Creating more efficiency and patient safety

by changing processes and contents of instrument trays

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February 2009

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Executive summary

There is a trend that care providers are to be held more accountable for the costs and quality of health care. One of the primary focuses of health care change will be to provide quality of care at the lowest possible costs. Quality of care is a frequently discussed theme, which includes efficiency and safety. Materials are listed as one of the areas where an improvement in efficiency can be made.

The focus of this research is the instruments used in the operating theatres (OTs) of the Medical Spectrum Twente. The overuse of instruments in the OTs and the safety issues related to this overuse are the topics of this research, it explores and describes the opportunities for improvements. The main research question that is used to support this goal is: *How can the Medical Spectrum Twente enhance the efficiency and safety of instrument trays used in the operating theatres?*

This research is undertaken in the OTs and the centralized sterilization department (CSD). Different data gathering methods are used. Based on findings in the literature we present a conceptual model, which connects theoretical and instrumental attributes on efficiency and safety together. These instrumental criteria are the key factors that influence patient safety and efficiency related to the contents and use of instrument trays and, are the base of the interview questions. Secondly, we interviewed actors within the process. A survey is taken out to elaborate on the perceived problems mentioned in the interviews and the solutions regarding the contents and processing of instrument trays. The survey distinct the opinion of the CSD employees and the OT nurses. We have enumerated all perceived problems, which arise around the use and processes of instruments trays.

The problems marked as efficiency related are: emergency sterilizations and unnecessary sterilizations of unused instruments due too large trays or expired maturing dates. Both problems lead to unnecessary costs. A few differences between the OT nurses and CSD employees are the following: the operating theatre nurses indicate that it often occurs that surgeries are delayed due to the unavailability of trays. CSD employees mention the long turnover times and the continuity in the CSD as problems, these are caused by missing instruments on trays. These problems are time related. The most frequently mentioned safety related issues are: the occurrence of torn wrappers amount trays and instruments that supposed to lie on trays are often changed for alternative ones.

We also made a selection of the possible outcomes of changing instrument trays to the actual use of instruments the benefits are: transparency in the operating theatres, reduction in size and weight of trays, and decrease in turnover time in the CSD. Furthermore, we took the communication in consideration, both departments depend on each other, this indicates the importance of good communication. Nevertheless, the communication between both departments is described as poor.

Based on the conclusions, a number of recommendations are given:

- Appoint a general head that is responsible for both departments. This will increase the communication, coordination and cooperation of both departments and a better overview of problems can be achieved.
- Reduce the size and weight of instrument trays. Efficiency enhancements can be made when adapting instrument trays to the actual use of the trays, this will lead to a decrease in sterilization costs, and has several additional benefits: more transparency in the OT, less working acts for the CSD employees and a reduction of the physical burden for the OT nurses and CSD employees. This will also probably lead to a decrease in the occurrence of torn wrappers.
- Measure the number of emergency sterilization, torn wrappers and measure the turnover times of instrument trays in de CSD. This information is important when introducing changes and showing that improvements are achieved by changes.
- Replace the management of instrument trays to the centralized sterilization department. This increases turnover times and traceability of instruments and trays. By pointing out responsible CSD members for different specialties, OT nurses will have a clear spokesperson and problems considering specific trays will be solved more quickly, which in turn increases cooperation.
- Present a protocol to report all problems with instrument trays and a protocol that is aimed at revising the contents of trays on a certain period. These protocols should be easier to work with, and decentralized.
- We suggest implementing a FEFO system (First expired-First out), that reduces the amount of instrument trays with expired maturing dates.

Additionally a number of recommendations are made towards further scientific research on this subject. For example, there is no literature available concerning cost analysis of the sterilization process of instruments and complete trays. This information is important to show efficiency improvements.

Preface

This research concludes my master Health Sciences at the University of Twente (The Netherlands). It describes a research undertaken at the Medical Spectrum Twente, a large teaching hospital located in the east of the Netherlands.

Over four years ago, I took a huge step when I decided to start this master. After practicing as a dental hygienist, the health care sector grasped my interest. I noticed the changes and many opportunities within the sector, and so the choice to start Health Sciences was made quickly. I have enjoyed my time at the University a lot and have gained a lot of knowledge.

The completion of this research could not have been carried out without the support of various persons who have directly or indirectly contributed to a successful completion of my graduation assignment. Hereby I would like to express my gratitude to the following persons, first, I would like to thank Dr. Klaase for giving me the opportunity to undertake the research in the operating theatres and centralized sterilization department of the Medical Spectrum Twente, and for introducing me to the right persons. Hans Siegersma, who is working in the Medical Spectrum Twente for over 30 years, thank you for sharing your expertise and enthusiasm. Rein Dragt, for sharing an office and your advice.

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Pieter Wolbers, we started this research together, which was great fun, thank you for the lunches, talks and discussions. Sabine Wevers and Ellen Keur, for introducing me to the right persons and being very helpful during the first phases of the research. I also want to thank all the persons that I have interviewed and especially Maartje Brouwer for helping me to spread the survey.

Most of all, I want to thank all my dear friends who kept on believing in me and have encouraged me to pursue. You have been there in good, but most of all during bad times. Thank you for your loving support. I would also especially like to thank my parents for their unconditional support and encouragement.

Last but certainly not least, I would like to dedicate a few special words to my sister Denise. You are very much appreciated by me because you are always there for me, in good and bad times and for many more reasons. Thank you so much for your grammatical contribution but most important because you always show I can count on you. That feeling is special!

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Enschede, February 2009

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List of Abbreviations

CSD Centralized Sterilization Department

EMGO The Institute for Research in Extramural Medicine

FONA Fouten, Ongelukken en Near Accidents

IGZ Inspectie van de Gezondheidszorg

IHC Inspection of Health Care

IOM Institute of Medicine

MIP Medical commission Incidents Patient care

MIS Minimal Invasive Surgery

MST Medical Spectrum Twente

NIVEL Nederlands Instituut voor onderzoek van de Gezondheidszorg

OT Operating Theatre

RGO De Raad voor Gezondheidsonderzoek

Introduction

While the health care sector is dealing with rising costs, the government in the Netherlands is stimulating care providers to implement policies, which aim at reducing costs. The health care system functions at lower levels than it can and should, the system is fragmented and 'wasteful' (Berg, Schellekens & Bergen, 2005). In order to achieve a more efficient health care system, one of the challenges is to identify critical processes of inefficiencies within a hospital. One of the core processes involves the procedures of the operating theatres (OTs) which is proven to be an important level of the overall quality of hospitals services (Rodger, Paper & Pendharkar, 1998).

The research is undertaken in the OTs and centralized sterilization department (CSD) of the Medical Spectrum Twente (MST). Opportunities for improvements in the flow and use of instrument trays relating to safety and efficiency are explored and described. To successfully carry out this research, actors within the process are interviewed and a survey is taken out to gain an overall picture of the situation.

There are clear improvement opportunities within the flow and use of instrument trays of which a few examples of this fragmented and 'wasteful' system became clear in the exploration phase. The current situation shows inefficiencies in the use of instrument trays. An example of this is the often-endangered sterility of instrument trays, due to paper tears that should guarantee the sterility of the instruments that are the contents of the tray. Subsequently, the OT sends these trays back to the CSD, and requires repetition of the sterilization process, which increases the costs and influences the safety of the process. A second example is the contents of the instrument trays. These instrument trays are metal baskets that contain instruments that are required for surgeries. In practice, many of these trays contain instruments that are (often) not used during surgeries. Through an evaluation of the contents of the trays, expenses are saved on the sterilization process, purchase, and replacement of instruments.

§ 1.1 describes the context analysis, which is followed by the problem analysis in § 1.2. Based on the problem analysis, § 1.2 also describes the research objective from which the research question is distracted (§1.3). Finally, in § 1.4 the methodology is discussed. The execution of the research is described in §1.5. Consequently §1.6 describes which data gathering methods are used for each research question and how these methods contribute in answering the central research question.

1.1 Context description

The research is undertaken at the Medical Spectrum Twente. The Medical Spectrum Twente is one of the largest non-academic hospitals in the Netherlands. Currently, the hospital has locations in Enschede and Oldenzaal. They serve approximately 264,000 inhabitants and have an acknowledgement for 1070 beds. Approximately 4000 people work in the hospital of which around 200 are specialists.

This research focuses on instrument trays used by the OTs located in Enschede. The OT department consists of thirteen OTs, the thorax centre contains four of them. In Oldenzaal four additional OTs are located.

The Centralized Sterilization Department (CSD) is situated near the OTs. The customers of the CSD are: the OTs, the outpatient clinics, and the private clinics, situated in the surroundings of Enschede. The CSD has twenty-six customers. The OTs provide 80% of the total instruments that need to be sterilized. Data is obtained at the departments mentioned above.

1.2 Problem analysis

There is a trend that care providers will be held more accountable for the costs and quality of health care (Kanich & Byrd, 1996). One of the primary focuses of health care change will be to provide quality care at the lowest possible costs (Kanich & Byrd, 1996). In the Netherlands, the government stimulates care providers to implement policies that are designed to cut costs. The 'Sneller Beter' program is an example of a project that intends to stimulate the Dutch health care system, in order to achieve more transparency, efficiency, quality and innovation in the curative sector. This can be achieved for example by redesigning work processes or introducing logistic concepts. Bakker (2004) claims that a 20% cost reduction within the Dutch health care system is possible by redesigning the logistics of patients, goods and pharmaceuticals.

Within the 'Sneller Beter' program, the 'OK oke' project focuses on making improvements in the efficient performance of OTs of hospitals. The 'OT ok' project indicates six relevant areas for improvement to achieve an increased efficiency level within the OTs complexes. The availability of materials is listed as one of the areas where an improvement in efficiency can be made. For example, surgeries can be canceled when the necessary instruments are not available (Sneller Beter, 2007).

A typical Dutch hospital invests millions of Euros in sterile instruments (Van de Klundert, Muls & Schadd, 2006). Instruments are used in clinical procedures for example in outpatient departments and in OTs of hospitals. The MST can gain efficiency profits by looking at the instrument trays and their processes, which can lead to a reduction in attentive costs. The focus of this research will be the instruments used in the OTs of the MST. Instruments used in the OT are packed in metal baskets also called trays. The contents of these instrument trays are not frequently evaluated and the trays contain instruments that are (often) not used during surgeries. Most of the trays are large and heavy, meaning there are high sterilization costs for the instruments that are not used and deterioration of the quality of the material. One of the first focus points of this research is the search for possibilities to change processes and the contents of the instrument trays in order to achieve

improvements in the efficiency. Furthermore, as has been mentioned, the sterility of instrument trays is often endangered due to a tear in the paper that should guarantee the sterility of the instruments. These trays are sent back to the central sterilization department, and require repetition of the sterilization process. Such incidents increase sterilization costs and influence the safety of the process.

Picture 1 Example of instrument trays

The CSD is an important actor in the research, as they are responsible for the cleaning, disinfection and sterilization of instruments. The activities of the CSD are expanded by an increase in production. As a result of this the costs of materials and personnel are increasing. According to the annual report by the CSD, the department should develop towards a more business-oriented department supporting the primary care process (Annual report CSD, 2008). This indicates that the CSD has triggers to minimize sterilization costs by changing the composition of instrument trays.

Instruments can be characterized for example by their function, or their complementary property. Furthermore, disposable instruments and reusable ones can also be distinguished. Disposable instruments are only for single use, and solely require the purchasing costs. The reusable instruments on the other hand are costly instruments that entail unique properties, which are described in this paragraph. The focus of this research is on the reusable instruments. Reusable instruments that are used during surgery in OTs are packed in metal baskets that are called instrument trays. The composition of the trays is made by surgeons (mostly historically) and reflect all instruments needed for surgery. This also makes the work for operating assistants easier, they collect the trays prior to surgery, instead of collecting all the instruments individually. The weight from some trays can be up to seven kilograms and most trays contain a large amount of instruments. Depending on the type or the complexity of the surgery, one or more types of instrument trays might be used. When opened in the OT, regardless the amount of instruments that is used in the OT, the complete instrument tray needs to be cleaned and sterilized by the central sterilization department (CSD).

The activities in the CSD are labor intensive and include investments in expensive (cleaning and sterilization) equipment, which makes the sterilization process costly. From this point of view, hospitals will try to minimize

the costs by exploring the inefficiencies in the processes and use of instrument trays. There is a direct relationship between efficient working procedures and additional safety risks involved in such procedures. Working more efficiently can decrease the safety of processes or activities, for example, when working only with the necessary instruments and no additional instruments are available, the safety risk of the surgery can increase. Efficiency enhancement can on the other hand increase the safety as well. An enhancement in safety will contribute to efficiency. For example, safety issues arise when unsterile trays are detected. The high occurrences of unsterile instrument trays in the operating theatre lead to re-sterilization of these instrument trays and unnecessary costs. Furthermore, torn wrappers create safety issues for patients because of the potential for contamination. When adapting processes that lead to a lower occurrence of unsterile trays, both factors are influenced positively.

1.3 Research Objective

This research explores and describes the opportunities for improvements of the sterile instruments used in the OTs. The context of this study is taken into a broad field, namely the efficiency and safety that is connected to the use of instruments trays. The intention is to introduce improvements in the use, handling and contents of instrument trays in order to achieve improvements in the efficiency level, and safety of the use of the trays. An introduction to solutions that enhance the efficiency and safety level will probably also have an impact on the user-friendliness of the trays. We pursue the following objective:

The objective of this research is to gain insight in the efficient use of instruments during surgeries and the problems related to the high occurrence of unsterile instrument trays in the operating theatre, in order to introduce recommendations that will improve the efficiency level and the safety of the use of instrument trays.

Efficiency is explained as: the unused instruments that are placed on the trays and the unnecessary sterilization costs of instrument trays that are considered to be unsterile (but not used in the OT) due to mistakes made in the process. An enhancement in safety is explained as: a reduction in unnecessary unsterile trays which will enhance the safety and awareness which as a result will contribute to a better safety climate.

1.4 Research questions

We formulate the following central research question:

How can the MST enhance the efficiency and safety of instrument trays used in the operating theatres?

The following research questions will contribute to answering the central research question.

I. How can the concepts: 'efficiency' and 'safety', in relation to the instrument trays be operationalized as outcome measures from the current literature?
II. What are the current process characteristics of instrument trays in the MST that influence the efficiency and safety?
III. What problems within the processes of instrument trays that influence efficiency and safety of the contents and the use of instrument trays are found?

1.5 Research design

The purpose of a research design is to structure the research process. An important part of this research design is the research strategy, which gives direction to the research (Doorewaard & Verschuren, 1995). Doorewaard en Verschuren (1995) distinguishes five types of research strategies: a case study, a survey, an experiment, a grounded theory approach and desk research. For the questions identified in § 1.4, we use a mix of qualitative and quantitative methods. The research has an exploratory character, because there is a lack of clear ideas on the problems that exist within the processes between the CSD and the OT and the contents of instrument trays. Social research is mainly conducted to explore a topic, this approach is typically performed when a researcher examines a new interest or when the subject itself is relatively new (Babbie, 2004). Given the fact that the subject of the contents of instrument trays and the relation with efficiency and safety improvements is not widely explored, a small preliminary research on the subject is done by means of interviews (qualitative). In this way, relevant issues can be tested, determined and adjusted. After performing the interviews, a questionnaire is spread over a larger population.

The characteristics of this research show the most similarities with a case study. A case study is an in-depth examination of a single instance or a few time-restricted objects or processes (Babbie, 2004). Robson (in Saunders, Lewis & Thornhill, 2007) defines a case study as: '*a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence'*. Yin (1984) also highlights the importance of the context, adding that, within a case study, the boundaries between phenomenon and context are not evident. It is mentioned before that this research has an exploratory character, a case study is most often used in exploratory research (Saunders, Lewis & Thornhill, 2007). Furthermore, in case studies the data collection methods maybe various en are likely to be used in combination. This is called triangulation, and refers to the fact that the use of different data collection techniques within one study ensures that the data is telling you what you think it is telling you (Saunders, Lewis & Thornhill, 2007).

In the interviews, the current processes between the CSD and the OR are topic of discussion. The second and third research questions are answered by the interviews and questionnaires that are undertaken within both departments. The questionnaires are performed in the second part of this research, which can be characterized as a survey. The main objective of a survey is to gain an overall picture of a comprehensive phenomenon. It is used for exploratory and descriptive research. Characteristics of a survey are: a large number of respondents, a deductive approach and quantitative data analysis. A survey is undertaken in the form of a questionnaire, another data collection technique is structured observation (Saunders, Lewis & Thornhill, 2007). In this research, a questionnaire is used to test and replenish the results of the interviews and form the input in answering the third research question. Using a survey strategy gives more control over the research process.

1.6 Data collection

In this paragraph, the strategy to collect the adequate data is described per research question.

Research question 1- Operationalization of the concepts: efficiency and safety

To answer this question a general literature study is performed on the 'quality of care', the factors efficiency and safety are part of the general theoretical description 'quality of care'. Next to this a literature study on efficiency and safety in relation to the use of instrument trays is performed. For this we approach, electronic databases like Medline, Web-science and JStor using the following key terms: quality of care, efficiency, safety, user-friendliness, effectively, OT, operating room, instrumentation trays, sterilization costs and a combination of these terms. The references of these articles can be used to find more related articles on the subject. A conceptual model that captures all relevant theoretical instruments and corresponding instrumental attributes is presented lastly.

Research question 2- Current processes in terms of efficiency and safety

This research is based on a practical problem. Therefore, the context of the research is strongly determined by the CSD and the OTs of the MST. For determining the current processes of instrument trays, insights from the practical field are used. These insights are gathered by observing in the OT and in the CSD area and exploration of internal documents (see Annex 1). This information contributed to an overview of the current situation with respect to the processes and contents of instrument trays.

Research question 3- Problems that influence efficiency and safety of the contents and the use of instrument trays

This third research question is answered by semi-structured interviews. The first objective of the interview questions is to get a general idea of the opinions of the interviewee on the subject of introducing surgical specific trays and on directions how to solve the safety problems. The second objective of the interviews is to verify the completeness of the questionnaire and replenish the missing answer options of the questionnaire. The questions are based on the conceptual model derived from the literature and described in chapter 2. The first objective is dealt with when answering question 3. The discussion subjects in the interviews are the safety of processes and safety protocols, efficiency of the processing and contents of instrument trays, emergency

sterilizations and communication between and within both departments. The interviews were semi-structured. This method is chosen, because this benefits the comparability of the results. Eight interviews are executed, by speaking with surgery, CSD employees, the head of the CSD division and the team leader of the CSD. Interviewing is done face-to-face, this choice gives the possibility to interact with the interviewee. For example, the interviewee could be asked to elaborate on the answer. Furthermore, the interviewee is able to ask a more detailed explanation when the question is not clear. Another advantage of face-to-face interviewing is the opportunity to observe the facial expression and body language of the interviewee, which may be important for a correct interpretation of the answers. In addition, the interviews are recorded. The analysis of the interviews is undertaken in a structured way. The questionnaire subjects are formed into tables, the answers of the interviewees are shortly formulated into these tables. This allows for comparing the results. The general outcomes are described, admitted anonymously in this thesis and can be found in chapter four.

The subjects of the survey questionnaire are the same as the questions asked in the interviews, questions on safety and efficiency all related to instrument trays. A number of questions are multiple-choice, from which some have an open-ended answer option. The other questions are Likert Scaled statements, the answer options range between strongly agree and strongly disagree (see Annex 2). The multiple-choice options and the Likert Scaled statements are based on the interview results. The questionnaire is sent to all (90) operating assistants by email and with regular post, the CSD employees (31) received the questionnaires in their mailboxes present at the CSD. The data is analyzed with the analytical software program SPSS.

Central research question- Recommendations that achieve improvements in the safety and efficiency level

After analyzing the questionnaire results, an advice is formulated on how to improve efficiency and safety relating to the (contents) of instrument trays. In this part of the research, the options or scenarios are described in terms of advantages and disadvantages, concerning the outcomes of the interviews and questionnaires.

1.7 Thesis Structure

Chapter 2 describes the theoretical framework, the focus of the conceptual framework is on the terms ‘efficiency’ and ‘safety’ in relation to processes between the OT and CSD and instrument trays. We analyze the results in chapter 3 and 4. Chapter 3 and 4 present a profile of the current processes between the OT and CSD as collected by observation, interviews, explorative conversations and studying internal documents. Chapter 5 displays an analysis of the inefficiencies within the current processes and with an ongoing focus on patient safety, collected trough a survey. The conclusions of the research are described in chapter 6, which outlines the strong and weak points of this research and gives recommendations that will improve the current situation on efficiency and safety in relation to the contents and use of instrument trays.

2. Theoretical framework

This chapter addresses to the first research question: *How can the concepts 'efficiency' and 'safety', in relation to the instrument trays be operationalized as outcome measures from the current literature?"* and is analyzed by conducting a literature review.

General aspects on quality of care, definitions and the relation to efficiency are highlighted in § 2.1. Subsequently 'waste' in the health care sector and more specifically in the OTs is described § 2.2. A short overview of the theoretical concepts derived from the literature on efficiency is given in § 2.3. In § 2.4 a general description of 'safety' as part of quality of care and the determination of definitions are given. Within this section the design of a safety model and a description of the main influencing factors, which can contribute to a rise of incidents, are outlined (§2.5). Furthermore the two elements: structure and culture that contribute to enhancing patient safety are mentioned in § 2.6 and § 2.7. A short overview of the theoretical concepts derived from the literature on safety is given in § 2.8. We present a conceptual model (§2.9) based on the findings in the literature, in which the important notions are connected to each other.

2.1 Quality of care

Over the past few years, quality of care has been a frequently discussed theme. In the United States, this subject was especially stimulated by two reports of the Institute of Medicine (IOM): '*To Err is Human'* (2000) and '*Crossing the quality chasm*' (2001). These reports indicate that a change in the United States health care system is crucial, and this subject should have a priority on the political agenda. The IOM argues that there is a chasm between what the overall quality delivered by the system should be and what it actually is. The US care system is fragmented and 'wasteful', the IOM outlines that the most disturbing point is the absence of real progress towards restructuring health care systems by addressing both quality and costs concerns. In order to improve quality it is important to establish how quality can be defined and what the current quality status is.

2.1.1 Definition quality of care

The institute of Medicine (IOM) has defined quality as: *'The degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge*' (IOM, 2001). According to the IOM quality of care can be evaluated based on *structure*, *process* and *outcomes*. Donabedian (1988) states that each of these three categories has a direct influence on the following one (Figure 2.1). Structure refers to health system characteristics that affect the system's ability to meet the health care needs of individual patients or a community. The process describes what is actually done in the delivery of care and refers to interactions between clinicians and patients, and outcomes are shown in the health status of a patient as a result of contact with the health care system.

Figure 2.1 Three categories of quality measures (adapted from Donabedian, 1988).

All three dimensions can provide information about the quality of care, but most of the literature about quality of care is focused on measuring the processes of care (IOM, 2001). There are two measurement types that can measure the process of care: *assessing the appropriateness of care* and *adherence to professional standards*. When assessing the appropriateness of care, the health benefits of an intervention or service for individuals must exceeds its expected health risks to be considered appropriate. The other way to measure process quality is to determine whether care meets professional standards. This can be done by creating a list of quality indicators, the quality indicators are based on standards of care and can be found in: research literature, in statements of professional medical organizations or determined by an expert panel (IOM, 2001). This latter one will be the subject of this research.

2.1.2 Quality aims by the IOM

In crossing the quality chasm (2001), the IOM recommends the adoption of six quality aims for improving the Health care system in the United States. When meeting these aims we can speak of good quality of care. According to the IOM health care should be (IOM, 2001):

- **Safe**: injuries to patients from the care that is intended have to be avoided.
- **Effective**: the provided care has to be evidence based and under and overuse has to be avoided. Differences in the delivered care can only be due to differences in the patients, they cannot be due to the preferences of care professionals.
- **Patient-centered**: the services should be organized around the patient.
- **Timely**: reducing waste and sometimes harmful delays for both those who receive and those who give care.
- **Efficient**: avoiding waste, including waste of equipment, supplies, ideas and energy.
- **Equitable**: the quality of the provided care does not vary because of personal characteristics or socio-economic status.

According to Berg et al. (2005) the insights of the report are applicable to most western countries. They state that the safety, effectiveness, patient-centeredness, and timeliness of care have to be improved, while keeping costs' from rising further (Berg, et al. 2005). Efficiency is an important part of the quality policy. Therefore, there is a rise of attention on creating a more efficient level of care (Harteloh & Casparie, 2001). The overuse of instruments in the OT and the safety issues related to this overuse are the topics of this research. Therefore, the main subjects are efficiency and safety. Next to this, the processes between the OT and the CSD show

inefficient steps. Quality waste from both overuse and errors (safety) is abundant in health care and contributes to excessive costs.

2.2 Efficiency: 'Waste'

As mentioned before, one of the primary focuses of health care change will be to provide quality of care at the lowest possible costs (Kanich & Byrd, 1996). In an efficient care system, resources are used to get the best value for the money spent. The opposite of efficiency is waste, the use of resources without benefit to the patients. There are two ways to improve efficiency: (1) some operational inefficiencies are associated with direct medical service delivery: reducing waste is a way to improve efficiency, and (2) other ways are associated with the administrative and logistical side of the delivery system: reducing administrative or production costs is a way to improve efficiency (Koning, de et al. 2006; IOM, 2001).

2.2.1 Types of waste by the IOM

The IOM (2001) distinct seven types of waste:

1. **Overuse of services** (refers to the provision of health services for which the potential risks outweigh the potential benefits, for example the provision of antibiotics for a common cold, and for which they are ineffective)
2. **Waiting** (for example, for a laboratory test to be performed or for its results)
3. **Transportation** (for example, requiring a patient to go to another floor level)
4. **Processing** (using more steps than are needed)
5. **Stock** (using more materials than are needed, maintaining unused materials in inventory or unused work floor skills)
6. **Motion** (wasting both energy and time)
7. **Defects in production** (this can be found in health care delivery in the form of mistakes in execution or lack of competence in performing a procedure, so that the patient does not receive the full benefit of the delivered care)

It is estimated that 30.1% of all health care expenses are related to surgical expenditures (Kanich & Byrd, 1996). Surgical costs are related to OT utilization, inventory volume, supplies used and the costs of equipment. To ensure quality of care at the lowest costs these issues must be monitored.

2.2.2 Time 'waste'

There is a lot of literature about specific types of waste commonly seen in the OT area. Waiting is a one-dimensional quality measure, which can be readily perceived (Rodger et al. 1998). Weinbroum (2003) assessed the time wasted in OTs, this in need to control the high costs of running OTs. The 'time-waste' was defined as the time in which the scheduled OT was not busy with the scheduled patient, this led up to 79 hours over a 30-day study period. The 'time-waste' could be divided in multiple underlying factors such as: unavailability of surgeons, delay in transport to the OT and, inappropriately prepared patients. After determining the causes of time delays, a committee introduced new guidelines and most of the time-waste was reduced (35%),

nevertheless a fair amount of time-delay remained existent. The shortage of nurses and anesthesiologists, and OT emergency reassignment remained the major causes of OT 'waste-time'.

Overdyk, Harvey, Fishman & Shippey (1998) also analyzed wasted time, but broadened this subject with the hypothesis that by determining the most frequent and time-consuming causes of OT-delays, strategies to improve OT efficiency could be implemented and the impact and duration of these strategies on efficiency could be measured. The outcomes were that factors such as: the starting time of a procedure for the first case of the day, was on average, 22 minutes earlier. Furthermore, there was a decrease in the average turnover time and the unavailability of surgeons and anesthesiologists. The identification of OT efficiencies was followed up by staff interventions, multidisciplinary awareness training and personal accountability, which contributed to significant time reductions. Hereby it has shown that the study by Overdyk et al. (1998) has had more success in delaying waste-time because of the introduction of additional staff interventions, creating more awareness of the problems. Overdyk et al. (1988) examined all the factors that caused delay in the OT, one of the elements mentioned is: 'OT equipment delay'. The incidence (per 100 cases) measured prior to the educational period and afterwards decreased from 2.7 to 1.9 incidences.

2.2.3 Cost efficiency

Wolbers (2008) made a selection of the frequently performed surgeries (over 200 times per year), by the General Surgery department for which the number and type of instruments used is relatively predictable (see Annex 4). This data is extracted from the database of the MST and includes all surgeries performed between May 2006 and May 2008. It is assumed that for these surgeries it might be beneficial to design surgery specific trays, 11 surgery types are taken into account (115 instrument types and 4 tray types). At this point, large and commonly used tray types are used for these short surgeries. According to the OT nurses, the selected procedures indeed use a small selection of the instruments that are present in the large trays. We used the expertise of the OT nurses to determine the instruments, which are needed per procedure. There is no cost price information available to indicate the sterilization costs per instrument, based on information by Florijn (2008) we used an average of €1 per instrument. The sterilization costs of the instrument trays used in the selected procedures, sum up to €332,334 per year. Wolbers (2008) altered the tray compositions of these specific procedures in order to minimize the number of instrument sterilizations per year. The savings that can be achieved by altering the tray compositions are approximately between €55,000 to €65,000. Florijn (2008) also developed a model that distributes instruments over trays, this research was conducted for 15 different types of surgery, including 12 tray types (239 instrument types). By altering the trays, a possible cost reduction of approximately €125,000 per year can be achieved.

2.2.4 Determinants of OT quality

Rodger, Paper & Pendharkar (1998) on the other hand, performed their research on a wider scale than was done by Weinboum et al. (2003) and Overdyk et al. (1998). Rodger et al. (1998) derive theoretical attributes from the literature that characterize processes in the OT and measure OT quality. The theoretical attributes are: respect and caring for customers, continuity of services, safety of customers, efficiency of tasks,

effectiveness of services, efficiency in technique application, availability of services, timeliness of services, appropriateness of services and facility and personnel tangibles. The research focused on identifying determinants (variables) of operating room quality. The variables were operationalized into a survey instrument. This research examines the relationship between the perceived important attributes as well as the actual performance of the attributes. The theoretical attributes were translated to instrumental attributes, measuring the overall quality of OT. We display a few examples of instrumental attributes and their corresponding theoretical attributes in Table 2.1, however we do not consider all theoretical and instrumental attributes. We believe these attributes are not only applicable in the OT, but are also in the CSD and in the processes between the OT and CSD. Because the CSD and OT are alternately client and supplier, they have a dependent relation. For example, issues outside of the OT like instrument handling can affect surgery start times.

Table 2.1 Example: comparison of theoretical and instrumental attributes used by Rodger et al. (1998)

Theoretical attributes	**Instrumental attributes**
Continuity of services	- *Communication with surgical and OT staff*
Safety of customers	- *Postoperative care*
Efficiency of tasks	- *No delays, cancellations, excessive work up* - *Small groups providing services*
Timeliness of services	- *Short waiting times* - *Timely starts*
Effectiveness of services	- *Cost effective care*

The research by Rodger et al. (1998) indicates that there are significant differences between the perceived important attributes and the performance attributes of the OT practice. This means that the perception of quality is different from the actual performance. Which is the when speaking about: communication, small groups providing services and timely starts. Meaning that in these areas, the importance is high and the performance low. Heslin, Doster, Daily, Waldum & Boudreaux et al. (2008) also takes factors of satisfaction into account when analyzing OT efficiency and safety. In this research, communication between staff is a variable that indicates the level of continuity of work. We further elaborate on communication in § 2.4, because it is an important factor of patient safety.

An overview of the instrumental attributes derived from the literature found on quality of healthcare in OTs and in particular related to efficiency is given in § 2.3 and Table 2.2. How such attributes are translated into attributes usable for this research will also be discussed.

2.3 Defining measures for efficiency

Summarizing we can conclude that most literature on efficiency deals with quality attributes that can be used in the OTs. To enhance efficiency in the use of instruments, the focus has to be on attributes that relate to quality performance in the OT and the CSD, since both departments have a dependent relation to each other. Adequate support from the CSD is essential for an efficient working OT, furthermore the CSD is a client of the OT, they receive unsterile instruments from the OT, and are therefore dependent on the OT.

We derived efficiency characteristics from the current literature and these characteristics are used as input for the conceptual model. Part of efficiency characteristics are processes between departments or within departments. Processing relates unnecessary steps taken within a process. Waiting is linked to delays, for example surgical equipment delay (Overdyk et al. 1998). Overdyk et al. (1998) measured the turnover times in the OR, which is defined as the time between a patient leaving the OT and the next patient entering. When surgeries are delayed or cancelled, this results in increased waiting times for surgery, longer lengths of hospital stay, staff that copes with stress, and a decrease in the overall quality of patient care. There is no literature on the contents of *instrument trays* and the use of it, and a relation with delay, this particular issue has therefore not been a subject of discussion within this research.

Efficiency and safety are mentioned by Rodger et al. (1998) as part of the overall OT quality. They state that these attributes are applicable to health care departments and therefore usable in this research. Three theoretical attributes from the research by Roger et al. (1998), can contribute to this research, these are: *continuity of services, efficiency of tasks* and *timeliness of services.* Rodger et al. (1998) translated these theoretical attributes into instrumental attributes. The definition of continuity given in Rodger et al. (1998) is as follows: 'the degree to which service is coordinated with other functional areas'. Part of the continuity of services is the communication between departments and staff (Rodger et al. 1998). We define the continuity of services as: the communication between the CSD en the OT and the coordination between both departments. The definition given on the efficiency of tasks in Rodger et al. (1998) is as follows: *'the ration of results of services to the resources used'*. This attribute relates to the waste in *processes* mentioned by the IOM (2001). The IOM mentions that stock is a type of waste. Stock waste refers to using more materials than are needed, maintaining unused materials in inventory.

Summarizing we show the Instrumental attributes that correspond with the theoretical attributes in Table 2.2.

Table 2.2 Comparison theoretical and instrumental attributes of efficiency related to instrument trays

Quality indicator	Theoretical attributes	Instrumental attributes
Efficiency	**Continuity of services**	- *Communication on the work floor* - *Continuity of work in the CSD*
	Efficiency of tasks	- *Handling steps*
	Timelines of services	- *Delays/ Cancellations of surgeries/ excessive work up* - *Short Turnover times*
	Stock 'waste'	- *Using more materials than needed*

2.4 Patient safety

In this part, we explore the factors of patient safety related to the contents and use of instrument trays. Patient safety is part of the six aims that are stated by the IOM (2001) and is an actual subject since the IOM published the report: '*To Err is Human*'. According to the report, approximately 10% of all patients admitted to hospitals suffer some kind of harm, about half of which is preventable with current standards and treatment. An estimated 44,000 to 98,000 patients still die in the USA each year because of unintentional medical errors. In addition, about 60% of all such events in which medical equipment is involved are due to improper equipment use (Kohn, Corrigan, Donaldson, 1999). Therefore, the safety of surgeries decreases when the correct instruments are not used. The report was important for a number of reasons, because of the dramatic figures, but also because the authors turned against the shaming and blaming of care providers and stood up against the American lawsuit culture.

2.4.1 Patient safety in the Netherlands

Also within the Netherlands, patient safety has received increased attention from the government in the past years. The CEO of Shell Netherlands, was requested in the frame of the national 'Sneller Beter' program, to study how safety in the Dutch health care can be enhanced, which resulted in the report '*Hier werk je veilig, of je werkt hier niet*' (Willems, 2004). Based on the American studies and comparatives studies from the UK an estimation of the Dutch situation can be made: between 1,500 and 6,225 patients in the Netherlands die each year due to medical errors (Willems, 2004). Based on the experiences with Shell, they indicated that over a 15-year period, the Netherlands could save up to 1-3 milliard euro's (Willems, 2004). The more recent profound study (EMGO & NIVEL, 2007) on the potential avoidable deaths (1,735) and the number of patients that suffer from avoidable health damage (30,000) is the first in which the Netherlands have precise figures (IGZ, 2008).

2.4.2 Definition of patient safety

Patient safety is a broad concept that illustrates a particular subject, more than a precise delineation of the concept (RGO, 2005). Safety is not a dichotomy, but a concept that can be graded, like size or strength. Safety cannot be directly measured, it can be quantified if safety is interpreted as 'the degree of reduction of risk'. Next to being a objective concept, safety can also be subjective, such as feeling (un)safe (Smorenburg, Kievit, Van Everdingen & Wagner, 2007). The Inspection of Health Care (IHC) gives the following definition of patient safety: *'patient safety deals with the unintentional harm a patient suffers from, obtained during the health care processes*. The harm is neither the logical result of the disease the patient is coping with nor the preceded known and weighed risk of a treatment (IGZ, 2004). The IOM defines patient safety as: *'the freedom from accidental injury due to medical care, or medical errors'*. Smorenburg et al. (2007) use the following definition: *'the (almost) lack of (the chance of) (physical/mental) harm suffered by a patient due to the failure of health providers to deliver care according to professional standards and/or to shortcomings in the health care system'.* The similarity that can be found within all three definitions is the statement that: harm to a patient arises through an error in the medical process. In this chapter on patient's safety the following terms will also be mentioned: an incident is defined as: *'an unintended event stemming from the health care process which either*

effectuated, or could have effectuated, or still can effectuate harm to the patient' (Smorenburg et al. 2007). If an incident results in injury, it is called an adverse event. If the incident does not cause injury, it is referred to as a near-miss.

2.4.3 Reporting incidents

The IOM wrote in '*To err is human*' that reporting and analyzing incidents contributes to consciousness and a safety attitude and will offer many starting points for improvement of daily health care in hospitals (2001). Patient safety does not only mean fixing protocols and rules, it also means exporting it by caregivers. They should be convinced of the importance of reporting incidents and acknowledge their responsibilities in this process. Learning form incidents seems easy, in daily practice it is not. Willems concluded in his analysis that most health care providers do not register their incidents or near-misses (2004). He recalls this as a problematic situation, because every time an incident is unreported, a chance is missed to enhance the safety of work processes, also mentioned in the report by Wagner, Smits, Van Wagtendonk, Zwaan & Lubberding et al. (2008).

2.5 How do incidents occur?

Reason (in Wagner et al. 2008) proposes the 'Organizational Accident Causation Model', which is based on research outside the health care sector. High-risk industries such as the air force industry or the chemical industry are used to report and analyze their incidents systematically according to a fixed procedure, with less focus on the individual who makes the error and more on pre-existing organizational factors. The 'Organizational Accident Causation Model', shows that the incident sequence begins with the negative consequences of decisions made at the higher management levels, they are transmitted down the departmental pathways to the workplace (OT), thereby creating task and environmental conditions that can promote unsafe acts (Taylor-Adams & Vincent, 2006). Defenses and barriers can be designed to protect against hazards and to weaken the consequences of equipment and human failure. This can be in the form of physical barriers (fence), natural barriers (distance) and administrative controls (training). When an incident is analyzed each of these elements is considered and analyzed in detail, working back to the organizational processes. Figure 2.2 displays the different steps in the rise of an incident.

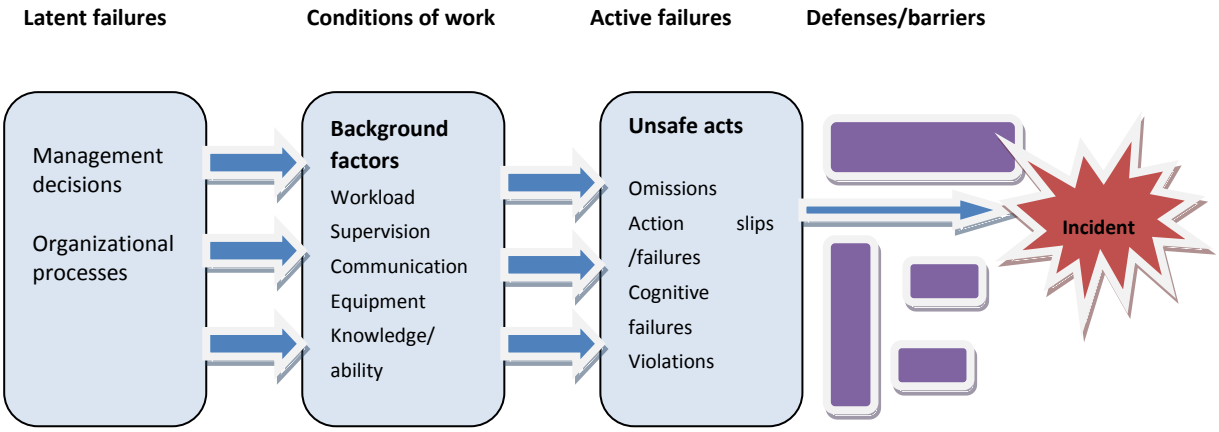


Figure 2.2 The 'Organizational Accident Causation Model' (Reason, 2002)

2.5.1 Persons and system approach of made errors

Reason (2000), makes a distinction between the *person approach* and the *system approach* of made errors. The person's failure is part of the person approach and errors are caused by forgetfulness, inattention, poor motivation, carelessness, negligence and recklessness. The other view of assigning medical errors is the system approach, errors are seen as consequences rather than causes, having their origins in systemic factors, for example error traps in the workplace and the organizational processes that give rise to them (Reason, 2000). Countermeasures are based on the assumption that though human conditions cannot be changed, conditions under which humans work can (Reason, 2000). The central idea is that of system defenses. When an adverse event occurs, the important issue is not who blundered, but how and why the defense failed. The IOM pleads for a system-oriented approach to the problem of safety (Smorenburg et al. 2007).

2.5.2 Active and latent failures

Reason (2000) also distinct active and latent failures, in which a failure is described as: *'the failure of planned actions to achieve their desired goal'*. The unsafe acts committed by people are called the active failures: they are mostly a result of underlying latent conditions. Active failures can be divided into three groups: mistakes, lack of knowledge and conscious protocol deviations (Wagner et al. 2008). Mistakes arise when a professional is performing routine procedures. A professional can be distracted in the process and fails to a good execution of the task. Knowledge related failures also often appear when a new situation arises. There is no suitable protocol for the new situation, and it comes down to the creative knowledge of the professional. Conscious failures on the other hand, appear when professionals work under time-pressure or when one has the feeling that protocols do not apply.

Latent failures are failures in the care system, the organization of the system or bad organized care processes that under normal conditions do not lead till damage. Health professionals are not always conscious of the shortcomings in the organization of health care (Wagner et al. 2008). When restrictions in the processes are known they adapt to them, for example: a neurosurgeon testing an instrument three times before surgery as a

precaution. Latent conditions arise from decisions made by designers, procedure writers and top level management and are often unintentional causes of policy decisions (Reason, 2000; Vincent, Taylor-Adams & Stanhope, 1998). Latent conditions are for example: heavy workloads, inadequate supervision, insufficient trained personnel, a culture where appointments are not being made, inadequate maintenance of equipment and or miscommunication between for instance physicians and nurses (Matern, et al. 2006). Although latent factors can influence staff performance and may precipitate errors and affect patient outcomes, these factors have been poorly studied in the field of OT and CSD. Unlike active failures, which are often hard to foresee, latent conditions can be identified and remedied before an adverse event occurs. This leads to proactive rather than reactive risk management (Reason, 2000).

Insight in incidents is necessary to start improvement initiatives. The danger lies in the fact that without insight in the underlying causes, improvement initiatives are started to prevent a specific incident, but fails to take away the underlying causes. Understanding the causes is necessary for choosing an improvement initiative that can contribute to the safety and quality of care.

Researchers have been concerned with developing tools for unsafe acts. This is called error management, and has two elements: limiting the incidence of errors and creating systems better able to deal with the occurrence of errors and counteracting their damaging effects (Reason, 2000). Followers of the system approach strive for a comprehensive management program aimed at several different targets: the person, the team, the task, the workplace and the situation as a whole. In literature the seven major factors mentioned that can contribute to the safety and quality of care are: the institutional context, organizational and management factors, work environment factors, team factors, individual (staff) factors, task factors and patient factors. In contradiction to this, followers of the person approach direct most of their management resources at trying to make individuals less fallible (Reason, 2000). Table 2.3 provides an overview of factors, which can contribute to a rise in errors and incidents. Five of these factors are used in the conceptual model.

Table 2.3: Framework of Contributory Factors Influencing Clinical Practice

Factor Types	Description
Patient Factor	• Condition (complexity & seriousness) • Language and communication • Personality and social factors
Task and Technology Factors	• **Task design and clarity of structure** • **Availability and use of protocols** • Availability and accuracy of test results • Decision-making aids
Individual (staff) Factors	• **Knowledge and skills** • Competence • Physical and mental health
Team Factors	• **Verbal communication** • **Written communication** • Supervision and seeking help • **Team structure (congruence, consistency, leadership, etc)**
Work Environmental Factors	• Staffing levels and skills mix • **Workload and shift patterns** • **Design, availability and maintenance of equipment** • Administrative and managerial support • Environment
Organizational & Management Factors	• Financial resources & constraints • **Organizational structure** • Policy, standards and goals • **Safety culture and priorities**
Institutional Context Factors	• Economic and regulatory context • National health service executive • Links with external organizations

Source: Taylor-Adams & Vincent, 2006.

All factors correspond with factors mentioned in the literature review, which can be found bold and underlined in Table 2.2. The patient and institutional factors on the other hand are not relevant for this research. All of the bold and underlined marked factors assess, the safety related to the contents and use of instrument trays. These factors apply to the third research question of this study and are used to analyze the current problems related to the safety of instrument trays in the MST.

Most descriptions of factors mentioned by Taylor-Adams (2006) are clear and need no further explanation: this assumption applies to the following described factors: availability and use of protocols, knowledge and skills, communication (verbal and written), workload, design and availability and maintenance of equipment. Two of the factors do however need a further explanation, these are: structure and culture.

The factor structure is a broad concept, which influences the organization in different levels. According to Taylor-Adams structure is part of the following factors: task and technology factors, team factors and organizational and management factors (2006). Thus, structure can influence the rise of errors and incidents from different angles and therefore this term calls for a broader explanation, given in § 2.6. Another element that contributes to an enhancement in safety is the culture of an organization or department (Wagner et al.

2008). Culture can be described differently and therefore needs to be explained in more detail. This second factor will be further explored in § 2.7, to obtain a clearer view of the relation between an organizational culture and safety issues.

2.6 Structure

Hospitals are complex organizations, in which various tasks among a large number of specialized caregivers are divided. These tasks should be coordinated to each other in order to provide responsible care. Patient safety is a part of responsible care. A good infrastructure consisting of training for employees, guidelines and protocols, cooperation agreements should be present in order to deliver responsible care (Wagner et al. 2008).

2.6.1 MIP commission

Reporting incidents is not a complete new subject for hospitals in the Netherlands. Hospitals are registrating their incidents on a central level for quite some years. The FONA commission, which stands for errors, incidents and near-incidents, was founded in the seventies. In a later stage, the FONA was changed to the MIP-commission, which stands for Medical commission Incidents Patient care (De Bekker & Van der Steeg, 2004). The MIP is often seen as a commission that 'analyses' and 'investigates' incidents. This is a wrong assumption, because with these tasks the MIP steps in the field of the responsibility of the attending physician and the responsible manager of the division. The attending team should perform the analysis and the investigation. The MIP does not belong on the patient level. The MIP is an advisory commission, with the following objective: "*to deliver a contribution in improving the patient safety, based on incoming reports, in the form of management advice"* (De Bekker & Van der Steeg, 2004). The question rises what should be reported? The report criteria in the Netherlands are broad: all 'unwanted events' should be reported. The unwanted events are all events that deviate from the normal care process (Legemaate, Christiaans-Dingelhoff, Doppegieter & De Roode, 2007). Other rules count for complications with permanent harm for the patient: these should be reported at the Inspection for Heath care (IGZ) (De Bekker & Van der Steeg, 2004). The amount of reports says nothing about the degree of patient safety: it says something about the openness of the organization. De Bekker & Van der Steeg (2004) state that the MIP commission has been unsuccessful in practice. It is widely acknowledged that there is an underreporting of incidents in health care, assessments of incidents are usually limited to the ones who had serious consequences. Only on rare occasions professionals are brought together to discuss the incidents. This deprives professionals from learning from each other's mistakes and gaining insight in the strong points of their collaboration. This makes it also difficult to discover factors like organizational failures. For professionals it is often not clear what the added value of the commission is, it is not always clear what they should and what they should not report (2006). As mentioned before there are a few misunderstandings on the rules and performance of the MIP commission. The advice of the commission is often neglected by the manager of the division. As mentioned before the commission only has an advisory task. Frustration appears, because the MIP has no competence to check if the advice has been applied in practice.

From the misunderstandings mentioned the overall conclusion that can be drawn is that the MIP commission does not function properly. The intentions are good but the added value is generally small. According to De Beer & Van der Steeg (2004), the commission does not fit well in the present situation and the central reports should be undertaken by a quality official on a departmental level. They also state that an open culture in hospitals and confidence contribute to this change. It must become clear for professionals that learning of incidents contributes to an improvement in patient safety. To underline the importance of the subject, it is positioned in the 'Sneller Beter' project (Legemaate et al. 2007).

2.7 Culture

The concept of culture deals with the values and standards that are handled within a department. These values and standards determine, if protocols are followed, if it is easy to ask for help or whether you are supposed to know everything yourself. An organizational culture that encourages reporting of incidents provides the caregiver with possibilities to learn from their own mistakes. Incidents could probably be avoided more effectively when systems are designed to minimized the change of mistakes by caregivers (Wagner et al. 2008).

A great deal of attention in literature is paid to the role of cultural factors as antecedents to incidents (Kristensen & Bartels, 2007). The two terms 'safety culture' and 'safety climate' are used interchangeably: they are distinct but have related concepts. When studying group-level perceptions, the most appropriate term to use is climate. Climates are more readily measurable aspects of a safety culture. The term 'safety climate' generally describes employee's perceptions, attitudes and beliefs about risk and safety, whereas safety culture is a more complex, highly dynamic and multidimensional concept. It can be said that a safety culture is: the product of all safety climate aspects and the style of an organization's health and safety management (Sexton, Helmreich, Neilands, Rowan & Vella et al. 2006; Kristensen & Bartels, 2007).

Different quantitative and qualitative approaches can be used in assessing the safety culture, such as observation, questionnaires, focus group interviews, individual interviews etc. Safety culture questionnaires are instruments for measuring aspects of a safety culture in organizations that operate in safety critical areas (Kristensen & Bartels, 2007). Kristensen & Bartels (2007) give an overview of five different instruments that can be used to assess the safety culture and the subjects that are covered by the instruments. Different instruments are designed to measure different objects, like for example:

- To gain information about the staffs perceptions on safety culture
- To help understand features of an organization and/or a team and the safety culture
- To make comparisons over time
- To make judgments and set priorities for developing a patient safety culture
- To survey the impact of initiatives to change the safety culture
- To provide a basis for the design of a report system

Professionals in health care organization that are trying to enhance safety and quality often identify culture as a barrier of change. Measurement of a safety culture requires not only in depth investigation but also analysis how members of the organization interact from a shared view of safety (Kristensen & Bartels, 2007). When trying to transform the culture it is important to understand it. Safety culture assessments are meant to give organizations the gift to see themselves. They provide information on how patient safety is viewed within the organization. The patient safety culture is classified in levels. Each level has distinct characteristics and shows progress from the one mentioned before. They are described by Ashcroft, Morecroft, Parker & Noyce (2005) and Wagner & Struben (2007) see also Figure 2.3:

1. **Pathological culture**. This is the culture that denies safety. The dominant attitude is 'why waste our time on safety'?
2. **Reactive culture**. Safety only gets attention when an incident has occurred.
3. **Bureaucratic or calculative cultures**. The system is characterized by the presence of a lot of paperwork, and a lot of collected information. There are many statistics and there are many protocols and rules. Nevertheless they lack in the implementation and evaluation of long-term changes.
4. **Proactive culture**. Safety takes high priority. They look forward to the future, preventive measures are taken in advance. Proactive organizations involve the working departments in practice, not only in theory.
5. **Generative culture.** Risk management is integrated in all acts.

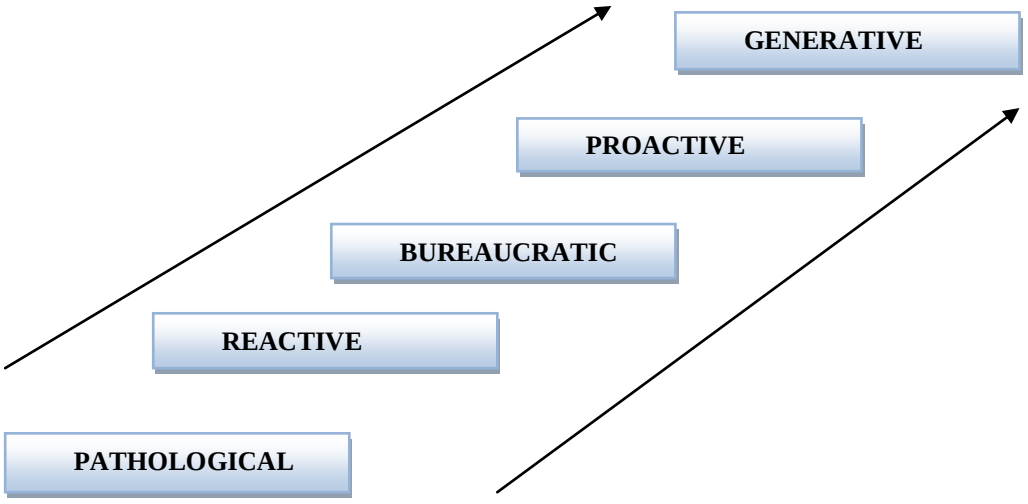


Figure 2.3 Culture levels

As mentioned before the system approach identifies causes of events within all layers of the organizational system. Health care professionals experience that the system and the culture are closely related and aim actions at changing the culture in order to obtain safety improvements within the system (Kristensen & Bartels, 2007). According to Berlowitz, Young, Hickey, Saliba & Mittman et al. (2003) quality improvement implementation is more successful in organizations that have an underlying culture that promotes innovation. Next to this, quality improvement implementation can result in professionals that are more satisfied with their jobs and believe they are providing better care. Characteristics of a positive safety culture that have been found are (Kristensen & Bartels, 2007):

- A good information and process flow
- Shared perceptions on the importance of safety
- Organizational learning
- Confidence in the efficacy of preventive (safety) measures
- Committed leadership and executive responsibility
- Proactive identification of latent threats to safety
- Openness and trust in communication
- A blame free incident reporting and analyzing approach

The RGO (2005) recalls that there are three interrelated cases of importance in understanding the safety culture these are: commitment of management, the presence of a reporting system and, the presence of fair rules for the handling of incidents. It is stated that commitment of management is the most important, it implies that management is prepared to look at its own organization and acknowledges that omissions or errors are not only caused by employees (active failures) but are often present in the design of the production process and how the work is organized (latent failures).

Willems (2004) calls the culture in Dutch hospitals a ‘closed safety culture’, in which acknowledging mistakes is a taboo, and where reporting incidents are not encouraged. The report states that this culture therefore should be changed on a short term, so that the culture in hospitals relates to the effectiveness of reporting systems.

2.8 Defining measures for safety

As has been mentioned, literature on patient safety makes a distinction between active and latent failures. According to Reason (2000) & Vincent et al. (1998) it is wrong to lay the attention on the human factor, therefore only the latent factors are taken into account in creating instrumental criteria. Instruments and materials are being described as latent risk factors. One of the aims of this research is an enhancement of patient safety that is related to instrument trays.

The literature recalls that all unwanted events should be reported, this also counts for incidents with instruments trays, even if they are not directly related to patients. Underreporting means there is no learning from mistakes and only by learning from mistakes, there will be an enhancement in patient safety. The amount of reports present within organizations says something about the openness and the culture of the organization or department, since culture is often identified as a barrier to change when trying to enhance safety. An important step in diagnosing and improving safety is according to Sexton et al. (2006), assessing the attitudes on teamwork. As mentioned above the organizational culture relates to the availability and the use of protocols, the team structure and communication between the employees and departments and when improving the safety the culture should be taken into account as well. Therefore, the organizational culture in the CSD and the OT of the MST is part of this research.

Taylor-Adams (2006) does not correctly choose structure as a description of team factors, organizational factors, task and technology factors. Since, structure is a broad description that has to be further operationalized. As mentioned above part of the structure is the availability of protocols, the structure of teams, the cooperation between employees and departments and the distribution of tasks.

We use five theoretical instruments for this research. Table 2.4 gives an overview of the theoretical attributes and the instrumental attributes that correspond.

Table 2.4 Comparison theoretical and instrumental attributes of safety related to instrument trays

Quality indicator	Theoretical Attributes	Instrumental Criteria
Safety	**Task and Technology Factors**	- *Availability of report protocol* - *Report incidents* - *Feedback on reports*
	Individual (staff) Factors	- *Knowledge and skills*
	Team Factors	- *Communication*
	Work Environmental Factors	- *Workload* - *Design, availability & maintenance of equipment*
	Organizational & Management Factors	- *Safety culture and priorities*

2.9 General conclusion

This chapter addressed the following question: *'How can the efficiency and safety in relation to the instrument trays be operationalized from the current literature?'* We present the findings of this literature review in a comprehensible figure (Table 2.5). The Table outlines the theoretical and additional instrumental attributes derived from the current literature on safety and efficiency issues. These instrumental criteria are the key issues that influence patient safety and efficiency related to the contents and use of instrument trays.

Table 2.5 Conceptual framework

Quality indicator	Theoretical Attributes		Instrumental attributes
Efficiency	**Efficiency of tasks**		*Handling steps*
	Timelines of services		*Delays/ Cancellations of surgeries* *Short Turn-over times*
	Continuity of services		*Communication on the work floor* *Continuity of work in the CSD*
	Stock waste		*Using more materials than needed*
Safety	**Task and Technology Factors**	*Structure* *Culture* *Structure*	*Availability of report protocol* *Report incidents un-sterility* *Feedback on reports*
	Individual (staff) Factors	*Structure*	*Knowledge and skills*
	Team Factor	*Culture*	*Communication*
	Work Environmental Factors	*Structure* *Structure*	*Workload* *Design, availability & maintenance of equipment*
	Organizational & Management Factors	*Culture*	*Safety culture and priorities*

3. Context description of the OT and CSD

This chapter gives a description of the current processes in the CSD and the OT and the interactions between these departments (§ 3.1). The descriptions are based on observations and interviews. In § 3.2, a few instrumental attributes from the conceptual model will be refined with information derived from the interviews en observations.

3.1 Process description

Instruments are found in a closed logistic chain with the primary intermediate stations being: the OTs and the CSD. Cleaning and sterilization of the instruments, used in the OT, is performed by the CSD. The location of the CSD is located near the OTs. Another task of the CSD is monitoring the quality of the instruments since instruments need to be replaced when they are worn out. The CSD and the OT are alternately client and supplier:

- The OT is a client of the CSD. The OT uses sterile instruments in their production process, which are supplied by the CSD.
- The CSD is a client of the OT: they receive unsterile instruments from the OT. This makes the OT a supplier to the CSD.

When the processes have an optimal course in the chain, instruments are available at the right moment in the correct quantities.

Figure 3.1 describes the process of instrument sterilization. Instrument trays follow a loop between the OTs and the CSD. It includes the processes in the CSD (displayed on the right side of the figure) as well as the processes of handling the instruments in the OT (displayed on the left side of the figure). Annex 3 shows a map of the CSD and OT areas.

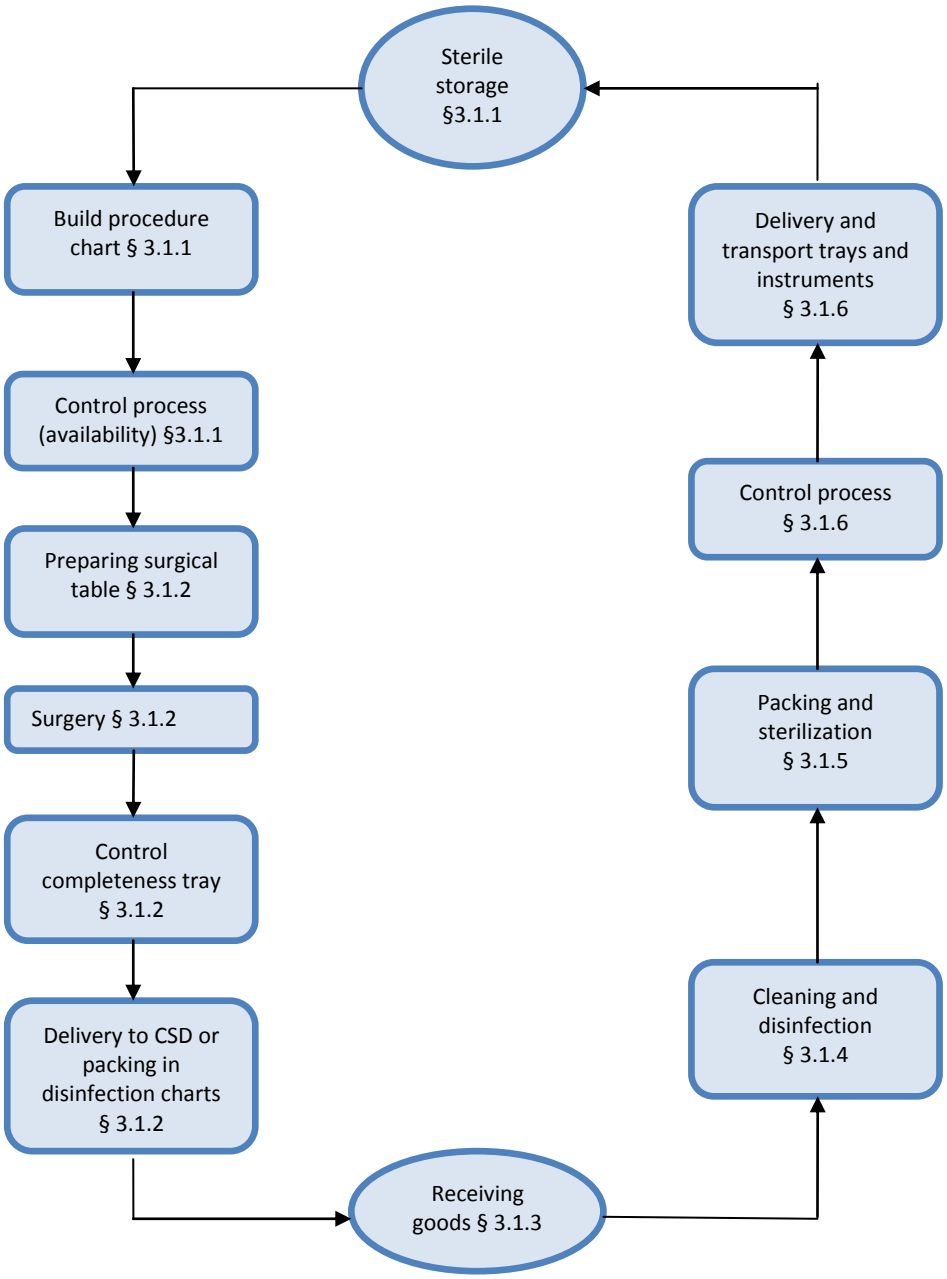


Figure 3.1 Sterilization loop and processes between CSD and OT (reverse logistic chain)

3.1.1 The sterile storage and preparation for surgeries

The flow of sterile instruments starts from the sterile storage of the OTs (see top of Figure 3.1). Here, the sterile instruments are placed in stock. CSD employees place the trays and individually packed instruments on the shelves in the storage warehouse. The production statistics of the CSD have indicated that per year approximately 565 tray- types have passed the CSD in the last three years (2005-2008), this corresponds to 1710 trays per year. The OTs initiated the majority of the demand (1300 trays). The OTs thus account for approximately 80% of the demand at the CSD. We have no clear indication of the actual number of tray- types

in the inventory, some trays might have remained unused over the past three years, and do not show up in the CSD production statistics. All items on a tray are considered needed for a particular surgery. In daily practice this might not be the case, the contents of a tray might be general, so that it applies to several types of surgery, there is also a possibility that one type of surgery requires trays of distinct types. The required trays can also vary for surgeons, some prefer an additional tray or specific instrument.

Before surgery, the required trays are taken from the storage, put onto a chart and this cart will be taken to the required OT room. There is a surgical nurse (the circulating nurse) that is responsible for collecting all trays and the individually laminated instruments needed for the scheduled surgeries that day or part of the day. The circulating nurse is responsible for the visual inspection of the packaging thereby checking the color of tape, torn wrappers, and the maturing date. During the day, four circulating nurses prepare the OT charts according to the OT schedule for the following day. Protocols for the types of procedures and the corresponding trays and laminated instruments are present in the sterile storage. These protocols also contain different preferences, concerning instruments, given by surgeons.

3.1.2 The operating theatres

Surgical teams consist of anesthetists, surgeons, nurses (surgical nurses and anesthesia nurses) and associated personnel. Surgical nurses can occupate three different tasks: scrub nurse, assistant nurse and circulating nurse. The scrub nurse is responsible for unpacking the trays, putting the instruments on a sliding table and handing the instruments to the surgeon during surgery. Prior to the surgery the scrub nurse is dressed sterile and prepares by unpacking the instrument tray(s) and by putting the separate instruments on a sterile sliding table. The scrub -and assistant nurse check the availability of the instruments needed and visually inspect the packaging by checking the indicator tape, inspecting the instruments, and checking for moisture in the tray. Moisture means the instruments are not sterile. When a tray is not sterile, the head of the OT should report this. The scrub nurse is responsible for the presence of the correct materials and quantities, even when a circulating nurse prepares the chart with the instrument trays. When the right materials are not present, the scrub or assistant nurse should collect the correct materials from the sterile storage. When not available in the sterile storage, the scrub nurse should apply for an emergency sterilization.

Picture 2 Interaction in the OT

The scrub nurse is positioned in the sterile field of the OT during surgery. The sterile field is a security zone in the OT, situated approximately 1.5 meter from the patient. The scrub nurse assists the surgeon during surgery, this means keeping the wound open, putting tissue aside etc. The assisting nurse is responsible for opening and handing sterile materials like gauzes to the surgeon and scrub nurse, (the assisting nurse is not dressed sterile). The circulating nurse who circulates over a few OTs is not dressed sterile and has the opportunity to get additional material or instrument trays outside the OT when needed. During surgery, the sterile instruments, whether they are used or not, will become contaminated. When the surgery is finished, all materials used during surgery are counted and brought to the contaminated chart of the OT, from where they are taken by the CSD employees and brought to the disinfection area of the CSD. When a surgery, which requires many trays, takes place, these are by exception brought to the CSD directly. Sometimes the required amount of trays needed in surgery can lead up to 14.

3.1.3 The Centralized Sterilization Department

The CSD has 26 customers, the instruments come from different departments, such as nursing units, outpatient's clinics, the OT, and external parties outside the hospital. The OT is responsible for 80% of the throughput of instruments. The sterilization process is a critical process. If contaminated instruments are not cleaned and sterilized well, they may cause infections to patients. Therefore, the quality of the process is of high importance. Similar to this, the availability of instruments is also important. If a particular instrument needed in a life saving emergency surgery is not available, due to bad logistics the life of patients could be endangered. The CSD is responsible for the sterilization process and guarantee the availability of instruments and trays. In the CSD, three areas are distinct: the disinfection area, the packing area and the sterile storage. Within the areas several tasks are performed, these tasks are explained in the following paragraphs.

3.1.4 The disinfection area

The contaminated instruments enter the CSD through the disinfection area. The two major tasks of the disinfection area are:

- Transportation of all contaminated instruments from all departments to the CSD.
- Cleaning and disinfection of all medical devices.

Disinfection take place over two separate streams:

- Ultrasonic cleaning. This means blood and tissue that cannot be removed by water is removed by vibrations. After the ultrasonic cleaning, the instruments are placed in washing machines. The overall process in washing machines takes about 50 minutes. The washing machines can only be opened on one side and not simultaneously to prevent contamination.
- The second stream consists of manual cleaning with disinfectants, such as alcohol. Instruments that are cleaned with this procedure are for example drills.

After washing the instruments, they are taken out of the washing machine into the packing area.

3.1.5 The packing and sterilization area

The four major tasks in the packing area are:

- Preparation of instrument trays
- Assessing the quality of instruments and possibly replacing them (in consultation with the customers)
- Maintenance of instruments
- Labeling and sterilizing packed goods

In the packing area instruments are packed. Before the instruments are packed, they are thoroughly checked for visible contamination and whether they are properly functioning. Hollow instruments are purged with compressed air and some instruments are lubricated. After this, the instruments are grouped to form trays. This is done based on standard sheets. These sheets are photos of the contents of a trays and each specialism. For example, General surgery and Orthopedics have distinct sheets and separate tables in the packing area where their trays are composed. After composing the trays, they are weighted and the weight is compared to the weight that is recorded at the previous sterilization process and marked on a label. The label is added to the tray. The label also contains the name of the CSD employee and possible deviations on the tray are marked. The OT nurse in the OT should fill in the label as well.

Picture 3 Example of a composed instrument tray

After composing the trays and before sterilization the trays are packed in two layers of paper: the outer layer is intended to protect the tray during transport, the inner layer is used in the sterile field of the OT. The paper should guarantee the sterility of the instrument tray. Individually stored instruments are packed in laminate. This is a kind of bag, with plastic at the top and paper on the bottom. The steam penetrates trough the paper side of the laminate. The packed instrument trays get an adhesive strip- indicator tape, which must be colored black after the sterilization process ended successfully. The laminated bags also indicate if the sterilization process ended successfully, the indicator should turn from blue to brown. After this, the trays are ready for the sterilization process.

The trays are put into the autoclaves where the sterilization takes place. The sterilization is performed with steam, the materials are heated above hundred degrees in just a few minutes. Sterilization with steam is a process of phases, to follow the phases a graph is printed during the sterilization. The sterilization process takes about 70 minutes. After sterilization, the trays should lose their heat, this takes about 20 minutes.

3.1.6 Control processes after sterilization before transport to sterile storage

Before transporting instruments and instrument trays to the sterile storage, the area behind the autoclaves pursues a control function. The inspections performed are:

- Visual inspection of the sterilized goods.
- Visual inspection of the cover indicator.
- Print process.

The inspections contain the following processes: the indicators should be discolored in the correct way, the print sheet of the sterilization process must be checked (on automated temperature, time of sterilization and pressure) and the instrument trays should be checked on for example: torn wrappers and moist paper. After this each tray is provided with a label that states: a batch number (which consists of date, year of sterilization, number of autoclave) and the maturity date. When errors occur after the complete process, for example, an instrument tray that is wet, the instrument or tray is brought back to the packing area and the sterilization process is repeated. This also counts for instruments and trays that have passed their maturity date. From there the instruments and trays are brought to the sterile storage of the OT, which completes the loop.

Picture 4 The CSD

3.2 Defining the theoretical measures into instrumental outcome measures

This chapter addresses to the second research question: *What are the current process characteristics of instrument trays in the MST that influence the efficiency and safety?* A description of the current processes and their characteristics is given by presenting a figure that shows the logistic chain of instrument trays. The second aim of this chapter is refining the conceptual model that is presented in § 2.9 with additional information derived from the interviews. These additions are highlighted in red in Table 3.1.

The interviewees state that processing relates to the procedure of re-sterilizing instruments that have not been used in the OT and the re-sterilization of trays with an expired maturing data. Waiting is linked to the turnover time of instrument trays and the delay or cancellation of surgeries when an instrument tray is not available in time. All CSD employees state that large instrument trays have a higher turnover time compared to small trays, small trays need less handling activities in the CSD than larger trays.

We define the continuity of services as: the communication between the CSD en the OT, the coordination between both departments, and the dependent relation between both departments. The efficiency of tasks refers to the use of instrument trays, instruments that have not been used in the OT need to undergo the entire process in the CSD before they can be re-used. This attribute relates to the waste in *processes* mentioned by the IOM (2001). Timeliness of services relates to the *waiting* 'waste'. Stock 'waste' refers to the revision of trays and the presence of an evaluation protocol for instrument trays.

In § 2.8 we selected five theoretical attributes from the research of Taylor-Adams & Vincent (2006). We refined these instrumental attributes on some points. The *task and technology factors* contain the following attributes: first of all the presence and use of reporting protocols for unsterile instrument trays and secondly contributed as a subject is the feedback on such reports. Knowledge and skills refer to awareness of the processes, like the fact that unused instruments in the OT will lead to unnecessary sterilization costs and the influence weight of a tray has on the sterilization process. Communication is often identified, as a cause of health care errors and adverse events, next to this communication is an important factor in the coordination of the processes between the CSD and the OT. Therefore, we refined the instrumental attribute and added coordination. Work environmental factors contain three attributes: a high workload, which can contribute to the incorrect handling of trays such as stacking trays on top of each other. The design, availability and maintenance of the trays refer to the size of trays, the availability and the problems with the maintenance of instruments. The physical aspects refer to the size of instrument trays and whether this relates to safety problems. The safety culture is the final factor that will be taken into account: this aspect is of relevance since it is of importance that when problems concerning instrument trays occur these are discussable and solutions will be found.

Table 3.1 outlines the theoretical attributes and the instrumental attributes that correspond and are used in this research.

Table 3.1 Comparison theoretical and instrumental attributes of efficiency related to instrument trays

Quality indicator	Theoretical Attributes	Instrumental Criteria
Efficiency	**1. Processes 'waste'/ Efficiency of tasks**	- *Re-sterilization of unused instruments on trays* - *Re-sterilization of expired instruments*
	2. Waiting 'waste'/ Timelines of services	- *Delays/ Cancellations of surgeries trough unavailable instruments* - *Short Turn-over times instrument trays*
	3. Continuity of services	- *Communication between the OT en CSD* - *Continuity of work in the CSD*
	4. Stock 'waste'	- *Revision of trays* - *Availability of evaluation protocol for trays*
Safety	**5. Task and Technology Factors**	- *Availability of report protocol for unsterile trays* - *Report incidents un-sterility* - *Feedback on reports unsterile trays*
	6. Individual (staff) Factors	- *Knowledge and skills*
	7. Team Factor	- *Communication & coordination between OT & CSD*
	8. Work Environmental Factors	- *Workload (Physical) in the OT and the CSD* - *Design, availability and maintenance of equipment*
	9. Organizational & Management Factors	- *Safety culture and priorities*

The key issues are used in the interviews and survey questions and will help to provide insight in efficiency and safety related problems with instrument trays. It will be interesting to see if the criteria used are recognized by the involved actors, and furthermore what other factors influence efficiency and safety related problems with instrument trays.

All of the instrumental criteria shown in Table 3.1 are directly taken into account when analyzing the perceived problems related to the safety and efficiency of instrument trays.

4. Interview results: inventory of problems

As described in chapter 1, eight interviews have been conducted with different actors within the processes of instrument trays in the OTs and CSD. In this chapter, the general outcomes of these interviews are reviewed in § 4.1, following the structure of the conceptual framework in § 2.9. To add more strength to the answers, we added the number of respondents that reflected on a subject between brackets. A general conclusion is given in § 4.2, the section is completed by displaying a flow diagram (Figure 4.1), which contains all perceived and possible problems in the OTs and the CSD. Each step in the diagram gives potential failure possibilities. It should be notified that this research is prospectively and no real incidents have occurred.

4.1 Exploration of the perceived problems: efficiency and safety

1. Efficiency of tasks

Separately laminated instruments

According to all OT nurses (3), the separately packed instruments give problems in the sterile storage. Too often, these separately packed instruments are stored in the wrong baskets, which is time consuming for the OT nurses since they have to search for them. However, in a way the opinions on this subject also contradict each other since the OT nurses on the other hand also see the importance of separately packing more individually laminated instruments. We observed that during surgeries often a complete new instrument tray is opened to use solely one single instrument, the causes are that the already opened trays contain broken instruments or certain instruments from that tray have fallen on the ground. OT nurses acknowledge the problem that too often a complete tray is opened for one single instrument (3). One OT nurse states that this leads to more trays on the sterile table, which creates a disordered surgical table. However, the opinions of the CSD employees differ on this subject: according to CSD employees (2), the separately packed instruments are often returned to the CSD when the maturing date is expired. CSD employees wrongly stack the instruments (the ones that are sterilized on an earlier date are left on the bottom of the basket), and the OT nurses do not check for the expiring date when collecting an instrument. They should pick the instrument with the oldest sterilization date. This leads to unnecessary sterilizations costs.

2. Timeliness of services

Turnover times and delays

All CSD employees state that large trays have a longer turnover time in the CSD (5), nevertheless there are no precise figures on turnover times of instrument trays in the CSD. When adjusting instrument trays to smaller sizes and less content, the turnover time in the CSD reduces.

The demand for sterile instruments is not determined by the surgeries that take place. Some of the surgeries may be emergencies, and some are scheduled. We discovered that there is no information about the whereabouts of the instrument trays during the day, except for the trays that are on the packing facility of the CSD. Here the trays are scanned and it is possible to analyze which trays are present in this part of the CSD

department. However, this information does not give the specific number of the trays present. For example, if there are 37 basic surgical trays, it cannot be clarified which one of the 37 is present in the packing area of the CSD? The unavailability of the whereabouts of instruments makes it impossible to adjust the sterilization activities to the planned surgical procedures. Next to this, the CSD does not use the OT planning in adjusting the sterilization activities. Summarizing, the processes in the CSD are not triggered by the OT planning or whereabouts of the instrument trays. Currently the contaminated trays are washed and sterilized as soon as they enter the CSD department.

When a surgical instrument tray does not pass the inspection by the scrub nurse, this can lead to delay in surgery. Two OT nurses indicate that it often occurs that surgeries are delayed due to the unavailability of trays. The interviewees think this is because the sterilization process is not adjusted to the surgery schedule (7). This affirms the earlier made statement on OT planning. All CSD employees acknowledge this. However, it does not often occur that surgeries are cancelled, because instruments are not available. When it occurs, it is because the lending instruments are not present.

3. Continuity of services

Missing instruments

Missing instruments in the CSD give problems that relate to the continuity of work in the CSD. We observed in a few cases that OT nurses identified a broken or malfunctioning instrument in the OT. Instrument trays are only being weight in the CSD, but missing instruments often occur in the OT. A few years ago, the management of instruments has been placed back into the control of the OT. This means the CSD cannot replace or add instruments to the trays. All incomplete trays and broken instruments are collected on a chart that is centrally located in the CSD. There is one person responsible in the OT, who replaces instruments on the trays and sends instruments for reparation. In practice this leads, to (unnecessary) long waiting times (up to several months) until the use of the tray can be resumed (5). The problems are sometimes urgent, especially in the weekends and during evening shifts when the responsible OT employee is not available. The interviewees all state that the management of instruments should be in hands of the CSD. One of the operating nurses states that employees of the CSD should feel responsible for specific trays. This can be obtained by appointing CSD employees, responsible for trays that apply to specific surgical specialism's like: general surgery, orthopaedics and gynaecology. According to two other OT nurses and two CSD employees, problems with missing instruments or broken instruments on trays should be discussed with the assigned CSD employees that are responsible. The OT nurses state that this probably enhances the motivation and responsibility of the CSD employees (2).

The team leader of the CSD agrees with the problems that result from missing instruments on the trays, and acknowledge the importance that the management of instruments and trays should be in the hands of the CSD. Missing instruments on trays are still a common phenomenon and occurs according to the team leader approximately four times a day.

Emergency sterilization

Emergency sterilization is a subject that relates to the continuity of services in the CSD. OT nurses apply for an emergency sterilization of a tray, subsequently the team leader of the CSD decides on whether the tray applied for will be granted. The standard time for the sterilization process is 12 hours, the processing of a tray that is signed as urgent is 4 hours (Schopman, Siegersma, 2008). The team leader of the CSD points out that up until a year ago, approximately 30-40 emergency sterilizations were requested daily. These situations occurred when circulating nurses who were preparing the charts for the OTs, would contact the CSD directly and requested an emergency sterilization because a certain tray was not available in the sterile storage. This problem was taken care of by introducing emergency forms. Nowadays, an emergency sterilization has to be applied for by the head of the OT, who approves and contacts one of the team leaders of the CSD. The team leader of the CSD then undertakes action and prepares the CSD staff for the emergency sterilization. There are currently no figures on emergency sterilizations. Emergency sterilizations require adaption of the processes in the CSD, washing machines needs to be reserved as well as an autoclave and an employee who prepares the tray. In the worst-case scenario, the tray passes the washing machine and the autoclave alone. This results in rising sterilization costs for emergency sterilizations. According to the team leader of the CSD, this measure reduced the emergency sterilizations to approximately eight per day (Siegersma, 2008). The MST has no cost price available for an emergency sterilization. Based on data from the Erasmus MC, they defined the costs for an emergency sterilization to €180 per tray. This results in approximately €1440 unnecessary sterilization costs per day due to emergency sterilizations and amounting to approximately €525,600 per year.

4. <u>Stock 'waste'</u>

Revision of trays

The general opinion of all interviewees is that instrument trays contain more instruments than used in the OT (8). The contents of instrument trays are not evaluated on a timely basis or according to guidelines and protocols. According to all interviewees (8), it rarely occurs that instruments are taken off trays, more often instruments are added to the trays, and trays are becoming heavier over the years. Florijn (2008) studied a dataset of 12 tray types in the Academic Medical Centre (AMC) in Amsterdam, on average 21% of the instruments in the dataset were obsolete. These instruments are not required for any surgery, but are cleaned and sterilized after each surgery and replaced when broken or missing. The unnecessary sterilization costs are €64,000 per year (€1 per instrument). All interviewees (8) acknowledge that most instrument trays are too large and heavy, these characteristics give problems both for the OT nurses and the CSD employees. The CSD employees encounter the process of lifting trays up above the head, which occurs while performing the inspection of the trays after the sterilization process as physically stressful process (3). All interviewees' state there is no protocol available that applies to the revision of the contents of trays (8). Furthermore, the turnover time of large trays in the CSD is longer compared to smaller trays. Large trays are especially common at orthopedic surgeries. When adjusting trays to surgeries, this section can firstly be taken into account. When the OT requires an additional instrument on a tray, a mutation form should be written and handed to one of

the team leaders of the CSD. They are responsible for arranging mutations on the trays and should perform adjustments in the documentation of the CSD. Most adjustments are made when a new surgeon is hired.

Operating specific trays

All interviewees acknowledge that surgery- specific trays will have many benefits. The OT nurses outline the following benefits (3): a better overview on the surgical table (3), especially when two or more trays are combined to a single tray, quicker detection of broken instruments (1), weight loss of trays (3) and an enhancement in turn-over time of trays in the CSD (2). This benefits the preparation of charts for the following day. Especially for the orthopedics, who use all available trays during the day, which makes it difficult to prepare the charts with the necessary trays for the next day. The maximum weight of an instrument tray is 8.5 kilos (Siegersma, 2008).

The CSD employees point out several corresponding benefits: weight loss (5), which results in less physical problems for CSD employees. Time profits when unpacking in the cleaning, disinfection and packing area of the CSD. Further benefits mentioned are: time profits in the autoclave and smaller trays, which need less sterilization time in the autoclave. All these time profits will benefit to the total turnover time of trays (5). The last point mentioned is less chance of missing instruments on the trays (4).

The interviewed CSD employees believe no disadvantages can be mentioned in constructing surgery specific trays, as long as these trays are documented (4). The OT nurses mention several disadvantages such as: less flexibility during surgery (1), enhancement of the types of trays (4) and resistance from surgeons (1). Some surgeons always require additional instruments, in practice there are instrument trays that are specifically composed for surgeons. Although it can be reported that the surgeries pointed out in this research are described as predictable in the use of instruments. Therefore, it hardly occurs that additional instruments are used during surgery. When revising the composition of existing trays, no disadvantages are remarked by the CSD employees and the OT nurses.

Conditions for success should be taken into account when revising or constructing additional trays. All interviewees mention the documentation of the trays in the CSD (8), the OT nurses mention adjusting the protocols in the sterile storage (3). Next to this, the communication should be correct. It occurs to often that changes are not communicated effectively (7). The possibility to install a project group is suggested (3), in the group CSD employees and OT nurses should be present.

5. Task and technology factors

Reporting incidents

In the beginning of this research an observation period in the OTs and the CSD was conducted, which gave insights that relate to safety. We observed that instrument trays that are used in the OT are often disapproved upon by the scrub nurse due to torn wrappers. The paper used around the trays should guarantee the sterility of the instruments when the paper is intact. Furthermore, during surgeries we observed that instruments that are supposed to lie on the trays are often not present. Sometimes a replacement is put onto it. Such incidents have to be reported. As has been mentioned before instrumentation is controlled by different departments. A controller has the decision-making power to opt for alternative instruments when necessary.

The OT nurses acknowledge the existence of a protocol for reporting incidents (3). All three OT nurses interviewed say it is not stimulated to report incidents. Two interviewees have reported an incident at the MIP commission in the past, none of the incidents dealt with the instrument trays. The lack of feedback following from that report does not contribute to reporting more incidents. During the interviews, it became clear that OT nurses have little confidence in the MIP commission (3). One OT nurse mentioned that a MIP report is only undertaken when it concerns a tray that is especially ordered for the patient and not available, the result is that the surgery is cancelled.

It is not acknowledged that incidents that concern instrument trays are reported in writing (3). All interviewees state that the team leader of the CSD deals with incidents with instrument trays. The CSD employees (3) state that incidents that are shown after the sterilization process are reported to the team leader of the CSD. The team leader writes an emergency report when it concerns a tray that is needed immediately or within a certain time amount. It also occurs that torn wrappers are noticed in the sterile storage or just before surgery. According to the OT nurses, it can occur that surgery procedures are delayed because the correct instrument trays are not available (3). There are no current figures on the amount of detected unsterile trays in the OTs. The interviewed OT nurses acknowledge they do not count the instruments that have not been used during surgery (2). The OT nurses visibly detect a torn wrapper 3-4 times a week. This also holds for the CSD employees, who detect the torn wrappers after the sterilization process.

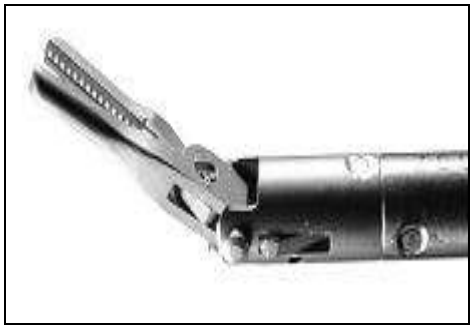
6. Individual (staff) factors

Handling factors

According to CSD employees, the occurrence of torn wrappers can be caused by several factors, the first factor takes place in the CSD when instrument trays are packed to tightly creating a torn wrapper more easily (1). The incorrect handling or collecting of the trays from the storage by OT nurses is mentioned as a second cause of torn wrappers (1). This means the trays are not kept in balance and are carried like a bag, which can create cracks. In practice, the trays should be kept in balance and picked up with two hands or carried with two persons. It also happens too often that OT nurses are not moving the trays through the correct corridors, but

take a short cut and most trays cannot be kept in balance while passing this narrow passage. According to the CSD employees, trays that are picked up too often and handled carelessly are more susceptible to torn wrappers (4). One CSD employee also mentioned the risks of stacking the trays. However, OT nurses argue that stacking trays is often necessary because of the unlimited space on the charts that are used to carry all trays needed for the scheduled surgery (2). We observed that these problems apply especially for large, heavy trays. The OT charts that hold the trays are too narrow for large trays, and with packing and unpacking the trays in the charts this leads to problems. Due to these circumstances the regulations are not observed.

There exists an overlap in the opinions of the OT nurses and the CSD employees. Mentioned by both groups is the stacking (3) and carelessness in handling the trays (6). Furthermore, the shelves where the trays are put upon are too high (4). One OT nurse also mentioned the guidelines for packing the trays in paper, she also worked in another hospital where they use a different packing technique, which made it impossible to carry the trays like bags. We observed in the CSD that changes in medical techniques and the use of more complex equipment, require a more complex cleaning and sterilization process, which results in a higher cost price of instruments. This also results in more requirements for the CSD employees such as: more specific instrument knowledge (3), an enhancement in workload (3) (manual cleaning requires more time) and CSD employees are more tempted to admit on maintenance quality (1). Picture 5 and 6 give examples of a conventional clamp and a clamp used in minimal invasive surgery (MIS).



Picture 5 Minimal Invasive Surgery clamp

Picture 6 Conventional clamp

Safety during surgery

Wolbers (2008) made a selection of the frequently performed surgeries (over 200 times per year), by the General Surgery department for which the number and type of instruments used is relatively predictable (see Annex 4). This data is extracted from the database of the MST and included all surgeries performed between May 2006 and May 2008. It is assumed that for these surgeries it might be beneficial to design surgery specific trays. Furthermore, the selection is based on the relatively short expected surgery time, between 20 to 70 minutes and the fact that not all instruments available on the trays are used during surgery. When revising these trays, all OT nurses indicate that the safety of these procedures will not deteriorate when adjusting the surgery trays to the instruments used or implementing additional trays. In addition, they all point out that the

question also can be interpreted differently depending on the procedure that is being reviewed (3). The CSD employees cannot answer this question, they cannot assess the instrument use of surgeries.

7. Team factors

Communication and coordination

Two CSD employees describe the communication between the CSD and the OT as incorrect and poor. The OT should communicate through the team leaders of the CSD. This is often not the case and CSD employees are contacted directly. As an example, CSD employees mention that OT nurses call directly to the CSD, often a few times a day on the same subject, this results in time-consuming extra tasks for the CSD employees. According to four CSD employees, the coordination and cooperation between both departments is insufficient as a result of poor communication. The internal communication is described as mediocre, mistakes should be discussed on a more frequent base, and employees should be appointed at their mistakes directly. A more frequently stated remark is that decision making by management is not communicated properly to the departmental workplace.

The OT nurses agree with the poor communication level between both departments and one OT nurse adds a comment on the lack of departmental control of management. This results in unmotivated CSD employees.

8. Work environmental factors

Paper quality

All interviewees recall the quality of the paper that is used for packing the trays as a cause for the occurrence of torn wrappers, this also counts for the size of the trays (8). Most torn wrappers occur with large heavy trays. The Orthopedic trays have the most occurrences in torn wrappers and are considered the heaviest.

Maintenance

The maintenance of the trays and instruments is discussed in point three of this chapter, the management of instrument trays, the problems with maintenance of instruments relate to the turnover times of trays. The physical problems relating to the weight of trays are discussed in the efficiency part. Weight related problems are stronger present with CSD employees.

9. Organizational and management factors

As mentioned all interviewees state that it is not stimulated to report incidents or discusses problems between both departments (8). It is agreed upon that large instruments trays, and the detection and report of unsterile trays are not the first priority. In practice, this leads to unnecessary sterilization costs.

4.2 General conclusion

During the exploration phase of this research, it became clear that there is no optimal tuning of control between the CSD and the OT. Both departments are dealing with problems regarding the flow and contents of instrument trays. Within the scientific literature, hardly any attention is paid to the efficiency of the processes regarding the use of instrument trays and the optimization of the contents of the trays (Van de Klundert, Muls & Schadd, 2006).

The objectives of the interviews were, to verify the completeness of the survey and to get a general idea on the opinions of the problems. They also provided an elaboration on solutions regarding the contents and processing of instrument trays. The personal perceptions of the interviewees differed from each other, and not all interviewees mentioned corresponding problems. This however gave us a good idea on the different views in both groups. Table 4.1 and Table 4.2 summarize the opinions of the interviewees. The plus sign stands for a positive response either to a particular subject or to the subject being mentioned by the interviewee. The minus sign indicates that an interviewee responded negatively. When a particular subject was not elaborated on, we used no sign for indication. Furthermore, the subject of adapting instrument trays to the use of instruments was taken into account. Possible failure options and positive outcomes have been discussed during the interviews.

Table 4.1 Efficiency Problems and solutions

Efficiency problems	**OT 1**	**OT 2**	**OT 3**	**CSD 1**	**CSD 2**	**CSD 3**	**CSD 4**	**CSD 5**
Re-sterilization instruments not used on instrument trays unnecessary sterilization costs	+	-	-	+	+	+	+	+
Re-sterilization of instruments with expired maturing date occurs often	-	-	-	+	+	-	-	-
Delays of surgeries occur trough unavailable instruments	+	+	-					
Long turn-over time in the CSD				+	+	+	+	+
Good communication between the OT and CSD	-	-	-	-	+	-	+	+
Continuity of work in the CSD				-	-	-	-	-
Benefits surgical specific trays								
Overview surgical table	+	+	-	-	-	-	-	-
Weight loss	+	+	+	+	+	+	+	+
Detection broken instruments	-	+	-	-	-	-	-	-
Decrease in turn-over time CSD	+	-	+	+	+	+	+	+
Less missing instruments on trays	-	-	-	+	-	+	+	+
Disadvantage surgical specific trays								
Less flexibility in operating theatre	+	-	-	-	-	-	-	-
Enhancement in types of tray	+	+	+	+	-	-	-	-
Resistance surgeons	-	-	+	-	-	-	-	-
Conditions constructing operating specific trays								
Documentation	+	+	+	+	+	+	+	+
Adapting protocols sterile storage	+	+	+					
Communication	+	+	+	+	+	+	+	+
Project group	+	-	-	+	-	+	-	-

4.2.1 The main problems, agreements and differences surrounding efficiency

To enhance the clarification of the tables, the subjects on which both groups and individual interviewees reach overall agreement on are omitted in the table. All interviewees agree on the fact that instrument trays contain more instruments than used, instruments are not revised within a certain period and that there is no evaluation protocol for instrument trays available. In the interviews, a few problems are marked as efficiency related these are: emergency sterilizations and unnecessary sterilizations of unused instruments due too large trays or expired maturing dates. The problem that has been mentioned most is the re-sterilization of instruments that have not been used in the OT. The CSD employees recognize the unnecessary sterilization of unused instruments and the visibility of unnecessary costs more than the OT nurses do. A possible explanation for this outcome is that CSD employees are processing the instruments and see that many instruments are not visibly contaminated, therefore have not been used in the OT. Nevertheless, they have to undergo the complete decontamination and sterilization process.

A few differences between both groups are the following: the OT nurses indicate that it often occurs that surgeries are delayed due to the unavailability of trays. CSD employees mention the long turnover times and the continuity in the CSD as problems. The continuity problems are mostly caused by missing instruments on trays. Missing instruments and large instrument trays will lead to longer turnover. The differences can be explained by the different working areas of both groups. We conclude that the different groups are not informed of each other's tasks and work area. This possibly explains the lack of understanding between both departments.

4.2.2 Benefits of surgical specific trays

When exploring the creation of surgical specific trays, weight loss and a decrease in turn-over time are mentioned in the CSD as most important benefits. The most indicated disadvantage is an enhancement in the number of instrument trays. Less flexibility and the resistance from surgeons are according to the interviewees not unconquerable barriers. According to the OT nurses, an enhancement in the number of types of trays can potentially deliver problems when creating surgical specific trays. The CSD employees believe there are no disadvantages, as long as these trays are well documented. Communication and documentation are recognized as the most important conditions when constructing surgical specific trays.

Table 4.2 Safety problems

Safety Problems	OT 1	OT 2	OT 3	CSD 1	CSD 2	CSD 3	CSD 4	CSD5
The occurrence of torn wrappers is caused by wrong handling	+	-	-	+	+	+	-	+
The occurrence of torn wrappers is caused by stacking trays	+	-	+	-	-	+	-	-
The occurrence of torn wrappers is caused by wrong packing method	+	-	-	-	-	-	-	-
The occurrence of torn wrappers is caused by size of trays	+	+	+	+	+	+	+	+
The occurrence of torn wrappers is caused by paper quality	+	+	+	+	+	+	+	+
The coordination between the OT and CSD is referred as good	-	-	-	-	-	-	-	+
Workload in the OT and the CSD is high	+	+	+	+	+	+	-	+
Maintenance of instrument trays is well organized	-	-	-	-	-	-	-	-
Availability of correct instruments	-	-	-					
Large trays give physical problems	+	+	+	+	+	+	+	+
The culture is open and problems are discussed	-	-	-	-	-	-	-	+

4.2.3 The main problems, agreements and differences concerning safety

Two subjects on which an overall agreement is reached are omitted from table 4.2. There is full consensus on the fact that torn wrappers occur on a regular base and the occurrence of unavailable correct instruments during surgeries. The latter one is mentioned specifically by the OT nurses. CSD employees do not elaborate on this subject. Both groups acknowledge that incidents concerning unsterile trays and torn wrappers have not been reported before and therefore solutions to overcome this problem have not been studied extensively. Another main problem mentioned by all interviewees are the large and heavy instrument trays, which give physical problems.

4.2.4 Why do torn wrappers occur?

Regarding safety issues, related to instrument trays, the opinions differ between the OT nurses and the CSD employees. In practice, we discovered that torn wrappers often occur when handling large trays, this relates to the inefficient contents of the trays and shows not only the relation to an enhancement of safety and user-friendliness but also a decrease of sterilization costs. In the complete loop, we discovered three moments of inspection for torn wrappers, once by a CSD employee and twice by surgical nurses. The chance that a torn wrapper is identified upon inspection is high. Both OT nurses and CSD employees acknowledge that the occurrence of torn wrappers is high. The question why torn wrappers appear is more interesting. Both groups mention incorrect handling, the size of the trays and paper quality as the main causes of the occurrence of torn wrappers. In addition, we discovered that a torn wrapper might lead to a delay in surgery, as the tray needs an emergency sterilization or replacement by an identical (available) tray.

4.2.5 Communication

Concerning the communication and coordination, both groups agree that these are poor and incorrect, it often occurs that changes and problems are not communicated effectively. Furthermore, almost all interviewees state that it is not stimulated to discuss problems between both departments.

This paragraph is finalized by displaying a flow diagram (Figure 4.1), outlining perceived and possible problems in the OTs and the CSD, concerning missing instruments and torn wrappers. Each step in the diagram gives potential failure possibilities.

A further analysis and exploration of the perceived problems and solutions that came forward in the survey is presented in chapter 5. A general conclusion on the third research question, which also includes the findings from this chapter, will be given in § 5.3.

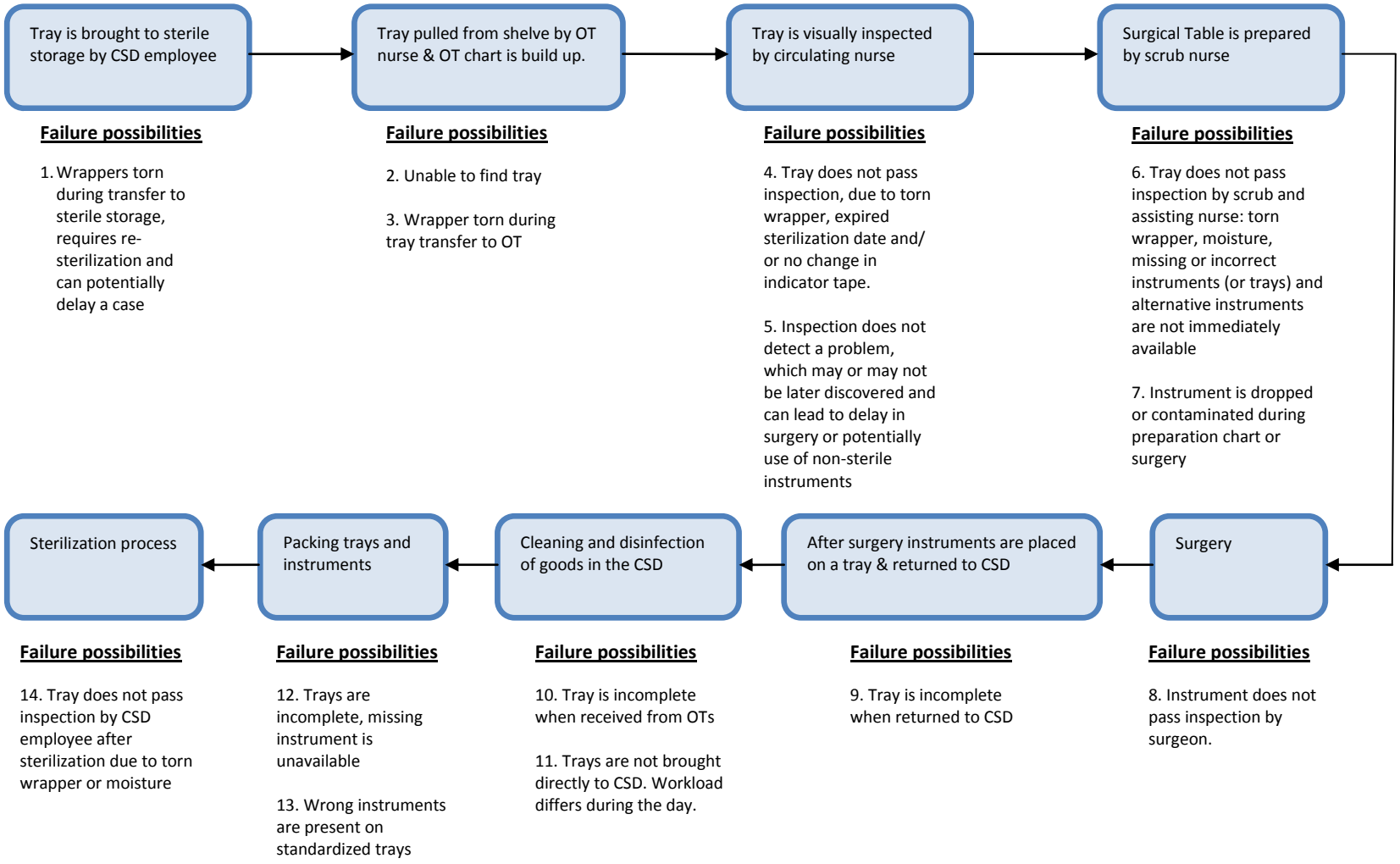


Figure 4.1 Flow diagram the interaction of CSD and OT analysis of inefficiencies and safety related problem

5. Survey results: perceived problems and investigation of solutions

After the interviews were held, a survey was conducted. The results of the survey are described in this chapter, together with chapter four (interview results), it will be the input in answering the third research question. This question is answered in § 5.3. The goal of the survey is to confirm the interview results and present an overall picture of the problems and possible solutions considering the efficiency and safety of instrument trays. The outcomes of the survey are of importance when introducing solutions, when there is a general agreement on solutions, the acceptance of CSD employees and OT nurses is positively influenced. Furthermore, the survey can enhance administrative support to implement strategies that improve efficiency and safety. The survey also gives a general opinion on changing the contents of instrument trays. Because no hard figures are kept in the MST, the survey tries to specify figures on the amount of unsterile trays, emergency sterilizations and the relation of these aspects to the delay of surgeries. Finally, the survey deals with a few questions that measure dimensions of a patient safety culture, like the notification and feedback in response to incidents including cooperation between the departments. The results of the survey are described according to the subjects discussed in the interviews.

§ 5.1 starts with a description of the respondents profile. Subsequently, the survey findings corresponding the problems, causes and consequences on efficiency (§5.2.1) and safety (§5.2.2) are discussed. This chapter concludes with §5.3, in which the third research question will be answered.

5.1 Profile respondents

The response rate of the survey was 76% for the CSD employees (19 out of 25) and 22% for the OT nurses (20 out of 91). The analyses were performed with the statistical program SPSS. In the first paragraph, we determine the profile of the respondents.

The data analysis was undertaken among a group of N= 39. In consultation with the head of the OTs, we decided to spread the survey for the OT nurses by post and e-mail, the CSD employees on the other hand received the survey in their mailbox. To determine to what extent the opinions of the respondents were influenced by their work experience, they were asked to fill in the amount of working years in one of the departments. The average work experience in both departments is 13.1 years (N=38). The average amount of hours worked per week in both departments is 32.3 (N=39). The average work experience for OT nurses is 12.5 years (n=19), the average amount of hours worked per week for OT nurses is 30.9 hours (n=20). The CSD employees have an average work experience of 13.6 years and 33.8 hours worked per week (n=19). The average grade the employees give for their work is a 7.2 (N=39). CSD employees give their work an average grade of 7.3 while OT nurses scale their work with an average grade of 7.1.

5.2 Survey exploration of the perceived problems: efficiency and safety

In this paragraph, the averages of the various components are plotted against each other, which will allow indicating the differences between the averages. When the CSA employees or the OT nurses estimate itself higher as a group, the averages are higher. The averages for the total sample, as well as the OT nurses and CSD employees as separate group are shown. The items are scored on a five point Likert-scale: *(1) Strongly disagree, (2) Disagree, (3) Neutral, (4) Agree, (5) Strongly agree* (see Annex 2). The final two statements on the importance of some items are scored on a 5-point Likert-scale using the following answering options: *(1) Very important, (2) Important, (3) Neutral, (4) Unimportant, (5) Very unimportant.* These statements are negatively formulated. To compare these answers with the other items, the responses are scored in reverse scored so that their valences match the positively marked items ('5' becomes '1', '4' becomes '2' etcetera). We also present an agreement percentage of the items and scales. The percentage of respondents (OT nurses or CSD employees) reporting 'agree' or 'strongly agree' for each of the items within a give scale were charted as positive percentage.

5.2.1 Efficiency

According to the OT nurses and the CSD employees, most instrument trays are large and heavy, the contents of instrument trays are not revised often. This question is answered with two possibilities 28.2% answered the trays are never revised, 59 % filled in the open answer. When checking for answers the following statements are given: only instruments are added on trays when physicians apply for additional instruments and/or the answer incidental is given multiple times. Most answers refer to the seldom character of this event. It can thus be concluded that there is no directive on revising the contents of trays.

In the interviews, emergency sterilizations are marked as an efficiency related problem. The occurrence of emergency sterilizations is high. According to the survey respondents, emergency sterilizations take place on a daily base. When looking at the cause of emergency sterilization (Table 5.1, multiple answer possibilities), 90% of the respondents mention the fact that the OT schedule is not adapted to the supply, 75% mention the insufficient amount of trays and lastly 45% mention the occurrence of unsterile trays.

Table 5.1 Cause of emergency sterilizations

Cause of emergency sterilization	OT nurses agree (%)(N=20)
Instrument tray not available	30
Instrument trays unstrile	45
Amount of trays not enough	75
Schedule OT not adapted to supply	90
Different	0

Table 5.2 gives an overview of all questions and statements that were used and that relate to the efficient use and contents of instrument trays.

Table 5.2 Descriptive analysis of efficiency

Efficiency survey items (n=39)	Total sample (n=39) Range(1-5)	Total Agree % (items 4 and 5)	OT nurses (N=20)	CSD employees (N=19)	Agree % OT nurses	Agree % CSD employees
➢ **Introducing surgical specific trays enhance the transparency in the OT**	3.79	79.5	3.70	3.89	7	84.2
➢ **The weight loss of instrument trays is an advantage when composing surgical specific trays**	3.64	69.2	3.45	3.84	55	84.2
➢ **By reducing trays broken instruments are identified quicker by OT nurses**	2.74	25.6	2.75	2.74	30	21.1
➢ **By reducing trays broken instruments are identified quicker by CSD employees**	2.51	23.0	2.60	2.42	2	21.1
➢ **Reducing the size and contents of instrument trays will contributes to less work acts for OT nurses**	3.21	53.9	2.95	3.47	40	68.4
➢ **Reducing the size and contents of instrument trays will contributes to less work acts for CSD employees**	3.62	76.9	3.45	3.79	70	84.2
➢ **Introducing surgical specific trays will create resistance with surgeons**	-	30.0	2.95	-	-	-
➢ **Introducing surgical specific trays will create resistance with OT nurses**	3.00	25.6	2.90	3.11	30	21.1
➢ **Separately packed instruments will lead to more lost instruments**	4.26	84.6	4.50	4.00	95	73.6
➢ **Unnecessary sterilization costs are made when sterilizing instruments that are not used during surgery**	3.79	76.9	3.55	4.05	70	84.2
➢ **How important is the decrease of weight of instrument trays**	3.82	79.5	3.55	4.11	65	94.7
➢ **How important is the transparency of instrument trays?**	4.05	87.1	3.90	4.21	80	94.7

When looking at Table 5.2 almost all instrumental items related to efficiency and the use of instrument trays are scored positively (average higher than 3). The exception to this is the item 'the identification of broken instruments', the respondents do not agree on this item as a positive advantage when adapting instrument trays. According to the respondents of the survey, the decrease of the weight of instrument trays and the transparency of instrument trays are the most important changes that should be made. With averages of 3.82

and 4.05, respectively 79.5% and 87.1 % stated that they would see the importance of changing the contents of the trays when they apply to the decrease in weight and the transparency of the trays. When looking at the individual percentages, we see a difference, the CSD employees perceive the weight and transparency as more important. The survey question on the advantage of weight loss also shows this distinction, 84.2% of the CSD employees agree on the fact that weight loss is one of the advantages of composing surgical specific trays, compared to 55% of the OT nurses.

The OT nurses and CSD employees do not perceive the resistance that can be created with surgeons and OT nurses as one of the disadvantages when adapting instrument trays (2.95 and 3.00). Introducing more separately laminated instruments is not seen as one of the solutions when adapting instrument trays, all survey respondents perceive that this will lead to more lost instruments (4.26). The OT nurses compared to the CSD employees agree more strongly on this item, with an average of 4.5 compared to 4.0.

When comparing the questions on the advantage of less work acts for both the CSD employees and the OT nurses. The respondents indicate that this advantage applies more to the CSD employees (3.62 for the CSD employees compared to 3.21 for the OT nurses).

The statement on the unnecessary sterilization costs that are made when sterilizing unused instruments in the CSD is recognized upon by 76.9% of all survey respondents. This statement is more positively agreed upon by the CSD employees (84.2%) compared to the OT nurses (70%). This indicates the importance of reducing instrument trays, when cost savings could be pursued. The differences on agreement per 'efficiency' factor are shown in Figure 5.1 for OT nurses and CSD employees.

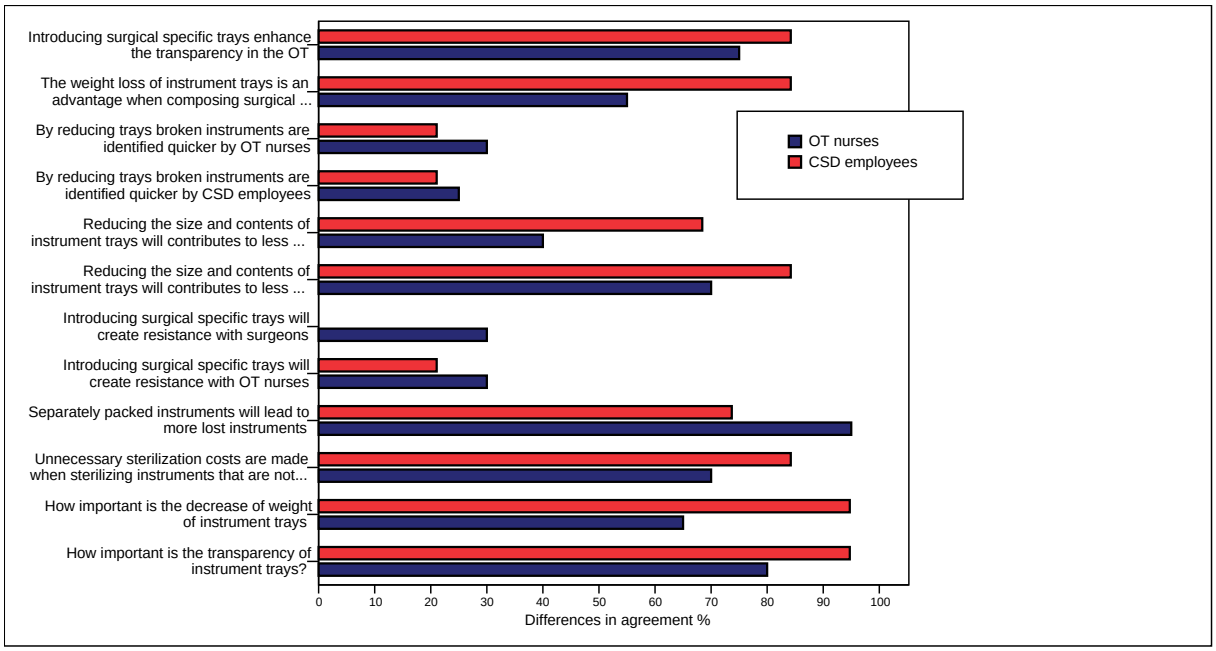


Figure 5.1 Percentage of agreement on efficiency factors

Figure 5.1 show that the CSD employees perceive the advantage of changing the instrument trays as more important than the OT nurses. Their agreement on the statement is of a higher percentage than the agreement of the OT nurses. The difference in importance can also be seen in the response rate of both groups, the CSD employees have a higher response rate (76%) than the OT nurses (22%). An explanation of this difference is that the CSD employees value the changes in the processes and the contents of instrument trays more than OT nurses do.

5.2.2 Safety

§ 2.8 describes the factors that influence patient safety in particular in relation to the instrument trays. A further exploration on these factors is given in chapter 4. The questions used in the survey to indicate the safety issues concerning the use and contents of instrument trays are derived from the interviews. Because the MST does not keep hard figures, we tried to give some clarity on figures like: 'How often does it occur that surgeries are postponed due to unavailable instrument trays?' by estimation from the respondents. Table 5.3 shows the estimation of the respondents on these figures. The OT nurses only replied to the first questions, since these questions relate to occurrences and work processes in the OT and are therefore not visible for CSD employees.

Table 5.3 Descriptive analysis of safety

Safety factors	Total sample (n=39) Mean (1-5)	Mean OT nurses (n=20)	Mean CSD employees (n=19)	Total Agree (%) N=39 (items 4 & 5)	Agree (%) OT nurses	Agree (%) CSD employees	Frequency Modus
➢ Are instruments changed for alternatives on trays					100 % yes		3-4 times a week (OT nurses)
➢ Are surgeries cancelled due to the unavailability of instruments					55 % yes		2 times a year (OT nurses)
➢ Are surgeries delayed due to the unavailability of instruments					90% yes		3-4 times a week (OT nurses)
➢ Are surgeries delayed due to torn wrappers					75% yes		
➢ When a torn wrapper occurs does the OT choose for an alternative trays					65 % yes		
➢ Do you count the instruments before leaving the OT?					60 % yes		
➢ Do you think the safety of surgeries is decreased when adapting trays to the actual use of instruments					20% yes		
➢ How often does a torn wrapper occur?							3-4 times a week (n=39)
➢ The weight of a tray influences the sterilization process	3.95	3.85	4.05	82.1%	80%	84.2%	
➢ A trays with low weight has a better manageable sterilization process	3.69	3.55	3.84	69.2%	65%	73.7%	

All OT nurses state that standardized trays are changed by adding alternative instruments when the correct instrument is unavailable. The average frequency that an alternative instrument is added on a tray is estimated by the OT nurses at 3-4 times a week. We noticed in the previous chapter that the OT performs the management of the contents of the trays, the CSD employees therefore are not responsible for these changes.

Of all OT nurses 55% states that surgeries are cancelled due to the unavailability of instruments, this occurs approximately 2 times a year. Furthermore, 90% of the OT nurses indicate that surgeries are delayed because the necessary instruments are not available, the frequency of such delays is estimated to occur approximately 3-4 times a week. Another cause of delayed surgeries is torn wrappers, this is acknowledged by 75% of the OT nurses. The occurrence of torn wrappers is estimated on 3-4 times a week (total sample n=39). One of the consequences of the occurrence of torn wrappers is that the OT staff chooses to perform surgery with an alternative tray. This occurs according to 65% of the respondents (n=20). When concerning the safety and instruments in the OT, 60% of the OT nurses state they always count the instruments used during surgery, most OT nurses state they mostly count the instruments, but not always (35%). When further exploring the contents of instrument trays we asked the OT nurses if they think the safety of surgeries will decrease when adapting the instrument trays to the actual use of instruments and therefore remove instruments from the trays that are rarely used, this statement was positively reacted on by 20% of the OT respondents. This means 80% of the OT nurses do not see any safety hazards in adapting the contents of trays to the actual use. To create more awareness on safety issues among OT nurses and CSD employees we asked questions on the sterilization process. It shows that CSD employees agree more on these statements. The knowledge on the sterilization process is more present with the CSD employees than the OT nurses, although the majority of the respondents confirms the statements and is aware of the process and its characteristics.

As mentioned before torn wrappers can cause delays in surgery and additionally the OT staff can choose to use a different type of instrument tray, which can influence the overall safety of surgeries. Because the tray used is not the first choice of trays, and do not contain the similar instruments. When trying to avoid torn wrappers we will need to know the causes of torn wrappers. By reporting torn wrappers, the extent of the problem is visualized. Torn wrappers also create unnecessary sterilization costs. We made an inventory of the possible causes of torn wrappers. The bar diagram (Figure 5.2) shows that the OT nurses indicate that the most important cause of torn wrappers is the size of instrument trays (75%), the second most important indicated cause is the packing material (65%). A few OT nurses filled in a different answer than available at the options, these answers are mostly more detailed descriptions of the size and weight and incorrect handling of the trays. The CSD employees agree less on these causes and indicate stacking (78.9%), handling, and carrying (89.5%) as most important causes of torn wrappers. The third mentioned cause mentioned is the size of the trays (47.5%). This shows that CSD employees find that the causes of torn wrappers are the effect of the handling activities of OT nurses. The frequencies of all mentioned causes are given in Table 5.4.

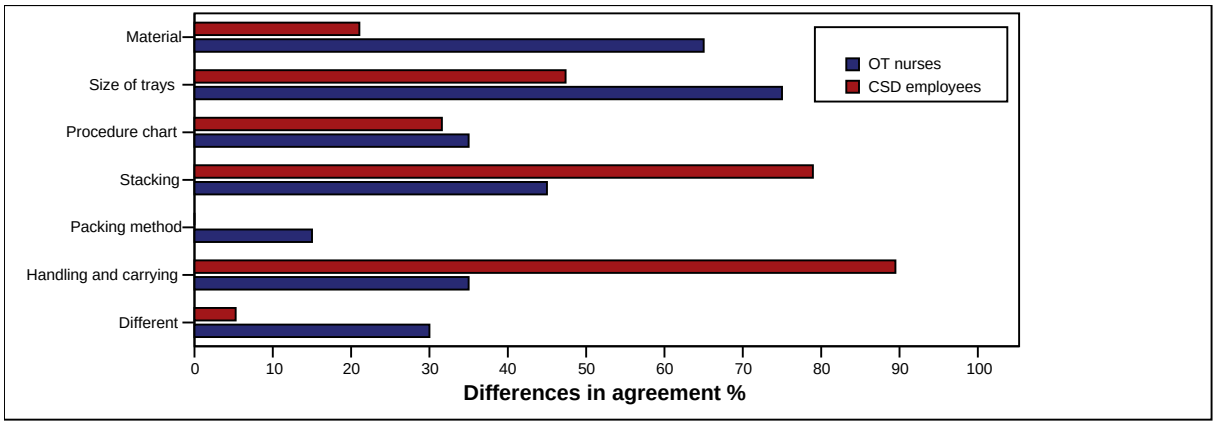


Figure 5.2 Percentage of agreement on the causes of torn wrappers

Table 5.4 Descriptive analyses of causes torn wrappers

Cause of torn wrappers	Total sample agree (%)	OT nurses agree (%)	CSD employees agree (%)
➢ Material	43.6	65	21.1
➢ Size of trays	61.5	75	47.4
➢ Chart	33.3	35	31.6
➢ Stacking trays	61.5	45	78.9
➢ Packing method	7.7	15	0
➢ Handling trays	61.5	35	89.5
➢ Different	17.9	30	5.3

The communication and collaboration considered to be part of the safety factors. The survey also includes a communication and collaboration section, respondents are asked to indicate the quality of communication and collaboration between both departments.

Table 5.5 Descriptive analysis of communication and cooperation

Communication and cooperation	Total sample (n=39) Mean (1-5)	Total Agree % (items 4 & 5)	OT nurses (N=20)	CSD employees (N=19)	Differences means	Agree % OT nurses	Agree % CSD employees
➢ The OT nurses and CSD employees here work together as a well coordinated team	2.33	15.4	2.75	1.89	0.86	30	0
➢ Cooperation between both departments is encouraged	2.69	23.1	3.00	2.37	0.63	35	10.6
➢ Communication between both departments is good	2.44	17.9	2.80	2.05	0.75	30	5.3
➢ Reporting incidents is stimulated	-		3.10	-		35	
➢ The workload in this department high	4.08	87.1	4.10	4.05	0.05	90	84.3
➢ Problems considering instrument trays are solved properly	2.87	25.7	3.25	2.47	0.78	35	15.8

In § 2.7 we described that the literature implies that the culture of an organization can contribute to an enhancement in safety. While attempting to change the safety issues that relate to the contents and use of instrument trays, it is valuable to assess the current safety climate in the departments. Therefore, statements on communication and coordination are taken into account in the survey, and provide a small snapshot of the current situation.

Table 5.5 shows the statements that we used to measure the communication and cooperation between the OT and the CSD. The lower the respondents estimate the statements, the more negative they interpret the statements. The interview results reveal that all statements are scored negative. This also counts for the scores of the survey questions.

Five out of six statements are positively formulated. These statements do not score high on agreement. We see that the averages by the CSD employees are lower than the OT nurses, for example, the OT nurses score on the statement: 'The OT nurses and CSD employees work tighter as a well coordinated team' an average of 2.75, the average of the CSD employees on this subject is 1.89. This means that the CSD employees disagree more on that particular statement than the OT nurses do and they perceive a lower coordination level than the OT nurses. Overall, the averages of the OT nurses reach the 3.00 level closer than the averages of the CSD employees. This indicates that the opinions of the OT nurses on the statements are neutral. The statement on workload has a negative score among both respondent groups, both groups experience a high workload. The difference on the 5-point Likert –scale is 0.05. The two highest differences between OT nurses and CSD employees are found on the statements considering the coordination between the two departments and the way problems considering instrument trays are handled. For both statements, the OT nurses score close to a neutral opinion while the CSD employees have a negative experience.

The statement on 'the report of incidents' is used only in the surveys of the OT nurses since they have to report incidents in writing. Their opinion on this subject is neutral. This does not match the outcomes of the interviews, since the interviewees indicated that reporting incidents is not stimulated. Figure 5.3 shows the differences on agreement per 'climate' factor for OT nurses and CSD employees.

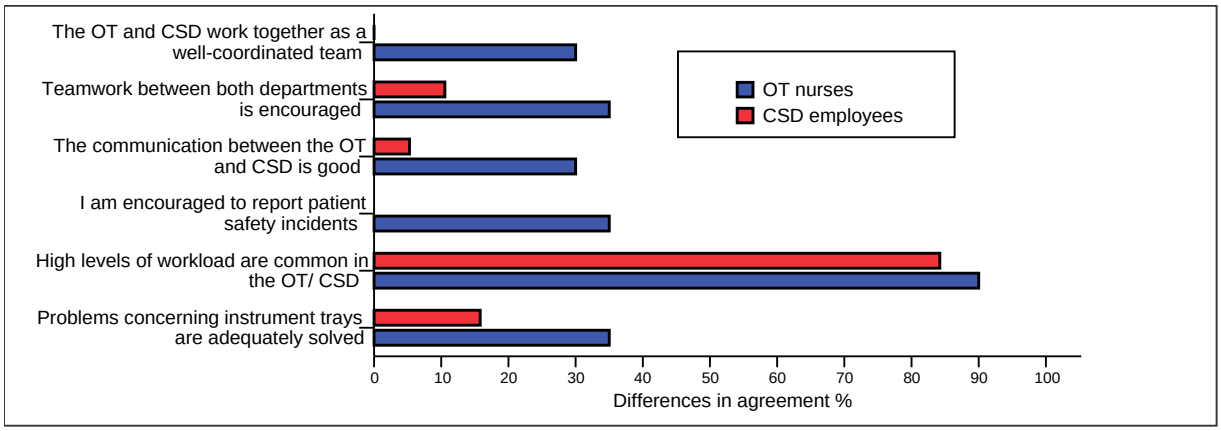


Figure 5.3 Percentage of agreement on the 'climate' factors

Overall, Figure 5.3 shows that the CSD employees have a stronger negative opinion on all statements than the OT nurses. In their opinion the coordination, cooperation and communication are all areas that need to be improved, while OT nurses have a more neutral opinion on these aspects.

5.3 Conclusion

In this paragraph, we connect the outcomes of the interviews and survey, in order to present a complete overview of the problems and answer the third research question:

What problems within the processes of instrument trays that influence efficiency and safety of the contents and the use of instrument trays are found?

Table 5.6 gives an overview of the perceived problems. Subsequently the causes and consequences of the problems are discussed.

Table 5.6 Overview perceived problems

Theoretical attributes	**Perceived problems**
Efficiency of tasks	- Resterilization of unused instruments - Emergency sterilizations - Heavy and large instrument trays
Timeliness of services	- Delays in surgery starting times - Large trays high turnover times in CSD
Continuity of services	- Missing instruments on trays in CSD
Stock 'waste'	- No protocol for revision of trays available - Trays are not frequently revised
	- **Main safety problem:** - **Torn wrappers**
Task and technology factors	- Unsterile trays are not reported
Individual factors	- Missing instruments on trays - Instruments on trays are changed for alternative ones
Team factors	- (Lack of) Communication - Unclear responsibilities - No teamwork
Organizational and management factors	- Reporting protocol not followed - Problems not discussed

The response rate of the survey is high (76%) among the CSD employees, therefore the results for the CSD employees represent the whole population of CSD employees. Among the OT nurses, on the other hand the response rate of the survey is low, just 22% of the research population responded. A possible reason for such a low response rate could be that OT nurses are regularly asked to participate in surveys and are therefore bound to make choices between the numerous requests. Another possible reason could be the lack of time or interest in the subject. The subject reaches beyond their work field and could therefore be found uninteresting. The consequence is that the survey results are not representative for the whole population. Nevertheless, the survey results are interesting.

The MST does not keep hard figures that clarify the frequency of some events, therefore we rely on the opinions of the OT nurses and CSD employees to reflect the problems. In order to get a complete overview we made a selection of the efficiency and safety problems, which are presented in Table 5.6 and the solutions mentioned most frequent by the two groups.

Problems that relate to efficiency are: emergency sterilizations and heavy and large instrument trays, these trays contain instruments that are not used during surgeries. Unnecessary sterilization costs are made when sterilizing instruments that have not been used during surgery (76.9%). Another consequence of sterilizing instruments that have not been used is the deterioration of the quality of material. This leads to a shorter life of instruments and quicker replacement of instruments, which leads to higher costs. The main cause of emergency sterilizations is the fact that the OT schedule is not adapted to the supply. Another cause is the insufficient amount of some trays, unavailability of such trays occurs approximately eight times a day. Emergency sterilizations can lead to a delay in surgery start times and in rising sterilizations costs because the processes in the CSD have to be adapted. CSD employees and OT nurses believe that the turnover time of instrument trays in the CSD can be decreased by reducing the size of trays.

Large and heavy trays are seldom revised because neither a revision protocol for the adaption of trays is available, nor instruments are added or removed from trays. The awareness that unnecessary sterilization costs are made when re-sterilizing instruments that have not been used is present within both groups, although with more conviction by the CSD employees. Solutions to overcome this problem are: reducing the contents of instrument trays and/ or adjusting them to the actual use of instruments for particular trays, by for example creating surgical specific trays. We have summarized the four most important changes according to both groups. Table 5.7 gives an overview of these changes.

Table 5.7 Preferences caused by changing instrument trays

OT nurses	**CSD employees**
Transparency 80%	Weight loss 94.7%
Less sterilization costs 70%	Transparency 94.7%
Less work acts for CSD employees 70%	Less work acts for CSD employees 84.2%
Weight loss 65%	Less sterilization costs 84.2 %

Transparency of the instrument trays and reduction of weight are the most frequently mentioned important benefits. There is a difference between the opinions of the CSD employees and the OT nurses, the latter group mention transparency as most important and scale weight loss in fourth position. We assume that OT nurses experience less physical obstructions and they find it more important that the transparency of instrument trays is increased.

Both groups would prefer an enhancement of transparency of instrument trays, by changing the contents of the trays to the use of instruments, trays could be made smaller in size and weight, which solves the physical

problems created by the weight. Heavy trays and the physical consequences of those trays may contribute to an increase in the dropout rate of employees. When adapting the contents and size of trays, it should be taken into account that it is not preferred to introduce more separately packed instruments (84.6%).

In order to get a complete overview we made a selection of the problems that relate to safety issues. The main problems mentioned are: the occurrence of torn wrappers (3-4 times a week) and adding or changing the available instruments on a tray for alternative instruments (3-4 times a week). Unsterile trays result in delays of surgeries and changing instruments for alternative instruments, this is acknowledged by 90% of the OT nurses. Holes in wrappers create safety issues for patients because of the potential for contamination. Therefore, it is important to lower the frequency of unsterile trays. A delay of surgeries due to the unavailability of instruments is estimated at 3-4 times a week.

In this research, we studied the causes of torn wrappers. Willems (2004) and Wagner et al. (2008) mention the importance of reporting incidents, caregivers should be convinced of the importance of reporting incidents. Without reports, chances are missed to analyze and enhance the safety of work processes. To ascertain the causes of torn wrappers we used the answers given in the interviews and included them in the survey. The causes most frequently mentioned are shown in Table 5.8. We made a distinction between the OT nurses and the CSD employees.

Table 5.8 Causes of torn wrappers

OT nurses	**CSD employees**
1. Size of trays 75 %	1.Handling trays 89.5%
2. Material 65%	2.Stacking trays 78.9%
3. Stacking trays 45%	3.Size of trays 47.4%

There is an agreement that the size of trays and stacking of trays are causes of torn wrappers. Nevertheless, the stacking of trays is mentioned as a third main cause by the OT nurses, and acknowledged by 45%, which is less than half of the population, while almost 80% of the CSD employees acknowledge this factor as a cause. Reason (2000) refers to these causes as latent factors. These different opinions are to be explained by the different backgrounds of the employees. We speculate that OT nurses try to protect their environment by first calling out other causes. These causes are not being solved, because reporting incidents is not a common occurrence in both departments, therefore causes from incidents are hard to foresee and incidents can hardly be prevented.

Communication and cooperation are factors that can contribute in solving safety and efficiency problems. The communication is marked as poor and due to this, many problems arise. The OT nurses perceive a neutral opinion on the statement of communication and coordination, the CSD employees however score negative on all statements. We can thus assume that the CSD employees value the level communication and coordination between both departments lower than the OT nurses do. Matern et al. (2006) appoint communication as an

important factor in the occurrence of problems, it is therefore important to mention that good communication is necessary because of the dependent relation both departments have. Communication is part of a positive safety culture as well as a blame free incident reporting environment (Kristensen & Bartels, 2007).

Summarizing, we pose that there are many opportunities to enhance the safety and efficiency of the use and contents of instrument trays. Many factors do not contribute to the prevention of unsterile trays and efficient measures concerning the use and processes of instrument trays are not taken.

6. Conclusions and recommendations

The objective of this research is to gain insight in the efficient use of instruments during surgeries and the problems related to the high occurrence of unsterile instrument trays in the operating theatre, in order to provide recommendations that will improve the efficiency level and the safety of the use of instrument trays. This has been achieved by first operationalizing the concept efficiency and safety in instrumental attributes that relate to the use and contents of instrument trays. By comparing and analyzing the current situation, the problems concerning the use and processes of instrument trays are detected. This chapter aims to answer the central research question:

'How can the MST enhance the efficiency and safety of instrument trays used in the operating theatres?'

This is executed by highlighting the main conclusions of the research (§6.1). In § 6.2 the results of adjusting two new tray types are described. Subsequently recommendations are given and future research possibilities are discussed (§ 6.3).

6.1 Conclusions

When discussing the main conclusions we use the same classification as before. First, the main conclusions that relate to efficiency problems are discussed, the second topic is safety.

As highlighted in the previous chapter, we identified the main efficiency problems: *unused instruments* and *emergency sterilizations.* Both problems lead to unnecessary costs. Studies by Wolbers (2008) and Florijn (2008) show that sterilization costs can be cut by altering instrument trays to the use of instruments. Next to this, these problems relate to another classification of inefficiency, time. Unused instruments have to undergo the entire sterilization process, which prolongs the reprocessing of instrument trays and which provides CSD employees with an unnecessary workload. Emergency sterilizations require an adaption of the processes in the CSD, since washing machines and autoclaves need to be reserved for emergency sterilization, which affects the turnover time of other instrument trays in the CSD. When summarizing, we pose that time and cost associated problems should be eliminated in order to achieve a more efficient working process.

To conclude the main efficiency problems are:

1. Unused instruments
2. Emergency sterilizations
3. Large and heavy instrument trays

This leads to:

- Low cost effectiveness
- High workload for OT nurses and CSD employees
- Long turnover times of trays in the CSD

The main safety issues are the *occurrence of torn wrappers* and the *occurrence of alternative instruments on trays.* Torn wrappers create a safety issue for patients, these compromised trays need re-sterilization, or in emergencies, emergency sterilizations, which leads to a delay in surgery. Here the link is shown with inefficiency in costs and time. The causes of replacing instruments with alternative ones can be found in the *individual factors*, shown in the conceptual model. The management of the contents of instrument trays is in the hands of one person. Kohn, Corrigan & Donaldson (1999) discovered that in about 60 % of unintentional medical errors, involved improper equipment use. This means the safety of surgeries decreases when the correct instruments are not used. We pose it is therefore important to always use the standardized instruments. The three main causes of torn wrappers can be classified as *work environmental factors*: often instrument trays are stacked on top of each other, usually with no regard for heavy trays put on top of lighter ones. This is a result of the design of the current charts, which are often too small to carry all trays needed. Furthermore, due to heavy workloads OT nurses often choose to stack trays on top of each other instead of making their way into the sterile storage several times a day. Incorrect handling of trays is also a result of a heavy workload, friction created tears in wrappers occur for example when OT nurses hit the edge of carts or do not carry the trays in balance. This outcome shows that the size of trays forms a safety issue, because torn wrappers occur more often with heavy trays.

To conclude the main safety problems are:

1. Torn wrappers
2. Alternative instruments on trays

This leads to:

- Lower patient safety in the OT
- Lower cost effectiveness
- Lower time effectiveness

To conclude we pose that the current working procedures in the OT and the CSD are the result of historical development. We recommend restructuring of the working procedures. Hospitals can optimize the processes around the use and contents of instrument trays, in order to achieve safer and more efficient working conditions. This can be achieved in the area of cooperation and communication between both departments, granting of responsibilities, introducing protocols and changes in the contents of instrument trays (see § 6.2). We believe that the OTs and CSD work more effectively when the teams understand each other's work better.

We believe that our research has achieved the objective of the research, since it discovered many efficient and safety related problems, and the value it has to addressing future surgical instrument issues. We also believe that by subjecting the outcomes and recommendations outlined in § 6.3 of the research to the OT nurses and the CSD employees, an enhancement in communication and coordination between both departments can be made.

6.2 Implementation of two new tray types

Based on the expertise of OT nurses we introduced two new trays types, the 'a hip-joint fracture' and the 'wrist-ankle' trays. The necessary instruments required for these surgeries have been discussed with two OT nurses, specialized in trauma surgery. These tray types have however not been implemented yet.

Today a hip-joint fracture surgery requires two tray types: a large basic tray (contains 70 instruments) and a large bone tray (contains 31 instruments). The contents of the new 'hip joint' tray are 51 instruments. This surgery is performed 120 times a year. The cost savings for sterilization are high since only 51 instruments require sterilization, instead of the previous 101 instruments. By introducing one instead of two trays roughly, an estimated €6,000 on sterilization costs can be saved per year. Another advantage is that solely one tray type has to be prepared in the OT, which significantly improves transparency in the OT, creates better working conditions for the OT nurses and will reduce handling for the CSD employees. The second tray type introduced as has been mentioned is the 'wrist-ankle' tray. This surgery nowadays requires two tray types; a children's tray (containing 48 instruments) and a small bone trays (containing 36 instruments). The contents of the new 'wrist-ankle' tray will be solely 49 instruments. This surgery is performed 69 times a year (an average of 2006 and 2007). The cost savings for sterilization when introducing this new tray type will amount to €1,715.

6.3 Recommendations

Our research has several limitations. As in other qualitative studies, it is difficult to demonstrate statistical figures or demonstrate a significant decrease in events (e.g. decrease in the occurrence of unsterile trays, decrease in the occurrence of emergency sterilizations, decrease in delays of surgeries). The lack of a quantitative outcome may increase the difficulty of obtaining administrative support for interventions. However, our study uncovered previously unacknowledged system errors that potentially may have led to adverse events for patients. Next to this, we present several interventions that may lead to a more efficient use and process of instrument trays.

We suggest that a multidisciplinary efficiency team, which exists of representatives from both departments, carries out the following recommendations. According to McGowan et al. (2007), a critical piece is to have a relatively small but multidisciplinary group of stakeholders to participate in the leadership for change. Large groups become unwieldy and produce circular discussions. In this case, a small group of OT nurses, CSD employees, surgeons and administrative support should participate in the efficiency team. The hospital administration needs to provide the financial resources. The first recommendation relates to the OT and the CSD.

- Appoint a general head that is responsible for both departments. This will increase the communication, coordination and cooperation of both departments and subsequently a better overview of problems can be achieved. McGowan et al. (2007) demonstrated the importance to have the support of institutional leaders to achieve change, this helps to win general acceptance.

Recommendations that relate to the efficiency problems are:

First of all, the advice is not to implement too many interventions at once, start with the introduction of 1 tray, than further expand for the General Surgery department and generally take more trays of departments in consideration.

- Reduce the size and weight of instrument trays. Efficiency enhancements can be made when adapting instrument trays to the actual use of the trays, this will lead to a decrease in sterilization costs, and has several additional benefits. Reducing the size of trays will lead to more transparency in the OT, less workload for the CSD employees and a reduction of physical burden for the OT nurses and CSD employees. Other benefits are: smaller trays will enhance the possibility that procedure charts can be built up for the cases schedule per day, which avoids entering the sterile storage multiple times a day, and stacking trays on top of each other and therefore this solution also benefits the problem of torn wrappers We suggest to start with the implementation of one of the assigned new tray types (‘hip joint tray’ or ‘wrist-ankle’ tray) mention in §6.2 as a trail for an optional 4 weeks. After four weeks, the implementation needs to be evaluated and decided if permanent implementation is desirable.
- Secondly, we recommend carrying out the study results of Wolbers (2008), by implementing the standardized trays for 12 surgeries for the General surgery department (seeing Annex 4). Use this

standardization as a pilot and review the pilot before adjusting more trays. Evaluate the new tray types after for example four weeks and the realized performance improvement can be compared to the expected improvement. If the new tray types are successful, these can permanently implemented. Furthermore, the specialism that is characterized by the largest and most heavy trays can be taken into account secondly. New trays are shown and explained during work meetings.

- Measure the number of emergency sterilizations. This is important when introducing changes and showing that the changes contribute to decreasing the number of emergency sterilizations. Heslin et al. (2008) have shown that the ability to collect and analyze data is the most powerful tool to accomplish change in the culture of an organization. According to Heslin et al. (2008), it is equally important to share this data with the involved actors, in order to gain more problem awareness.
- There should be sufficient instrumentation to support the OT schedule. This can be achieved by analyzing the shortcomings and investing in additional instruments. Sufficient instruments will decrease the amount of emergency sterilizations and therefore the extra costs emergency sterilizations bring.
- Measure the turnover times of instrument trays in the CSD. This information can be important for obtaining administrative support for interventions. When for example introducing changes in the size and weight of trays, this can show a reduction in turnover time in the CSD which in turn can be used as a best practice target. Time reduction can also contribute to the fact that instruments are becoming more complex over the years, and highly complex instruments need more handling time (cleaning and sterilizing) in the CSD.
- We suggest introducing a protocol that is aimed at revising the contents of trays on a certain period, for example once a year. Secondly, obsolete instruments should be removed from trays and separately packed. This leads to a reduction in sterilization costs (Florijn, indicates a reduction of 21%, 2008) and can improve the turnover time of trays.
- We suggest implementing a FEFO system (First expired-First out), that reduces the amount of instrument trays with expired maturing dates. The tray with the nearest expiring date is taken from the storage when preparing for surgeries.

<u>Recommendations for safety problems are:</u>

- Torn wrappers mostly occur with large trays. Actions that can be taken are: using thicker paper to overcome the problem and/ or change the transport charts, making it easier to reach for trays. Moreover, already mentioned is reducing the size and weight of trays. In addition, it is important to educate the staff in handling the trays and informing them about the consequences of the inadequate use and handling of trays. Secondly, measure the number of torn wrappers. This information is important when introducing changes and can show that the changes contribute to a lower number of torn wrappers.

- De Bekker & Van der Steeg (2004) state that the MIP commission has been unsuccessful in practice. We conclude this statement when looking at reporting incidents with instrument trays. This provides the base for a reporting system on a lower level. De Beer & Van der Steeg advise to implement a central reporting system on departmental level (2004). We recommend developing a protocol to report all problems with instrument trays. This protocol should be easier to work with, and should be decentralized. With decentralized we mean the reports are evaluated by the Head of the OT and the CSD. Feedback follows from these reports. Errors should be used to make improvements.
- Instrument management should be in the hands of the CSD. This increases the traceability and turnover times of instruments and trays. By pointing out responsible CSD members for different specialties, OT nurses will have a clear spokesperson and problems considering specific trays will be solved more quickly, which in turn increases cooperation. By making CSD employees more responsible, an enhancement in job satisfaction can also be achieved.

Recommendation for future research:

- There is no literature that presents a cost analysis of the sterilization process of instruments and complete trays. This information is important to show efficiency improvements. Information on cost analysis will also be of importance when changing processes.
- Currently the processes in the CSD are not adjusted to the OT planning. The OT does not consider if the instruments are available. We recommend a study to investigate the possibilities of adjusting the sterilization activities to the OT planning, and reserving required trays when a surgery is scheduled.

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Annex 1: Interview Questions CSD and OT (Dutch)

Interview Instrumenten netten CSA

Introductie onderwerp

Algemene gegevens

- Wat is uw functie in het MST?
- Hoe lang bent u al werkzaam in het MST?
- Hoeveel dagen per week bent u werkzaam op de CSA in het MST?
- Bent u tevreden met u huidige baan, welk cijfer kunt u daaraan verbinden?

Veiligheid

- Wie is er verantwoordelijk voor het melden van gescheurde netten?
- Bij wie moeten gescheurde netten worden gemeld?
  - Hoe gebeurt dat? Schriftelijk of mondeling?
- Heeft u weleens een gescheurd net gemeld?
  - Nee, waarom niet?
  - Ja, waarom wel?
  - Bij wie en hoe?
- Hoe vaak komt het voor dat een net gescheurd is?
  - … per week
  - ….per maand
- Wat zijn volgens u de oorzaken van gescheurde netten?
- Op welke manier(en) kunnen gescheurde netten voorkomen worden?
- Denkt u dat de veiligheid van operaties achteruit gaat wanneer netten kleiner worden en alleen instrumenten bevatten die **altijd** worden gebruikt tijdens een specifieke ingreep? (Instrumentarium welke sporadisch wordt gebruikt wordt dan los opgeslagen).

Efficiency

- Wie is er verantwoordelijk voor de inhoud van instrumenten netten?
- Hoe vaak wordt de inhoud van de netten gewijzigd en/ of geëvalueerd?
- Kunt u aangegeven wat de meest voorkomende problemen met instrumenten netten zijn?
- Welk type netten zorgen voor de meeste problemen?
- Wat vindt u van het samenstellen van operatie specifieke netten?
- Is het wenselijk om verbeteringen in netten aan te brengen, uit het oogpunt van gebruiksvriendelijkheid? (minder gewicht, minder tellen instrumentarium)
- Ziet u voordelen in het aanleggen van operatie specifieke netten (bijvoorbeeld een liesbreuk net)? Zo ja, welke?
- Ziet u ook nadelen in het aanleggen van operatie specifieke netten? Zo ja, welke?
- Worden er instrumenten los opgeslagen en in hoeverre is dit mogelijk / wenselijk?
- Wat is een goede manier om nieuwe netten te introduceren?

Spoedsterilisaties

- Bij wie moeten spoedsterilisaties worden gemeld?
- Wie is er verantwoordelijk voor het melden van spoedsterilisaties?
  - Hoe gebeurt dat? Schriftelijk of mondeling?
- Heeft u weleens een spoedsterilisatie aangevraagd?
  - Nee, waarom niet?
  - Ja, waarom wel?
  - Bij wie en hoe?

- Hoe vaak wordenspoedsterilisaties aangevraagd?
    - … per dag
    - …per week
    - …per maand
- Wat zijn volgens u de oorzaken van spoedsterilisaties?

Communicatie/ werkdruk

- Hoe zou u de samenwerking (communicatie) tussen de CSA en OK beschrijven?
    - Zijn er zwakke punten in de samenwerking?
    - Loopt u weleens tegen problemen aan?
- Hoe verloopt de communicatie op de afdeling CSA?
    - Loopt u weleens tegen problemen aan?
- Wordt een goede samenwerking tussen medewerkers onderling aangemoedigd?
    - Zo ja, hoe?
    - Zo niet, waaruit blijkt dat?
- Wordt het melden van incidenten gestimuleerd? Zo ja, hoe?
- Welke verbeterinitiatieven zijn er mogelijk in de communicatie tussen de afdelingen OK en CSA?
- Kunt u de werkdruk omschrijven op de werkvoer in de CSA?
- Worden problemen t.a.v. instrumenten netten bespreekbaar gemaakt en adequaat opgelost?

Eind interview

Interview Instrumenten netten OK

Introductie onderwerp

Algemene gegevens

- Wat is uw functie in het MST?
- Hoe lang bent u al werkzaam in het MST?
- Hoeveel dagen per week bent u werkzaam op de OK in het MST?
- Bent u tevreden met u huidige baan, welk cijfer kunt u daaraan verbinden?

Veiligheid

- Bent u bekend met de meldcriteria die gehanteerd worden voor incidenten in het MST?
- Wordt er feedback gegeven op de werkvloer wanneer er een MIP procedure is ingevuld of er op een andere manier melding is gemaakt van incidenten? Zo ja, hoe en van wie?
- Wie is er verantwoordelijk voor het melden van gescheurde netten?
- Bij wie moeten gescheurde netten worden gemeld?
- Hoe gebeurt dat? Schriftelijk of mondeling?
- Heeft u weleens een gescheurd net gemeld?
    - Nee, waarom niet?
    - Ja, waarom wel?
    - Bij wie en hoe?
- Hoe vaak komt het voor dat een net gescheurd is?
    - … per week
    - ….per maand
- Wat zijn volgens u de oorzaken van gescheurde netten?
- Op welke manier(en) kunnen gescheurde netten voorkomen worden?
- Denkt u dat de veiligheid van operaties achteruit gaat wanneer netten kleiner worden en alleen instrumenten bevatten die **altijd** worden gebruikt tijdens een specifieke ingreep? Instrumentarium welke sporadisch wordt gebruikt wordt dan los opgeslagen.
- Gebeurt het dat operaties worden afgezegd of vertraagd omdat het juiste instrumentarium niet aanwezig is?
    - Zo ja, hoe vaak gebeurt dat?
- Komt het voor dat een operatie geen doorgang kan vinden of wordt vertraagd door dat het benodigde net gescheurd is?
    - Zo ja, komt als gevolg hiervan het voor dat er voor een alternatief ander type net wordt gekozen?
- Kunt u aangeven hoe de procedure verloopt wanneer een net in het magazijn ligt en moet worden klaargezet voor een operatie?
- Bestaat er een klaarzetprotocol voor instrumentennetten? (volgorde beschrijven van ophalen uit magazijn en verantwoordelijkheden weergeven, wie doet wat?)
    - Zo ja, wordt dit protocol ook gebruikt?
- Telt u de instrumenten voordat ze de OK verlaten? Nee, waarom niet?

Efficiency

- Wie is er verantwoordelijk voor de inhoud van instrumenten netten?
- Hoe vaak wordt de inhoud van de netten gewijzigd en/ of geëvalueerd?
- Welk type netten zorgen voor de meeste problemen?
    - Bij welke operaties worden deze netten ingezet?
- Wat vindt u van het samenstellen van operatie specifieke netten?
- Is het wenselijk om verbeteringen in netten aan te brengen, uit het oogpunt van gebruiksvriendelijkheid?
- Ziet u voordelen in het aanleggen van operatie specifieke netten (bijvoorbeeld een liesbreuk net)? Zo ja, welke?
- Ziet u ook nadelen in het aanleggen van operatie specifieke netten? Zo ja, welke?

- Voorziet u problemen met chirurgen wanneer netten worden aangepast?
    - Zo ja, kunt u aangeven welke?
- Worden er instrumenten los opgeslagen en in hoeverre is dit mogelijk / wenselijk?
- Wat is een goede manier om nieuwe netten te introduceren?

Spoedsterilisaties

- Bij wie moeten spoedsterilisaties worden gemeld?
- Wie is er verantwoordelijk voor het melden van spoedsterilisaties
- Hoe gebeurt dat? Schriftelijk of mondeling?
- Heeft u weleens een spoedsterilisatie aangevraagd?
    - Nee, waarom niet?
    - Ja, waarom wel?
    - Bij wie en hoe?
- Hoe vaak wordt spoedsterilisaties aangevraagd?
    - … per dag
    - …per week
    - …per maand
- Wat zijn volgens u de oorzaken van spoedsterilisaties?

Communicatie/ werkdruk

- Hoe verloopt de communicatie op de afdeling en tussen de twee afdelingen CSA en OK?
    - Loopt u weleens tegen problemen aan?
- Wordt een goede samenwerking tussen medewerkers onderling aangemoedigd?
    - Zo ja, hoe?
    - Zo niet, waaruit blijkt dat?
- Wordt het melden van incidenten gestimuleerd? Zo ja, hoe?
- Welke verbeterinitiatieven zijn er mogelijk in de communicatie tussen de afdelingen OK en CSA?
- Wat vindt u van de werkdruk op de werkvoer in de operatiekamers?
- Worden problemen t.a.v. instrumenten netten bespreekbaar gemaakt en adequaat opgelost?

Eind interview

Annex 2: Survey Questionnaire CSD and OT (Dutch)

Beste CSA medewerkers,

Zoals wellicht bij u bekend wordt er op dit moment een onderzoek uitgevoerd naar de samenstelling van instrumentennetten die op de OK's worden ingezet. Het onderzoek vindt in samenwerking met Pieter Wolbers (student Technische bedrijfskunde) plaats en is in opdracht van Dr. Klaase.

Het doel van het onderzoek is om de samenstelling van de netten zoveel mogelijk af te stemmen op de ingrepen die ermee worden uitgevoerd. Dit ten behoeve van het gebruiksgemak, de overzichtelijkheid en de (sterilisatie-)kosten. Uit een eerste oriëntatie blijkt dat grote instrumentennetten met veel instrumenten worden gebruikt voor (kleine) ingrepen en veelvoorkomende ingrepen. Het blijkt dat veel instrumenten uit deze grote netten niet wordt gebruikt tijdens operaties.

Op dit moment hebben we uit de gegevens die via de OK en CSA zijn ontvangen een selectie gemaakt van veelvoorkomende (voorspelbare) ingrepen. Wij gaan proberen om voor deze ingrepen instrumentennetten aan te passen naar het daadwerkelijk gebruik van het instrumentarium. Ter illustratie: zo zou je voor een liesbreuk die rond de 680 keer plaatsvindt per jaar een specifiek liesbreuk-net kunnen maken.

Middels deze enquête probeer ik te achterhalen welke factoren van invloed zijn bij het veranderen en aanpassen van instrumenten netten. Daarnaast is de mening van de medewerkers omtrent dit onderwerp van belang.

De enquête is opgebouwd uit een aantal thema's: de **algemene gegevens** komen als eerste aan bod. Daarna wordt er naar de **veiligheid** op de OK in relatie tot instrumenten netten en instrumenten gevraagd. Het derde thema is **doelmatigheid**. Aan de hand van stellingen wordt er gevraagd naar jullie mening over het samenstellen van specifieke instrumenten netten. Daarna volgen er twee vragen over **spoedsterilisaties** en als laatste enkele vragen over de **communicatie** tussen de CSA en OK.

Het invullen van de enquête neemt ongeveer 15 minuten in beslag.
Ik zou het op prijs stellen als u uw medewerking aan de enquête zou verlenen. Alvast hartelijk dank voor het invullen van de enquête. De gegevens worden anoniem verwerkt en zullen niet aan derden worden verstrekt.

Mochten er vragen zijn ben ik te bereiken via onderstaand mailadres.

Met vriendelijke groet,
Leslie Kroes (student Gezondheidswetenschappen UT)
L.K.Kroes@student.utwente.nl

De ingevulde enquêtes mogen ingeleverd worden in het kantoor van Rein Dragt, er staat een geel postvakje.

Enquête Medewerkers CSA

Algemeen

1.Wat is uw functie in het MST?	
2.Hoe lang bent u al werkzaam in het MST in uw huidige functie?	
3.Hoeveel uren per week bent u werkzaam op de CSA in het MST?	
4.Bent u tevreden met uw huidige baan, welk cijfer kunt u daaraan verbinden?	

Onderstaande stellingen graag beantwoorden aan de hand van gegeven antwoorden	Zeer oneens	Oneens	Niet eens/ niet oneens	Eens	Zeer eens
5.Het gewicht van een net heeft invloed op het sterilisatieproces.	☐	☐	☐	☐	☐
6.Een net met een laag gewicht zorg voor een beter te beheersen sterilisatieproces.	☐	☐	☐	☐	☐

Veiligheid

De volgende vragen gaan over het scheuren van netten (vaststellen van onsteriele netten).	
7.Hoe vaak komt het voor dat een net gescheurd is? **(Wat is uw schatting?)**	☐1-2 keer per week ☐3-4 keer per week ☐5-6 keer per week ☐1x per maand ☐Nooit ☐Anders namelijk:
8.Wat is volgens u de oorzaak van gescheurde netten? (**meerdere antwoorden mogelijk**)	☐Het materiaal waarin de netten verpakt zijn ☐De grootte van de netten ☐De klaarzet kar ☐Stapelen van netten ☐De inpak methode ☐De wijze waarop netten worden gedragen ☐Anders, namelijk:

Doelmatigheid

9.Hoe vaak wordt de inhoud van de netten gewijzigd en/ of geëvalueerd?	☐wekelijks ☐maandelijks ☐nooit ☐anders, namelijk				
De stellingen gaan over het samenstellen van operatiespecifieke netten. Bijvoorbeeld een liesbreuk net.	Zeer oneens	Oneens	Niet eens/ niet oneens	Eens	Zeer eens
10. Het verkleinen van netten zorgt ervoor dat het hanteren van de netten voor de OK assistent **gebruiksvriendelijker** wordt.	☐	☐	☐	☐	☐
11. Het samenstellen van operatiespecifieke netten maakt het voor de OK assistent **overzichtelijker** aan de operatie tafel**.**	☐	☐	☐	☐	☐
12. Het **gewichtsverlies** van instrumentennetten is een voordeel in het samenstellen van operatie-specifieke netten.	☐	☐	☐	☐	☐
13. Door netten te verkleinen wordt kapot instrumentarium **sneller gesignaleerd** door OK assistenten.	☐	☐	☐	☐	☐
14. Door netten te verkleinen wordt kapot instrumentarium **sneller gesignaleerd** door CSA medewerkers.	☐	☐	☐	☐	☐
15. Het verkleinen van instrumentennetten zorgt voor **minder werkhandelingen** voor OK assistenten.	☐	☐	☐	☐	☐
16.Het verkleinen van instrumentennetten zorgt voor **minder werkhandelingen** voor de CSA medewerkers.	☐	☐	☐	☐	☐

Het vervolg van de stellingen over operatiespecifieke netten	Zeer oneens	Oneens	Niet eens/ niet oneens	Eens	Zeer eens
17. Het toevoegen van nieuwe typen netten zoals liesbreuk netten, zal voor weerstand zorgen onder de OK assistenten.	☐	☐	☐	☐	☐
18. Het los verpakken van instrumenten leidt tot het vaker zoek raken van instrumenten.	☐	☐	☐	☐	☐
19. Met het steriliseren van instrumenten die niet worden gebruikt op de OK worden onnodige sterilisatie kosten gemaakt.	☐	☐	☐	☐	☐

De volgende vragen gaan over de mate van belangrijkheid van het aanpassen van instrumenten netten	Zeer belangrijk	Belangrijk	Niet belangrijk/niet onbelangrijk	Onbelangrijk	Zeer onbelangrijk
20.Hoe belangrijk vindt u het dat instrumentennetten **lichter** worden?	☐	☐	☐	☐	☐
21.Hoe belangrijk vindt u het dat instrumentennetten **overzichtelijker** worden?	☐	☐	☐	☐	☐
22.Hoe belangrijk vindt u het dat instrumenten netten **kleiner** worden (minder instrumentarium bevatten)?	☐	☐	☐	☐	☐

Spoedsterilisaties

23.Hoe vaak worden spoedsterilisaties aangevraagd? **(getal invullen bij aantal keer)**	☐dagelijks… …….keer ☐wekelijks… …….keer ☐maandelijks …….keer ☐nee, nooit ☐anders, namelijk

Communicatie/ werkdruk

De volgende vragen gaan over de communicatie en werkdruk op de afdelingen CSA en OK	Zeer oneens	Oneens	Niet eens/ niet oneens	Eens	Zeer eens
24.De medewerkers van de CSA en OK werken samen als een gecoördineerd team.	☐	☐	☐	☐	☐
25. Een goede samenwerking tussen medewerkers van beide afdelingen wordt aangemoedigd.	☐	☐	☐	☐	☐
26. De communicatie tussen de afdelingen CSA en OK verloopt goed.	☐	☐	☐	☐	☐
27. De werkdruk op de CSA is hoog.	☐	☐	☐	☐	☐
28. Problemen t.a.v. instrumenten netten worden bespreekbaar gemaakt en adequaat opgelost.	☐	☐	☐	☐	☐
29. De werkzaamheden op de CSA verlopen in een continu proces.	☐	☐	☐	☐	☐
30. Er gaat veel tijd zitten in het steriliseren van instrumenten die niet op de OK zijn gebruikt.	☐	☐	☐	☐	☐

Hartelijk dank voor het invullen van de enquête
De gegevens worden anoniem verwerkt en zullen niet aan derden worden verstrekt

Beste OK medewerkers,

Zoals wellicht bij u bekend wordt er op dit moment een onderzoek uitgevoerd naar de samenstelling van instrumentennetten die op de OK's worden ingezet. Het onderzoek vindt in samenwerking met Pieter Wolbers (student Technische bedrijfskunde) plaats en is in opdracht van Dr. Klaase.

Het doel van het onderzoek is om de samenstelling van de netten zoveel mogelijk af te stemmen op de ingrepen die ermee worden uitgevoerd. Dit ten behoeve van het gebruiksgemak, de overzichtelijkheid en de (sterilisatie-)kosten. Uit een eerste oriëntatie blijkt dat grote instrumentennetten met veel instrumenten worden gebruikt voor (kleine) ingrepen en veelvoorkomende ingrepen. Het blijkt dat veel instrumenten uit deze grote netten niet wordt gebruikt tijdens operaties.

Op dit moment hebben we uit de gegevens die via de OK en CSA zijn ontvangen een selectie gemaakt van veelvoorkomende (voorspelbare) ingrepen. Wij gaan proberen om voor deze ingrepen instrumentennetten aan te passen naar het daadwerkelijk gebruik van het instrumentarium. Ter illustratie: zo zou je voor een liesbreuk welke rond de 680 keer plaatsvindt per jaar een specifiek liesbreuk-net kunnen maken.

Middels deze enquête probeer ik te achterhalen welke factoren van invloed zijn bij het veranderen en aanpassen van instrumenten netten. Daarnaast is de mening van de medewerkers omtrent dit onderwerp van belang.

De enquête is opgebouwd uit een aantal thema's: de **algemene gegevens** komen als eerste aan bod. Daarna wordt er naar de **veiligheid** op de OK in relatie tot instrumenten netten en instrumenten gevraagd. Het derde thema is: **doelmatigheid**. Aan de hand van stellingen wordt er gevraagd naar jullie mening over het samenstellen van specifieke instrumenten netten. Daarna volgen er twee vragen over spoedsterilisaties en als laatste enkele vragen over de **communicatie** tussen de CSA en OK.

Het invullen van de enquête neemt ongeveer 15 minuten in beslag.
Ik zou het op prijs stellen als u uw medewerking aan de enquête zou verlenen. Alvast hartelijk dank voor het invullen van de enquête. De gegevens worden anoniem verwerkt en zullen niet aan derden worden verstrekt.

Deze enquête wordt zowel per post als via de mail verstuurd. Wanneer u ervoor kiest de enquête op papier in te vullen kunt u deze bij Maartje Brouwer (secretariaat OK) weer inleveren. Wanneer u ervoor kiest de enquête per mail in te vullen kunt u deze via de mail retourneren.

Mochten er vragen zijn ben ik te bereiken via onderstaand mailadres.

Met vriendelijke groet,
Leslie Kroes
L.K.Kroes@student.utwente.nl
Student Gezondheidswetenschappen Universiteit Twente

Enquête Medewerkers OK

Algemeen

1.Wat is uw functie in het MST?	
2.Hoe lang bent u al werkzaam in het MST in uw huidige functie?	
3.Hoeveel uren per week bent u werkzaam op de OK in het MST?	
4.Bent u tevreden met u huidige baan, welk cijfer kunt u daaraan verbinden? **(cijfer tussen de 1 en 10 geven)**	

Veiligheid

De volgende vragen gaan over instrumentarium en het scheuren van netten	
5. Komt het voor dat een instrument wat op een net behoort te liggen niet aanwezig is of vervangen voor een alternatief?	☐ja (ga door naar vraag 6) ☐nee (ga door naar vraag 7)
6. **Vervolg vraag 5**. Hoe vaak komt het voor dat een instrument niet aanwezig is op een net of vervangen voor een alternatief?	☐1-2 keer per week ☐3-4 keer per week ☐5-6 keer per week ☐1x per maand ☐Nooit ☐Anders namelijk:
7.Gebeurt het dat operaties worden afgezegd omdat het juiste instrumentarium **niet aanwezig is**?	☐ja (ga door naar vraag 8) ☐nee (ga door naar vraag 9)
8. **Vervolg vraag 7.** Hoe vaak komt het voor dat operaties worden afgezegd omdat het juiste instrumentarium niet aanwezig is?	☐1-2 keer per week ☐3-4 keer per week ☐5-6 keer per week ☐1x per maand ☐Nooit ☐Anders namelijk:
9. Gebeurt het dat operaties worden vertraagd omdat het juiste instrumentarium **niet aanwezig is**?	☐ja (ga door naar vraag 10) ☐nee (ga door naar vraag 11)
10. **Vervolg vraag 9**. Hoe vaak komt het voor dat operaties worden vertraagd omdat het juiste instrumentarium niet aanwezig is?	☐1-2 keer per week ☐3-4 keer per week ☐5-6 keer per week ☐1x per maand ☐Nooit

	☐ Anders namelijk:				
11. Komt het voor dat een operatie wordt afgezegd of vertraagd door dat het benodigde papier om het net **gescheurd** is?	☐ ja ☐ nee (ga door naar vraag 13)				
12. **Vervolg van vraag 11**: Zo ja, komt als gevolg hiervan het voor dat er voor een alternatief **ander type net** wordt gekozen?	☐ ja ☐ nee				
13. Telt u de instrumenten voordat ze de OK verlaten?	☐ ja, altijd ☐ ja, meestal ☐ nee, nooit				
14.Denkt u dat de veiligheid van operaties achteruit gaat wanneer netten kleiner worden en alleen instrumenten bevatten die **altijd** worden gebruikt tijdens een specifieke ingreep? (Instrumenten die sporadisch worden gebruikt worden dan los opgeslagen)	☐ ja ☐ nee				
Onderstaande stellingen graag beantwoorden aan de hand van gegeven antwoorden	Zeer oneens	Oneens	Niet eens/ niet oneens	Eens	Zeer eens
15. Het gewicht van een net heeft invloed op het sterilisatieproces.	☐	☐	☐	☐	☐
16. Een net met een laag gewicht zorg voor een beter te beheersen sterilisatieproces.	☐	☐	☐	☐	☐
17.Hoe vaak komt het voor dat een net gescheurd is?	☐ 1-2 keer per week ☐ 3-4 keer per week ☐ 5-6 keer per week ☐ 1x per maand ☐ Nooit ☐ Anders namelijk:				
18. Wat is volgens u de oorzaak van gescheurde netten? (**meerdere antwoorden mogelijk**)	☐ Het materiaal waarin de netten verpakt zijn ☐ De grootte van de netten ☐ De klaarzet kar ☐ Stapelen van netten ☐ De inpak methode ☐ De wijze waarop netten worden gedragen ☐ Anders, namelijk:				

Doelmatigheid

19.Hoe vaak wordt de inhoud van de netten gewijzigd en/ of geëvalueerd?	☐wekelijks ☐maandelijks ☐nooit ☐anders, namelijk				
De stellingen gaan over het samenstellen van operatie- specifieke netten. Bijvoorbeeld een liesbreuk net.	Zeer oneens	Oneens	Niet eens/ niet oneens	Eens	Zeer eens
20. Het verkleinen van netten zorgt ervoor dat het hanteren van de netten voor de operatie assistent **gebruiksvriendelijker** wordt.	☐	☐	☐	☐	☐
21. Het verkleinen van netten zorgt ervoor dat het voor de CSA medewerker **gebruiksvriendelijker** wordt.	☐	☐	☐	☐	☐
22. Het samenstellen van operatie-specifieke netten maakt het voor de operatie assistent **overzichtelijker** aan de operatie tafel**.**	☐	☐	☐	☐	☐
23. Het **gewichtsverlies** van instrumentennetten is een voordeel in het samenstellen van operatie-specifieke netten.	☐	☐	☐	☐	☐
24. Door netten te verkleinen worden kapot instrumentarium **sneller gesignaleerd** door OK medewerkers.	☐	☐	☐	☐	☐
25. Door netten te verkleinen worden kapot instrumentarium **sneller gesignaleerd** door CSA medewerkers.	☐	☐	☐	☐	☐
26. Het verkleinen van instrumentennetten zorgt voor **minder werkhandelingen** voor OK assistenten.	☐	☐	☐	☐	☐
27.Het verkleinen van instrumentennetten zorgt voor **minder werkhandelingen** voor de CSA medewerkers.	☐	☐	☐	☐	☐
28. Het samenstellen van operatie-specifieke netten zorgt voor weerstand bij chirurgen.	☐	☐	☐	☐	☐

De stellingen gaan over het samenstellen van operatie- specifieke netten. Bijvoorbeeld een liesbreuk net.	Zeer oneens	Oneens	Niet eens/ niet oneens	Eens	Zeer eens
29. Het toevoegen van nieuwe typen netten zoals liesbreuknetten, zal voor weerstand zorgen onder de operatie assistenten.	☐	☐	☐	☐	☐
30. Het los verpakken van instrumenten leidt tot het vaker zoek raken van instrumenten.	☐	☐	☐	☐	☐
31. Met het steriliseren van instrumenten die niet worden gebruikt op de OK worden onnodige sterilisatie kosten gemaakt.	☐	☐	☐	☐	☐

De volgende vragen gaan over de mate van belangrijkheid van het aanpassen van instrumenten netten	Zeer belangrijk	Belangrijk	Niet belangrijk/niet onbelangrijk	Onbelangrijk	Zeer onbelangrijk
32.Hoe belangrijk vindt u het dat instrumentennetten **lichter** worden?	☐	☐	☐	☐	☐
33.Hoe belangrijk vindt u het dat instrumentennetten **overzichtelijker** worden?	☐	☐	☐	☐	☐

Spoedsterilisaties

34. Heeft u weleens een spoedsterilisatie aangevraagd?	☐ja ☐nee
35.Hoe vaak worden spoedsterilisaties aangevraagd? (getal invullen bij aantal keer)	☐dagelijks…….keer ☐wekelijks…….keer ☐maandelijks…….keer ☐nee, nooit ☐anders, namelijk

36.Wat zijn de belangrijkste oorzaken van spoedsterilisaties?	☐ Benodigd instrumentarium niet aanwezig ☐ Onsteriel net (scheur in net) ☐ Te weinig netten aanwezig ☐ Planning OK niet afgestemd op aanbod netten ☐ Anders, namelijk

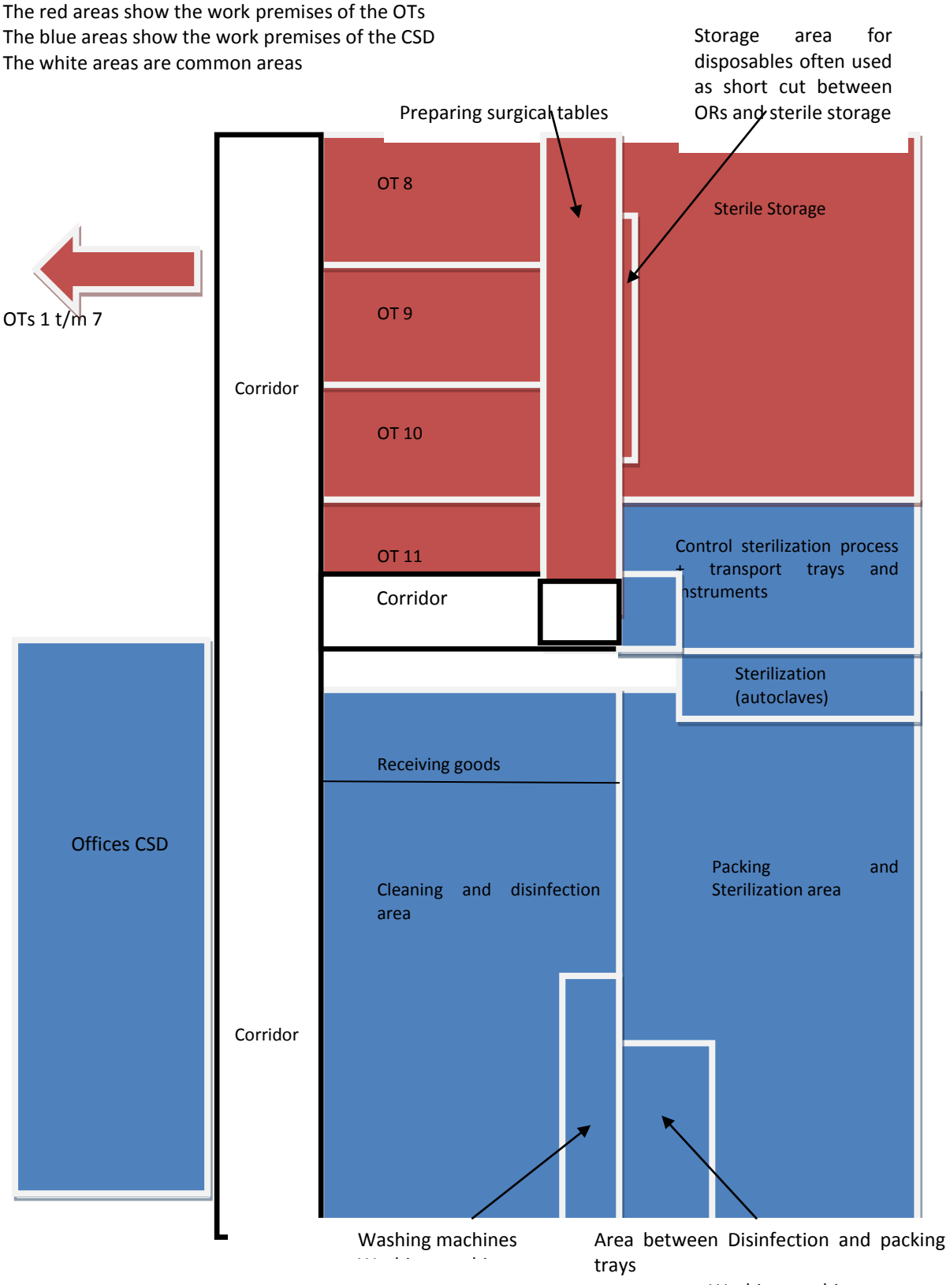
Communicatie/ werkdruk

De volgende vragen gaan over de communicatie en werkdruk op de afdelingen CSA en OK	Zeer oneens	Oneens	Niet eens/ niet oneens	Eens	Zeer eens
37. De medewerkers van de CSA en OK werken samen als een gecoördineerd team.	☐	☐	☐	☐	☐
38. Een goede samenwerking tussen medewerkers van beide afdelingen wordt aangemoedigd.	☐	☐	☐	☐	☐
39. De communicatie tussen de afdelingen CSA en OK verloopt goed.	☐	☐	☐	☐	☐
40. Het melden van incidenten wordt gestimuleerd.	☐	☐	☐	☐	☐
41. De werkdruk op de OK is hoog.	☐	☐	☐	☐	☐
42. Problemen t.a.v. instrumenten netten worden bespreekbaar gemaakt en adequaat opgelost?	☐	☐	☐	☐	☐

Hartelijk dank voor het invullen van de enquête
De gegevens worden anoniem verwerkt en zullen niet aan derden worden verstrekt

Annex 3: Map of CSD and OT areas

The red areas show the work premises of the OTs
The blue areas show the work premises of the CSD
The white areas are common areas



Annex 4: Overview of all surgeries selected based on the data analysis by Wolbers (2008)

CTG	Description (Dutch)	Freq.	Exp. surg. time (95% CI)
35700	Hernia inguinalis / lichtenstein plastiek / BZR / liesbreuk	687	45.39 - 47.71
33656	Crossectomie	526	50.9 - 54.12
35138	Haemorrhoidectomie	439	16.96 - 18.52
33780	Diagnostische lymfeklierextiraptie supr / infra claviculair	372	37.38 - 45.12
34910	Appendectomie	344	35.88 - 39.55
35512	Buik spoelen	339	38.37 - 44.69
38912	Excisie fibro-adenoom	431	22.32 - 24.86
33911	Excisie biopsie mamma + localisatie	381	32.34 - 35.57
38853	Peri-anaal abces	538	13.72 - 15.63
34738	Colonresectie	336	84.2 - 90.77
35350	Cholecystectomie	295	58.53-64.96