøj, som bare falder ind i jeres værktøjkasse og ikke bliver brugt. Fordi, sygehusene er jo fyldt op af værktøjer som ikke er brugt og bliver udviklet som en smart løsninger men alligevel ikke bliver brugt for det er simpelthen for meget. Så der skal findes et eller andet som kan hjælpe men også stadigvæk forbedre også den process i kører med lige nu...

I: Ja men også hvis du skal ind i for mange, og det har vi jo med vores elektroniske patient journal lige nu fordi vores er for gammel, nu kommer vi så over i det der Clinical Suite.

J: Nå, Clinical Suite, det er de ved at implementere alle steder næsten.

I: Ja, men det gør jo at du har et kodeord, og du vil komme ind i samme tid til billeder.... før i tiden skulle vi jo ind i, ja men, jeg ved ikke hvor mange, billeder for at kunne, så skulle vi egentlig ind i Labka for blodprøver, så skulle vi ind i røntgen, så skulle vi ind i EPJ, så skulle vi ind i.... ja men jeg ved ikke. Og du skal have nyt kodeord til hvert eneste. Altså man skal have et man kan luk op, medicin... og så altså. Og så kunne du jo komme ind og så kunne du gør de ting du skal gøre. Sådan skal det jo være ikke også? Så hvad du som udvikler, skal det ikke være... hvis du skal lave en tablet, så skal det altid være overførbart. Fordi, det andet det gider vi ikke og det er der ikke tid til. Der er ikke tid til at lave noget andet dobbelt arbejde.

J: Ja vi har jo analyseret sundhedsvæsenet og fundet ud af at brugerene gider ikke lære noget nyt som ikke fungerer med de andre systemer som bruges i dag. Der skal være et synonym imellem alt.

I: Men jeg vil så sige, lige så snart sygeplejerskerne finder ud af, at det her det gider man ikke... det afgiver tid, det vil sige du får noget tid frigivet, det er håndterbart, så accepterer de det. Lige så snart at det... at det er ikke let at bruge, og lige så snart at... at det kræver får meget tid, så bliver vi frygt.

J: Hvor glad tror du at sygeplejersker er for tablets for eksampel?

I: Altså, i dag, de unge mennesker er jo glad for alt muligt sådan noget, computer noget, iphones og den slags og hvad det nu de har.

J: Hvad nu hvis i fik sådan en tablet i stedet for alle de der dokumenter.

I: Det jeg tænker nu her, at hvis alt det jeg skriver nu her, bliver ført ind, uden at jeg skal til at skrive det her ind igen og man kan sige ok, højde og vægt hopper ind i Clinical Suite hvor de egentlig hører til. Så bliver BMI regnet ud, OK , fint nok, ikke? Alt det her, det hopper ind hvor det hører til i STATUS. Så sparer du tid.

J: Ja præcist. I selvfølgelig skriver indlæggelsessamtalen ind også.

I: Ja, det er jo VIPS. Og, altså, der udfylder vi, og så sygepleje anamnesen. Det bedste vil jo være, hvis du laver en tablet hvor den optog og vil sende alt det ind i anamnesen.

J: Jaaa.. Ok.

I: Ja men det kan de faktisk finde ud af i USA, jeg har en veninde som arbejd derover. Jeg var ind at se hvor at de, det var sådan en akut modtagelse. Men hvor at, jeg skriver jo min historie, men det er ikke altid fordi... kun have de relevante ting med og nogle bruger for mange ord. Men derover der var der simpelthen, patienten blev indlagt med... og så skulle du tryk eller kunne vælge, så kom gående ind i afdelingen eller kom liggende... dvs. historien var der. Lige som da du var barn, så skulle du skrive på nogle linje, så kunne man så tryk eller vælge imellem hvad der nu var mest gentaget.

J: Ja, jeg tror jeg har set det før. Det er sådan et automatisk system som kan finde ud af hvad det tror du skal til at skrive.

I: Ja nemlig. Så var jeg i Canada på kongres i 2006 eller 5, det er jo lige meget. Der havde jeg fået kontakt til Otowa heart center, så der havde jeg tre dage som sygeplejerske på afdelingen. Der

var jeg med en sygeplejerske, hvor alle patienter som skulle hjerte opereres, der var de samlet til indlæggelsessamtale for nogen skulle jo rejse i to dage for at komme ind og blive opereret, det er jo Canada, det er jo kæmpe... Men så holdt hun det her indlæggelsessamtale, og så holdt hun udskrivningssamtale og når de så kom hjem, de var nemlig i gang med at lave noget, jeg tror de kalder det TeleAsk. Så når patienterne kom hjem, så havde de... det var nok deres mobiltelefon, så havde de... hvis nu at de blev kortåndet, hvis de ikke kunne få vejret og så ringet ind til hende der, så var der sådan en computer der gik i gang, så som sagde: Ja men kan du gå 10 metre, har du problemer når du trækker vejret når du sidder i en stol. Så blev de kategoriseret, ikke...og så smerter, og så blev de spurgt ind til alle de ting og så får man den uden. Så på hendes telefon der ståede der så, patienten skal kontaktes hvis det er akut indenfor 2 timer, patienter skal kontaktes indenfor 48 timer.

J: Så de blev faktisk screenet af en computer inden de blev kontaktet. **I:** Ja, jeg har simpelthen ville have det i gang siden jeg så det derover. Men jeg har ikke haft mulighed, jeg har nemlig materiele der hedder noget med telefon, jeg kalder den telefonkontrakten hvor jeg har søgt på det og jeg har hendes adresse derover. Hvor den så, det vil så sige, de har så de der sygeplejersker der er "practicioners" som må ordinere lidt medicin, så ringer hun tilbage og sagde til ham egentlig indenfor 2 time, ja men du skal lige tage 2 vanddrivende, og så skal du lige ringe tilbage til mig, ikke? Det vil sige hun havde sæt en behandling i gang, ikke? I er jo med, og det er jo næsten det samme som, det der Teledialog, det er jo faktisk at... det er jo også det vi oplever at patienterne mangler tryghed når de kommer herfra, ikke? Men kunne man nu... sige til patienterne, ja men får du... bliver du kortåndet, får du ondt, altså man kan sige noget... er du ked af det, ja men så kan du ringe til det her telefon nr. og så i hvert fald indenfor 48 vil du blive kontaktet af en sygeplejerske, det vil give en enorm tryghed.

J: Ja, det ligner faktisk det vi vil tilbyde dem i Teledialog. De kan ringe til SOS... der er da også nogle sygeplejersker som kan tage telefonen.

I: Ja, men her er de så kategoriseret, ikke? At du skal ringe indenfor 2 timer, jeg synes det var helt fantastisk. Og g har snakket om det siden, og der er ingen som vil tage min idé. Den har jeg haft liggende siden, og jeg har hendes adresse og jeg... jeg synes det var godt. Jeg ved det godt, at jeg ved at i Canada nogen af dem bor jo 2 dage væk. Men det er jo trygheden, det er den. Ja men vi har jo også folk der ringer ind for de er jo utrygge. Men kan man ringe ind til computer og få svaret på noget og få at vide, jo hvis det er slemt så bliver man ringet op indenfor 2 timer, så falder folk så til ro.

J: Ja, de bliver fortalt... ja, tag det nu med ro, og du bliver ringet op om et lille styk tid.

I: Ja, og er det så en sygeplejerske der sidder der som kan sige, ok, prøve lige at tage to vanddrivende. Så har du allerede... så behøver patienten ikke at gå til egen læge med det samme. Afhjælpe symptomerne, lidt, og måske ikke nok. Altså, men sådan hele tiden kan du jo hjælpe ikke? Sundhedsvæsenet.

J: Jeg vil så sige, det er jo ikke en kompliceret løsning.

I: Nej nej nej nej, og jeg vil jo tro at det er let i dag. Jeg har jo ikke forstand til det men altså... Jeg kan godt fortælle dig, det er ikke ret lang tid siden at jeg var ved at gå op, jeg har en hel taske med de ting jeg har indhentet. Jeg snakkede med en oversygeplejerske før, hun synes også at det var en god idé. Vi er bare ikke kommet videre, altså, jeg har litteratur på noget af det og idéer og hvad det så er hen. Vi er bare ikke kommet videre med det.

J: Kan du huske hvad hun hedder? Ja men altså jeg har hende herover.

[Pause]

I: Altså, jeg vil tro at hun var omkring 50, der er alligevel nogle år siden.

J: Ja men jeg kan alligevel google det.

I: Men det var noget helt andet.

J: Ja men det var også fint nok. Men jeg tror alligevel jeg har fået det at vide jeg har brug for, tak skal du have.

APPENDIX

C Use case specifications

The following covers detailed description of each Use Case defined for the solution model. The Use Cases are listed in their own table as:

- Use case name;
- ID (use case ID);
- Brief description of use case-function;
- Actors invoking the use case;
- Preconditions (happens before);
- Main flow (Activity flow);
- Postconditions (happens after);
- Alternative flows.

Abbreviations:
Practicing healthcare professional : HP
Administrative professional: AP
A citizen or a patient: P

Use case: Log in
ID: 1
Brief Description: The actor is prompted to sign in to use the Web application.
Actor: HP, AP
Preconditions: None.
Main flow: 1. The web application is accessed from a browser. 2. The actor chooses to log-in 3. The actor inputs username. 4. The actor inputs password. 5. The actor logs in. 5.1. The application validates the credentials. 5.2. The actor is logged in.
Post-conditions: The actor is logged in.
Alternative flow: 5.1. The credentials are not validated. 5.2. The log in screen is displayed

Table C.1: *Use case-specification: Log in*

Use case: Log out
ID: 2
Brief Description: The actor is logged out of the web appication. If the actor doesn't log out an leaves the browser open, log out will automatically happen after 5 minutes of inactivity.
Actor: HP and AP
Preconditions: 1. The actor is logged in. (Extends UC 1)
Main flow: 1. The actor chooses to log out. 2. The actor confirms log out. 2.1. The actor is signed out of the web application and the main view appears.
Post-conditions: The actor is logged out from the web application.
Alternative flow: 2.1 The actor cancels log out
2.2 The actor stays logged in

Table C.2: *Use case-specification: Log out*

Use case: Add guideline
ID: 3
Brief Description: An actor can add a new clinical-guideline into the web application
Actor:AP
Preconditions: Actor is Logged-in.
Main flow: 1. The actor chooses the manage-menu 2. The actor chooses to add a guideline into the system 3. The actor chooses which operation type the guideline should be linked with 4. The actor saves the guideline
Post-conditions: The desired guideline has been added to the web application system and can be accessed by any actor.
Alternative flow: 2. The actor cancels the process 3. The guideline is not stored within the web application system

Table C.3: *Use case-specification: Add guideline*

Use Case: Find guideline
ID: 4
Brief Description: Any actor has the ability to search for a guideline and review it
Actors: HP, AP and P
Preconditions: At least one guideline has been added to the system.
Main Flow: 1. The actor chooses to search for a specific guideline 2. The actor can either type in a search keyword, or choose operation type to search for guidelines. 3. The web application provides the actor with the search results 4. The actor chooses which guideline he would like to view. 5. The actor can review the specific guideline
Post-conditions: None.
Alternative flow: 3.1. No specific guideline/guidelines are found 3.2. The actor can choose to search with a different keyword or with a different operation type

Table C.4: *Use case-specification: Find guideline*

Use Case: Edit guideline
ID: 5
Brief Description: A administrative professional has to be able to adjust/edit specific guidelines
Actor: AP
Preconditions: 1. The actor is logged in. 2. Guideline has been found (extends UC 4)
Main Flow: 1. The actor chooses which part of the guideline he wants to edit. 2. The actor stores his changes by pressing save/store
Post-conditions: The specific guideline gets updated within the web application system, thereby the database as well.
Alternative flow: 2.1. The actor chooses to cancel the edit process 2.2. The actor is returned to the view-guideline view, and the specific guideline is not updated within the database

Table C.5: *Use case-specification: Edit guideline*

Use Case: Add checklist
ID: 6
Brief Description: It should be possible to add a specific checklist to be followed within a specific operation pathway.
Actor: AP
Preconditions: 1. The actor is logged in. 2. A guideline has been defined for a specific operation type 3. A pathway has been defined for the specific operation type.
Main Flow: 1. The actor chooses which operation type he wants to add the checklist to 2. The actor defines where in the operation pathway the checklists should be filled out, i.e. in which phase. 2. The actor defines which guidelines should be linked with the specific checklist. 3. The actor defines an informative text to each question/check which specifies *Why* the specific check is to be completed. This information/knowledge should be taken directly from the linked guideline. 4. The actor saves the checklist.
Post-conditions: The newly defined checklist is stored in the database and linked with the specific pathway.
Alternative flow: 4.1. The actor cancels the process.

Table C.6: *Use case-specification: Add checklist*

Use Case: Find checklist
ID: 7
Brief Description: Actors should be able to find a specific checklist related to a specific operation type
Actor: AP
Preconditions: 1. The actor is logged in. 2. A guideline has been defined for a specific operation type 3. A pathway has been defined for the specific operation type. 4. A checklist has been defined for the specific pathway
Main Flow: 1. The actor chooses the specific operation type. 2. The actor chooses the specific phase from the operation type. 3. The actor is presented with the checklists for reviewing
Post-conditions: None.
Alternative flow: None.

Table C.7: *Use case-specification: Find checklist*

Use Case: Edit checklist
ID: 8
Brief Description: It should be possible to edit a checklist which has been defined within a surgery pathway.
Actor: AP
Preconditions: 1. The actor is logged in. 2. A guideline has been defined for a specific operation type 3. A pathway has been defined for the specific operation type. 4. A checklist has been defined for the specific pathway 5. The actor has found the specific checklist within the pathway (extends UC 10)
Main Flow: 1. The actor chooses which checklist he wants to edit. 2. The actor changes the parameters within the checklist. 3. The actor saves his changes.
Post-conditions: Changes to the specific checklist are updated in the database
Alternative flow: The actor cancels the process and the checklist is not changed or updated in the database.

Table C.8: *Use case-specification: Edit checklist*

Use Case: Add patient
ID: 9
Brief Description: It should be possible to define a patient "profile", which is used to fill out all the relevant checklists for a specific patient.
Actor: HP or AP
Preconditions: 1. The actor is logged in.
Main Flow: 1. The actor chooses to add new patient 2. The actor chooses which operation type should be linked with the patient 3. The actor specifies a patient id - a CPR nr. 4. The patient "profile" is saved
Post-conditions: The patient profile is stored in the database and checklists linked to the patient can be filled out
Alternative flow: 4.1 The actor chooses to cancel the process 4.2 The new profile is not saved an no checklists related to the patient can be filled out

Table C.9: *Use case-specification: Add patient*

Use Case: Find patient
ID: 10
Brief Description: The actor should be able to find a specific patient, either to fill out checklists related to the patients operation pathway or to edit his profile.
Actor: HP or AP
Preconditions: 1. The actor is logged in. 2. The patient's profile has been added into the system
Main Flow: 1. The actor chooses the ward and operation type. 2. The actor is presented with a list of patients linked with the specific ward and operation type. 3. The actor can search through the list for the patient to be found. 4. The actor chooses the patient profile. 5. The actor is displayed with the patient's pathway and checklist.
Post-conditions: None.
Alternative flow: None.

Table C.10: *Use case-specification: Find patient*

Use Case: Edit patient
ID: 11
Brief Description: An actor shall be able to edit the patient's profile in case needed.
Actor: HP or AP
Preconditions: 1. The actor is logged in. 2. The patient's profile has been found (extends UC 13)
Main Flow: 1. The actor changes specific parameters within the patient's profile 2. The actor confirms the changes with his pin number
Post-conditions: Changes to the patient profile are stored/updated in the database.
Alternative flow: 2.1 The actor cancels the process. 2.2 The patient profile is not changed in the database

Table C.11: *Use case-specification: edit patient*

Use Case: Fill out checklist
ID: 12
Brief Description: Healthcare professionals must be able to complete checklists for each patient
Actor: HP or AP
Preconditions: 1. The actor is logged in. 2. A patient profile has been found (extends UC 14).
Main Flow: 1. The actor chooses which checklist in the pathway for the specific patient he needs to fill out. 2. The actor checks off each procedure/check during his work-routine. 3. The actor confirms the checks that he has made by typing in his pin number at the end of the checklist form 4. The checklist closed and its status updated.
Post-conditions: The specific checklist for the patient is updated, i.e. those checks which the actor did fill out are stored as completed within the databse If all the checks within a checklis have been completed, the checklist will be marked as *completed* for that specific patient and the status stored within the database
Alternative flow: 3.1. The actor does not complete the whole checklist, but still types in his pin number and completes the form 3.2. The checklists current status is updated.

Table C.12: *Use case-specification: Fill out checklist*

V

Annex

Hjerte- Lungekirurgisk Afdeling T, Aalborg Universitetshospital

Label

Tjekliste til Hjerteoperationer

Underskrivende sygeplejerske er ansvarlig for at alle punkter på tjeklisten er krydset af. Under Ok skrives initialer.

Dato:

	Bst.	Ok	Generelt		Ok
Seponering af tbl. Magnyl 5 dage præoperativt				Klipning ifølge procedure	
Blodprøver + signering af læge, **OBS** INR ved klap				2 P-drikke inden faste, tilbyde natmad	
Type og svar i journalen				Seng med navn	
BAC-/BF-test				Seng klargjort ifølge instruks i PRI	
Røntgen af thorax taget				2 PreOp drikke OP morgen inden kl. 06	
Præ- og postoperativ lungefysioterapi				Journal på OP af nattevagt	
Anæstesilægetilsyn				Evt. speciel medicin medsendes til TIA	
Eventuelt speciallægetilsyn				Tjek af vask/klipning hos hotelpatienter	
Patientidentifikation (armbånd på højre håndled)			BMI ≥ 35 BH skål ≥ D	Sternumsele/BH medsendt til OP, hvis relevant	
Urinstix: A: B: S: N: L:					
EKG signeret af læge			**Klap**	AK-behandling: INR <= 2.5	
Højde: Vægt:					
BT i begge arme: Venstre:			**Diabetes**	Blodsukker målt på indlæggelsesdagen:	
Højre:				Venflon højre arm	
Kvinder: ikke pågående menstruation				Morgenblodsukker:	
Ernæringsscreening				GIK-drop opsat	
Samtale med operatør					
Samtale med sygeplejerske fra TIA					
Morgenvægt: Tp.: SAT: BT: Puls:					

Præmedicin:

Præparat	Ordination	Anæstesilægens signatur	Givet dato/kl.	Sygeplejerskens signatur
1. Paracetamol Retard	Kl. 2 g			
2. Tbl. Dormicum + 3 l O^2 + evt. eleveret hovedgærde	Kl.			
3.				
4.				
5.				

Fasteregime (sæt x)

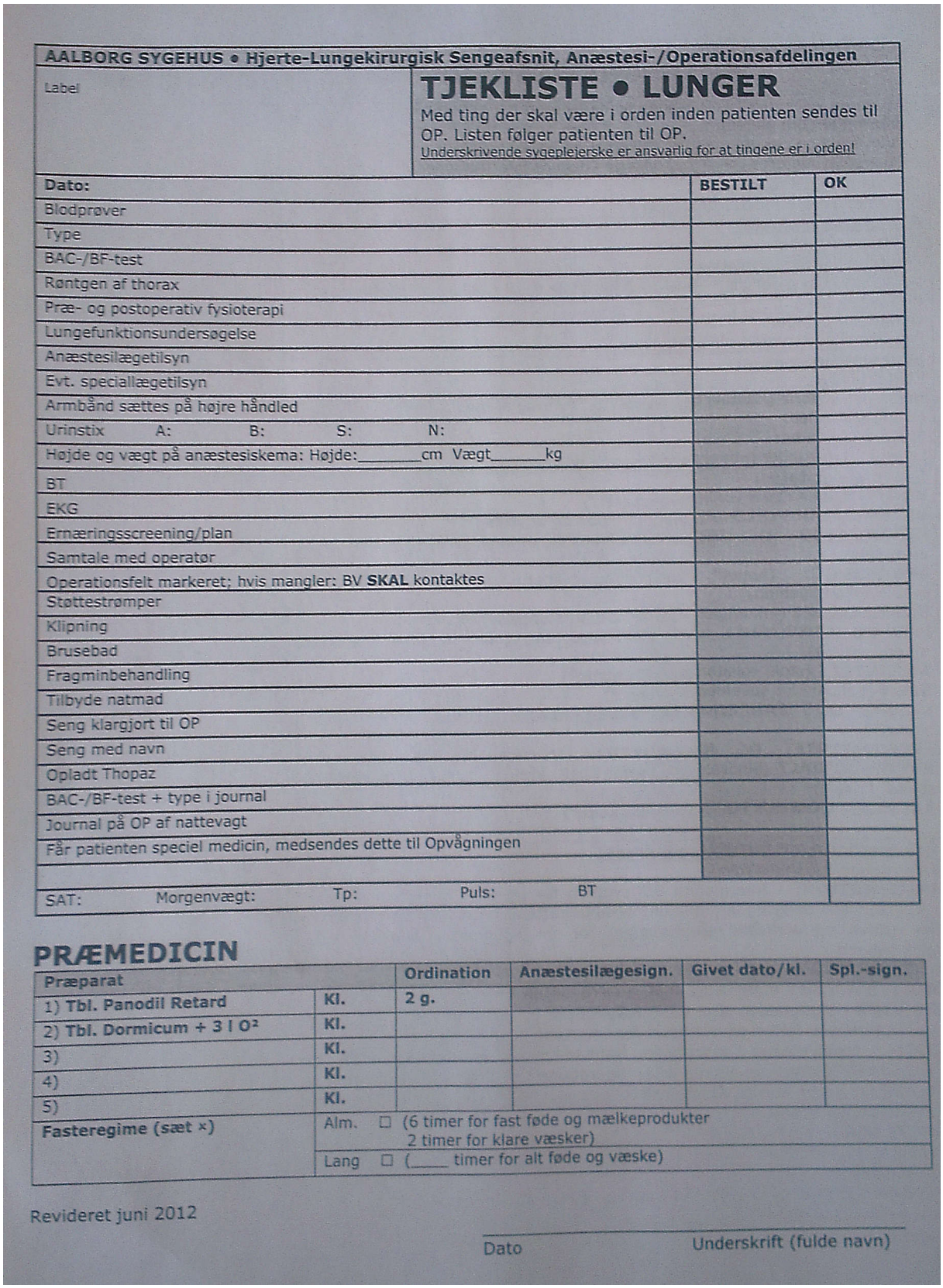
☐ **Alm.** (6 timers faste for fast føde og mælkeprodukter inden operationen, 2 timer for klare væsker)

☐ **Lang** (____ timer for alt føde og væske)

Revideret september 2011

Dato Underskrift

Figure .1: *A pre-operative heart-surgery checklists used at Aalborg University Hospital.*



AALBORG SYGEHUS • Hjerte-Lungekirurgisk Sengeafsnit, Anæstesi-/Operationsafdelingen

Label

TJEKLISTE • LUNGER

Med ting der skal være i orden inden patienten sendes til OP. Listen følger patienten til OP.

Underskrivende sygeplejerske er ansvarlig for at tingene er i orden!

Dato:	BESTILT	OK
Blodprøver		
Type		
BAC-/BF-test		
Røntgen af thorax		
Præ- og postoperativ fysioterapi		
Lungefunktionsundersøgelse		
Anæstesilægetilsyn		
Evt. speciallægetilsyn		
Armbånd sættes på højre håndled		
Urinstix A: B: S: N:		
Højde og vægt på anæstesiskema: Højde:_____cm Vægt_____kg		
BT		
EKG		
Ernæringsscreening/plan		
Samtale med operatør		
Operationsfelt markeret; hvis mangler: BV **SKAL** kontaktes		
Støttestrømper		
Klipning		
Brusebad		
Fragminbehandling		
Tilbyde natmad		
Seng klargjort til OP		
Seng med navn		
Opladt Thopaz		
BAC-/BF-test + type i journal		
Journal på OP af nattevagt		
Får patienten speciel medicin, medsendes dette til Opvågningen		
SAT: Morgenvægt: Tp: Puls: BT		

PRÆMEDICIN

Præparat		Ordination	Anæstesilægesign.	Givet dato/kl.	Spl.-sign.
1) **Tbl. Panodil Retard**	**Kl.**	**2 g.**			
2) **Tbl. Dormicum + 3 l O²**	**Kl.**				
3)	**Kl.**				
4)	**Kl.**				
5)	**Kl.**				
Fasteregime (sæt x)	Alm. ☐ (6 timer for fast føde og mælkeprodukter 2 timer for klare væsker)				
	Lang ☐ (____ timer for alt føde og væske)				

Revideret juni 2012

Dato Underskrift (fulde navn)

Figure .2: *A pre-operative lung-surgery checklists used at Aalborg University Hospital.*

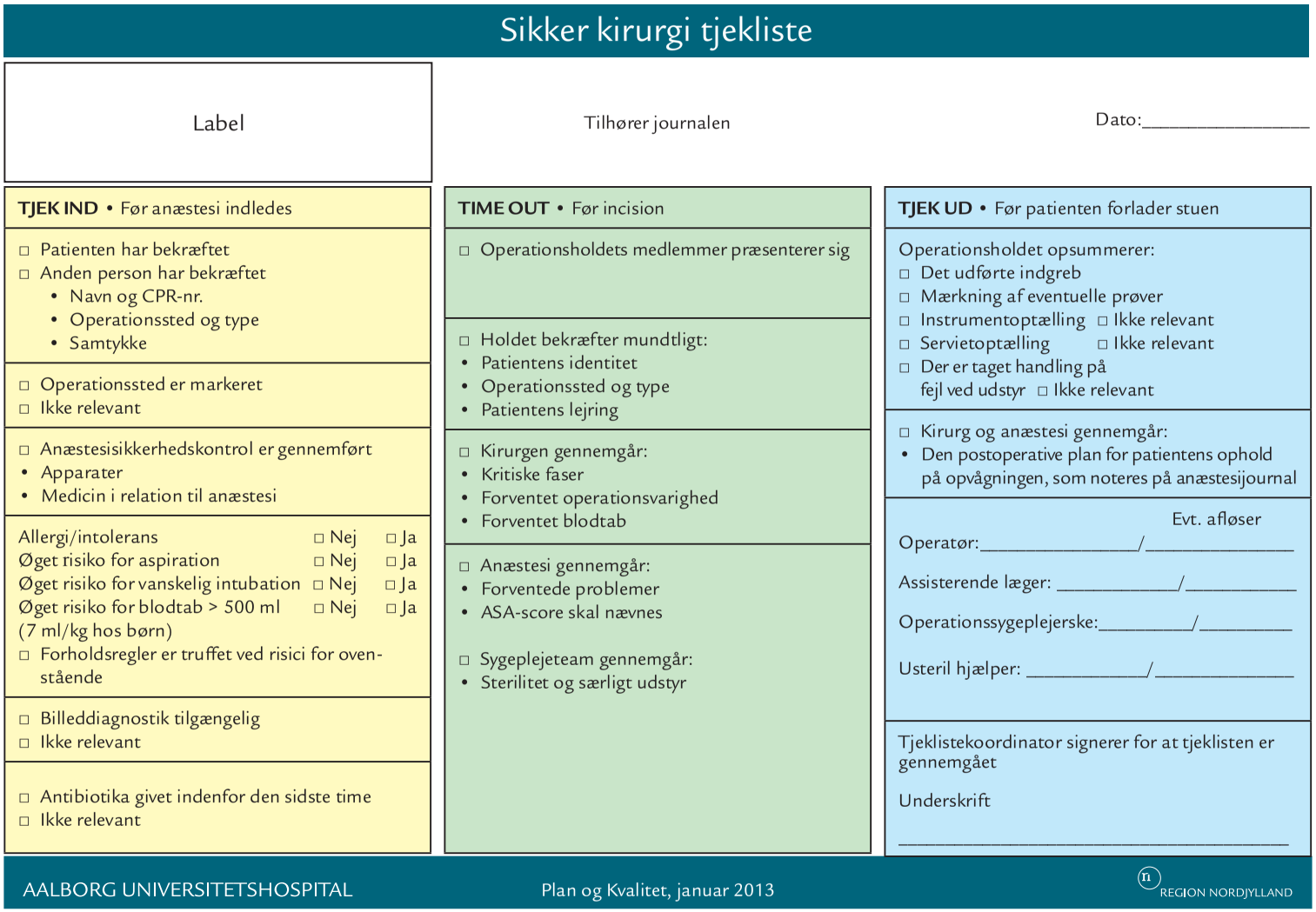
Hjerte-Lungekirurgisk Afdeling

PLEJEPLAN • LUNGER

	0. dag	1. dag	2. dag	3. dag	4. dag	5. dag	6. dag
Basale funktioner	BT-puls x 3 Tp. x 1 Cont. SAT + telemetri Resp. x 2/vagt CVK CPAP/PEEP	BT-puls x 3 Tp. x 2 SAT x 3 Telemetri sep. Resp. x 1/vagt CVK sep. PEEP x 1/vagt	BT-puls x 2 Tp. x 2 SAT x 3 Sep. PEEP	BT-puls x 2 Tp. x 2 SAT x 2 PEEP	BT-puls x 1 Tp. x 1 SAT x 2 PEEP	BT- puls x 1 Tp. x 1 SAT x 2 PEEP	BT-puls x 1 Tp. x 1 SAT x 1 PEEP
Væskeregnskab	Væskeskema	Væskeskema	Væskeskema	Evt. Væskeskema			
Dræn	Thopaz ml/min. Prod. ml. Pleuraflaske Prod.ml. +/luft. osc.	Cont./evt. sep. dræn	Cont./evt. sep. dræn	Ved cont. skiftes forbinding	Cont./evt. sep. dræn	Cont./evt. sep. dræn	Ved cont. skiftes dr. forbinding Pleuraflaske skiftes Thopaz canister + slange skiftes
Sår	Forbinding tilses x 3/vagt	Forbinding tilses x 1/vagt	Evt. sep./eller skiftes	Evt. sep./eller skiftes	Sep.		
EPI-kateter/smerter	Obs. indstiks-sted/OP-site Smertefri i hvile/hostesuff. VAS-scores x 1/vagt	Obs. indstiks-sted/OP-site Smertefri i hvile/hostesuff. VAS-scores x 1/vagt	Ved cont. forbinding skift VAS-scores x 1/ vagt	Obs. sep. EPI evt. slukkes 8.00 sep. kl. 18.00 VAS-scores x 1/vagt	VAS-scores x 1/vagt	Cont.	Cont.
Udskillelser	Urin måles	KAD sep. kl. 8 Obs. vandladning Magnesia 1 g x 2 Picolon dr. 10 kl. 22	Magnesia 1 g x 2 Picolon dr. 10 kl. 22	Magnesia 1 g x 2 Picolon dr. 10 kl. 22	Magnesia 1 g x 2 Picolon dr. 10 kl. 22	Cont. Cont.	Cont. Cont.

Y:\Afd. TI\Plejeplan - laminering\Plejeplan, LUNGER • skema23.02.12.doc

Figure .3: *A post-operative heart-surgery checklists used at Aalborg University Hospital.*



Sikker kirurgi tjekliste

Label

Tilhører journalen

Dato:_____

TJEK IND • Før anæstesi indledes

- □ Patienten har bekræftet
- □ Anden person har bekræftet
  - Navn og CPR-nr.
  - Operationssted og type
  - Samtykke

- □ Operationssted er markeret
- □ Ikke relevant

- □ Anæstesisikkerhedskontrol er gennemført
- Apparater
- Medicin i relation til anæstesi

Allergi/intolerans	□ Nej	□ Ja
Øget risiko for aspiration	□ Nej	□ Ja
Øget risiko for vanskelig intubation	□ Nej	□ Ja
Øget risiko for blodtab > 500 ml (7 ml/kg hos børn)	□ Nej	□ Ja

- □ Forholdsregler er truffet ved risici for ovenstående

- □ Billeddiagnostik tilgængelig
- □ Ikke relevant

- □ Antibiotika givet indenfor den sidste time
- □ Ikke relevant

TIME OUT • Før incision

- □ Operationsholdets medlemmer præsenterer sig

- □ Holdet bekræfter mundtligt:
- Patientens identitet
- Operationssted og type
- Patientens lejring

- □ Kirurgen gennemgår:
- Kritiske faser
- Forventet operationsvarighed
- Forventet blodtab

- □ Anæstesi gennemgår:
- Forventede problemer
- ASA-score skal nævnes

- □ Sygeplejeteam gennemgår:
- Sterilitet og særligt udstyr

TJEK UD • Før patienten forlader stuen

Operationsholdet opsummerer:
- □ Det udførte indgreb
- □ Mærkning af eventuelle prøver
- □ Instrumentoptælling □ Ikke relevant
- □ Servietoptælling □ Ikke relevant
- □ Der er taget handling på fejl ved udstyr □ Ikke relevant

- □ Kirurg og anæstesi gennemgår:
- Den postoperative plan for patientens ophold på opvågningen, som noteres på anæstesijournal

Evt. afløser

Operatør:_____/_____

Assisterende læger: _____/_____

Operationssygeplejerske:_____/_____

Usteril hjælper: _____/_____

Tjeklistekoordinator signerer for at tjeklisten er gennemgået

Underskrift

_____

AALBORG UNIVERSITETSHOSPITAL Plan og Kvalitet, januar 2013 REGION NORDJYLLAND

Figure .4: *A locally adjusted version of the WHO SSC used at Aalborg University Hospital.*