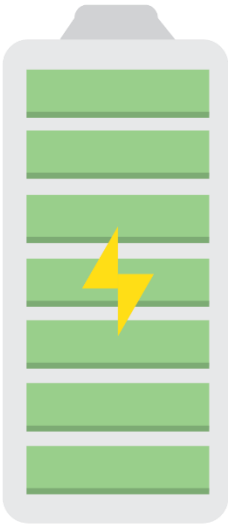
Surgical team' sustainable employability in minimally invasive surgery

To achieve a balanced employability to counteract waste of talent and skills in a sustainable way



by

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TU Delft

LUMC

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Abstract

Technological developments in the medical world introduce a shift in responsibilities of the surgical team members which might result in waste of talent and skills. The latter might result in disengagement and decreased productivity and thus in illness-related absenteeism. The people pillar of sustainability aims to create a healthy workplace and thus to manage illness-related absenteeism.

The objective of this research was to optimise the responsibilities of the surgical team members in minimally invasive surgery (MIS) in order to achieve a balanced and sustainable employability of the surgical team to counteract waste of talent and skills.

Empirical data was collected in two different steps. In the first place, an overview of the surgical phases during the MIS procedure and an overview of the tasks performed by the perioperative nurses were made. In the second place, two different methods were used to obtain data. First, seven video recordings of a laparoscopic gynaecological procedure were analysed to obtain the distribution of the responsibilities and the percentage of (technical) tasks for each phase and the entire MIS procedure. Second, interviews with fourteen perioperative nurses were conducted to map the peak moments of a MIS procedure and to evaluate the impact of the technological developments on the nurse's workload.

As a result, a fluctuation of the total duration of all tasks during the procedure was shown. A percentage higher than 70% was measured in the start phase. The perioperative nurses experienced low peak moments during 66% of the entire surgical procedure. A high impact of the technological developments was experienced by the nurses. The physical activity for MIS and robot-assisted surgery (RAS) was lower than a conventional open procedure (OS). The total duration of the technical tasks was highest in the second phase of the MIS procedure. The nurses indicated that this phase took longer compared to the same phase in OS procedures because of the amount of equipment that has to be connected.

In conclusion, an unbalanced employability was recognised during MIS and technological developments had a high impact on the activities of the perioperative nurses. This research has several recommendations. First, a more sustainable employability will be achieved when two perioperative nurses will be scheduled for three surgical procedures during 66% of the MIS procedure. Second, deployment of a technical perioperative nurse will decrease the amount of workload. Last, by giving the perioperative nurses more responsibilities in MIS, the talent and skills will not be wasted leading to a more balanced employability of the surgical team members.

Preface

Bridging the gap between healthcare professionals and technology was my goal when I started at the Delft University of Technology as a student. After four years of Applied Physics and two years of Biomedical Engineering, I achieved this goal during my graduation project as I enjoyed discussions with several healthcare professionals and interviews with perioperative nurses.

In Delft (and other technical universities), several technologies for the medical world are developed to achieve a higher quality of life for the patient. In addition to this function, these technological developments also have more consequences than just for the patient. Questions that are important to take into account include; what is the influence of technology on the responsibilities of the surgical team? For example do robots take over care tasks? How do the perioperative nurses experience the difference between conventional open surgeries and minimally invasive surgeries?

This project gave me more insight into the answers to these questions. To hear the stories of the users of these technologies, namely the perioperative nurses was very inspirational. I am glad that I was able to complete this research with great pleasure despite COVID-19. I would like to take this opportunity to say thanks to some people who made it possible for me to complete this project.

First of all, John van den Dobbelsteen who guided me by setting a valid scope of my project and who helped me not get extracted in small details, by letting me know clearly what needed to be done to obtain my Master's degree. Secondly, a special thanks to Frank Willem Jansen who helped me in several areas of my project, especially the medical side, and took the time to thoroughly discuss my project when we had an appointment. Thirdly, I would like to thank to Anne van der Eijk who managed my project well in the beginning and put the finishing touches on my project at the end. Fourthly, I would want to thank Diederich Cornelisse who has taken over Anne's role and helped me gain insight in the working atmosphere of the operating room, the perspective of the OR personnel towards this project and the impact of this project for the OR. I would also like to thank Mathijs Blikkendaal for his confidence to watch the videos and his answers to all my questions, Ummiye and Saskia for scheduling the perioperative nurses for the interviews, and the interviewed OR nurses for their open attitude. Lastly, I would like to thank my parents, sisters, and friends, for their support and discussions. Without you, completing this thesis would have been a lot less fun.

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K. Peters
Amsterdam, October 2020

Contents

1 Introduction

Since the last decennial, people focus on saving the planet for future generations. They have to live on a planet that is not damaged by previous generations [6, 12]. Sustainability is therefore a hot topic these days. Sustainability could be applied to daily activities at home to activities at companies with a high impact on the world. The Leiden University Medical Center (LUMC), the academic hospital of Leiden with 7000 employees participate, for example, in the national Health Care Environmental Thermometer. Thus, the LUMC makes and shows structural improvements in their environmental achievements and care [1].

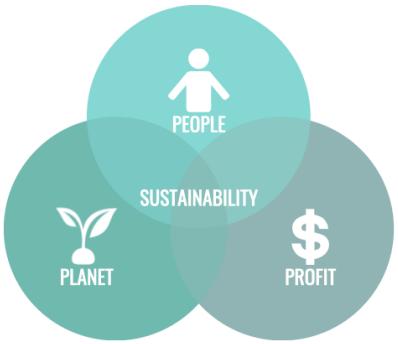


Figure 1.1: The three P's of sustainability [3]

Sustainability is defined in three pillars, namely planet, people, and profit (Figure 1.1). The LUMC defined the planet pillar as to use resources and energy sustainable, to produce less waste, to separate waste, and to reduce animal testing. Transparency of policy on sustainability, diversity, and integrity belongs to the profit pillar. The people pillar is defined as no limitation in and equal distribution of age, sex, ethnicity for employees, and no barriers for people with a work-limited disability to work at the LUMC [1]. Creating a healthy workplace is also an important aspect of this pillar. A healthy workplace is defined, according to the World Health Organization, as an environment "where pressures on employees are appropriate in relation to their abilities and resources, to the amount of control they have over their work, and support they receive from people who matter for them" [13, p. 4]. Creating a healthy workplace is related to managing illness-related absenteeism and thus employability of personnel. In the health care sector, the most common cause of long-term absenteeism and the second cause of short-term absenteeism is stress [15].

Surgical techniques became more complex due to the introduction of technological developments [2]. Last decennial, a shift from open to minimally invasive surgery (MIS) took place. The responsibilities of the different operating room (OR) team roles such as a surgeon, anaesthesiologist, anaesthetist and perioperative nurse shift due to this new technology. The main tasks of the perioperative nurse, the circulating and scrub nurse are the provision of care and communication with the patient during the procedure. A new main task for the perioperative nurse is the management of medical devices [2]. Due to these technological developments, the demand for perioperative nurses increases, and a shortage of OR personnel started to exist in the Netherlands [2]. The vacancy rate increased from 2% in 2016 to 7% in 2018 for nurse anaesthetists and from 1.5% to 5% for scrub and circulating nurses [2]. Due to this, ORs become unavailable, which, in turn, results in long patient waiting lists [17]. The combination of a shortage of personnel and an environment in which high time pressure exists might result in a higher workload for OR personnel [18]. Furthermore, a shift in responsibilities of OR personnel might result in waste of talent and skills: "being required to perform tasks below level of expertise, loss of

good employees due to working conditions and failure to hire good candidates because of hiring practices" [9, p. 832]. This, in turn, might result in inefficiencies and reduced job satisfaction and therefore, disengagement and decreased productivity [4, 9, 11]. This can introduce an increase in illness-related absenteeism which has to be managed as mentioned in the sustainable pillar people.

The OR team at the LUMC
The perioperative period consists of three phases, namely preoperative, intraoperative, and postoperative. The intraoperative phase starts when the patient enters the OR and ends when the patient is transferred to the area where post-surgical recovery care is performed. During the intraoperative phase, a surgical team is present which consist of a primary surgeon, assistants to the surgeon (i.e., secondary surgeon, resident, registered nurse first assistant (RNFA)), an anaesthesiologist, nurse anaesthetist, anaesthesia assistant, a scrub nurse and one or two circulating nurses. This team consists of sterile members and non-sterile members. The primary surgeon, the assistant to the surgeon, and the scrub nurse are the scrubbed members of the team. The RNFA provides assistance during the surgical procedure (i.e., handling tissue, suctioning, and suturing). The main tasks of the scrub nurse provide instruments, sutures, and supplies to the surgeon, continuously monitoring of the sterility of the sterile area and anticipating the surgeon's needs. The responsibility of the circulating nurse is to manage and implement activities in the non-sterile area [10]. The perioperative nurse varies in scrub or circulating nurse during different surgeries throughout the day. Especially in the LUMC, these nurses are versatile in various specialism, such as gynaecology, urology, and thorax.

1.1. Thesis aim

In terms of sustainability, many studies are focused on how MIS affects costs, operative time/OR turnover time, etc. However, as mentioned by Cook and Woods [7], an analysis of (cognitive) workload is also needed when a new technology is introduced. A new technology could cause an increase in physical workload, whereas cognitive workload could be decreased [7, 19]. For example, in a study of Dias et al. [8], cognitive workload changed throughout a robotic cardiac surgery procedure, peaks of high workload alternated with valleys of low workload. The objective of this thesis is to optimise the responsibilities of the surgical team member' roles in MIS in order to achieve a balanced and sustainable employability of the surgical team to counteract waste of talent and skills. It addresses the following question: How could the responsibilities of the members of the surgical team be optimised to achieve a balanced and sustainable employability in MIS?

To answer this question a distribution of the responsibilities during the entire MIS procedure was obtained via video analysis and the peak moments were mapped through video analysis and the interviews with scrub and circulating nurses of the LUMC. Furthermore, the percentage of the total duration of technical tasks was measured through video analysis and interviews and the impact of technological developments on the workload (i.e., physical and technological knowledge) of scrub and circulating nurses was evaluated during the interviews.

The thesis is structured as follows. In chapter 2 the methods (i.e., the video analysis and the interviews) to obtain these data will be explained in more detail. The results of the overview of responsibilities and the workload of technological developments are given in chapter 3. These results will be discussed and recommendations will be given in chapter 4. The conclusion of this thesis and suggestions for future research will be mentioned in chapter 5 and 6, respectively. In the appendices, extra information can be find.

2

Methods

The current employability of the scrub and circulating nurses was obtained by performing measurements on existing video recordings and by conducting interviews with the perioperative nurses. These methods and analysis of the data are described in detail in this chapter.

2.1. Data collection

Before the measurements and interviews, the surgical procedure was divided into phases and the tasks which the perioperative nurses performed during a laparoscopic procedure were observed. The goal of this research was to compare the data of the video analysis with the experiences of the interviewees. The procedure was divided into several surgical stages to obtain a distribution of the total duration of all tasks for the entire surgical procedure and the peak moments per phase. To detect these phases, an overview of all surgical stages during a general MIS procedure was defined by Blikkendaal et al. in which the specific LH steps were categorised in one general MIS phase (i.e., surgical procedure) [5]. This research was focused on the period between the scrub nurse was scrubbed and the wounds of the patient were closed. The start and end cues of the phase were determined by observation of several recordings. These phases with the corresponding first and last surgical steps of the phase are given in Table 2.1.

Table 2.1: Surgical phases undertaken during MIS. The start and end cues are defined per phase. [5]

Phase			Cue	
#	Abbreviation	Name	Start	End
1	PO	Pre-operative	Scrub nurse puts on a surgical gown	Scrub nurse starts to prepare the disinfection of operating area and placement of sterile drapes
2	A&SP	Anaesthesia and surgical preparation	Scrub nurse disinfects the operating area and places sterile drapes	Instruments are installed
3	CO2	Create CO2 pneumoperitoneum	Scrub nurse hands over scalpel to start first incision	Abdomen are inflated
4	IAP	Insert access ports	Inserting first (optical) port	Last port is inserted
5	SP	Surgical procedure	Inserting laparoscopic instrument	Last action of surgical procedure is performed
6	FC&I	Final check and irrigation	Checking hemostasis	Hemostasis is checked
7	CUP	Close up patient	Removing laparoscopic instruments and trocars	Scrub nurse takes care of wounds

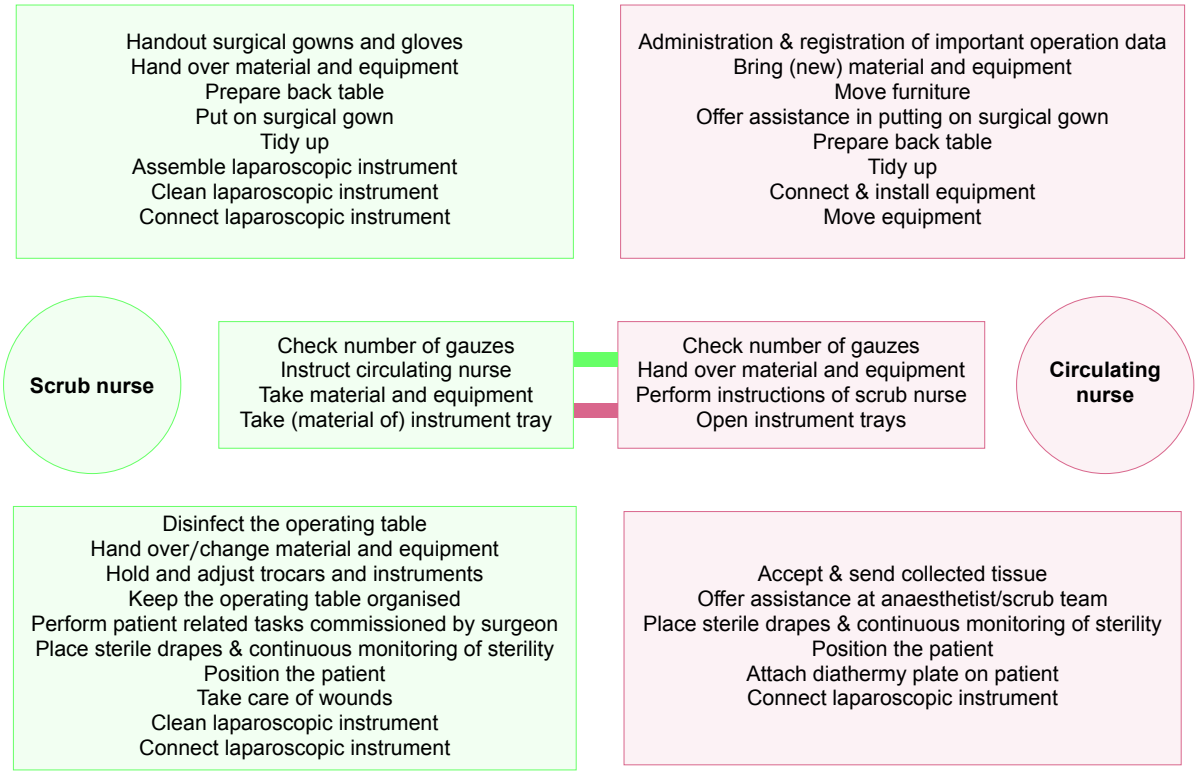


Figure 2.1: Overview tasks of the scrub and circulating nurse. The tasks of the scrub nurse and circulating nurse are shown in the green and in purple rectangles respectively. The first row of boxes are tasks performed in back table and non-sterile area for scrub and circulating nurse respectively. The middle boxes are transfer tasks between the scrub and circulating nurse. The boxes below are the tasks performed in the operating area.

Several recordings were observed to obtain an overview of the responsible tasks of both the scrub and circulating nurses. These responsibilities were divided into several categories: patient-related, technology-related and remainder. The scrub and circulating nurses' tasks are defined in Table 2.2, Table 2.3 and Table 2.4. In Figure 2.1 an overview of these tasks is given, categorised for every different operating area.

After a clear definition of the tasks and the cues of the phases, video recordings were observed and interviews were conducted. These two methods were performed independently; no results of the video analysis were shared with the interviewees.

2.1.1. Video recordings

A laparoscopic gynaecological procedure (i.e., the laparoscopic hysterectomy (LH)) was recorded in an integrated OR, a functionally connected OR environment, in a university-affiliated teaching hospital (Bronovo Hospital, The Hague) from September 2011 to 2012. LH was chosen as procedure because of the high frequency at which this advanced laparoscopic gynaecological procedure is performed and the wide array of instruments and equipment which are required during this procedure [5]. Ten recordings were observed and analysed based on a time and motion study. In a time and motion study, the movements of a person are measured by a stopwatch [16]. The amount of time for each task was calculated to obtain a distribution of the responsibilities during the phases of the entire MIS procedure. The executed video analysis then gave an overview of the frequency of tasks for each phase and the ratio of technical and patient-related tasks for each phase and the entire procedure.

The start and end time of the tasks and the start time for each phase were determined by observing the ten recordings. These time intervals were determined for the phases PO, A&SP and CO2 by viewing the recordings of the OR. The timestamps for the phases IAP through CUP were obtained by viewing the recordings of the optical laparoscopic instrument. After the observation of the ten recordings, an analysis was performed using Microsoft Excel. The duration of the tasks was measured by the difference between the start time and the end time of the task. Tasks were divided into different MIS phases; the start time of each task corresponds to a specific interval between the starting times of the

Table 2.2: Patient related tasks defined for scrub and circulating nurses

Type of nurse	Patient related tasks	
	Name	Definition
Scrub nurse	Disinfect the operating table	Grabbing material for disinfection and lubricating the patient with disinfectants
	Hand out surgical gowns and gloves	Opening package of surgical gown and gloves and handing out surgical gown and gloves
	Hand over/change material and equipment	Grabbing material of back table or operating table and handing over to operating table
	Hold and adjust trocars and instruments (assistance)	Offering assistance at operating table by holding and adjusting trocars or instruments
	Instruct circulating nurse	Communicating and discussing with circulating nurse which result in actions of circulating nurse
	Keep operating table organised	Ordering cables and other material
	Perform patient related tasks commissioned by surgeon (assistance)	Offering assistance with tasks at operating table (no holding and adjusting of trocars and instruments)
	Put on surgical gown	Grabbing and putting on surgical gown and surgical gloves and button tie belt
	Take material and equipment of circulating nurse	Grabbing material of circulating nurse
	Take care of wounds	Cutting suture and/or attaching plaster on patient
Circulating nurse	Accept & send collected tissue	Grabbing collected blood, putting collected tissue in bin and/or measuring amount of unused fluid
	Administration & registration of important data of surgical procedure	Grabbing folder/papers and pencil and writing on paper or typing on computer at the OR
	Bring (new) material and equipment	Leaving OR and entering OR with material and equipment
	Hand over material and equipment to scrub nurse	Opening package and handing over to scrub nurse
	Move furniture	Moving stools, bins or tables
	Perform instructions of scrub nurse	Communicating and discussing with scrub nurse and performing these actions
	Offer assistance at anaesthetist/scrub team	Giving instructions as non sterile member
	Offer assistance in putting on surgical gown	Buttoning tie belt of surgical gown and handing over tie belt
Both	Check number of gauzes	Scrub nurse grabbing and counting gauzes and circulating nurse checking this
	Place sterile drapes & Continuous monitoring of sterility	Grabbing sterile drapes, putting on patient or other sterile drapes and moving sterile drapes in right position
	Position the patient	Moving patient or operating table
	Prepare back table	Collecting material and organising back table. No transfer to operating table
	Tidy up	Grabbing used material and putting in bin

Table 2.3: Technical tasks defined for scrub and circulating nurses

Type of nurse	Technical tasks	
	Name	Definition
Scrub nurse	Assemble laparoscopic instrument	Grabbing elements of instrument, bringing elements together and checking the functionality of instrument
	Clean laparoscopic instrument	Grabbing napkin or dosing syringe and cleaning laparoscopic instrument
Circulating nurse	Attach diathermy plate on patient	Collecting and opening package of diathermy plate and sticking diathermy plate on patient
	Connect and install equipment	Walking to equipment and touching a button or (dis)connecting cables to equipment
	Move equipment	Moving equipment and screens
	Open instrument trays	Unpackaging non-sterile package of instrument tray
Both	Connect laparoscopic instrument	Grabbing instrument with cable and handing over to circulating nurse. Specifically for the circulating nurse connecting the suction and irrigation instrument

Table 2.4: Remaining tasks defined for scrub and circulating nurses

Type of nurse	Remaining tasks	
	Name	Definition
Both	Ask extra colleague	Extra colleague entering OR
	Calling	Grabbing phone and holding the phone to the ear
	Chattering	Talking to colleague without any physical activity
	Discuss with colleague	Talking to colleague with any physical activities
	Have a break	Leaving the OR and coming back without material or equipment for a long time
	On mobile phone	Grabbing phone and looking at screen
	Shift change with colleague	Perioperative nurse entering OR and other perioperative nurse leaving the OR
	Watching	Circulating nurse watching to sterile area

phases. Furthermore, the frequency of tasks and the total duration for each task were measured. The full procedure time was calculated to obtain the percentage of the time spent on a certain task. These inputs then gave the ratio between the time spent on all tasks and the total procedure time, which is given as a formula in Equation 2.1.

The total employability was measured by Equation 2.1.

$$E_{tot} = \frac{T_{total}}{P_{end} - P_{start}} \tag{2.1}$$

T_{total} is the total duration of all tasks. P_{start} and P_{end} are the times of the start and end cues of the total procedure. The percentage of total duration of all tasks could then be divided into a percentage for each category (i.e., patient-related, technology-related and remainder).

Distribution of the responsibilities for each phase during the entire MIS procedure was obtained by calculating the amount of time for each task for each phase. The percentage of the total time for each phase to the total procedure time was measured. Furthermore, the percentages of the total duration of the tasks per phase to the total time per phase were computed for each category.

2.1.2. Interviews

To compare the results of the video analysis to the operating team' view on this topic, interviews were conducted with 14 perioperative nurses of the Leiden University Medical Center (LUMC) who had a level of experience in MIS. The experiences in the peak moments during the entire OR procedure and the impact of technological developments on the workload (i.e., physical and technological knowledge) were evaluated during this interview.

The participants were informed in advance about the objective of the study and the privacy regulations. Before the start of the procedure, the participants were asked to fill in a small survey about demography and the level of experience in MIS. Furthermore, information about the responsibilities described in a document of the Dutch association of perioperative nurses (Landelijke Vereniging Operatieassistent, LVO) and the surgical phases defined during the procedure (Table 2.1) were shared in advance, see Appendix A. In the pilot, four perioperative nurses were interviewed to indicate the comprehensibility of the questions. After some adjustments interviews were performed with ten perioperative nurses. An audio recording of the interview was started after the consent of the participant.

2.1.3. Questions

The questions were divided into four parts. The impact of technological developments on their activities and workload was asked in part 1. In part 2, questions were asked about the performed and desired main responsibilities of their profession. Subsequently, part 3 entails questions on the difference in the number of (technological) tasks for MIS, robot-assisted surgery (RAS) and conventional open surgery (OS). In the last part, an estimation of the peak moments for each surgical phase was asked in which the set of questions was asked twice for scrub and circulating nurses. Part 2 and 3 were open questions and the questions in part 1 and 4 were based on a scale between 0 to 10 (very low and very high) or a percentage between 0 to 100 (very low and very high). The questions were asked in Dutch, for this report the questions were translated to English.

The questions which were asked during the pilot and interview are shown in Table 2.5.

Table 2.5: Questions which were asked to four perioperative nurses in the pilot and ten perioperative nurse in the interview

#	Question	Pilot (N=4)	Interviews (N=10)
	Part 1: Influence of technological developments		
1.	How much influence do technological developments have on your work during MIS?	X	X
2.	What percentage do you spend on technology compared to the total duration of MIS?	X	X
3.	How much workload do you experience within your function?	X	
3.1	How much physical load do you experience within your function?		X
3.2	How much mental load do you experience within your function?		X

#	Question	Pilot (N=4)	Interviews (N=10)
4.	Which of the following two options do you experience the most during the entire MIS procedure? (a) The workload is spread evenly (b) The workload is fluctuated	X	X
5.	To what extent have technological developments contributed to this increased workload?	X	X
6.	How many more repetitive movements do you make and how often are you standing in the same uncomfortable position for a long time due to the technological developments?	X	
6.1	How many more repetitive movements do you make and how often are you standing in the same uncomfortable position for a long time due to the technological developments as a scrub nurse?		X
6.2	How many more repetitive movements do you make and how often are you standing in the same often uncomfortable position for a long time due to the technological developments as a circulating nurse?		X
7.	How much more physical load is requested to perform tasks because of technological developments? For example, connecting and installing equipment and changing positions of screens?	X	
7.1	How much more physical load is requested to perform tasks because of technological developments as scrub nurse? For example, connecting and installing equipment and changing positions of screens?		X
7.2	How much more physical load is requested to perform tasks because of technological developments as a circulating nurse? For example, connecting and installing equipment and changing positions of screens?		X
8.	To what extent are you more limited in performing the technical tasks due to a lack of knowledge about the instruments and equipment?	X	X
9.	To what extent are you more limited in performing the technical tasks due to the complexity of the instruments and equipment?	X	X
10.	How many times do you need the extra help of a colleague to install and adjust equipment or to assemble a (laparoscopic) instrument?	X	
10.1	How many times do you need the extra help of a colleague to assemble a (laparoscopic) instrument?		X
10.2	How many times do you need the extra help of a colleague to install and adjust equipment?		X
	Part 2: Responsibilities of scrub and circulating nurse		
1.	Which main tasks belong to the desired responsibilities of your positions for MIS?	X	X
2.	Which main tasks are performed to the current responsibilities of your position for MIS?	X	X
3.	Which reason(s) could you mention for the difference between the desired and the current responsibilities of your function?	X	X
4.	Which possible ways exist to reduce these differences?	X	X
5.	What percentage of the time do you perform administrative tasks during the surgical procedure?		X

#	Question	Pilot (N=4)	Interviews (N=10)
	Part 3: Responsibilities scrub and circulating nurses MIS versus OS		
1.	Would you specify for each task whether the task requires more time during MIS compared to OS?	X	X
2.	If you had the choice between MIS or OS procedures, how much more time would you like to perform an OS procedure instead of a MIS procedure?		X
3.	What is the ratio of technical and patient-related tasks in MIS at this moment?	X	X
4.	What is the desired ratio of technical and patient-related tasks in MIS?	X	X
5.	What percentage of your time do you perform physical actions for MIS or RAS and OS as a scrub nurse?	X	X
6.	What percentage of your time do you perform physical actions for MIS or RAS and OS as a circulating nurse?	X	X
	Part 4: Peak moments of MIS		
1.	What is your experience on the number of tasks for each surgical phase?	X	X
2.	What percentage of these tasks are technical?	X	X

2.2. Data analysis

The results of the video recordings and the interviews were analysed using a box plot. The box plots were measured through the method of Moore and McCabe depicted in Figure 2.2 .

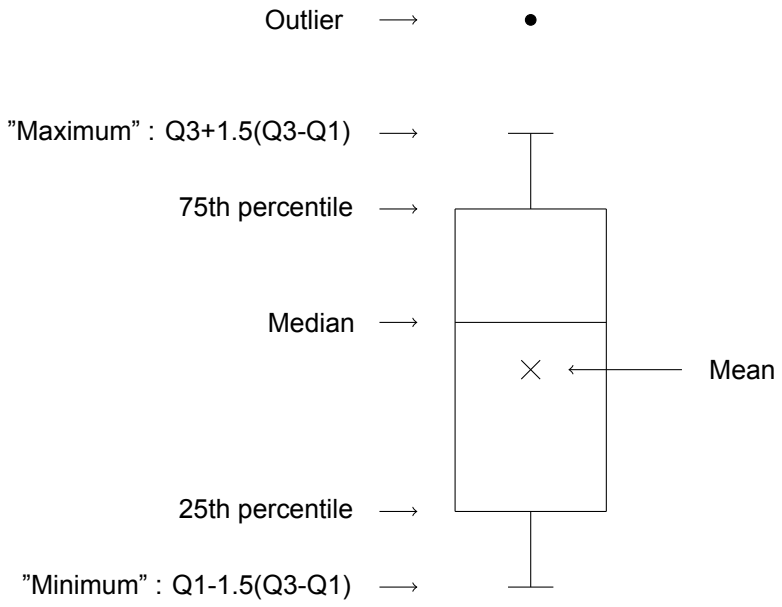


Figure 2.2: Explanation of the box plot by Moore and McCabe [14]

3

Results

The results were obtained through video recordings and interviews and are written in the first sections of this chapter. In both methods, an overview of the responsibilities throughout the surgical procedure was obtained by measuring the total duration of a task in the video recordings and the physical activity experienced by the perioperative nurses. The impact of technological developments was obtained by measuring the total duration and percentage of technical tasks in the video recordings and the impact on workload experienced by the perioperative nurses. These results were compared in the last section of this chapter.

3.1. Video recordings

There were ten LHs observed in the integrated OR. A scrub and circulating nurse were present in each of the videos. In four videos a perioperative nurse in training was (partly) present. In three of these videos, the OR nurse in training did many tasks of the circulating nurse during the surgery. Therefore, these three videos were excluded and the results are only based on the seven valid recordings. The recording started when the scrub nurse put a surgical gown on and ended when the scrub nurses took care of the wounds. The average duration of the surgeries with these as start and endpoints, was 2 hours, 20 minutes, and 29 seconds.

The procedure was divided into seven phases. The total duration of each phase differed. Phase SP was the surgical procedure with the longest duration; on average 66% of the total procedure. The shortest phases were phases IAP (i.e., insert access port and phase) and FC&I (i.e., final check and irrigation). The phases took on average 4% and 2% of the total procedure, respectively. An overview of the percentage of the phase time relative to the total duration of the procedure is shown in Table 3.1.

Table 3.1: The average ratio of the surgical phase time and total duration of the MIS procedure per surgical phase for seven LH's observations. The standard deviation (σ) is given in the brackets.

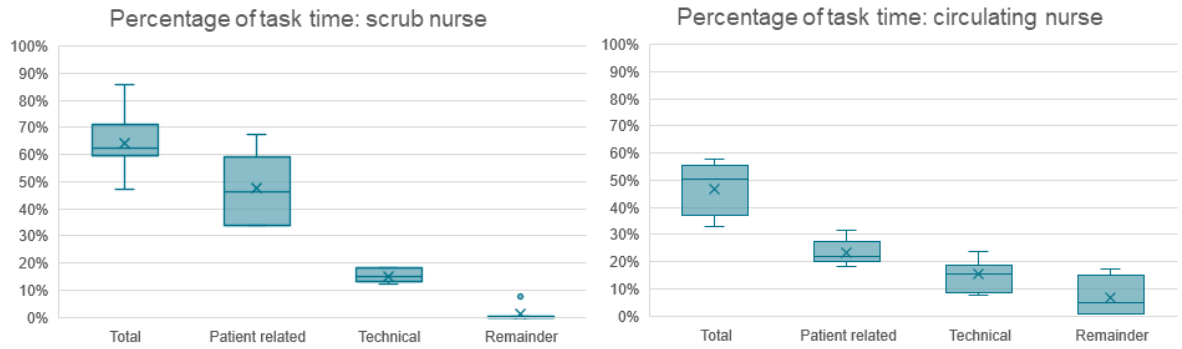
Task			Ratio phase time & total duration
#	Abbreviation	Name	[%] (σ)
1	PO	Pre-operative	9(2)
2	A&SP	Anaesthesia and surgical preparation	8(3)
3	CO2	Create CO2 pneumoperitoneum	5(2)
4	IAP	Insert access ports	4(2)
5	SP	Surgical procedure	66(6)
6	FC&I	Final check and irrigation	2(1)
7	CUP	Close up patient	7(3)

3.1.1. Overview of responsibilities: distribution of tasks

Employability The duration for each task for each perioperative nurse was measured during the video analysis. These tasks were divided into patient-related, technical, and remaining tasks. The total time for each task was measured for each procedure whereby the ratio of the total time for each task and the total time of the procedure was calculated.

General The mean percentage of the total employability for all seven recording was for the scrub nurse 64.05% (±11.90%) and the circulating nurse 46.86% (±9.29%).

The percentage of patient-related tasks was measured through the summation of the percentage of all patient-related tasks. This measurement was also performed for the technical and remaining tasks. This resulted in a mean percentage of the patient-related tasks of 47.77% (±12.39%) for the scrub nurse and 23.24% (±4.69%) for the circulating nurse. The mean percentage of the technical tasks were 15.15% (±2.36%) for the scrub nurse and 15.33% (±5.65%) for the circulating nurse. The scrub nurse spent 1.13% (±2.90%) of the procedure on average on remaining tasks and the circulating nurse on average 6.91% (±6.92%). A box plot of the percentage of the total duration of the tasks divided into patient-related, technical, and remaining tasks for the scrub nurse and the circulating nurse is shown in Figure 3.1.



(a) Employability of the scrub nurse

(b) Employability of the circulating nurse

Figure 3.1: Box plot of the employability for each perioperative nurse and the tasks divided into the categories: patient related, technical and remaining tasks obtained through video analysis

Per phase The percentage of the total duration of tasks for each phase was the total time of the patient-related and technical tasks divided by the duration of the corresponding phase.

Table 3.2: Mean percentage of the total duration of each task per phase of seven procedures and the distribution of the technical, patient-related and remaining tasks measured during the video analysis

Scrub nurse							
%	PO	A&SP	CO2	IAP	SP	FC&I	CUP
Phase	**107.98**	**95.57**	65.60	48.42	50.76	70.01	**95.05**
Technology	0.00	44.21	15.59	8.91	28.59	22.32	21.57
Patient	100.00	55.79	80.60	91.09	68.74	77.68	78.43
Remainder	0.00	0.00	3.81	0.00	2.67	0.00	0.00
Circulating nurse							
%	PO	A&SP	CO2	IAP	SP	FC&I	CUP
Phase	**77.59**	**63.99**	49.74	51.24	25.73	20.65	**72.58**
Technology	6.02	62.38	67.05	21.83	30.04	4.54	46.31
Patient	91.31	33.11	32.95	54.10	44.59	52.61	53.69
Remainder	2.67	4.51	0.00	24.08	25.37	0.00	0.00

Table 3.3: Standard deviation of the mean percentage of the total duration of each task per phase of seven procedures and distribution of the technical, patient-related and remaining tasks measured during the video analysis

Scrub nurse							
%	PO	A&SP	CO2	IAP	SP	FC&I	CUP
Phase	13.44	10.73	29.29	27.43	17.42	26.52	11.61
Technology	0.00	18.54	12.66	11.91	3.69	37.07	19.96
Patient	0.00	18.54	11.10	11.91	9.48	37.07	19.96
Remainder	0.00	0.00	10.08	0.00	6.73	0.00	0.00
Circulating nurse							
%	PO	A&SP	CO2	IAP	SP	FC&I	CUP
Phase	12.67	15.52	13.97	35.34	8.52	27.69	13.65
Technology	4.40	20.06	13.32	18.85	13.27	12.00	34.81
Patient	7.47	18.57	13.32	24.74	17.96	50.47	34.81
Remainder	5.39	7.73	0.00	30.22	22.28	0.00	0.00

A summary of the mean percentage and standard deviation for each phase and the corresponding ratio of technical, patient-related, and remaining tasks for scrub and circulating nurses are shown in Table 3.2 and Table 3.3 for seven recordings, respectively. In three phases the scrub nurse performed tasks for more than 75% of the phase, namely in phases PO, A&SP, and CUP. Less than 50% of the phase spent the scrub nurse on tasks in phase IAP. In phase PO, the circulating nurse performed tasks more than 75% of the phase. In phases SP and FC&I, the circulating nurse performed tasks below 30% of the phase.

In Figure 3.2, the percentage of the total duration of all tasks for each phase is shown for seven recordings. Some tasks were performed at the same time, which resulted in a percentage above 100. The employability was higher for the scrub nurse than the circulating nurse for each phase. An exception was phase IAP, both nurses had a large variation in the percentage of the total duration of all tasks performed during this phase.

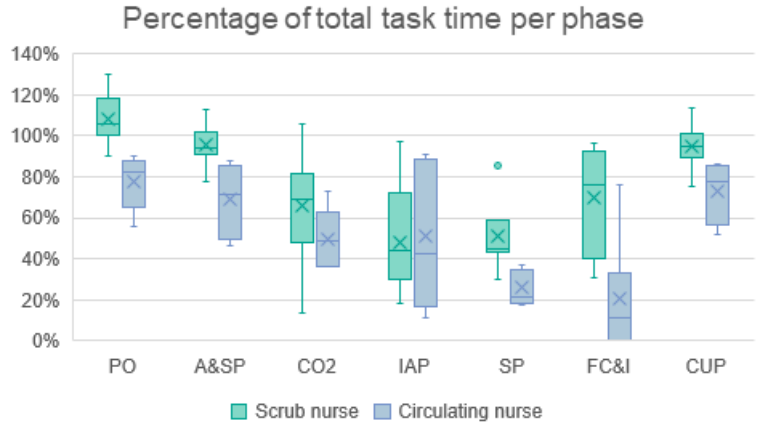


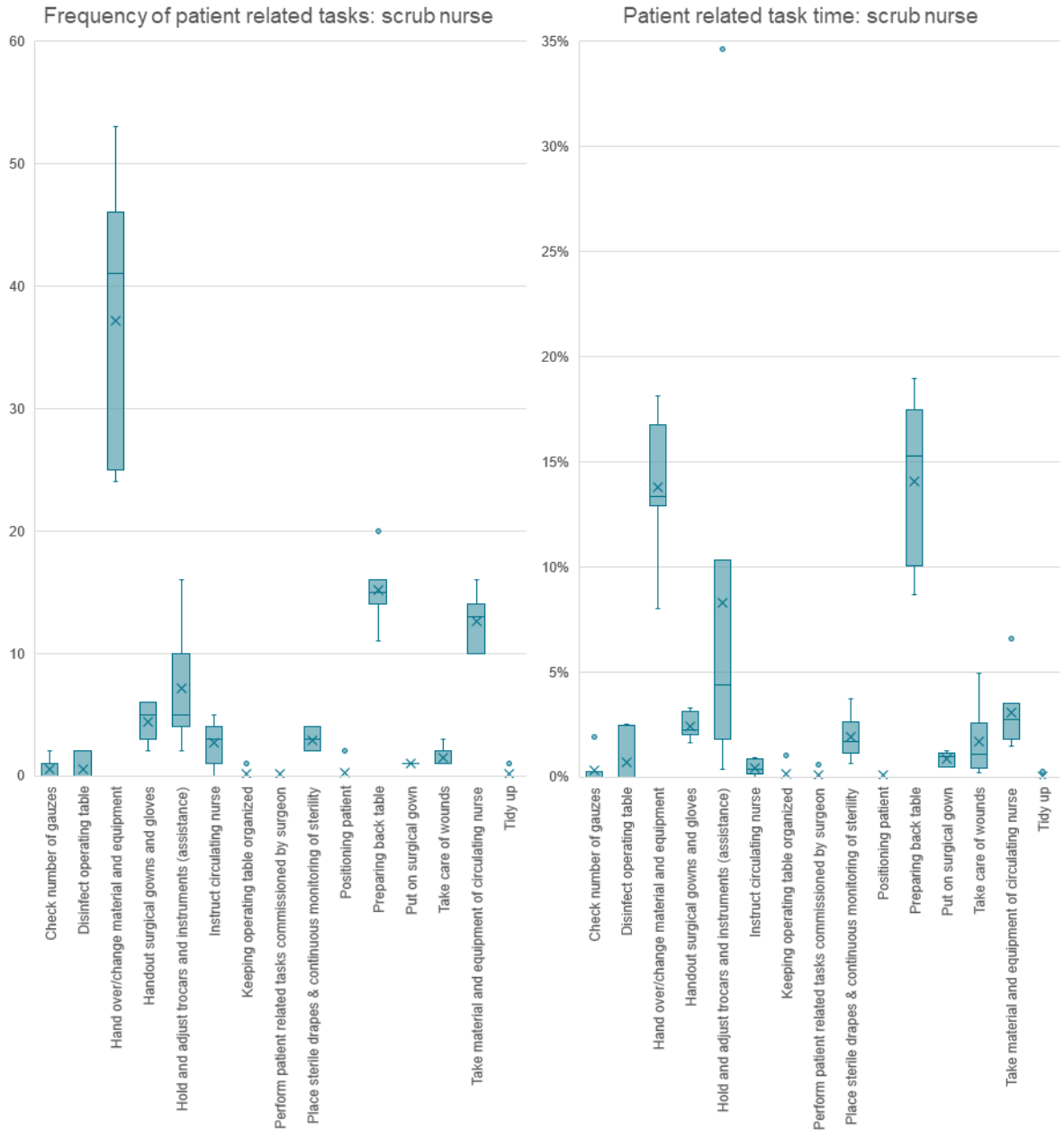
Figure 3.2: Box plot of the percentage of the total task time for each phase for the scrub and circulating nurses measured during video analysis

Task frequency After measurement of the duration of the task, the frequency and the total duration of the task during each recording was calculated for the scrub and the circulating nurse.

Scrub nurse In seven out of seven videos a scrub nurse was present. The three tasks with the highest frequency were patient-related. For the scrub nurse, the task material handover/change material and equipment had the highest frequency, namely 37.1. The other tasks which had the highest

scores were preparing the back table and take material of the circulating nurse with 15.1 and 12.6 respectively. The technical tasks assemble and connect laparoscopic instruments scores the highest with 8.1 and 6.3, respectively. The lowest patient-related tasks were tidy up (0.1), keeping the operating table organised (0.1), and perform patient-related tasks commissioned by the surgeon (0.1).

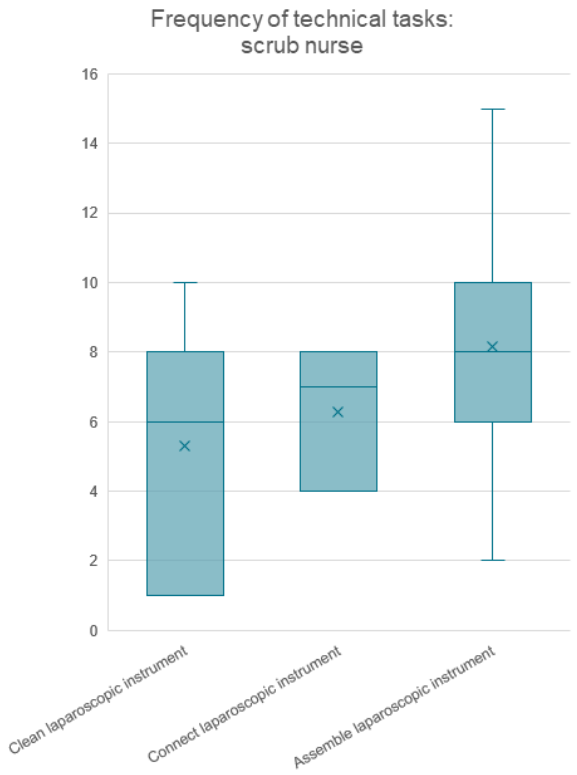
The percentage of task time to the total duration of the procedure for preparing back table, handover/change material and equipment, and hold and adjust trocars and instruments (assistance) were 14.04% (±4.12%), 13.78% (±3.24%), and 8.30% (±12.05%), respectively. The two lowest percentages were 0.06% for positioning the patient and 0.03% for tidy up. The remaining tasks which were measured were calling (0.1, 0.03%), chattering (0.4, 1.02%) and discuss with colleague (0.4, 0.08%). A box plot of the results of seven LH recordings for the scrub nurse is given in Figure 3.3.



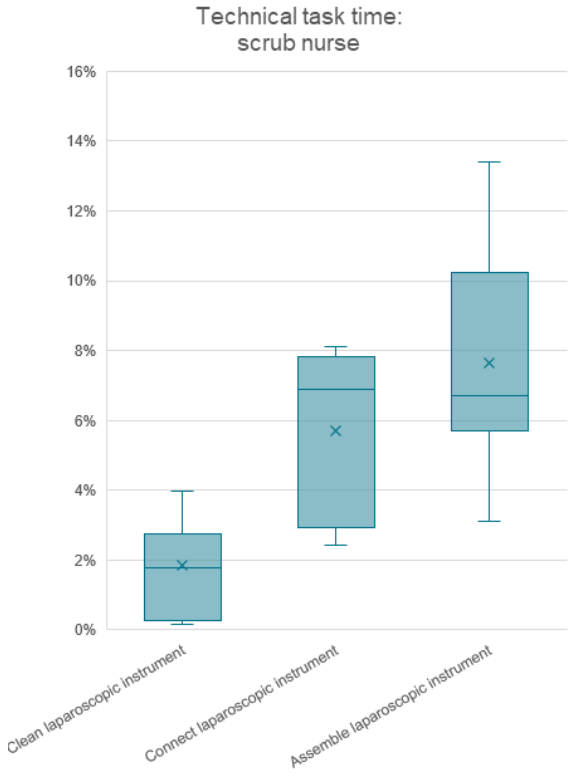
(a) Frequency of patient-related tasks

(b) Patient-related task time

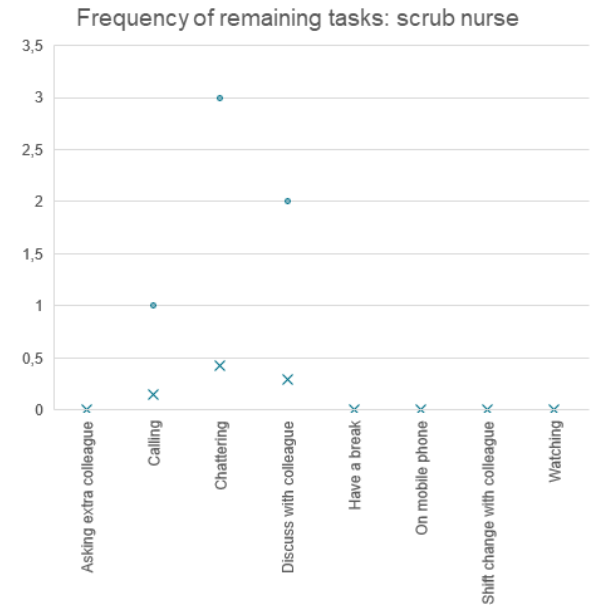
Figure 3.3: Box plots of the frequency of each task of the scrub nurse and total duration of each scrub nurse' task relative to the total duration of the procedure in seven recordings for each category



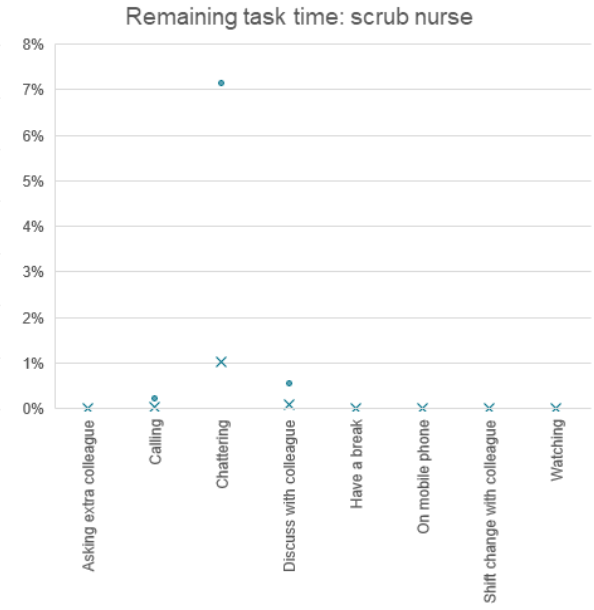
(c) Frequency of technical tasks



(d) Percentage of technical task time



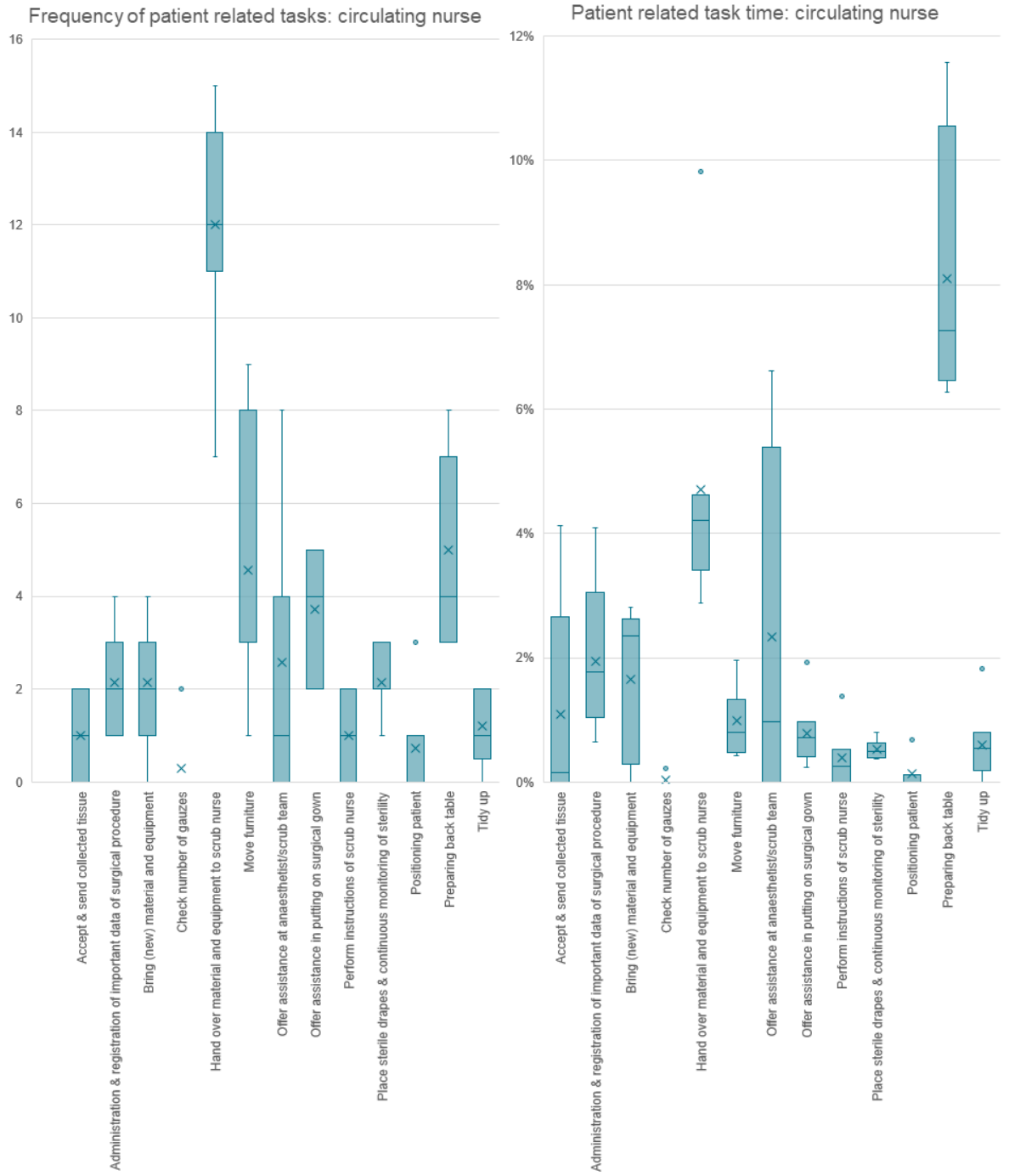
(e) Frequency of remaining tasks



(f) Percentage of remaining task time

Figure 3.3: Box plots of the frequency of each task of the scrub nurse and total duration of each scrub nurse' task relative to the total duration of the procedure in seven recordings for each category

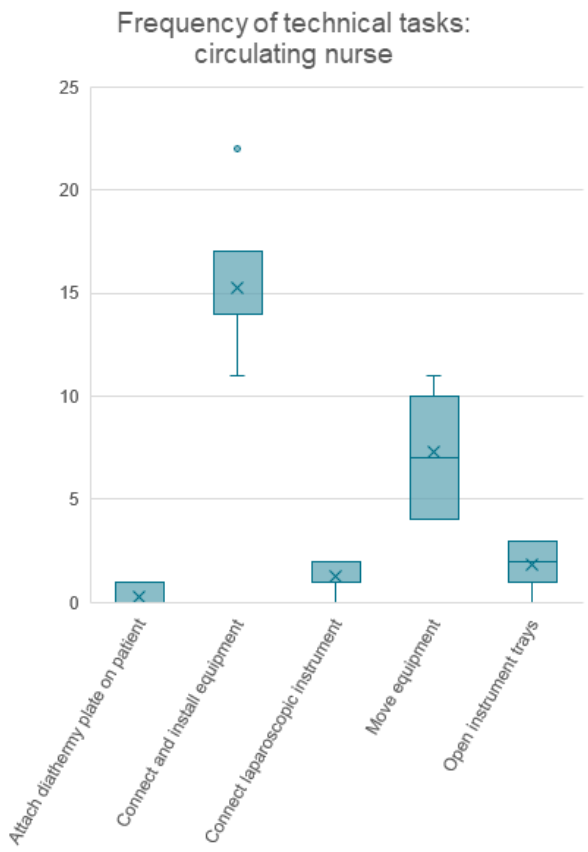
Circulating nurse The circulating nurse was present in seven out of seven videos. The three tasks with the highest frequency were connect and install equipment, handover material, and equipment to the scrub nurse and move equipment, 15.3, 12.0, and 7.3. Connect and install equipment, preparing back table, and to handover material and equipment to scrub nurse were tasks which had the highest percentage of task time to the total duration of the procedure, respectively, 10.52% ($\pm$4.35%), 8.10% ($\pm$2.09%), and 4.70% ($\pm$ 2.34%). The tasks which had the lowest frequency scores and lowest percentages were check the number of gauzes (0.3, 0.03%), attach diathermy plate on the patient (0.4, 0.25%), and positioning patient (0.7, 0.13%). Besides the technical task attach diathermy plate, the task connect laparoscopic instruments was the technical task which was not performed frequently and had a score of 1.3. This task had also the lowest percentage, 0.82%. The remaining tasks were measured in a range of 1.0 and 1.9 times. Calling, shift change with a colleague, and discuss with a colleague had the highest frequency (1.9, 1.7, and 1.3, respectively) for the remaining tasks. However, the task chattering which had a lower frequency score (1.1) had a higher percentage, 3.50%. A box plot of the results of all procedures is given in Figure 3.4.



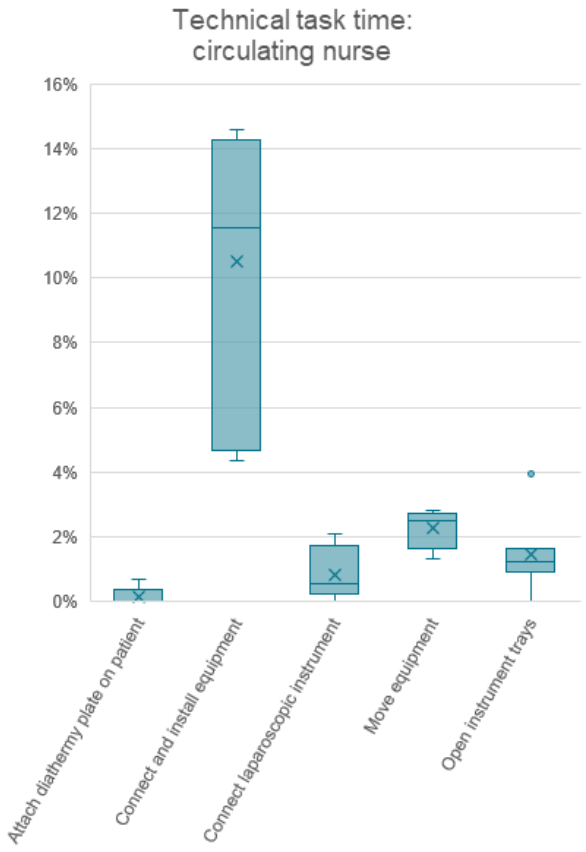
(a) Frequency of patient-related tasks

(b) Percentage of patient-related task time

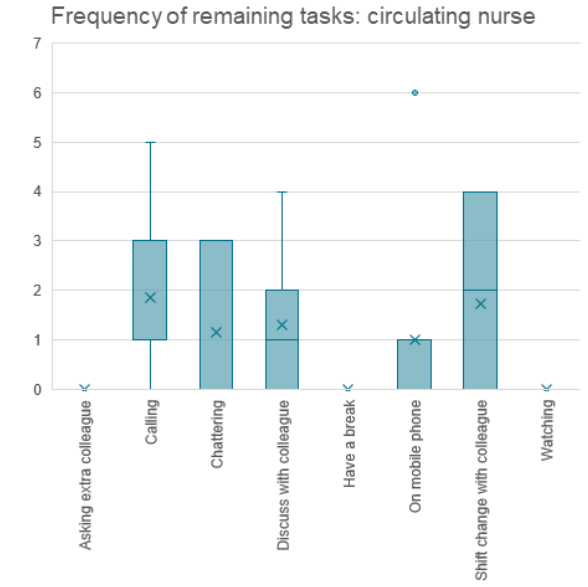
Figure 3.4: Box plots of the frequency of each task of the circulating nurse and total duration of each circulating nurse' task relative to the total duration of the procedure in seven recordings for each category



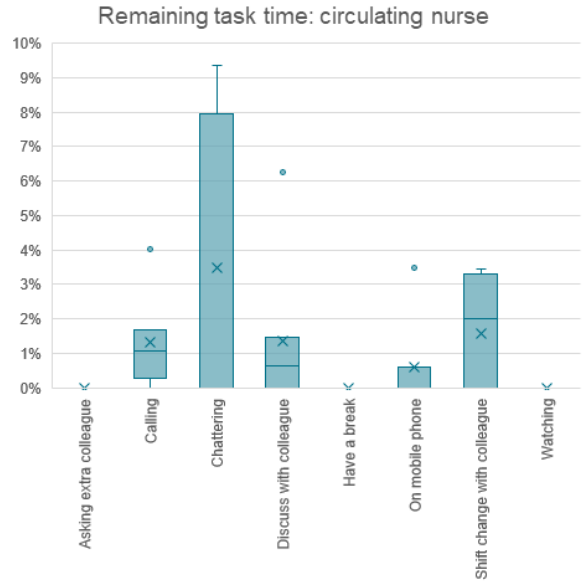
(c) Frequency of technical tasks



(d) Percentage of technical task time



(e) Frequency of remaining tasks



(f) Percentage of remaining task time

Figure 3.4: Box plots of the frequency of each task of the circulating nurse and total duration of each circulating nurse' task relative to the total duration of the procedure in seven recordings for each category

Per phase The total duration of each task per phase was measured for the scrub and circulating nurse and given in Table 3.4 and Table 3.5, respectively.

Table 3.4: Heat map of the mean percentages of the duration of each task of the scrub nurse per phase measured in seven procedures

Scrub nurse								
%	PO	A&SP	CO2	IAP	SP	FC&I	CUP	*Total*
Check number of gauzes	0.00	0.00	0.00	0.00	0.02	0.03	0.28	*0.33*
Disinfect the operating table	0.48	0.22	0.00	0.00	0.00	0.00	0.00	*0.71*
Handout surgical gowns and gloves	1.12	0.55	0.14	0.00	0.51	0.00	0.06	*2.38*
Hand over/change material and equipment	0.00	0.94	1.23	0.98	9.15	0.58	0.90	*13.78*
Hold and adjust trocars and instruments (assistance)	0.00	0.00	0.00	0.00	8.30	0.00	0.00	*8.30*
Instruct circulating nurse	0.00	0.01	0.12	0.04	0.20	0.00	0.05	*0.42*
Keep the operating table organized	0.00	0.14	0.00	0.00	0.00	0.00	0.00	*0.14*
Perform patient related tasks commissioned by surgeon	0.00	0.00	0.00	0.00	0.08	0.00	0.00	*0.08*
Place sterile drapes & continuous monitoring sterility	0.71	0.77	0.11	0.29	0.04	0.00	0.00	*1.92*
Position the patient	0.00	0.00	0.04	0.02	0.00	0.00	0.00	*0.06*
Prepare the back table	6.14	1.51	0.86	0.00	3.49	0.29	1.75	*14.04*
Put on surgical gown	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.85
Take care of wounds	0.00	0.00	0.00	0.00	0.00	0.07	1.60	*1.66*
Take material and equipment of circulating nurse	0.00	0.20	0.23	0.33	1.80	0.15	0.35	*3.07*
Tidy up	0.00	0.00	0.00	0.00	0.00	0.00	0.03	*0.03*
Assemble laparoscopic instrument	0.00	0.11	0.11	0.23	6.80	0.09	0.29	*7.64*
Clean laparoscopic instrument	0.00	0.29	0.23	0.00	1.22	0.09	0.00	*1.83*
Connect laparoscopic instrument	0.00	2.47	0.25	0.03	1.58	0.07	1.19	*5.68*
Asking extra colleague	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*
Calling	0.00	0.00	0.00	0.00	0.03	0.00	0.00	*0.03*
Chattering	0.00	0.00	0.00	0.00	1.02	0.00	0.00	*1.02*
Discuss with colleague	0.00	0.00	0.03	0.00	0.05	0.00	0.00	*0.08*
Have a break	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*
On mobile phone	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*
Shift change with colleague	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*
Watching	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*

Table 3.5: Heat map of the mean percentage of the duration of each task of the circulating nurse per phase measured in seven procedures

Circulating nurse								
%	PO	A&SP	CO2	IAP	SP	FC&I	CUP	*Total*
Accept & send collected tissue	0.00	0.00	0.00	0.00	0.09	0.12	0.87	*1.08*
Administration & registration of important data of surgical procedure	0.00	0.00	0.10	0.11	1.60	0.09	0.04	*1.95*
Bring (new) material and equipment	0.00	0.24	0.00	0.24	1.16	0.00	0.00	*1.65*
Check number of gauzes	0.00	0.00	0.00	0.00	0.01	0.00	0.02	*0.03*
Hand over material and equipment to scrub nurse	0.00	0.41	0.32	0.50	2.81	0.16	0.50	*4.70*
Move furniture	0.08	0.22	0.12	0.13	0.43	0.00	0.00	*0.99*
Offer assistance at anaesthetist/scrub team	0.00	0.05	0.00	0.00	2.11	0.00	0.16	*2.33*
Offer assistance in putting on surgical gown	0.55	0.19	0.00	0.00	0.03	0.00	0.00	*0.78*
Perform instructions of scrub nurse	0.00	0.04	0.00	0.05	0.30	0.00	0.00	*0.39*
Place sterile drapes & continuous monitoring of sterility	0.12	0.04	0.25	0.03	0.08	0.00	0.00	*0.52*
Position the patient	0.05	0.02	0.04	0.00	0.01	0.00	0.00	*0.13*
Preparing back table	5.42	0.49	0.03	0.04	1.03	0.10	0.98	*8.10*
Tidy up	0.01	0.00	0.01	0.08	0.36	0.00	0.14	*0.60*
Attach diathermy plate on patient	0.25	0.00	0.00	0.00	0.00	0.00	0.00	*0.25*
Connect and install equipment	0.12	2.04	1.23	0.17	4.66	0.14	2.16	*10.52*
Connect laparoscopic instrument	0.03	0.36	0.12	0.00	0.16	0.00	0.15	*0.82*
Move equipment	0.02	0.59	0.48	0.44	0.62	0.00	0.12	*2.26*
Open instrument trays	0.00	0.00	0.00	0.00	1.48	0.00	0.00	*1.48*
Asking extra colleague	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*
Calling	0.16	0.12	0.00	0.10	0.94	0.00	0.00	*1.31*
Chattering	0.00	0.00	0.00	0.00	3.50	0.00	0.00	*3.50*
Discuss with colleague	0.00	0.08	0.00	0.21	1.06	0.00	0.00	*1.35*
Have a break	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*
On mobile phone	0.00	0.00	0.00	0.15	0.44	0.00	0.00	*0.58*
Shift change with colleague	0.09	0.00	0.00	0.00	1.19	0.00	0.00	*1.28*
Watching	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*

3.1.2. Technological developments: percentage of technical tasks

The percentage of the total duration of all technical tasks for each phase was measured. The technical tasks for the scrub nurse were clean laparoscopic instruments, connect laparoscopic instruments, and assemble laparoscopic instruments. Attach diathermy plate on the patient, connect and install equipment, connect laparoscopic instruments, move equipment, and open instrument trays were technical tasks of the circulating nurse. An overview of these tasks is shown in Figure 3.5. The scrub nurse performed the highest average of technical tasks in phases A&SP and SP. In phases PO and IAP, the lowest average was measured for the scrub nurse. In phases A&SP and CUP, the highest variance in the percentage of the total duration of the tasks for the scrub nurse during the seven procedures was observed. The highest average of technical tasks performed by the circulating nurse was measured in phase CO2 and phase A&SP. The lowest average was measured in phases PO and FC&I for the circulating nurse. The highest variance was measured in phases A&SP, IAP, and CUP. Outliers were measured in phase FC&I for both nurses.

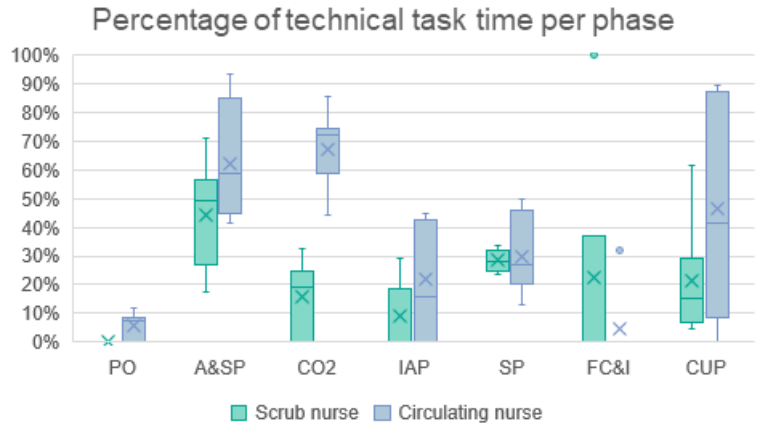


Figure 3.5: Box plot of the percentage of total duration of all technical tasks for each phase for the scrub and the circulating nurses according to video analysis

3.2. Interviews

Before the start of the interviews, a pilot was performed with four perioperative nurses to validate the questions. The set of questions were extended and some questions were divided into sub-questions. After these assumptions, interviews with ten perioperative nurses were performed. These perioperative nurses had different levels of experience in MIS. An overview of the characteristics of the participants is shown in Table 3.6.

Table 3.6: Participants characteristics of the interviews

	Pilot (N=4)		Interviews (N=10)	
	Median	IQR	Median	IQR
Gender (M/F)	0/4		2/8	
Age (years)	36	1.75	32	20.5
Experience level as perioperative nurse (years)	14	2.5	8.5	10
Experience level in MIS (years)	14	2.5	8.5	10.75
Amount of procedure	>100	0	>100	0

3.2.1. Overview of responsibilities: peak moments

Employability The employability was asked as the amount of physical activity for different surgical types and for each MIS phase.

General During the interviews, the participants were asked in part III of the interviews to estimate the percentage of their time they perform physical actions during OS, MIS, and RAS. This question was asked as a scrub nurse and as a circulating nurse. The results are presented as box plots in Figure 3.6. In the pilot interview, a distinction in MIS and RAS was not asked. Therefore, only the ten perioperative nurses who had experience in RAS were asked this specific question for that surgical procedure. Eight perioperative nurses answered this question for RAS.

As shown in Figure 3.6, the physical activity was the highest for OS and lowest for RAS for both perioperative nurses. In OS, the circulating nurse had a lower mean of the physical activity compared to the scrub nurse. For MIS and RAS, no difference between the results for both perioperative nurses was obtained. However, the variance for the circulating nurse was higher than for the scrub nurse in RAS and lower in OS.

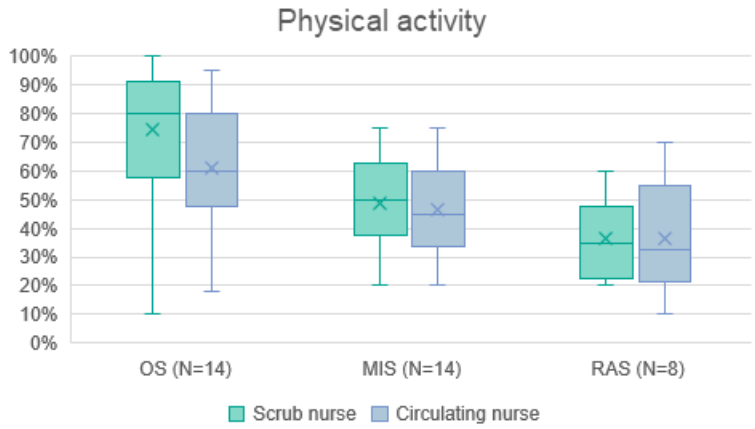


Figure 3.6: Physical activity for the scrub and circulating nurse for each surgery type answered by fourteen nurses for OS and MIS and eight nurses for RAS

The perioperative nurse indicated that the amount of physical activity depends on the type of procedure, the duration of a procedure, and the level of experience of the surgeon. For example, a procedure in which more blood loss occurred induced a higher amount of physical activities of the circulating nurse.

One reason was given about the lower score for MIS in comparison with OS. The score was related to the lower amount of instruments used, therefore the scrub nurse performed less hand over/change of instruments. The circulating nurse had to connect more equipment during MIS than during an OS procedure. The scrub nurse had nothing to do when the surgeon worked on preparations. The lower score for both nurses could be explained to the duration of the procedure: RAS procedures take all day.

Per phase During part IV of the interview, the perioperative nurses were asked to estimate the physical activity they experienced during the surgical procedure per phase. In phase PO, A&SP, and CUP, the scrub and the circulating nurse scored a high level of employability as shown in Figure 3.7. In the other phases, the percentage of the physical activity of the scrub nurse was higher than the circulating nurse.

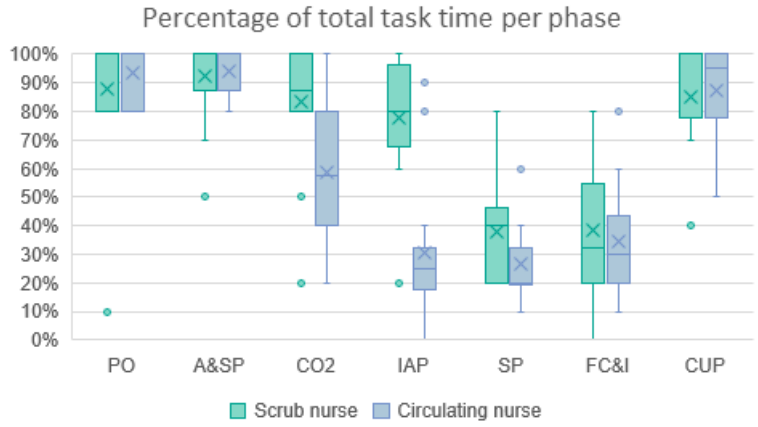


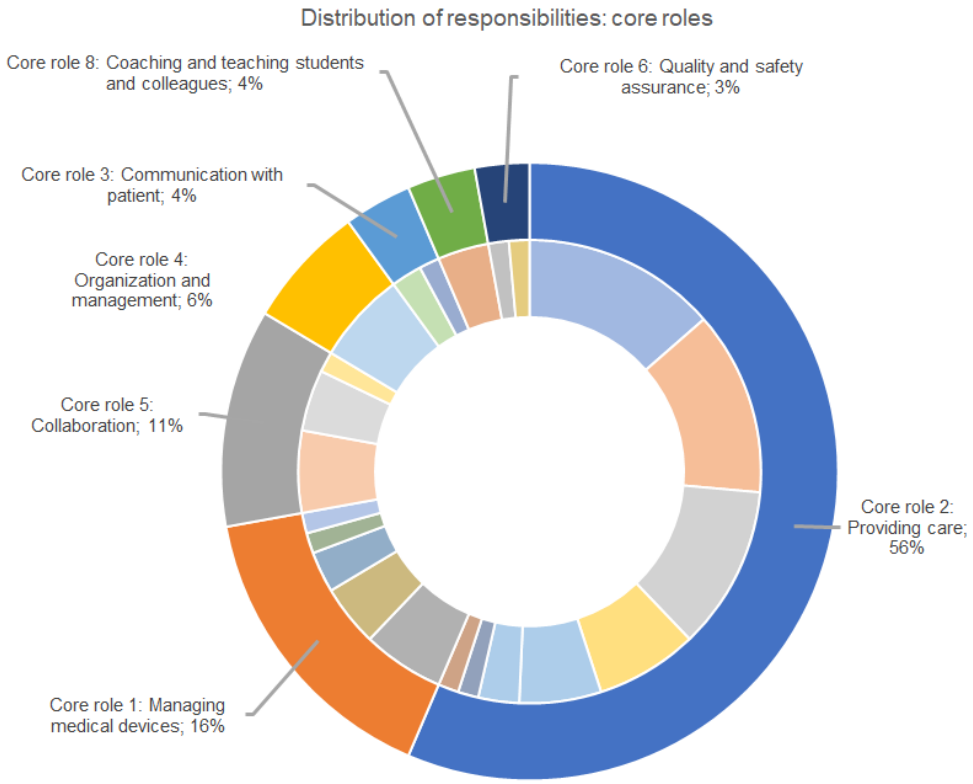
Figure 3.7: Box plot of the physical activity for each phase for the scrub and the circulating nurse according to the interviews. The number of interviewees was fourteen.

Tasks The interviewees received a part of the list of core roles with corresponding tasks formulated by the Dutch association of perioperative nurses (Landelijke Vereniging Operatieassistent, LVO) in advance. The interviewee was asked to mention the five main tasks of the desired responsibilities for MIS. The five main tasks according to fourteen perioperative nurses were:

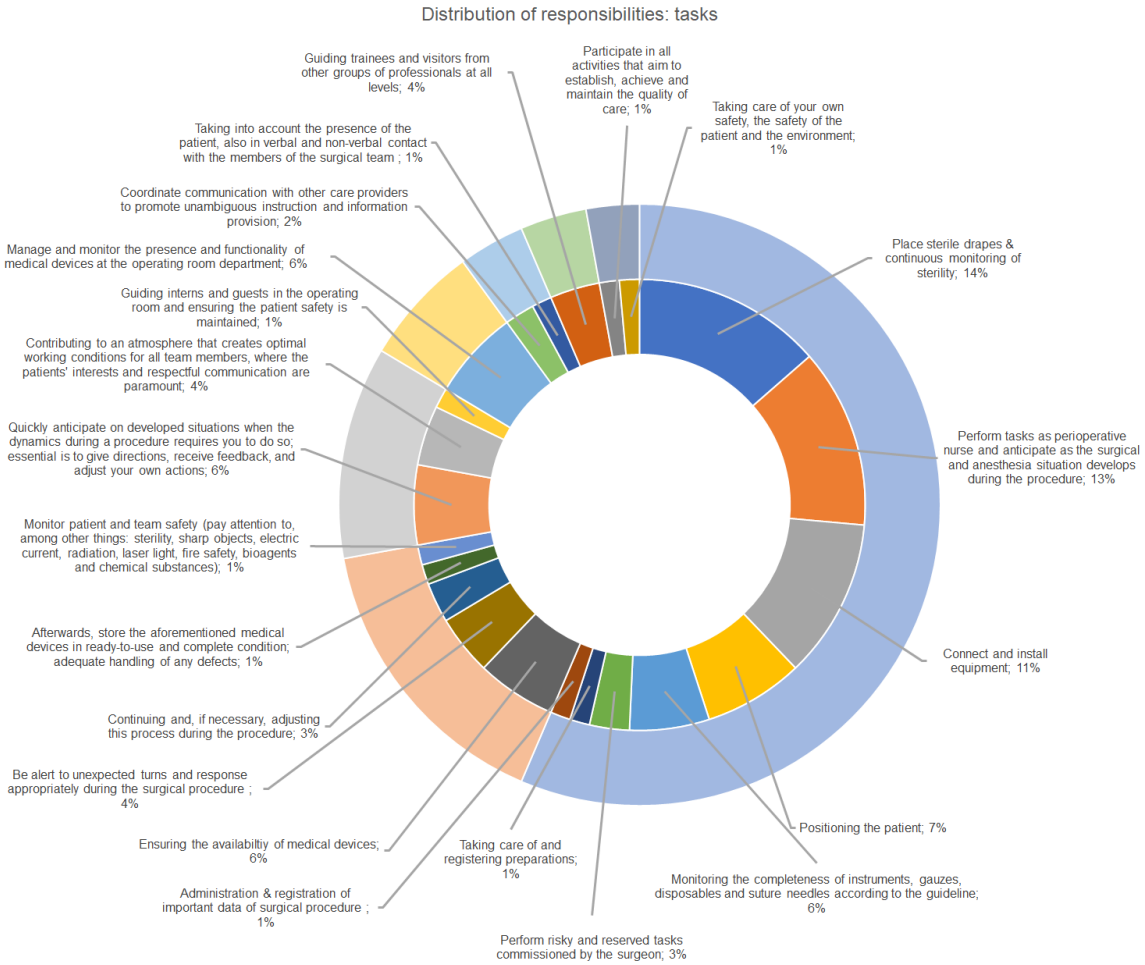
- Place sterile drapes & continuous monitoring of sterility (14%)
- Perform tasks as perioperative nurse and anticipate as the surgical and anaesthesia situation develops during the procedure (13%)
- Connect and install equipment (11%)
- Manage and monitor presence and functionality of medical devices at the operating room department (6%)
- Ensuring the availability of medical device (6%)

The order of the core roles and the distribution of the most desired responsibilities for each core role is depicted in Figure 3.8.

The second question corresponded to the main tasks of the current responsibilities. 11 out of 14 perioperative nurses indicated that the main tasks of the desired responsibilities correspond to the current responsibilities. The others stated that ensuring the availability of medical devices was taken over by logistics and the current definition of managing and monitoring is checking on time and taking the device somewhere if it is necessary. Another addition to the list is the assisting role during RAS. Furthermore, one perioperative nurse stated that there is too much focus on checking and administrative tasks.



(a) Distribution of the seven core roles



(b) Distribution of the tasks for each core role

Figure 3.8: Distribution of responsibilities according to the fourteen perioperative nurses

An extra question was added to figure out the percentage of the number of administrative tasks the perioperative nurse experience during a procedure (see Figure 3.9). The perioperative nurse who score the administrative tasks as 75% declared that this percentage occurred in procedures in which the nurse was busy with tissue collections.

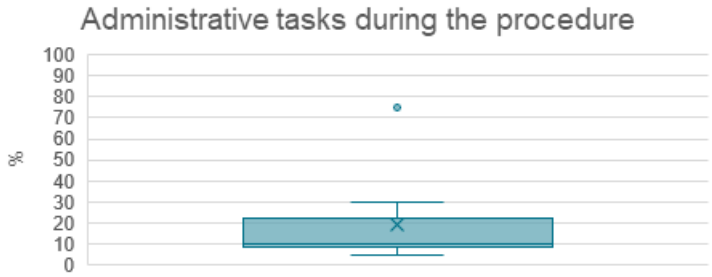
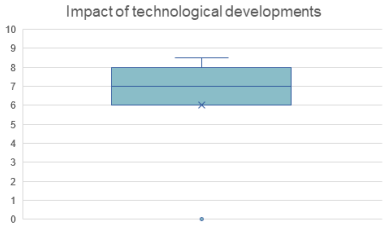


Figure 3.9: Box plot of the percentage of the number of administrative tasks during the procedure experienced by ten perioperative nurses

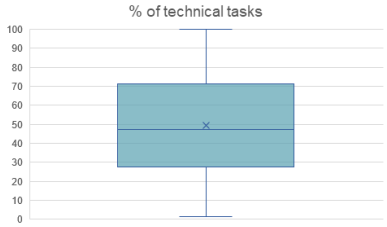
3.2.2. Technological developments: workload

In part I of the interview, the impact of technological developments were asked in ten questions. The multiple-choice question (1.4) is not presented in the figures. Every participant agreed that the workload differed for each phase during the surgical procedure.

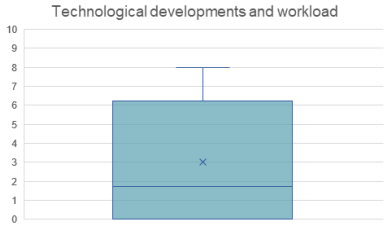
The participants of the pilot had different scores of workload (question 1.3); some participants experienced another level of the physical load than mental load. Therefore, this question was divided into physical and mental load in the interviews. One perioperative nurse would like to give other scores for the circulating nurse than for the scrub nurse in question 1.6 and 1.7, therefore these questions were subdivided in the two different roles. Furthermore, the participants gave different answers to the last question. More extra help was needed to install and adjust equipment than to assemble an (laparoscopic) instrument. The questions which were not changed after the pilot are shown in Figure 3.10. The answers on the modified questions of the pilot and interviews are shown in Figure 3.11 and Figure 3.12, respectively.



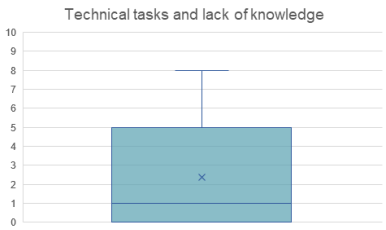
(a) Q:How much influence do technological developments have on your work during MIS?



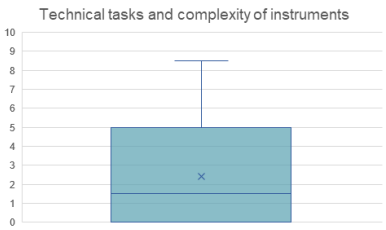
(b) Q:What percentage do you spend on technology compared to the total duration of MIS?



(c) Q:To what extent have technological developments contributed to this increased workload?

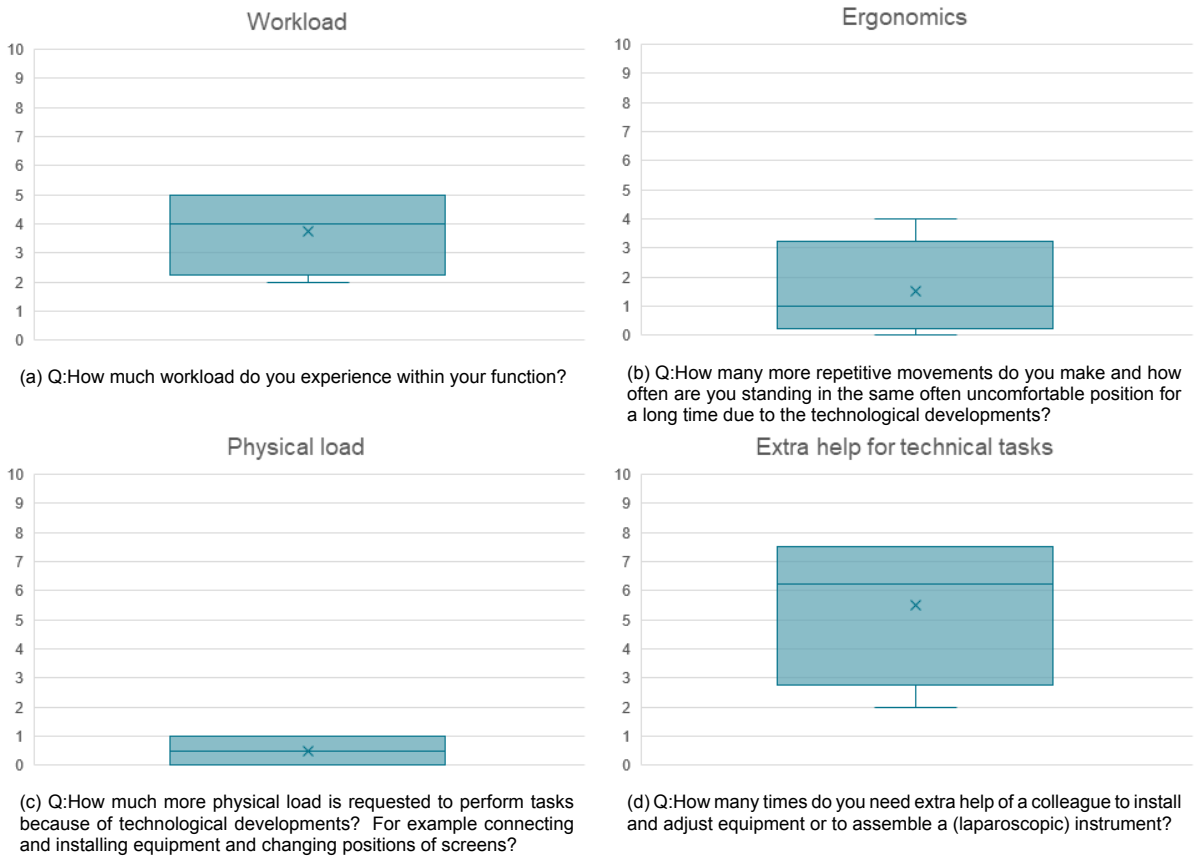


(d) Q:To what extent are you more limited in performing the technical tasks due to a lack of knowledge about the instruments and equipment?



(e) Q:To what extent are you more limited in performing the technical tasks due to the complexity of the instruments and equipment?

Figure 3.10: Answers on question of part 1 of the pilot and interview: impact of technological developments. The number of interviewees was fourteen.



(a) Q:How much workload do you experience within your function?

(b) Q:How many more repetitive movements do you make and how often are you standing in the same often uncomfortable position for a long time due to the technological developments?

(c) Q:How much more physical load is requested to perform tasks because of technological developments? For example connecting and installing equipment and changing positions of screens?

(d) Q:How many times do you need extra help of a colleague to install and adjust equipment or to assemble a (laparoscopic) instrument?

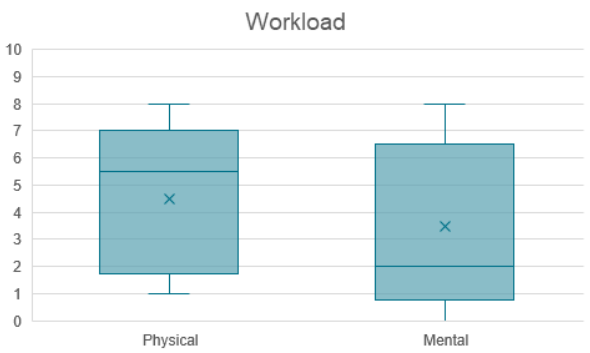
Figure 3.11: Answers on question of part 1 of the pilot interviews: impact of technological developments. The number of interviewees was four.

All participants agreed that the technological developments had a high influence on their work during MIS. The technological developments introduced other tasks (2), more technical tasks (2), and more equipment (1). One nurse indicated that more technical tasks introduced more irritation of the team members. The graduated perioperative nurses were introduced with the new methods, therefore the technological developments had always an impact (3). For RAS, the perioperative nurses had to follow robotic courses (1). The opinion about the difficulty of the activities differed; one perioperative nurse agreed that the activities were more difficult by the increase of technical procedures and another found the procedure easier than an open procedure.

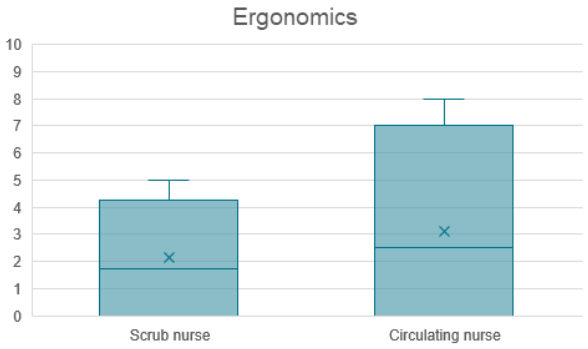
There was no consensus about the amount of time they spent on technology compared to the total duration of a MIS procedure. Three perioperative nurses spent the entire procedure on technology (i.e., diathermy, camera, bring new equipment, turning light on/off, set up, assembling, disconnecting instruments). Two nurses stated that the start phase was mentioned as a phase with more technology. One nurse had only technical tasks before the procedure. According to one nurse, a correlation between the percentage of technical tasks and the type of procedure was mentioned.

The perioperative nurse experienced slightly less mental workload in comparison with the physical workload. The technological developments had an average influence on this workload, especially new technological developments, such as RAS, contributed to a higher workload. Four different reasons were mentioned, namely knowledge (i.e., the expert has to know everything), costs (i.e., afraid to damage instruments/equipment), the amount of work, and quality of the instruments/equipment.

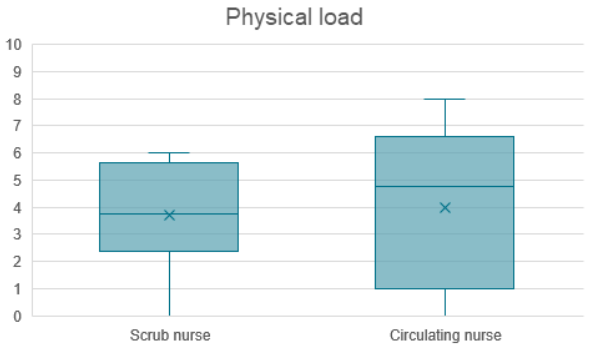
The circulating nurse made slightly more repetitive movements and stand slightly more in an uncomfortable position for a long time. Mentioned by the perioperative nurses, due to technological developments the possibility to take a seat became higher and the possibility to stand in a comfortable position became lower for the scrub nurse. The latter was caused by the longer instruments during MIS and the arms of the robot according to one perioperative nurse. Three operative nurses indicated



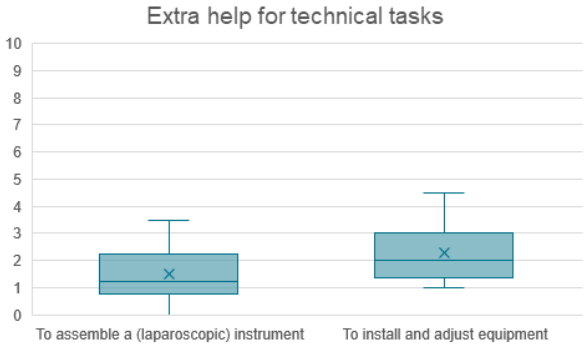
(a) Q:How much workload do you experience within your function?



(b) Q:How many more repetitive movements do you make and how often are you standing in the same often uncomfortable position for a long time due to the technological developments?



(c) Q:How much more physical load is requested to perform tasks because of technological developments? For example connecting and installing equipment and changing positions of screens?



(d) Q:How many times do you need extra help of a colleague to install and adjust equipment or to assemble a (laparoscopic) instrument?

Figure 3.12: Answers on question of part 1 of the interviews: impact of technological developments. The number of interviewees was ten.

an uncomfortable position as a circulating nurse, especially sitting on the knees to connect instruments and equipment. One reason mentioned for the lower score was the high amount of time sitting during the procedure.

A higher variance in the requested ergonomics for the circulating nurse was obtained. Overall, both nurses score on average on this aspect. Some perioperative nurses scored the ergonomics of the scrub nurse with more than 4 out of 10. A reason was the amount of squirming movements. Also, a preference to do more work in an uncomfortable position than to bore or to sit for a long time during the procedure was mentioned by one nurse. The nurse gave a high score because of this reason. The grounds of the high ergonomic level of the circulating nurse were sitting on the knees, moving equipment, and connecting instruments and equipment. Less freedom of movement was given as a low ergonomic score.

The nurses were less limited in performing technical tasks due to a lack of knowledge or the complexity of the instruments and equipment. The limitation to perform technical tasks due to a lack of knowledge depend on age and the low frequency of usage of instruments and equipment according to the perioperative nurses. New instruments are more difficult to use. In the current education application of the instruments and equipment is included. Therefore, recently graduated nurses were not limited to perform technical tasks. One perioperative nurse stated that they have a lack of knowledge to solve instrument problems. A correlation between knowledge and complexity was obtained. One perioperative nurse scored high on both limitations because of the complexity of the laparoscopic instruments. Two perioperative nurses specifically said that the equipment was complex. The level of introduction of new instruments for RAS was high and therefore performing technical tasks increased. Others said that the instruments were idiot-proof and therefore the level of limitation due to the complexity of instruments was low.

The nurses need slightly more help for installing and adjusting equipment than for assembling a

(laparoscopic) instrument. One perioperative nurse asked the technical service for help when assembling an instrument and one perioperative nurse said that colleagues ask him/her for help. Another nurse asked the circulating nurse to bring a new instrument when the instrument is not working. Other nurses tried to fix the instrument by themselves. Extra help from a colleague was needed when the usage frequency was low of the equipment. Another nurse asked the technical service quickly when installing equipment. If the failure of the equipment occurred, one nurse stated that the nurse has no knowledge to solve it and extra help is needed.

The phase and tasks which required more time during a MIS procedure relative to OS procedure were asked in part III of the interviews. The results are shown in Table 3.7 and Table 3.8. According to two perioperative nurses, no task required more time during MIS than OS. Another perioperative nurse mentioned that the physical activity of the circulating nurse was increased during MIS relative to OS.

Table 3.7: The phase which required more time during a MIS procedure relative to OS procedure. In the brackets, the number of perioperative nurses who mentioned the corresponding phase.

Phase which required more time during MIS vs OS	
Beginning (2)	Tidy up (1)
Starting (3)	
Introduction (1)	

Table 3.8: The tasks which required more time during a MIS procedure relative to OS procedure. In the brackets, the number of perioperative nurses who mentioned the corresponding task.

Task which required more time during MIS vs OS	
Connecting equipment (7)	Checking equipment (4)
Problem solving (1)	Insert trocars (1)
Roll out cables (1)	No tangle of cables (1)
Packing the camera (1)	Setting up the camera (1)
White balance (1)	Positioning (1)
Adjusting the robot properly (1)	Sterile covering of robot (1)

In part III an extra question was added after the pilot interviews. The preference for OS versus MIS was asked for ten perioperative nurses. The nurses gave a preference score for OS versus MIS between 5 and 10 out of 10 (see Figure 3.13).

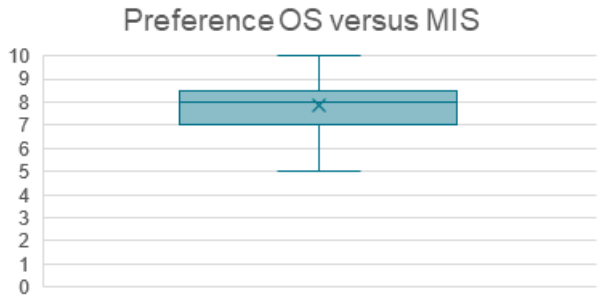


Figure 3.13: Preference to work as perioperative nurse during OS versus MIS. The number of interviewees was ten.

Six perioperative nurses mentioned that OS is more interesting and nicer, however, MIS is more efficient and has more advantages for the patient. Two perioperative nurses preferred the combination of both procedures. Five nurses gave a high score because OS is more challenging and the physical activity is higher. Another nurse said that the reason to became a perioperative nurse was to assist an OS procedure.

In part III the current and ideal ratio between technical tasks and patient-related tasks were asked. No assumptions were made. These results are shown in Figure 3.14. The nurses preferred a slightly

less number of technical tasks. Five perioperative nurses gave the current and ideal situation the same score and declared that technology is part of it. The nurses (4 out of 10) who gave a lower ratio of technology vs patient-related tasks for the ideal situation than for the current situation mentioned that the patient-related tasks are nicer to perform. One perioperative nurse gave a higher score to technical tasks relative to patient-related tasks because more technology is important. Two perioperative nurses who gave a low score to both situations declared that they were not much concerned with technology. Three nurses gave for RAS a higher ratio of technical tasks relative to patient-related tasks because the robot is new, which is not depicted in Figure 3.14

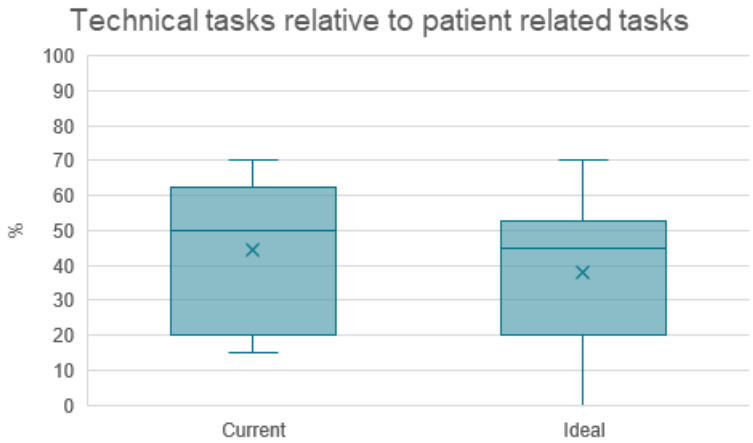


Figure 3.14: Box plot of the ratio of technical tasks versus patient-related tasks in a current and an ideal situation in MIS. The number of interviewees was fourteen.

In part IV of the interview, the percentage of the total duration of technical tasks for each phase was asked. No assumptions were made after the pilot. The answers of the fourteen perioperative nurses are given in Figure 3.15. In phase FC&I the lowest percentage of the total duration of technical tasks was obtained for the scrub nurse. The percentage of the total duration of technical task was the lowest for the circulating nurse during phases IAP, SP, and FC&I. The highest value was obtained in phase A&SP for the circulating nurse. In phases A&SP, CO2, and CUP, the circulating nurse performed more technical tasks than the scrub nurse.

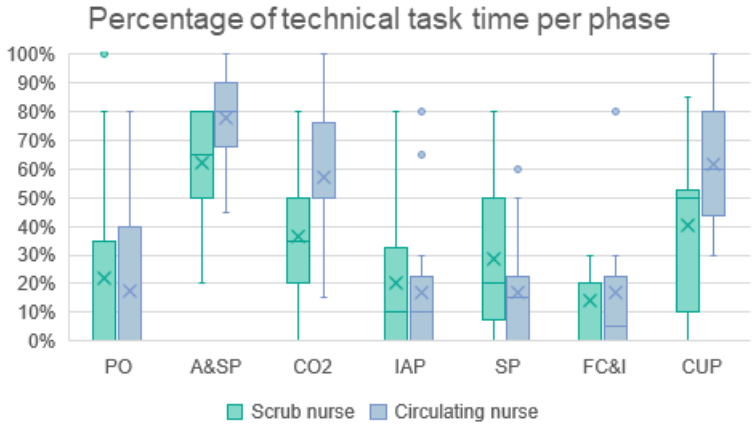


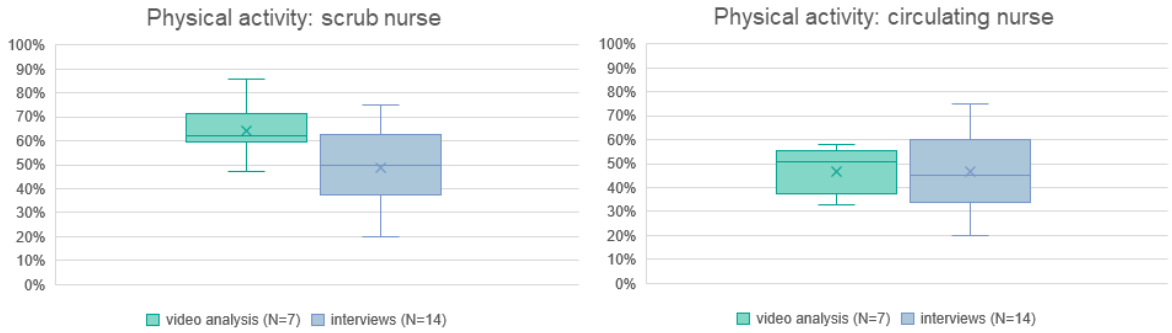
Figure 3.15: Box plot of the percentage of the total duration of the technical tasks for each phase for scrub and circulating nurse according to fourteen interviewees.

3.3. Video analysis versus interviews

3.3.1. Overview of responsibilities

The total physical activity measured during the video analysis (Figure 3.1) and experienced by the perioperative nurses for MIS procedure (Figure 3.6) are merged in Figure 3.16.

The outcomes of both methods for the scrub nurse were different. No difference was found for the circulating nurse. A higher variability during the interviews was obtained.



(a) Physical activity of the scrub nurse

(b) Physical activity of the circulating nurse

Figure 3.16: Box plot of the physical activity of the perioperative nurses measured during the video analysis and interviews

The outcomes of the video analysis and the interviews of the percentage of the total duration of the patient-related and technical tasks are merged for each phase in Figure 3.17. The main tasks measured through the video analysis and mentioned by the participants of the interviews are shown in Table 3.9

In phase PO, the results of the scrub nurse were likely to be different between the two methods. The video analysis indicated a wider distribution in phase PO compared to the interviews. According to the video analysis, many tasks were performed simultaneously in phase PO for the scrub nurse. These were experienced as continuously busy by the perioperative nurses in the interviews. 75% of the data of the scrub nurse was higher than the data of the interview. As shown in Table 3.5, many tasks were performed by the circulating nurse in this phase, however for a small mean duration of the tasks. The outlier of the scrub nurse in phase PO could be declared by a perioperative nurse which stated during the interview: ”Many preparation tasks, e.g., checking equipment, were performed before this phase”.

The data of the video analysis were more variable in phase A&SP for both nurses. Different results measured through both methods were obtained for the circulating nurse in phase A&SP. 75% of the data of the interviews was higher than the video analysis of the circulating nurse. Similar to the outcomes of phase PO, many tasks were performed by the circulating nurse, however with a small mean duration of the tasks, as shown in Table 3.5. According to the video analysis, many tasks were performed simultaneously in phase A&SP for the scrub nurse, these were experienced as continuously busy by the perioperative nurses in the interviews. During the interviews, one perioperative nurse stated that the circulating nurse connect all instruments and equipment in phase A&SP and therefore, the scrub nurse had fewer tasks to perform which was shown as an outlier.

The outcomes for the scrub nurse in phase CO2 between the two methods were likely to be different. A wider distribution of the total duration of all tasks in phase CO2 was measured for the scrub nurse during the video analysis. The outliers obtained through interviews were included in this range of scores. 75% of the data of the scrub nurse in all seven video recordings was lower than the data according to the interviews. The perioperative nurses were continuously busy with inserting the trocars according to the interviews. In the video analysis the same number of tasks as in phase A&SP were performed, however in a small time frame. No explanation of the outlier at 20% in the data of the interviews was mentioned. One perioperative nurse gave a score of 50% to the amount of physical activity during this phase. This was given as an outlier and the nurse stated as ”waiting till the abdomen are insufflated”. The outcomes of the interviews showed more variability in phase CO2 for the circulating nurse. The answers of the perioperative nurses varied from nothing to do till many to do. The main tasks of the circulating nurse according to the video analysis in this phase were connect and install equipment and move equipment which was also mentioned by the perioperative nurses. However,

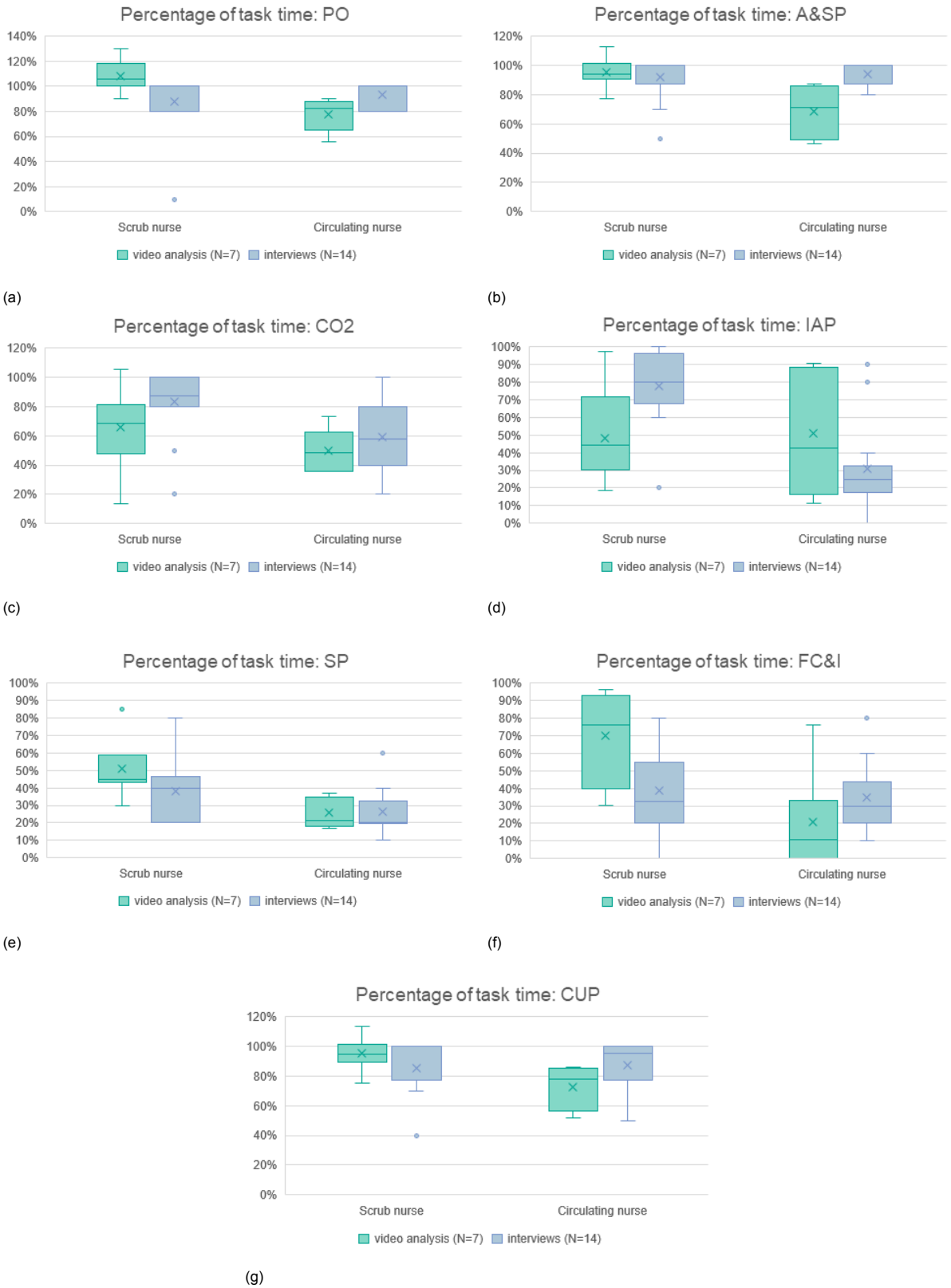


Figure 3.17: Percentage of the total duration of the patient related and technical tasks obtained through video analysis and the percentage of the physical activity experienced by the perioperative nurses during the interviews.

these tasks took roughly half of the phase time.

The outcomes for the scrub nurse in phase IAP between the two methods were likely to be different. A correlation in the number of tasks for the scrub nurse and the total duration of the task 'hand over/change material and equipment' was obtained. A higher ratio task time and phase time contributed to a higher percentage of the total duration of the tasks. Therefore, the duration of the task and the phase varied a lot. According to the perioperative nurses, phase IAP was experienced as a busy phase with hand over/change material and inserting trocars. The outlier in the data of the scrub nurse experienced this phase not as high. For the circulating nurses, wider distribution was obtained in phase IAP during the video analysis. The participants of the interviews stated that the circulating nurse had some tasks in this phase. The outliers mentioned that both nurses are busy during phase IAP. A correlation with the ratio of different types of tasks and the percentage of the total duration of the tasks was obtained for the circulating nurse in phase IAP. During the procedures in which the circulating nurse had no remaining tasks and the duration of the patient-related tasks was higher than the duration of the technical tasks, the circulating nurse had a higher total duration of the tasks in phase IAP.

The outcomes for the scrub nurse in phase SP between the two methods were likely to be different. The outcomes of the interviews showed more variability in phase SP for both nurses. The highest percentage of the total duration of the tasks was performed in a procedure in which the scrub nurse more than 50% of the phase performed the assistance task 'hold and adjust trocars and instruments'. Hand over/change material and equipment was the main task of the scrub nurse in phase SP which was scored between 20% and 50% and by one perioperative nurse experienced as 80%. The medians of both methods in phase SP for the circulating nurse were the same. However, slightly more variable data in the middle 50% of the data were obtained during the video analysis compared to the interviews. The outlier of the circulating nurse obtained during the interview was declared by the administrative tasks the circulating nurse performed during phase SP.

The outcomes for both nurses in phase FC&I between the two methods were likely to be different. No correlation between the duration of the tasks and ratio between different types of tasks or the performed tasks can be found in phase FC&I. The middle 50% of the data of the video analysis was more variable for the scrub nurse than the data of the interviews. According to the video analysis, the main task of the scrub nurse was hand over/change material and equipment which was, besides tidy up, also mentioned by the perioperative nurses in the interviews as the main task. The circulating nurse obtained a wider distribution of the total duration of tasks for the video analysis. The circulating nurse was waiting/not busy according to the perioperative nurses. The nurse of the outlier of 80% counts gauzes in this phase. The results of the video analysis for the circulating nurse were based on one task, namely, hand over material to the scrub nurse. The highest duration of the total task time could be declared to administration and accept & send collected tissue.

In the last phase, the circulating nurse obtained a wider distribution of the total duration of tasks for the interviews. The outlier in phase CUP according to the interviews was stated by a perioperative nurse that the scrub nurse is sort of busy.

An overview of the responsibilities in time are given in Figure 3.18. As mentioned above, every perioperative nurse has their owned order of tasks during the different phases.

Table 3.9: Overview of the main tasks of each phase for each perioperative nurse per method

	Scrub nurse		Circulating nurse	
Phase	Video analysis	Interviews	Video analysis	Interviews
PO	Preparing back table, handout surgical gowns put on surgical gown, disinfect operating table/place sterile drapes	Put on surgical gown, helping sterile team with surgical gown, pack the camera, preparing instruments and equipment	Preparing back table, offer assistance in putting on surgical gown, positioning patient and connect an install equipment	(Constantly) Busy: positioning, attach diathermy plate on patient, offer assistance to sterile team in putting on surgical gown
A&SP	Connect laparoscopic instrument, preparing back table, place sterile drapes	Placing sterile drapes, connect and install instruments and equipment	Connect and install equipment, move equipment, hand over material and equipment, preparing back table	Connect and install instruments and equipment
CO2	Hand over/change material and equipment, preparing back table	Constantly busy: busy with trocars	Connect and install equipment, move equipment	Amount of tasks depending per nurse, busy with light and CO2
IAP	Hand over/change material and equipment	Constantly busy: hand over and adjust trocars	Hand over material and equipment to scrub nurse, move equipment	Not busy: hand over some material and equipment, administration (sometimes)
SP	Hand over/change material and equipment, assemble laparoscopic instrument, hold and adjust trocars and instruments, preparing back table	Not busy: hand over/change material and equipment	Connect and install equipment, hand over material and equipment, offer assistance at anaesthetist/scrub nurse, preparing back table, open instrument trays, administration	Not busy: bring new material and equipment, adjust equipment, administration
FC&I	Hand over/change material and equipment and preparing back table	Depend on check: hand over instruments	Hand over material and equipment, preparing back table	Waiting
CUP	Take care of wounds, preparing back table, disconnect laparoscopic instrument	Busy: tidy up, check and counting instruments	Disconnect and uninstall equipment, preparing back table, accept and sen collected tissue	Busy: tidy up

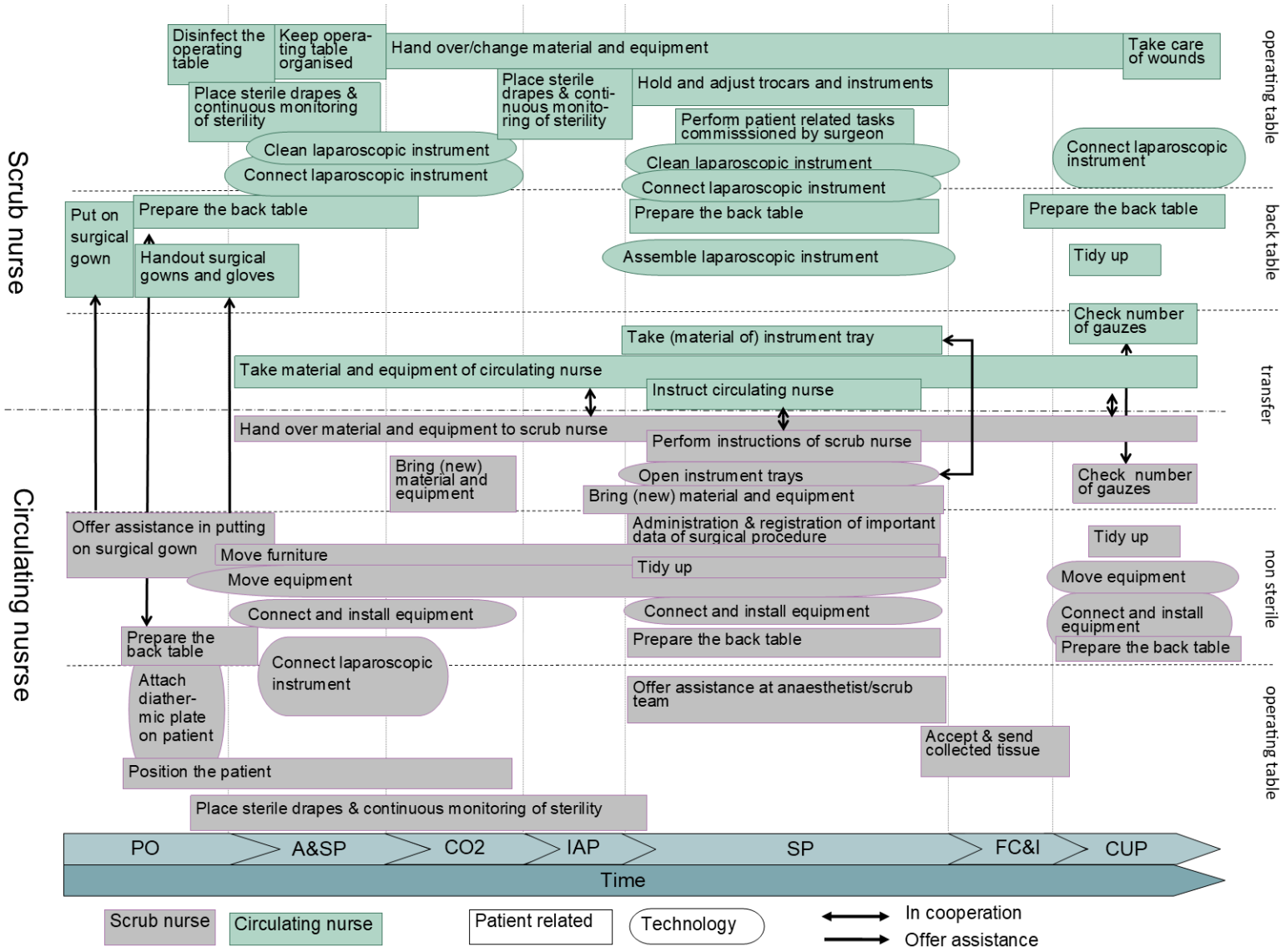


Figure 3.18: Realistic conceptual model of all tasks performed during a surgical procedure. The tasks in the same phase were not performed simultaneously and the size of the block does not correspond to the duration of the task.

3.3.2. Technological developments

The outcomes of the video analysis and the interviews of the total duration of all technical tasks are merged for each phase in Figure 3.19.

No difference between the outcomes of the video analysis and the interviews were obtained.

Wider distribution for both nurses was obtained in the interviews in phase PO. The scrub nurses who performed technical tasks in phase PO were focused on assembling and connecting instruments and checking the functionality of the medical devices in which one perioperative nurse scored this result as 100%. The outcomes of other perioperative nurses were similar to the video analysis namely, no technical tasks were performed in phase PO. The circulating nurse focused on attaching a diathermy plate and connecting equipment. These two tasks were also the main tasks according to the video analysis. However, the total time of these tasks was small.

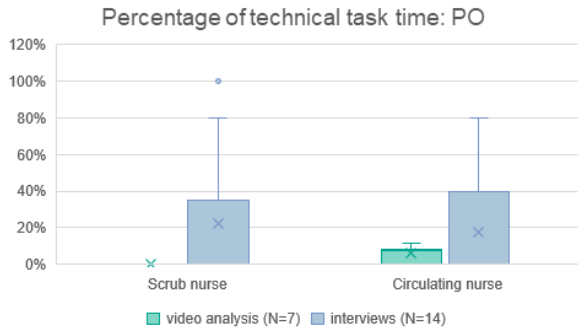
The results of both methods for both nurses in phase A&SP were likely to be different. The middle 50% of the data of the video analysis was more variable in phase A&SP for the circulating nurse. Connecting of equipment was the main task of the scrub nurse in phase A&SP according to both methods. Both nurses performed many patient-related tasks in a small time frame.

Wider distribution for both nurses was obtained in the interviews in phase CO2. The total duration of the task of the scrub nurse in phase CO2 was likely to be different. In phase CO2 the scrub nurse did some technical tasks as connecting the equipment and insert CO_2. Other technical tasks were adapting the light and white balance mentioned by one perioperative nurse. In the video analysis, these tasks took less time, other patient-related tasks were performed for a longer period by the scrub nurse during this phase. For the circulating nurse, the same tasks were mentioned by the perioperative nurses in which light was one of the main tasks. However, the ratio of technical and patient-related tasks was higher for the circulating nurse than the scrub nurse. According to the video analysis, connecting and moving equipment were the main tasks of all tasks in phase CO2. Therefore, the outcomes of the video analysis were slightly higher than the data of the interviews.

The interviews and the video analysis indicated a wider distribution in phase IAP for the scrub nurse and the circulating nurse, respectively, compared to the other method. Most perioperative nurses were not concurred with performing technical tasks as a scrub nurse in phase IAP. The perioperative nurse who gave a high score, they were busy with connecting equipment. In the video analysis, the task hand over/change material and equipment was the main task of the scrub nurse and the duration of technical tasks was small in this phase. According to the interviews, the circulating nurse was not busy with technical tasks in this phase. The technical task which was mentioned were preparing instruments and equipment and turning the light off. The perioperative nurses of the outliers were focusing on changing CO_2 value, adjusting settings of diathermy, and connecting equipment. In the video analysis, the technical tasks were moving, connecting, and installing equipment.

The total duration of the task of both nurses was likely to be different in phase SP. The data for both nurses showed a wider distribution of the interviews in comparison with the video analysis, in which the difference of the range of data was larger for the scrub nurse than the circulating nurse. In phase SP the duration of the technical tasks varied. Some perioperative nurses were focused on hand over/change instruments and others in adjusting the setting of light and CO2, assembling, and checking instruments. In the video analysis, hand over/change instruments and assemble instruments were both tasks with a large time frame. Therefore, the scrub nurse performed technical tasks and patient-related tasks as well. The outlier of the circulating nurse in phase SP was declared by the task, bringing and hand over extra instruments and administrative tasks. These tasks were not assigned as technical tasks in this research. These tasks were measured by the video analysis in a small time frame and assigned as patient-related tasks. In the video analysis connecting and installing the equipment was the main task, therefore the outcome of the total duration of the technical tasks was higher for the video analysis than the interviews.

The data of the video analysis were more variable in phase FC&I for the scrub nurse. A larger range of data was obtained for the circulating nurse during the interviews compared to the video analysis. In phase FC&I, the diathermy was the only equipment that was mentioned during the interviews. Therefore, the total duration of technical tasks of the scrub nurse was low according to the perioperative nurses. The total number of tasks was very low, on the contrary, the duration of the technical task in comparison with the duration of the patient-related tasks was relatively high. The higher outcomes were obtained in procedures with a low number of tasks and small phase time. For example, the outcome of 100% was obtained in a surgery where only one task was performed: assemble the laparoscopic



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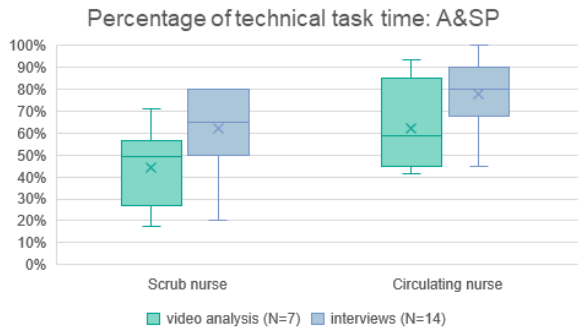

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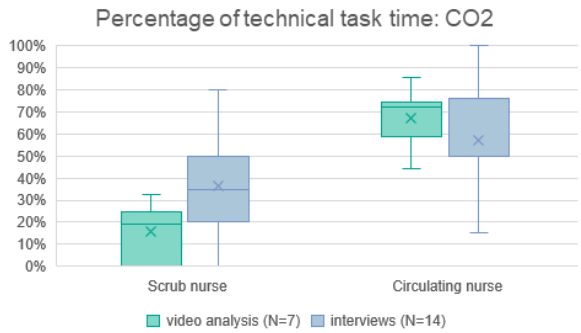
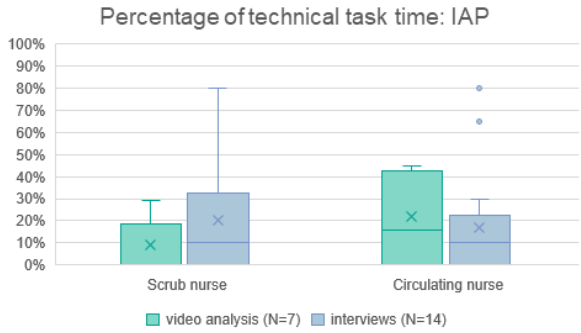
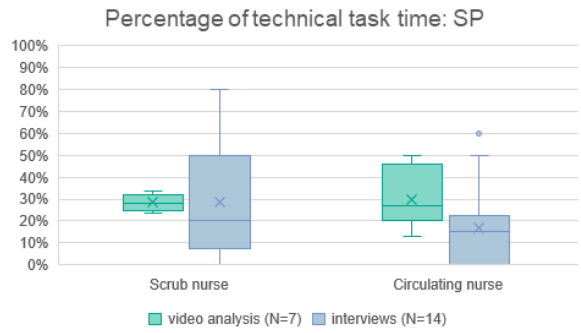


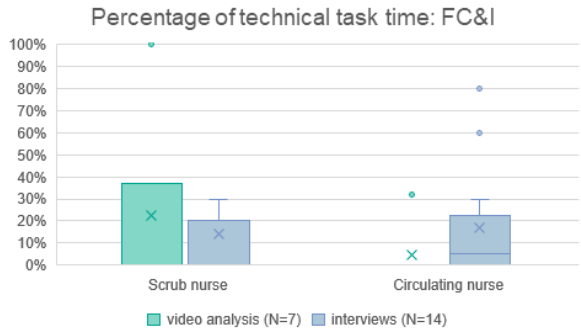
(c)



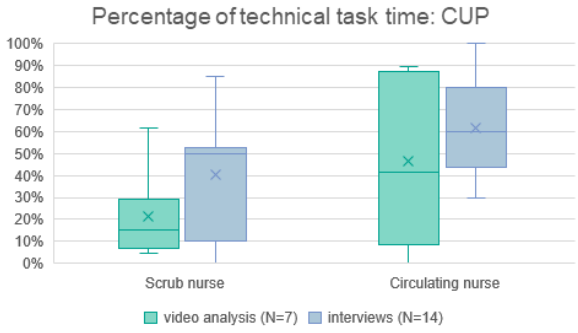
(d)



(e)



(f)



(g)

Figure 3.19: Percentage of the total duration of the technical tasks obtained through video analysis and the percentage of the technical tasks experienced by the perioperative nurses during the interviews.

instrument. The circulating nurse performed only in one surgery technical tasks, shown as an outlier in the graph. The technical task which was performed during the procedure was connecting and installing equipment which took a large amount of time compared to the duration of the phase. This explanation could be also applied to the outliers of the interviews in phase FC&I.

In the last phase, the total duration of the task of both nurses was likely to be different. The data of the interviews were more variable in the last phase for the scrub nurse and the video analysis indicated a wider distribution for the circulating nurse compared to the interviews. The scrub nurse focused on preparing the back table and taking care of wounds according to the video analysis. The perioperative nurses stated that disassembling and disconnecting instruments and equipment were the main tasks in this phase. Other technical tasks that were mentioned were checking completeness and functionality of instruments. The circulating nurse was disconnecting and uninstalling all equipment in this phase according to the interviews and the video analysis.

4

Discussion

The people pillar of sustainability aims to create a healthy workplace and manage illness-related absenteeism. Furthermore, the responsibilities of the surgical team members are shifted due to technological developments. The main goal of this research was to investigate the employability of the surgical team members and to optimise the responsibilities of the OR team members in order to achieve a balanced employability in MIS. Distribution of the responsibilities and the total duration of all tasks was measured and the impact of technological developments on the workload and the contribution of technology to the responsibilities of the perioperative nurses were researched. In this chapter, the results will be interpreted and discussed. Furthermore, the limitations of this research will be discussed and recommendations will be given.

4.1. Interpretation of the main results

Several aspects were measured in the video analysis and obtained during the interviews. These main results will be compared and discussed in this section. Extra results which were obtained are discussed in appendix C.

4.1.1. Overview of responsibilities

To answer the research question, a distribution of the responsibilities during the entire MIS procedure was obtained through video analysis and the peak moments were mapped through video analysis and interviews.

Physical activity As shown in Figure 3.16, the scrub nurse performed more tasks than the circulating nurse according to the video recordings in comparison with the outcomes of the interviews. The perioperative nurses experienced lower physical activity than measured during the video analysis when attending a procedure as a scrub nurse. An agreement in the amount of physical activity was made in both methods for the circulating nurse. Especially for the video analysis, the percentage of technical tasks was likely the same for both nurses, shown in Figure 3.1. The patient-related tasks for the scrub nurse were divided into patient-related and remaining tasks for the circulating nurse. This showed that the circulating nurse had less patient-related tasks and more remaining tasks such as calling, watching and chattering.

Task distribution per phase During part IV of the interview, the perioperative nurses did declare their answer with the main tasks they perform during each phase. In general, the differences in outcomes for the video analysis and interviews could be declared to the variation of tasks each perioperative nurse performed in each phase. Furthermore, there was a difference in the manner the perioperative nurses experienced the total tasks per phase.

The phases PO, A&SP, and CUP, were measured and experienced as high peak moments for both nurses. Low peak moments (all results without outliers lower than 40%) were measured and experienced for the circulating nurse during phase SP, the surgical procedure phase. In phase IAP, a high peak moment and a low peak moment were experienced by the perioperative nurses for the scrub

nurse and circulating nurse, respectively. Each perioperative nurse had different peak moments during the procedure.

During the video analysis, the total duration of task time was measured for each phase, therefore the sum of all task times was higher than the total duration of the phase. A higher percentage of 100% was measured in phases PO, A&SP, CO2, and CUP for the scrub nurse, and this was experienced as continuously busy (70-100%). Logically this could be experienced as a phase with high time pressure. Perioperative nurses had to do many things in a short period. This could be an important note to shift the number of tasks in this phase to an earlier phase or later phase if that is possible. In phases PO, A&SP, FC&I, and CUP, the percentage of task time for the circulating nurse was measured lower through the video analysis than experienced by the perioperative nurses. An interesting point is here obtained: the number of tasks in this phase was experienced as many, however, in the video analysis the nurses needed less time to finish the tasks. This conclusion can also be made for the scrub nurse in the phases CO2 and IAP. On the contrary, the data of the video analysis gave higher percentages than the data of the interviews in phases SP and FC&I for the scrub nurse and in phase IAP for the circulating nurse. In these phases, more tasks were measured during the video analysis than mentioned in the interviews. It could be concluded that the tasks experienced by the perioperative nurses were unilateral tasks in these phases: no variation of tasks was experienced. One interesting task of the scrub nurse in phase SP measured in the video analysis was assembling laparoscopic instruments. The videos were recorded ten years ago and thus the nurses could have a lower level of technical knowledge in the video recordings. Therefore, more time was needed to assemble laparoscopic instruments. This technical task took most of the time compared to other technical tasks as shown in Figure 3.3. This statement corresponded to the increased limitation to perform technical tasks when a new instrument was introduced. The perioperative nurses stated that new instruments were more difficult to use. A high range of data for the video analysis and interviews could show the difference in which tasks were performed by the perioperative nurses and the duration of the tasks performed. The perioperative nurses experienced their total task times in different ways which were shown as outliers in the data of the interviews. Some perioperative nurses scored the total task time higher for the same tasks compared to other nurses. Some nurses performed different types of tasks compared to others. An interesting point is that the longest phase had the lowest peak moments. The circulating nurse experienced 66% of the time an average percentage of 30% to perform tasks. In other words, the circulating nurse experienced no physical activity during 70% of the time of phase SP, the surgical procedure.

4.1.2. Workload and technological developments

Percentage of the number of technical tasks (per phase) measured through video analysis and interviews and the impact of technological developments on the workload of the scrub and circulating nurses were asked during the interviews.

Physical activity per surgery type In Figure 3.6, the physical activity for each surgery type was shown for the scrub and circulating nurses according to the interviews. A conclusion could be that a procedure in which more technology is involved, introduces lower physical activity for both nurses. OS was the procedure that achieved a high physical activity according to the perioperative nurses. No change in the amount of physical activity was required for this surgical type according to the interviewees. Contrary, the experienced amount of physical activity for MIS and RAS could be increased by several solutions. MIS was the only procedure that was measured through video analysis. The results of OS and RAS could not be compared to the video recordings. Therefore, no correlation could be made in the total technical task time and surgical type. A correlation about the preference for OS instead of MIS and the amount of physical activity was found. The perioperative nurses preferred OS because of the higher amount of physical activity. In OS, the nurses performed more tasks, especially the patient-related tasks which were experienced as more interesting and nicer. The only reason the nurses gave as a preference for MIS was the advantages for the patient in this surgical type. In the interview, the question about the amount of workload experienced in their function was asked. Some perioperative nurses focused on the differences in surgical types. One perioperative nurse stated that all procedures have a higher workload. Two perioperative nurses disagreed with this statement. According to them, the physical load was lower for MIS and higher for RAS. Standing for a long time was a reason for a relatively high physical load. The mental workload was also higher for RAS. A reason was that knowledge of technology is required. One perioperative nurse stated that it was important to

distinguish in tasks you could perform to limit the amount of physical and mental load.

Technical tasks The mean percentage of the duration of the technical tasks for the scrub and circulating nurse varied between 7.14% and 24.18% as shown in Figure 3.1. The perioperative nurses were asked in part I of the interview what the percentage of technical tasks was. This answer varied between 20% and 100% with an average of 56.5%. This large range of percentages was related to the amount of technology spent on different phases of the procedure. Some perioperative nurses spent the entire procedure on technology, others mentioned the start phase as the phase with the largest percentage of technology involved and one nurse spent technical tasks before the procedure. The answer to this general question could be compared to the mean percentage of the technical tasks of the scrub nurse based on the answers for each phase. The percentage of technical tasks was 29% for the scrub nurse and 23% for the circulating nurse. The ratio phase time and the total duration of the procedure of the video analysis was used to measure these mean percentages. A higher percentage of technical tasks was experienced for an entire procedure, when this percentage was asked for each phase a lower percentage of technical tasks was measured. Two different conclusions could be obtained, the phases in which a high percentage of technical tasks was scored, was experienced as a heavier phase or more technical tasks were performed outside the start and end time of this research and therefore, during a surgical procedure the percentage of technical tasks was experienced as high. The latter conclusion can also be applied to the difference between the percentage of the technical tasks based on the answers for each phase and the answers on the question of the ideal and current ratio of technical tasks and patient-related tasks. The average ratio in the current situation was roughly 45% and the median 50%. In the ideal situation, the average ratio was 40% and the median 45%. During the entire procedure, the perioperative nurses experienced a higher contribution to technology than tasks related to the patient.

Technical tasks per phase The results of the number of technical tasks for both methods were shown in Figure 3.19. During the interview, a brief explanation of the answer which the participant gave was asked.

The highest peak moments were measured in phase 2, anaesthesia and surgical preparation, for both nurses. A higher percentage of technical task time was also measured for the circulating nurse in both methods for phase CO2 and in phase CUP during the interviews. Phase CUP was an example of a large range of data for the video analysis. The technical task which was performed was to connect and install equipment. The duration of the technical tasks and the ratio of patient-related and technical tasks differed for each perioperative nurse. One nurse did the technical tasks during phase FC&I. In the phases, PO and A&SP the perioperative nurses of the interview experienced a higher percentage of technical tasks for both nurses and in phases CO2, IAP, and CUP only for the scrub nurse. The main reasons for this difference are the variation in tasks that were mentioned in the interviews and measured during the video analysis and the difference in the total duration of the tasks. In the video analysis, the tasks which were performed in a small time frame or the duration of the patient-related tasks were higher and the perioperative nurses experienced this ratio differently. The duration of the technical tasks was higher according to the video analysis for the circulating nurse in phases IAP and SP and in phase FC&I for the scrub nurse. A reason was the duration of the technical task: connect and install equipment. The perioperative nurse experienced this task lower than measured in the video analysis. Furthermore, the ratio of technical tasks and patient-related tasks were relatively high. This in combination with a very low number of tasks resulted in higher outcomes of procedures with a low number of tasks and small phase time. According to the question about the variation of the workload during the surgical procedure, all perioperative nurses agreed that the amount of workload varied for each phase. The fluctuation depends on the type of procedure (2) and occurrences of problems and complications (3). One nurse made a distinction between mental and physical workload: the mental workload fluctuates more than the physical workload. Two perioperative nurses experienced more stress during the start of the procedure. The latter could be related to the higher number of tasks during the start of the procedure.

Experiences of technological development The results of the ratio of technical tasks and the patient-related tasks gave an overview of the tasks measured through video analysis and experienced by the perioperative nurses. A sub-question of this research was: what is the influence of this ratio on

the workload of the perioperative nurses? Is there a relation between a higher ratio of technical tasks and patient-related tasks and a higher workload experienced by the perioperative nurses? What is the impact of technological developments on their activities during a surgical procedure?

According to the perioperative nurses, technological developments had an influence on their activities in their work; the technological developments introduced other tasks (2), more technical tasks (2), and more equipment (1). One nurse indicated that more technical tasks introduced more irritation to the team members. Especially, the increase in the number of technical tasks was also mentioned as tasks that took more time during MIS than OS. This was also shown in phases A&SP and CO2, the ratio of technical tasks and patient-related was large during these phases.

There was a variation in the amount of workload and the technical tasks for each phase according to the perioperative nurses. The technical tasks; connect and install equipment introduced a higher amount of sitting on the knees for the circulating nurse. Furthermore, moving of equipment gave a high ergonomic score. Some perioperative nurses scored sitting as a higher uncomfortable position, other scores that as low. The squirming movements due to the equipment and longer instruments were scored as higher ergonomics for the scrub nurse. Every perioperative nurse experienced the level of ergonomics differently, however, a relation between technical tasks and the ergonomic level was obtained. Technical tasks in which new equipment and instrument were involved introduce a higher mental load because of the lack of knowledge.

4.2. Limitations

In this research, some assumptions were made which are important issues to discuss. In both methods, several issues could be discussed.

4.2.1. Video analysis

First, no observer was at the OR to measure the task time of the perioperative nurses which minimised the Hawthorne effect. Nevertheless, the Hawthorne effect was still present, the perioperative nurses knew that they were recorded. Therefore, the results could be influenced by this effect. However, the surgical team was informed about another study purpose, therefore the tasks which were performed by the perioperative nurses and measured in this research were less influenced by this bias.

Second, an observer variation existed, especially the intraobserver bias. This research did not consist of an interobserver. The researcher was the only person who observed the video recordings. However, an interobserver enhance the credibility of the research. The intraobserver bias arises when data were measured in several recordings. A variation in the observation of data could occur. Nevertheless, this variation will be small because the definition and the start and end cues of the tasks were defined in advance.

Third, the used data were debatable. The video recordings were outdated. In ten years the technologies were further developed, for example, the instruments and equipment could be more idiot-proof. Besides, the perioperative nurses increased their knowledge about technology during the years, and the graduated perioperative nurses were more educated in technological developments these days than ten years ago. Furthermore, the video recordings consisted of one type of surgical procedure (i.e., LH), and the perioperative nurses in the interviews were experienced in many surgical fields, their answers were based on their experience in several surgical procedures in these fields. Moreover, the videos were recorded in a general hospital, namely, Bronovo hospital in The Hague, and the interviewees worked at an academic hospital (i.e., LUMC in Leiden). At a general hospital, the care is more standardised compared to an academic hospital. Last, the results were based on seven video recordings and fourteen perioperative nurses. For a small sample size, no general conclusions could be made. Although, the results of the video analysis were likely to be similar to the results of the interviews. This showed that the observed laparoscopic procedure was correctly chosen. LH corresponds to a general laparoscopic procedure in other specialisms and the phases and instruments/equipment of the procedure was presumably not changed during the years and are presumably not performed differently in an academic and general hospital.

Fourth, the video recordings were recorded for another purpose, therefore the video and audio recordings focused on the activities performed at the sterile area. Consequently, the entire OR was not filmed. The activities of the circulating nurse were not detectable. Some recordings were not used because of a screen that was in front of the camera. For this reason, more details of the activities of the

scrub nurse were not visible. Some actions were gambled when the actions of the perioperative nurses were partly visible for the measurement of the physical activity of the surgical procedure. To distinguish the remaining tasks: discussion with a colleague or chattering was hampered by the fact that the sterile team members only had microphones. Therefore, the circulating nurse was not understandable. For these reasons, the total duration of all tasks could be higher than shown in the results. Nevertheless, this bias had only an influence on the frequency and duration of the remaining tasks. The experienced physical activity of the interviewees corresponds to the measured employability.

Finally, a time slot was defined and therefore more tasks were performed outside these two cues. Thus, the total employability of the entire surgical procedure was not measured. However, the total physical activity of MIS in the interviews, and the total physical activity of the video analysis were the same, especially for the circulating nurse. The tasks performed outside these cues had less influence on these total physical activities

4.2.2. Interviews

First, a general bias when conducting interviews is the interviewer bias which directly affects the reliability and validity of the outcomes of this research. However, the interviewees were informed with the same information before the start of the interview which minimised the interviewer bias. Although, some interviewees needed more context to understand the question in the right way. A lack of alertness of the interview was present at times. For example, the task administrative activities on the computer were not corrected to patient-related tasks and were counted as a technical task. Nevertheless, these occurred in one or two interviews and were not showed as outliers in the data.

Second, some tasks were mentioned during the interviews and contributed to data of the interviews which were unfeasible to measure as a task during the video analysis. As already mentioned, the results of the video analysis were comparable to the data of the interviews. Thus, this bias had less effect on the results.

Third, the group of interviewees had different levels of experience. There was less variation in gender; the ratio male to female was not in proportion. However, this ratio corresponds to the ratio of male/female in perioperative nursing.

Last, the interviewees pointed out the differences in the total duration of tasks for each surgical procedure (i.e., simple vs complex, short vs long, low frequency vs high frequency). Furthermore, perception and reality differed for each nurse. This was shown as a large range of data in the box plots. Nevertheless, the median and average of these data correspond to the results measured during the video analysis.

4.3. Recommendations

As shown in the results, the percentage of the total duration of all tasks differed for each phase. The percentage to achieve the desired employability of perioperative nurses was unknown. The focus of the recommendations was to achieve an even distribution of the employability of the surgical procedure or to change the responsibilities of the perioperative nurses during a workday. The latter introduces different solutions for each limited percentage of employability of the perioperative nurses. These solutions will increase the total employability of perioperative nurses during the surgical procedure. These recommendations can be divided into four categories: redesigning responsibilities, changes in logistics, exploit talent and skills, and implementing technical applications.

4.3.1. Redesigning responsibilities

First, the creation of more tasks, especially in phase SP, for the perioperative nurses is a possible solution to create an even distribution. To make it more challenging for the scrub nurse, more assistance related tasks can be created. As shown as an outlier for the circulating nurse, the number of tasks during phase SP was higher because of the administrative tasks the nurse performed. Performing administrative tasks during phase SP is a possibility to increase physical activity. Furthermore, the results of the video recordings showed the large total task time for the perioperative nurses during phases PO, A&SP, and CUP. According to the interviews, especially the perioperative nurses experienced phases PO and A&SP as active phases. The number of tasks in the start phase was related to the shift of OS to MIS. In the results, some perioperative nurses shifted the tasks to a phase earlier or later. A list of fixed tasks for each will result in a more evenly distribution of tasks. However, freedom is also an

important aspect, thus the list has not to be obliged.

4.3.2. Changes in logistics

When the percentage of the total task time is limited to 30%, the circulating nurse does not meet the requirement in phase SP which took 66% of the total time of the surgical procedure. The circulating nurse performed many different tasks in this phase which took a small amount of time. Connect and install equipment took most of the time during the surgical procedure, however, compared to the total duration of the phase, it took less time. Because of the low task time in this phase, the circulating nurse can perform nurse tasks in another surgical procedure. To guarantee the patient safety two circulating nurses for three surgical procedures could have a standby role during phase SP. These standby nurses have to be in a room next to the operating room in which a computer is present. A screen that shows the current phase of the surgical procedure is an option to inform the circulating nurse of the procedure. When the sterile team needs material or equipment or assistance of a non-sterile member, a lamp lights up or a notification is shown on the screen. The standby circulating nurse enters the OR and performs the instructions of the sterile team. When the circulating nurse does not have to offer assistance, the circulating nurse can perform administrative tasks of the surgical procedure or other tasks that can perform at the room next to the OR. When the third surgical procedure need assistance and the circulating nurses are presented at the other ORs, a circulating nurse which is not assigned to an OR receives a notification to offer assistance.

When the percentage of the total task time is limited to 50%, the circulating nurse does not meet the requirement in phases IAP till FC&I. No other tasks are performed in phase SP, therefore the circulating nurse will be a standby circulating nurse from phases IAP till FC&I when this limitation applies. To increase the total duration of all tasks in the other phases, some tasks of phase IAP to FC&I could shift to phases PO to CO2 or CUP. Focusing on the total duration of the technical tasks for each phase, the highest amount of the technical tasks was measured in phase A&SP. The perioperative nurses experienced more stress during this phase in comparison with OS. Scheduling of two circulating nurses during the start phase of the surgical procedure is a possible solution to lower the stress. The extra nurse has to be a perioperative nurse with a technical background or a recently graduated perioperative nurse. In the interviews, it became clear that the recently graduated nurses received enough technical knowledge during their education to experience less workload. An interesting situation was outlined by one perioperative nurse. The nurse admitted that the physical activity of RAS for the scrub nurse was very low when a patient-side assistant was present. The scrub nurse has fewer tasks to perform a RAS procedure. Therefore, an option is to schedule the scrub nurse during a RAS procedure when no patient-side assistant is present.

4.3.3. Exploit talent and skills

The results of the interviews showed that the perioperative nurses experienced a lower physical activity in MIS and RAS compared to OS. These results corresponded to the introduction of a waste of talent and skills due to the shift of responsibilities. To overcome this problem the perioperative nurses could have specific roles. Based on the total technical task time for each phase in both methods and the percentage of patient-related tasks according to the video recordings, the solutions to have the scrub nurse specialised in performing patient-related tasks and the circulating nurse in understanding all technical problems are alternatives. So, the scrub nurse could have a more assistance role and the circulating nurse could have a more technical role. According to the video recordings, the circulating nurse offered assistance when assembling the laparoscopic instruments and can read the instructions of the corresponding instrument. In education two different specialism can be offered; a patient-related scrub nurse or a technical circulating nurse. Otherwise, the perioperative nurse has to fulfill both roles to have variation during the day and focus on one specific role during the surgical procedure. Another option is to have a gradation in education level. When the scrub nurse has to perform assistance tasks at the operating table, the scrub nurse could fulfill a coordinating role to the circulating nurse. The scrub nurse will anticipate on the surgical process and will instruct the circulating nurse. An option is to schedule an experienced perioperative nurse in training as a circulating nurse. The experienced perioperative nurse in training knows the course of the procedure and understand the instructions of the scrub nurse.

4.3.4. Implementing technical applications

When the percentage of the total task time is limited to 50%, the scrub nurse does not meet the requirement in phase SP. When the scrub nurse does not perform assistance tasks, the only task which will take most of the time is to hand over/change material and equipment, preparing the back table, and assemble laparoscopic instruments. Other tasks could be performed by the other sterile members. For example, cleaning of the laparoscopic instruments is performed by the other sterile members in some video recordings of this research. Taking material and equipment from the circulating nurse, preparing the back table, assembling laparoscopic instruments, and handing over/changing material and equipment is related to each other and could be replaced by a technical application. The scrub nurse puts the material and sterile packages in a robot/equipment from which the surgeon or another sterile member can ask to hand over the desirable material. Artificial intelligence is upcoming, therefore in the future, the robot will anticipate the needs of the surgeon and present/hand over the desirable material or laparoscopic instrument. The task, preparing the back table is replaced and thus included in the robot. For assembling the laparoscopic instrument, the robot has to include a function to do this. At this moment, robots that could assemble instruments do exist. The most important requirement for the robot is sterility.

As mentioned in the subsection changes in logistics, a notification system that shows the progress of the surgical procedure in the room next to the OR could be designed. To create more comfort, solutions could be more integrated equipment in the OR to reduce movements of (heavy) equipment or realisation of wireless communication and a control panel to change the setting of the equipment. Adjusting the furniture is also an option to create more comfort such as the implementation of the extendable or adjustable shelf to reduce uncomfortable positions and/or replacement of a stool to a more comfortable stool with a backrest.

5

Conclusion

In this research, a distribution of the responsibilities of the members of the surgical team members was measured and peak moments were mapped. In addition, the impact and contribution of technology were measured and evaluated. The purpose of these data was to optimise the responsibilities of the surgical team members in order to achieve a balanced and sustainable employability of the surgical team to counteract waste of talent and skills.

The results showed a fluctuation in the total duration of all tasks during a laparoscopic procedure. During the start of the procedure, both perioperative nurses have a percentage of total task time above 70%. In the second phase, both nurses spent most of the time on technical tasks compared to patient-related tasks. According to their experiences, these tasks took more time during MIS than OS. During the longest period, namely the surgical procedure, the lowest peak moments were obtained. The employability experienced by the operative nurse varied because they distributed the performed tasks per phase differently. To achieve a more sustainable employability, the circulating nurse could be present during the longest phase, namely the surgical procedure when needed. Therefore, two instead of three perioperative nurses for three surgical procedures have to be scheduled.

The perioperative nurses experienced a high impact of technological development on their activities. The amount of technology involved in a procedure and the percentage of physical activity experienced by the perioperative nurses were related. A procedure in which more technology was involved, introduced a lower percentage of physical activity of the perioperative nurses. To prevent waste of talent and skills more responsibilities, especially in assistance tasks, for the scrub nurse during MIS or RAS is one of the solutions. The perioperative nurses experienced a higher duration of the start phase in MIS compared to OS. The reason was the large amount of equipment which has to be connected and installed. This was comparable to the highest technical task time for the scrub and circulating nurse which was measured in the second phase of the procedure. The deployment of a circulating nurse which is more specialised to perform technical tasks is an option to decrease the stress level of this phase.

In conclusion, an unbalanced employability during MIS was obtained. Several solutions were recommended. First, deployment of a technical perioperative nurse will decrease the amount of workload. Second, the talent and skills will not be wasted by giving the perioperative nurses more responsibilities. Last, scheduling of two instead of three perioperative nurses for three surgical procedures will lead to a more sustainable employability of the surgical team members.

6

Future research

During this research, several limitations, recommendations, and suggestions were given. In this chapter, several pieces of advice for future research are mentioned.

6.1. Research based on limitations

Future research could focus on the limitations mentioned in chapter 4.

Larger range of data The results of this research were focused on seven procedures and fourteen perioperative nurses. The data of both methods were consistent, however, the data will be more valuable when a higher number of procedures and interviewees were implemented.

Measurement current situation The results of this research were based on videos recordings in a general hospital ten years ago. In addition, the measurements of the video analysis were based on one specific laparoscopic gynaecologic procedure. To measure the current employability, video recordings of laparoscopic procedures in different specialisms in the LUMC has to be performed to compare these data with the results of the interviews.

Ideal employability The ratio total duration of all tasks to the total duration of the phase was shown as a percentage which resulted in box plots of the data of the video analysis and interviews for each phase. Several solutions were given for different limited percentages of employability. Further research could focus on the ideal percentage to achieve a balanced employability whereby a more valuable overview of solutions could be made.

Physical activity for different surgical types During the interviews, the physical activity experienced by the perioperative nurses for different surgical procedure types (i.e., OS, MIS, and RAS) were asked. The video recordings were based on one specific MIS procedure, therefore the physical activity of MIS could be compared to the interviews. Different OS and RAS procedures have to be measured to compare the physical activities of the recordings to the experiences of the perioperative nurses for OS and RAS.

Difference academic and general hospitals Another interesting point that could be investigated is the difference between academic hospitals and general hospitals. Interviews at a general hospital have to be conducted and observations or video recordings at a general and academic hospital has to be performed. These data can be compared to the data of the interviews presented in this study.

6.2. Correlations

The results showed that there were several correlations that were not covered in this study.

Employability and length of procedure The interviewees noticed that the employability depends on the duration of the surgery. For example, one nurse explained that the low physical activity during a RAS procedure was related to the high amount of time a RAS procedure took.

Employability and type of procedure Many interviewees found the questions difficult to answer. One of the main reasons was the difference in employability and the amount of workload for each type of procedure. Some procedures used complex and new instruments and equipment. Furthermore, the difference in simple and complex procedures was mentioned as a variable to the total duration of tasks.

Employability and experience of surgeon One perioperative nurse indicated that the amount of physical activity for each surgery type depends on the experience level of the surgeon. Some surgeons need more assistance from the scrub nurse than others which could be related to the employability of the nurse.

Employability and presence of a perioperative nurse in training Ten observations were analysed, but only in three surgical procedures, a perioperative nurse in training was present. These data were not implemented in this research for a more reliable comparison between the videos. A surgical procedure in which a scrub, circulating nurse, and perioperative nurse in training is a common situation, therefore research to compare the difference in the employability of a procedure with one circulating nurse and a procedure with one circulating nurse and a perioperative nurse in training is a potential research.

Technical task time and surgery type In the video analysis, the total duration of tasks was divided into patient-related, technical, and remaining tasks. The interviewees were asked to estimate the number of physical activities for each surgery type (i.e., OS, MIS, and RAS). The physical activity was lower in procedures where more technology was involved, therefore future research could focus on the correlation between technical task time and surgery type. The technical task time could increase if more technology is involved during a surgical procedure.

Workload and technical tasks During the interviews, the impact of technological developments was asked. The mental and physical workload was questioned as well. An average of 4 out of 10 and a median of 5 out of 10 were given on the question: ”To what extent have technological developments contributed to this increased workload?”. This showed that a correlation between technological developments and workload exists. The interviewees indicated a fluctuation of workload during a surgical procedure and an uneven distribution of the total duration of technical tasks. The latter was confirmed through the video analysis. Therefore, a correlation between the perceived workload and the ratio of technical tasks and patient-related tasks could be investigated in future research.

Ergonomic and surgical types The interviewees noticed the uncomfortable position of both the scrub nurse and the circulating nurse which arise during a laparoscopic procedure. More research about the impact of technological developments on the ergonomics could be done. For example, ergonomics measurements could be performed during different surgical types for each perioperative nurse.

6.3. Risk analysis

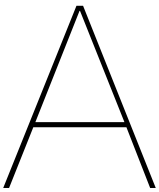
A risk analysis has to be performed for the possible solutions mentioned in the recommendations to guarantee the safety of the patient.

Two standby circulating nurses When two standby circulating nurses are present for three surgical procedures during phase SP or phases IAP to FC&I, more risks could arise. This will result in a procedure where the circulating nurse could be partly present during one procedure. Therefore, a risk analysis has to be performed to gain knowledge in all risks which could occur.

No scrub nurse present during RAS More knowledge has to be obtained to know the phases in which the scrub nurse has a very low percentage of physical activity. Furthermore, the risk has to be analysed when the scrub nurse is not present at the procedure. More research has to be performed about the logistics of this situation. When a scrub nurse is needed a standby nurse has to be deployed.

Replace circulating nurse in an experienced perioperative nurse in training Future research could focus on the deployment of an experienced perioperative nurse in training. Measurement of the level of experience of a perioperative nurse in training is needed to guarantee patient safety.

Appendices



Method

A.1. Information for interviewees

Optimization of the employability of the surgical team in minimally invasive surgery

Information for perioperative nurses

Together with Diederich Cornelisse and Frank Willem Jansen I am investigating sustainability at the OR on behalf of my graduation project which is part of the Master Biomedical Engineering at the TU Delft. In 2018, the LUMC approved the Green Deal Sustainable Care, from which a goal has been set to be a sustainable organization with a future-proof and healthy environment. The care givers play a crucial role in achieving this goal. Therefore, this interview focuses on the 'people' pillar of the Corporate social responsibility (MVO) model (of which the three sustainability pillars are; planet, profit, people). Past decade, many technological developments have been implemented in the LUMC, including in the OR department. I would like to know what the influence is of these technological developments on the surgical team. Therefore, I would like to ask you to participate in an interview (set up and conducted by me) and share your experiences with me on this subject. The results of this research might also be included in the renovation of the OR center of the LUMC.

To get a complete picture on the opinion of the perioperative nurses, I would like to ask you to participate in the full study. This includes participating in a possible second interview that will be scheduled for you. Regarding the processing of the data; your data will be anonymised.

Thank you for your participation.
Karlijn Peters
Diederich Cornelisse
Frank Willem Jansen

Preparations upfront

I kindly request you to complete the following questions prior to the interview.

Part A: General information

1. What is your age?
   _____
2. What is your gender?
   - ☐ Male
   - ☐ Female
   - ☐ Other
3. How many years of experience do you have as being a perioperative nurse?
   _____
4. How many years of experience do you have with minimally invasive surgeries?
   _____
5. How many minimally invasive surgeries have you assisted/attended throughout your career?
   - ☐ < 10
   - ☐ 10-20
   - ☐ 20-40
   - ☐ 40-60
   - ☐ 60-80
   - ☐ 80-100
   - ☐ > 100

6. Which type of minimally invasive surgeries have you assisted/attended?

_____

Part B: Responsibilities LVO and phases MIS

I have made an overview of the responsibilities which apply to your role during a surgery and add the different phases during a minimally invasive surgery. I request you to go through these two overviews in advance to make the interview run more smoothly.

Part 1: Responsibilities perioperative nurses

The responsibilities below are a selection of the *Professional profile perioperative assistant 2012* of the LVO that apply to this research. During the interview you will be asked what the ratio between patient-related tasks and technical tasks is. The technical tasks are therefore indicated in **bold** in the list below.

Core role 1: Managing medical devices

- Ensuring the availability of medical devices
- Continuing and, if necessary, adjusting this process during the procedure
- Be alert to unexpected turns and response appropriately during the surgical procedure
- Afterwards, store the aforementioned medical devices in ready-to-use and complete condition; adequate handling of any defects
- Monitor patient and team safety (pay attention to, among other things: sterility, sharp objects, electric current, radiation, laser light, fire safety, bioagents and chemical substances)
- Perform double checks if required

Core role 2: Providing care

- Get acquainted with the patient and transferring the patients' data
- Assisting the nurse anaesthetist on indication and request
- Verifying data in a team context (time-out);
- Catheterisation (= reserved procedure) if necessary;
- Create a blood void if necessary
- Positioning the patient
- Disinfecting the operating area
- **Connect and install equipment**
- Place sterile drapes & continuous monitoring of sterility
- Perform tasks as perioperative nurse and anticipate as the surgical and anaesthesia situation develops during the procedure
- Perform risky and reserved tasks commissioned by the surgeon
- Monitoring the completeness of instruments, gauzes, disposables and suture needles according to the guideline
- Checking the to be administered medication (double check)
- Taking care of and registering preparations
- Taking care of wounds
- Administration & registration of important data of surgical procedure

Core role 3: Communication with patient

- Coordinate communication with other care providers to promote unambiguous instruction and information provision
- Taking into account the presence of the patient, also in verbal and non-verbal contact with the members of the surgical team

Core role 4: Organization and management

- **Manage and monitor the presence and functionality of medical devices at the operating room department**
- **Monitoring specific quality requirements of the medical devices**
- Independently coordinate the planning during shifts in one to three operating rooms

Core role 5: Collaboration

- Contributing to an atmosphere that creates optimal working conditions for all team members, where the patients' interests and respectful communication are paramount
- Quickly anticipate on developed situations when the dynamics during a procedure requires you to do so; essential is to give directions, receive feedback, and adjust your own actions
- When changing the team composition, adequately transfer data on the progress of the perioperative process
- Accompany interns and guests in the operating room and ensure that the patients' safety is maintained

Core role 6: Quality and safety assurance

- Participate in all activities that aim to establish, achieve and maintain the quality of care
- Taking care of your own safety, the safety of the patient and the environment

Core role 8: Coaching and teaching students and colleagues

- Guiding trainees and visitor from other groups of professionals at all levels:
    - Monitoring the safety of the trainees
    - Monitor the safety and privacy of the patient among interns

Part 2: Phases MIS

Phase		**Start**	**End**
1	**Pre-operative**	Scrub nurse putting on a surgical gown	Scrub nurse starts to prepare the disinfection of operating area and placement of sterile drapes
2	**Anaesthesia and surgical preparation**	Scrub nurse disinfecting operating area and placing sterile drapes	Instruments are installed
3	**Create CO2 pneumoperitoneum**	Scrub nurse handing over scalpel to start first incision	Abdomen are inflated
4	**Insert access ports**	Inserting first (optical) port	Last port is inserted
5	**Surgical procedure**	Inserting laparoscopic instrument	Last action of surgical procedure
6	**Final check and irrigation**	Checking hemostasis	Hemostasis is checked
7	**Close up patient**	Removing laparoscopic instruments and trocars	Scrub nurse take care of wounds

A.2. Consent form interviewees

Consent Form for "Master thesis utilization of OR team"

Please tick the appropriate boxes	Yes	No
Taking part in the study		
I have understood the study information explained to me dated [DD/MM/YYYY]. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	○	○
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	○	○
I understand that taking part in the study involves an audio-recorded interview of which (during the interview) the researcher is allowed to take notes. The audio recordings will be transcribed as text and will not be distributed or played back in the presence of persons other than the researcher. The material will be used only for scientific analysis. When the thesis is completed, the audio recordings will be destroyed.	○	○
Use of the information in the study		
I understand that information I provide will be used for writing scientific reports.	○	○
I understand that personal information collected about me that can identify me, [such as e.g. my name or my age], will not be shared beyond the researcher.	○	○
I agree that my information can be quoted in research outputs.	○	○
Future use and reuse of the information by others		
I give permission for the anonymised transcripts that I provide to be archived in the TU Delft thesis database so it can be used for future research and learning.	○	○

Signatures

Name of participant [printed] _____ _____
Signature Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

Karlijn Peters _____ _____
Signature Date

Study contact details for further information:
Karlijn Peters, 06 30336662, K.Peters@lumc.nl

B

Results

B.1. Video analysis

B.1.1. Standard deviation of heat map

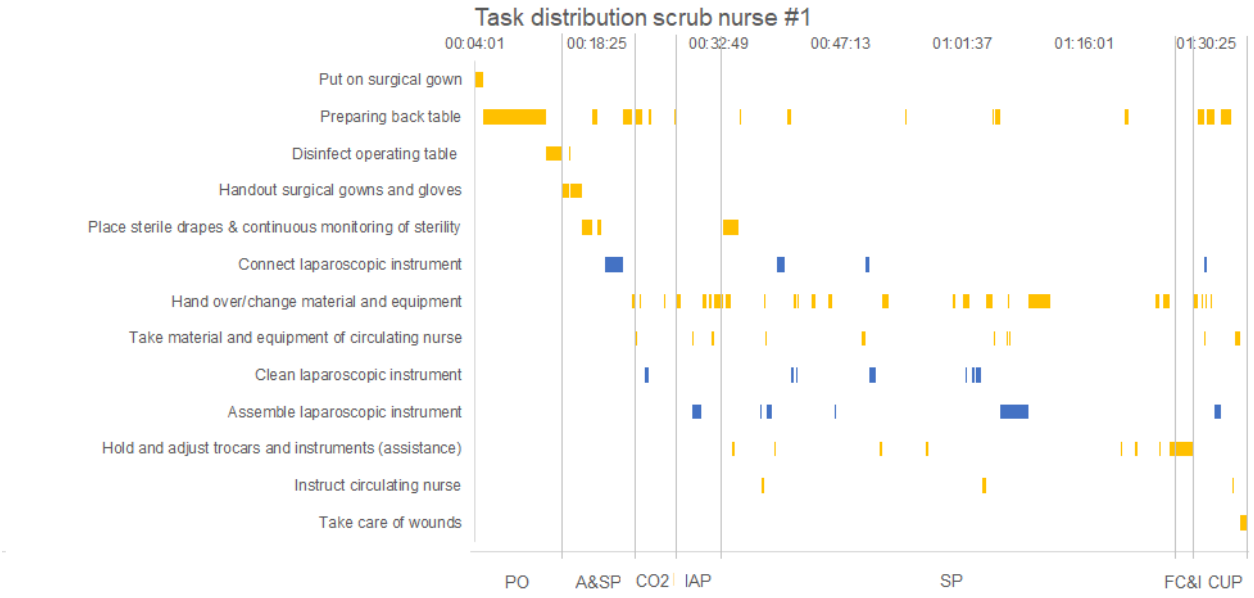
Table B.1: Standard deviation of the mean percentages of the duration of each task of the scrub nurse per phase measured in seven procedures

Scrub nurse								
%	PO	A&SP	CO2	IAP	SP	FC&I	CUP	*Total*
Check number of gauzes	0.00	0.00	0.00	0.00	0.06	0.09	0.66	*0.71*
Disinfect operating table	0.89	0.50	0.00	0.00	0.00	0.00	0.00	*1.21*
Handout surgical gowns and gloves	0.77	0.83	0.18	0.00	0.54	0.00	0.15	*0.59*
Hand over/change material and equipment	0.00	1.88	0.86	0.83	3.12	0.44	1.19	*3.24*
Hold and adjust trocars and instruments (assistance)	0.00	0.00	0.00	0.00	12.05	0.00	0.00	*12.05*
Instruct circulating nurse	0.00	0.02	0.25	0.06	0.26	0.00	0.09	*0.36*
Keeping operating table organized	0.00	0.38	0.00	0.00	0.00	0.00	0.00	*0.38*
Perform patient related tasks commissioned by surgeon	0.00	0.00	0.00	0.00	0.21	0.00	0.00	*0.21*
Place sterile drapes & continuous monitoring sterility	0.67	1.02	0.29	0.72	0.11	0.00	0.00	*1.07*
Position the patient	0.00	0.00	0.11	0.05	0.00	0.00	0.00	*0.16*
Preparing back table	1.80	0.56	0.60	0.00	1.74	0.41	1.48	*4.12*
Put on surgical gown	0.32	0.00	0.00	0.00	0.00	0.00	0.00	*0.32*
Take care of wounds	0.00	0.00	0.00	0.00	0.00	0.18	1.65	*1.63*
Take material and equipment of circulating nurse	0.00	0.38	0.34	0.17	1.07	0.34	0.26	*1.72*
Tidy up	0.00	0.00	0.00	0.00	0.00	0.00	0.09	*0.09*
Assemble laparoscopic instrument	0.00	0.30	0.28	0.42	3.30	0.25	0.30	*3.34*
Clean laparoscopic instrument	0.00	0.32	0.22	0.00	1.02	0.23	0.00	*1.34*
Connect laparoscopic instrument	0.00	0.78	0.57	0.08	1.07	0.19	1.44	*2.47*
Asking extra colleague	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*
Calling	0.00	0.00	0.00	0.00	0.08	0.00	0.00	*0.08*
Chattering	0.00	0.00	0.00	0.00	2.70	0.00	0.00	*2.70*
Discuss with colleague	0.00	0.00	0.08	0.00	0.13	0.00	0.00	*0.21*
Have a break	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*
On mobile phone	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*
Shift change with colleague	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*
Watching	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*

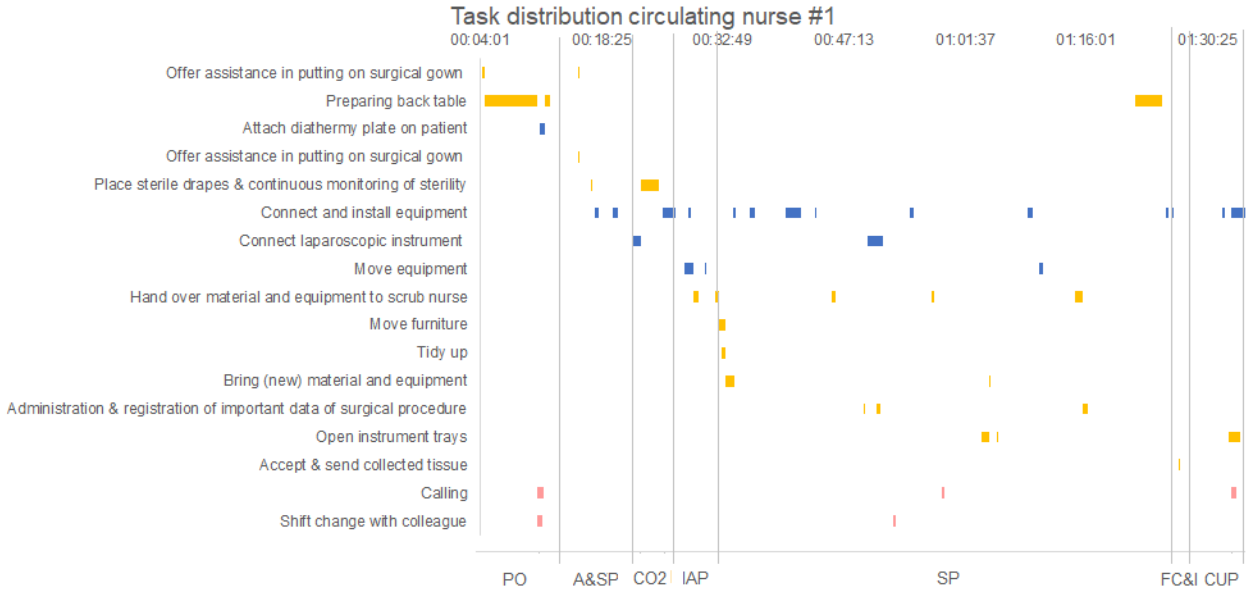
Table B.2: Heat map of the mean percentage of the duration of each task of the circulating nurse per phase measured in seven procedures

Circulating nurse								
%	PO	A&SP	CO2	IAP	SP	FC&I	CUP	*Total*
Accept & send collected tissue	0.00	0.00	0.00	0.00	0.20	0.31	1.58	*1.64*
Administration & registration of important data of surgical procedure	0.00	0.00	0.28	0.29	1.11	0.24	0.12	*1.22*
Bring (new) material and equipment	0.00	0.64	0.00	0.44	0.96	0.00	0.00	*1.20*
Check number of gauzes	0.00	0.00	0.00	0.00	0.00	0.00	0.04	*0.08*
Hand over material and equipment to scrub nurse	0.00	0.51	0.30	0.41	1.89	0.28	0.40	*2.34*
Move furniture	0.11	0.30	0.21	0.29	0.36	0.00	0.00	*0.54*
Offer assistance at anaesthetist/scrub nurse	0.00	0.14	0.00	0.00	2.53	0.00	0.43	*2.69*
Offer assistance in putting on surgical gown	0.28	0.43	0.00	0.00	0.09	0.00	0.00	*0.56*
Perform instructions of scrub nurse	0.00	0.10	0.00	0.13	0.51	0.00	0.00	*0.47*
Place sterile drapes & continuous monitoring of sterility	0.19	0.06	0.28	0.09	0.14	0.00	0.00	*0.15*
Position the patient	0.10	0.05	0.10	0.00	0.03	0.00	0.00	*0.25*
Preparing back table	1.66	0.63	0.09	0.10	1.47	0.26	1.59	*2.09*
Tidy up	0.02	0.00	0.03	0.21	0.66	0.00	0.22	*0.60*
Attach diathermy plate on patient	0.33	0.00	0.00	0.00	0.00	0.00	0.00	*0.33*
Connect and install equipment	0.23	0.61	1.27	0.20	2.36	0.38	1.52	*4.35*
Connect laparoscopic instrument	0.09	0.39	0.32	0.00	0.41	0.00	0.32	*0.79*
Move equipment	0.03	0.49	0.28	0.58	0.35	0.00	0.20	*0.58*
Open instrument trays	0.00	0.00	0.00	0.00	1.21	0.00	0.00	*1.21*
Asking extra colleague	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*
Calling	0.32	0.31	0.00	0.17	1.20	0.00	0.00	*1.33*
Chattering	0.00	0.00	0.00	0.00	4.41	0.00	0.00	*4.41*
Discuss with colleague	0.00	0.20	0.00	0.55	2.08	0.00	0.00	*2.23*
Have a break	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*
On mobile phone	0.00	0.00	0.00	0.39	0.92	0.00	0.00	*1.30*
Shift change with colleague	0.25	0.00	0.00	0.00	1.47	0.00	0.00	*1.55*
Watching	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*

B.1.2. Results for each procedure

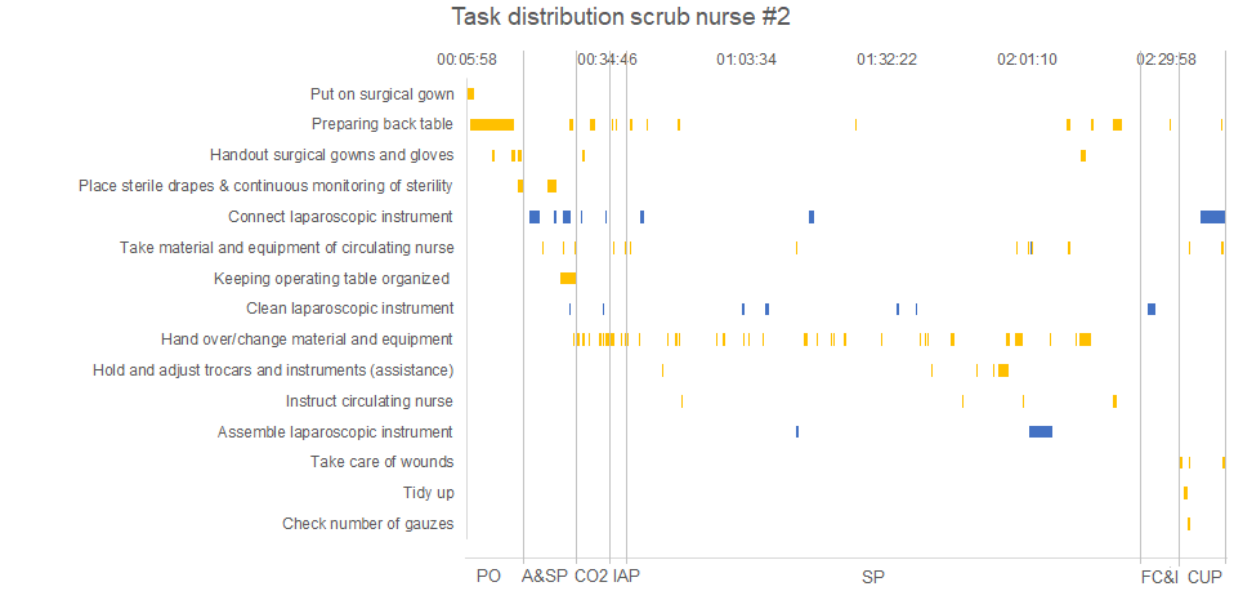


(a) Scrub nurse

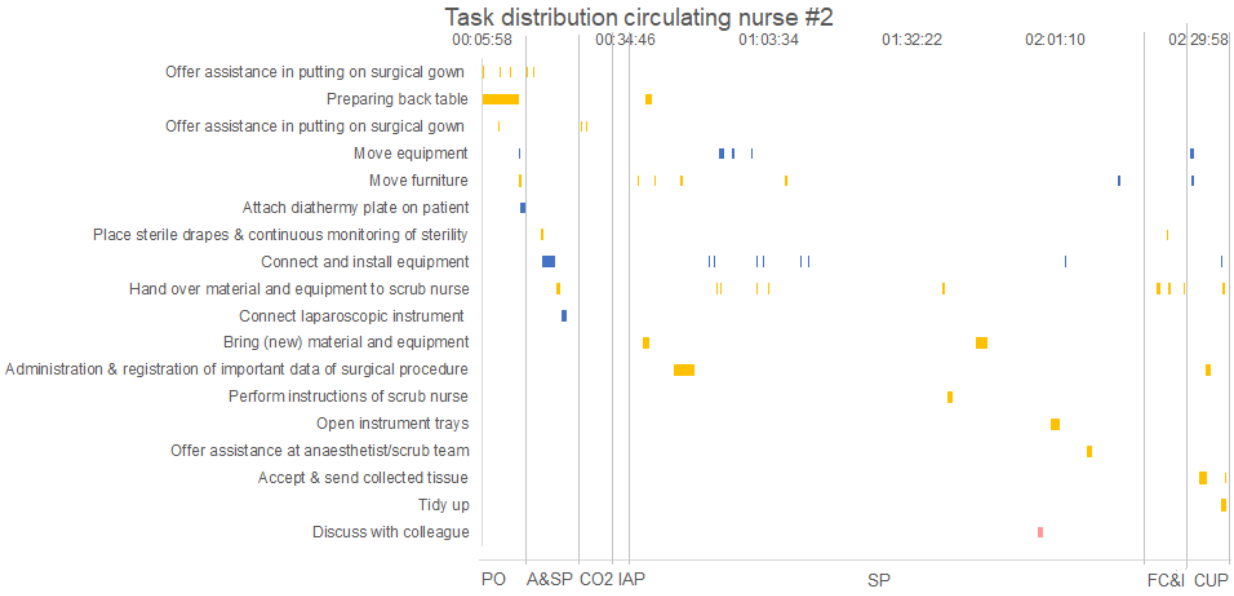


(b) Circulating nurse

Figure B.1: The duration of each task at a time for each perioperative nurse for procedure 1. The patient-related tasks are depicted in yellow, the technical tasks in blue and the remaining tasks in pink. The duration of each phase is given.

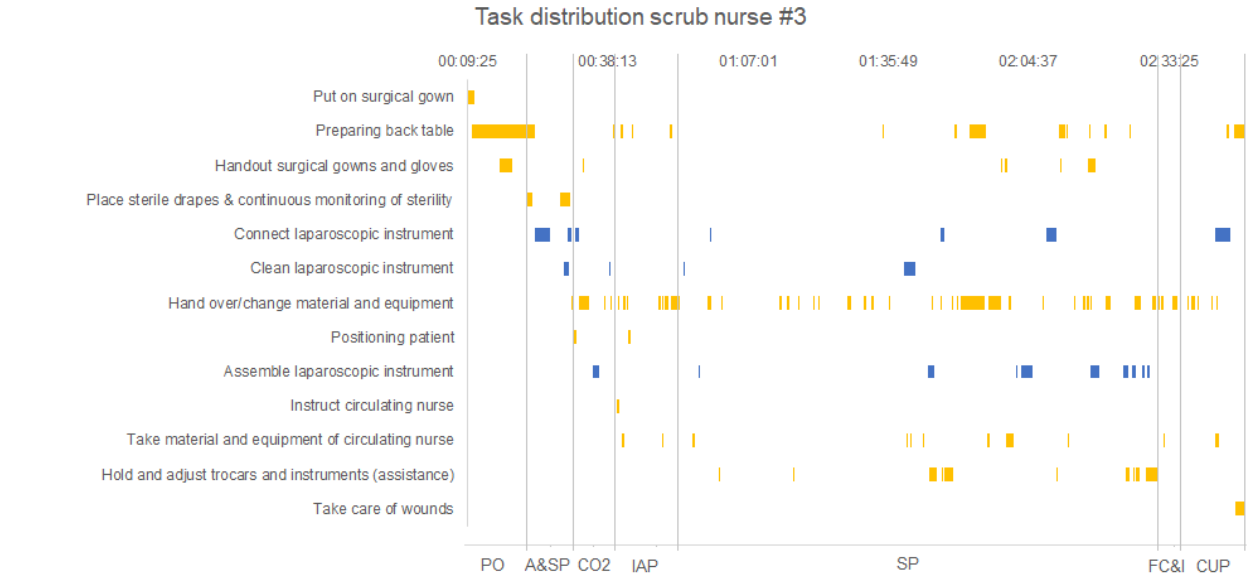


(a) Scrub nurse

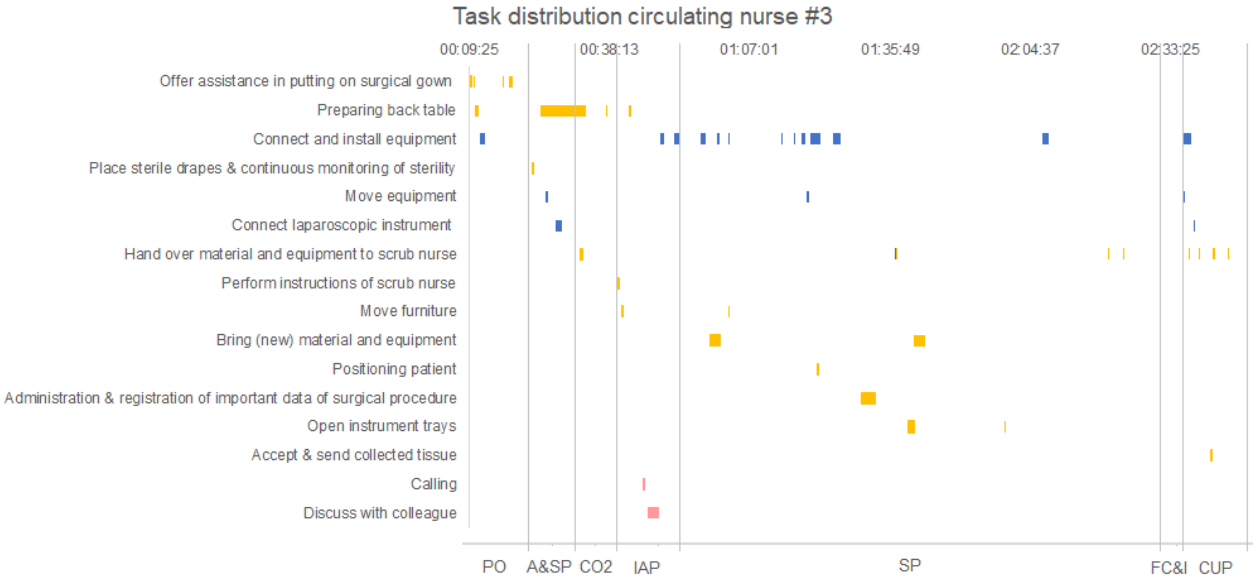


(b) Circulating nurse

Figure B.2: The duration of each task at a time for each perioperative nurse for procedure 2. The patient-related tasks are depicted in yellow, the technical tasks in blue and the remaining tasks in pink. The duration of each phase is given.

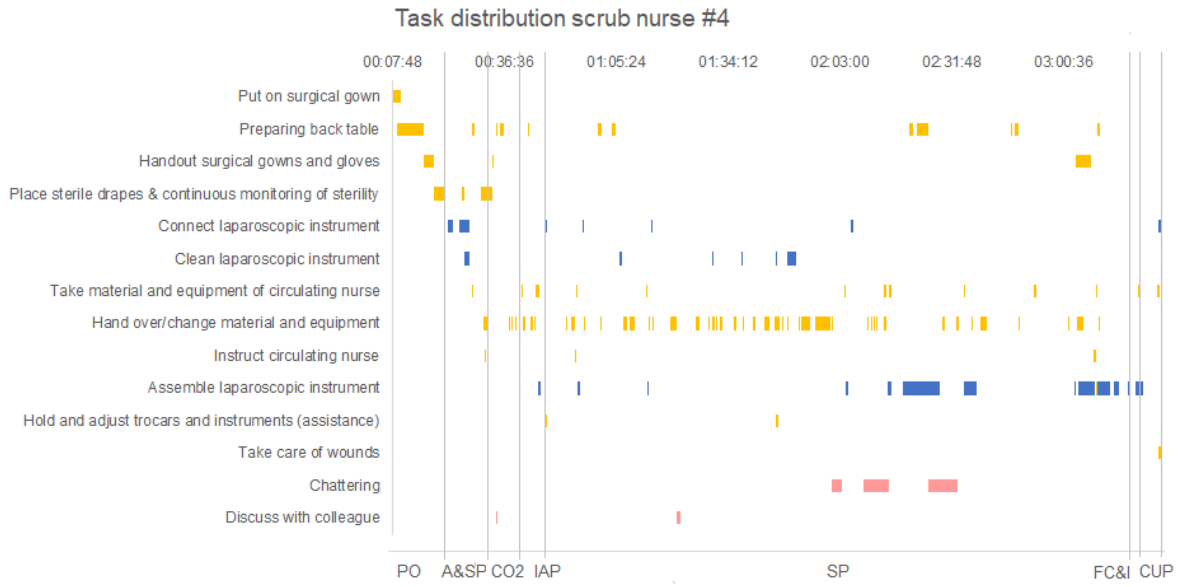


(a) Scrub nurse

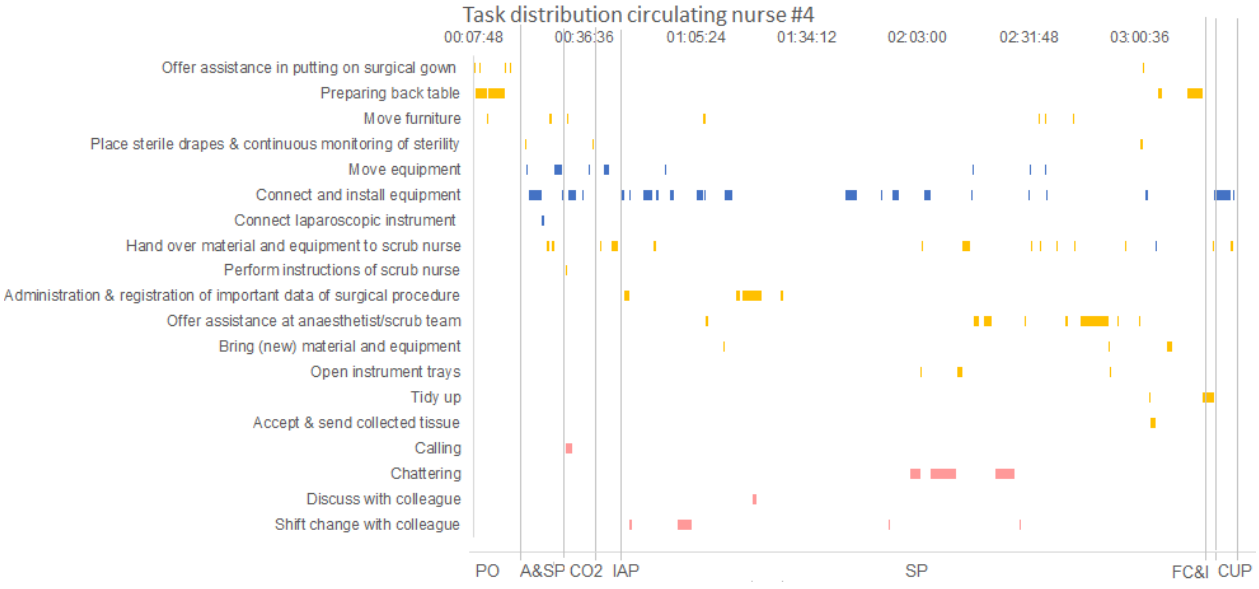


(b) Circulating nurse

Figure B.3: The duration of each task at a time for each perioperative nurse for procedure 3. The patient-related tasks are depicted in yellow, the technical tasks in blue and the remaining tasks in pink. The duration of each phase is given.

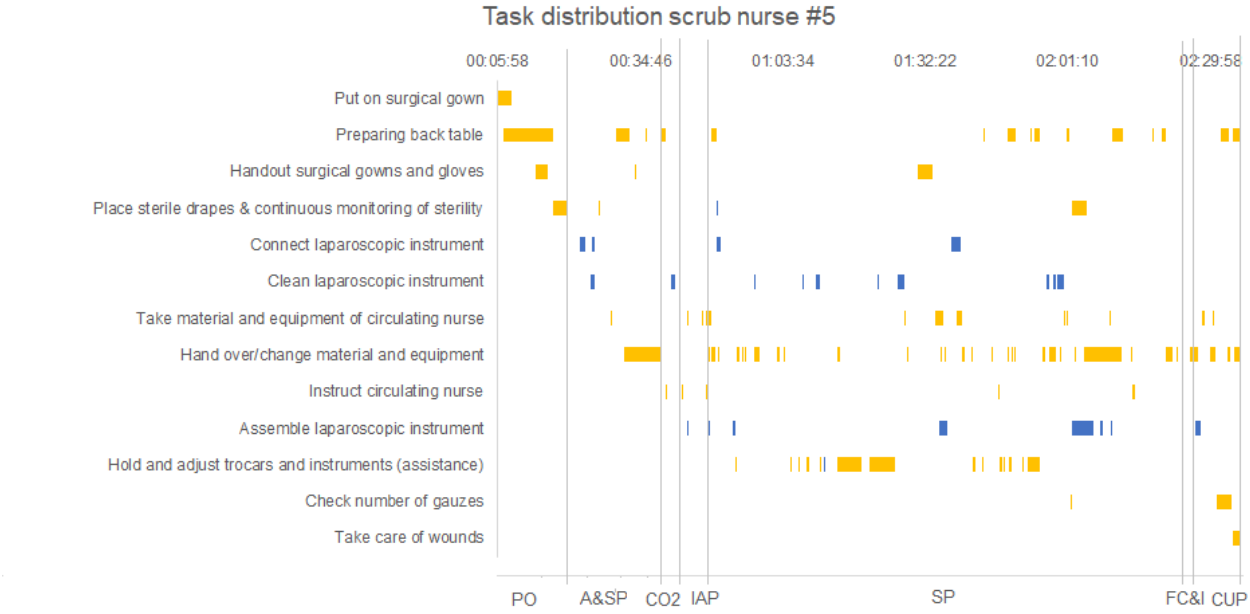


(a) Scrub nurse

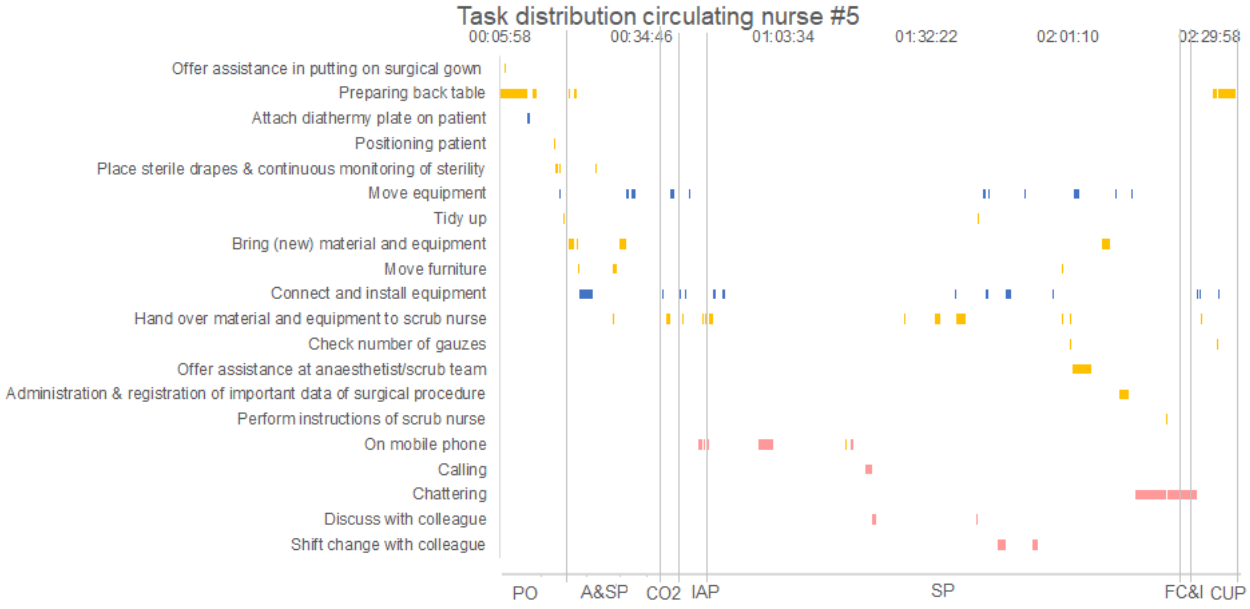


(b) Circulating nurse

Figure B.4: The duration of each task at a time for each perioperative nurse for procedure 4. The patient-related tasks are depicted in yellow, the technical tasks in blue and the remaining tasks in pink. The duration of each phase is given.

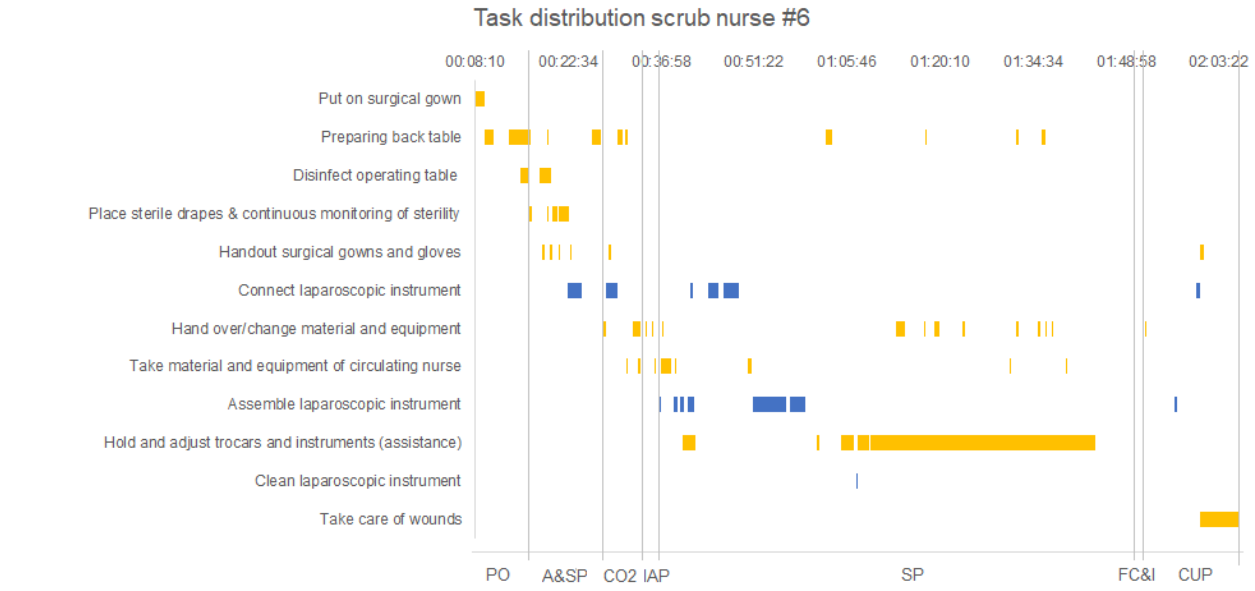


(a) Scrub nurse

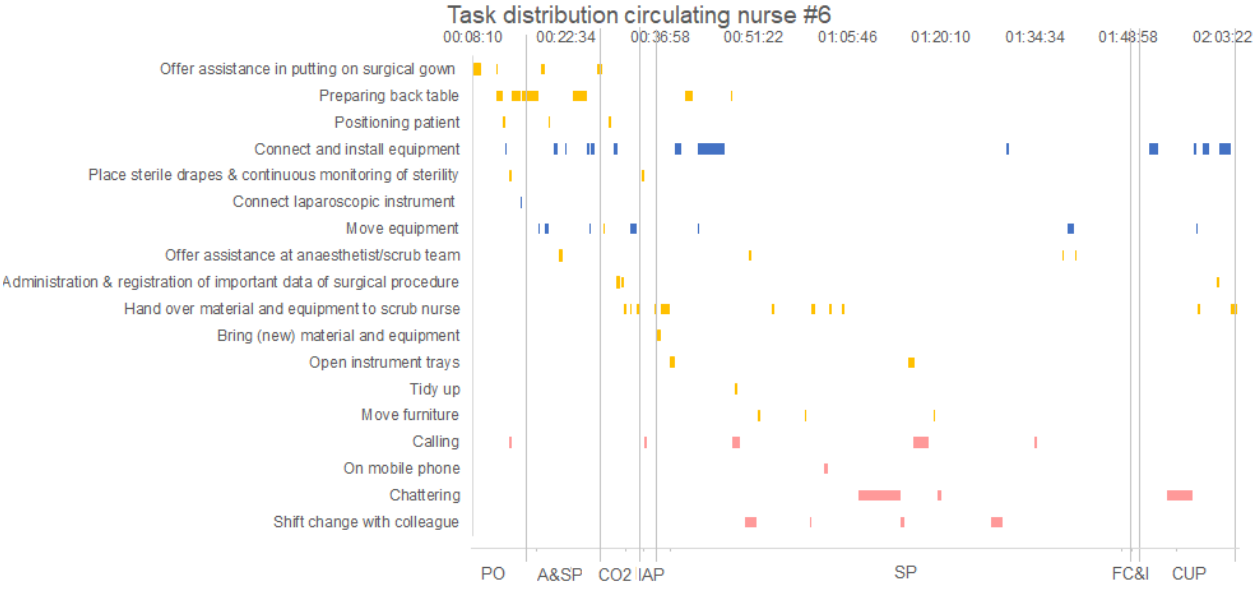


(b) Circulating nurse

Figure B.5: The duration of each task at a time for each perioperative nurse for procedure 5. The patient-related tasks are depicted in yellow, the technical tasks in blue and the remaining tasks in pink. The duration of each phase is given.

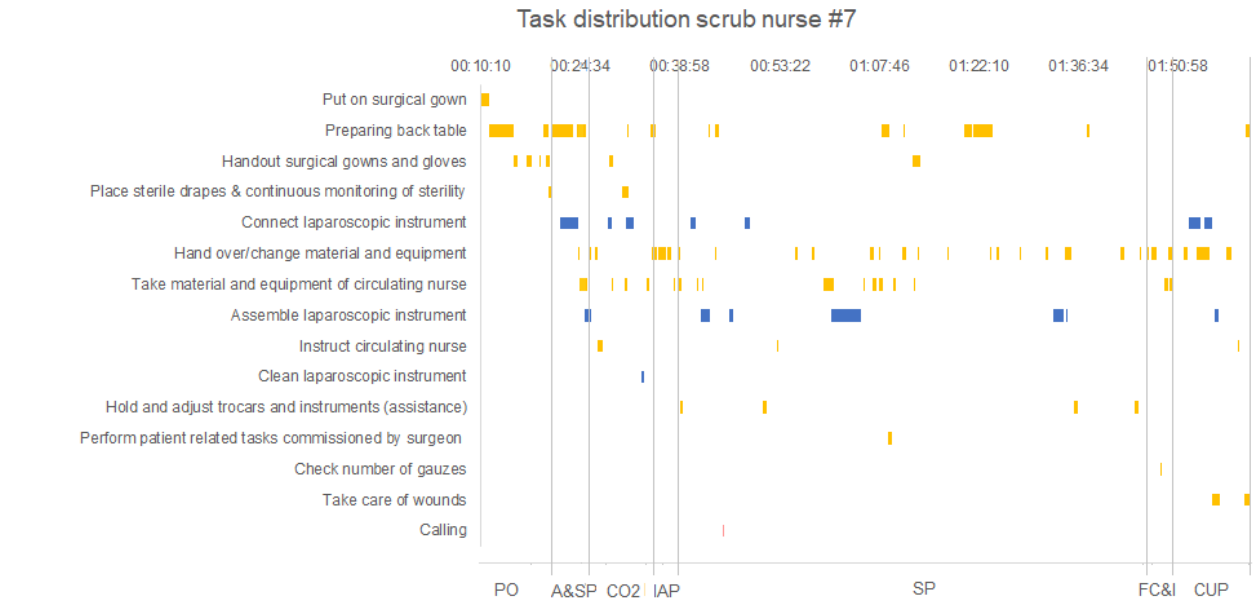


(a) Scrub nurse

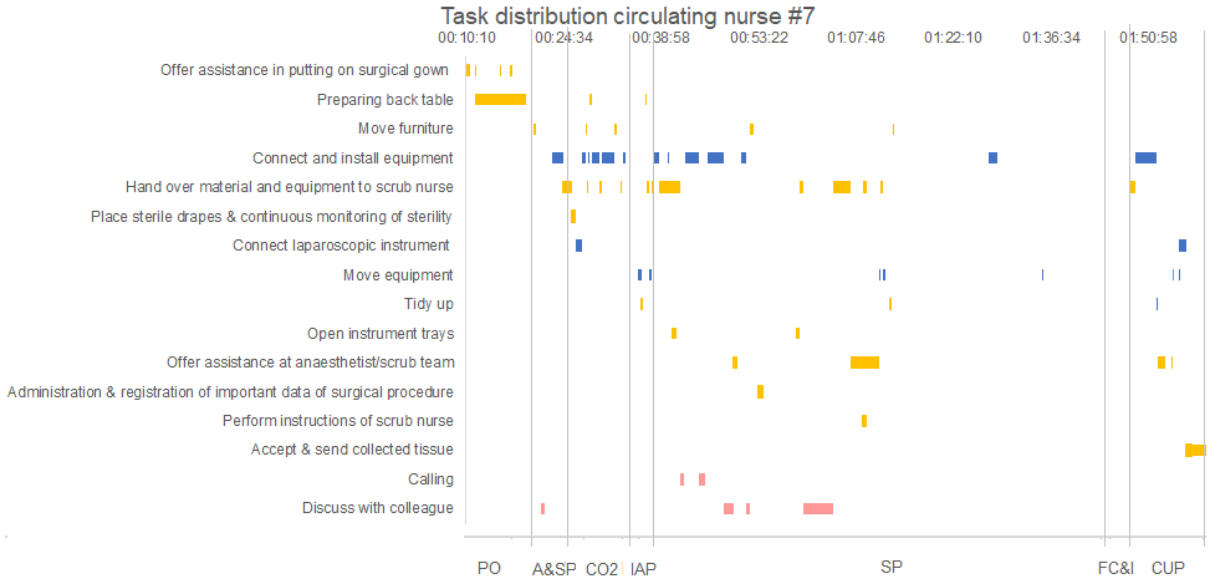


(b) Circulating nurse

Figure B.6: The duration of each task at a time for each perioperative nurse for procedure 6. The patient-related tasks are depicted in yellow, the technical tasks in blue and the remaining tasks in pink. The duration of each phase is given.



(a) Scrub nurse



(b) Circulating nurse

Figure B.7: The duration of each task at a time for each perioperative nurse for procedure 7. The patient-related tasks are depicted in yellow, the technical tasks in blue and the remaining tasks in pink. The duration of each phase is given.

Duration of procedure	01:31:24			
Scrub nurse				
	Type	**Frequency**	**Total duration**	**% of time**
Handout surgical gowns and gloves	P	2	00:02:04	2,26%
Disinfect operating table	P	2	00:02:15	2,46%
Check number of gauzes	P	0	00:00:00	0,00%
Hand over/change material and equipment	P	25	00:12:13	13,37%
Take material and equipment of circulating nurse	P	10	00:01:56	2,12%
Instruct circulating nurse	P	3	00:00:48	0,88%
Keeping operating table organized	P	0	00:00:00	0,00%
Tidy up	P	0	00:00:00	0,00%
Preparing back table	P	15	00:15:37	17,09%
Perform patient related tasks commissioned by surgeon	P	0	00:00:00	0,00%
Positioning patient	P	0	00:00:00	0,00%
Place sterile drapes & continuous monitoring of sterility	P	3	00:03:23	3,70%
Put on surgical gown	P	1	00:00:59	1,08%
Take care of wounds	P	1	00:00:55	1,00%
Clean laparoscopic instrument	T	7	00:02:30	2,74%
Connect and install equipment	T	0	00:00:00	0,00%
Connect laparoscopic instrument	T	4	00:03:40	4,01%
Assemble laparoscopic instrument	T	6	00:06:08	6,71%
Hold and adjust trocars and instruments (assistance)	P	8	00:04:23	4,80%
Calling	V	0	00:00:00	0,00%
Asking extra colleague	V	0	00:00:00	0,00%
Chattering	V	0	00:00:00	0,00%
Watching	V	0	00:00:00	0,00%
On mobile phone	V	0	00:00:00	0,00%
Discuss with colleague	V	0	00:00:00	0,00%
Have a break	V	0	00:00:00	0,00%
Shift change with colleague	V	0	00:00:00	0,00%
	Total			**62,20%**
	Technical			**13,46%**
	Patient-related			**48,74%**
	Remaining			**0,00%**

Circulating nurse				
	Type	**Frequency**	**Total duration**	**% of time**
Administration & registration of important data of surgical procedure	P	3	00:01:43	1,88%
Accept & send collected tissue	P	1	00:00:06	0,11%
Check number of gauzes	P	0	00:00:00	0,00%
Offer assistance at anaesthetist/scrub team	P	0	00:00:00	0,00%
Offer assistance in putting on surgical gown	P	2	00:00:22	0,40%
Hand over material and equipment to scrub nurse	P	7	00:03:07	3,41%
Move furniture	P	1	00:00:42	0,77%
Bring (new) material and equipment	P	2	00:02:09	2,35%
Tidy up	P	1	00:00:30	0,55%
Preparing back table	P	3	00:10:35	11,58%
Positioning patient	P	0	00:00:00	0,00%
Place sterile drapes & continuous monitoring of sterility	P	2	00:00:44	0,80%
Attach diathermy plate on patient	T	1	00:00:39	0,71%
Perform instructions of scrub nurse	P	0	00:00:00	0,00%
Connect laparoscopic instrument	T	2	00:01:55	2,10%
Connect and install equipment	T	15	00:13:21	14,61%
Move equipment	T	4	00:02:18	2,52%
Open instrument trays	T	3	00:03:36	3,94%
Calling	V	3	00:01:33	1,70%
Asking extra colleague	V	0	00:00:00	0,00%
Chattering	V	0	00:00:00	0,00%
Watching	V	0	00:00:00	0,00%
On mobile phone	V	0	00:00:00	0,00%
Discuss with colleague	V	0	00:00:00	0,00%
Have a break	V	0	00:00:00	0,00%
Shift change with colleague	V	2	00:03:01	3,30%
			Total	**50,71%**
			Technical	**23,87%**
			Patient-related	**21,85%**
			Remaining	**5,00%**

Figure B.8: The category, the frequency, the total duration and the percentage of the total task time to the total duration of the procedure are given for each task of the scrub and circulating nurses in procedure 1. The percentage of all tasks and for each category are displayed. P is patient-related task, T is technical task and V is remaining task.

Duration of procedure	02:36:00			
Scrub nurse				
	Type	**Frequency**	**Total duration**	**% of time**
Handout surgical gowns and gloves	P	5	00:03:09	2,02%
Disinfect operating table	P	0	00:00:00	0,00%
Check number of gauzes	P	1	00:00:16	0,17%
Hand over/change material and equipment	P	43	00:20:09	12,92%
Take material and equipment of circulating nurse	P	14	00:02:16	1,45%
Instruct circulating nurse	P	4	00:00:37	0,40%
Keeping operating table organized	P	1	00:01:33	0,99%
Tidy up	P	1	00:00:22	0,24%
Preparing back table	P	16	00:16:54	10,83%
Perform patient related tasks commissioned by surgeon	P	0	00:00:00	0,00%
Positioning patient	P	0	00:00:00	0,00%
Place sterile drapes & continuous monitoring of sterility	P	2	00:01:48	1,15%
Put on surgical gown	P	1	00:00:45	0,48%
Take care of wounds	P	3	00:02:15	1,44%
Clean laparoscopic instrument	T	8	00:03:20	2,14%
Connect and install equipment	T	0	00:00:00	0,00%
Connect laparoscopic instrument	T	8	00:12:40	8,12%
Assemble laparoscopic instrument	T	2	00:04:51	3,11%
Hold and adjust trocars and instruments (assistance)	P	5	00:02:50	1,82%
Calling	V	0	00:00:00	0,00%
Asking extra colleague	V	0	00:00:00	0,00%
Chattering	V	0	00:00:00	0,00%
Watching	V	0	00:00:00	0,00%
On mobile phone	V	0	00:00:00	0,00%
Discuss with colleague	V	0	00:00:00	0,00%
Have a break	V	0	00:00:00	0,00%
Shift change with colleague	V	0	00:00:00	0,00%
	Total			**47,28%**
	Technical			**13,37%**
	Patient-related			**33,91%**
	Remaining			**0,00%**

Circulating nurse				
	Type	**Frequency**	**Total duration**	**% of time**
Administration & registration of important data of surgical procedure	P	2	00:04:46	3,06%
Accept & send collected tissue	P	2	00:04:09	2,66%
Check number of gauzes	P	0	00:00:00	0,00%
Offer assistance at anaesthetist/scrub team	P	1	00:01:00	0,64%
Offer assistance in putting on surgical gown	P	5	00:00:47	0,50%
Hand over material and equipment to scrub nurse	P	13	00:05:40	3,63%
Move furniture	P	8	00:03:04	1,97%
Bring (new) material and equipment	P	2	00:03:55	2,51%
Tidy up	P	1	00:00:52	0,56%
Preparing back table	P	4	00:10:04	6,45%
Positioning patient	P	0	00:00:00	0,00%
Place sterile drapes & continuous monitoring of sterility	P	2	00:00:37	0,40%
Attach diathermy plate on patient	T	1	00:01:03	0,67%
Perform instructions of scrub nurse	P	2	00:02:09	1,38%
Connect laparoscopic instrument	T	1	00:00:50	0,53%
Connect and install equipment	T	11	00:06:49	4,37%
Move equipment	T	7	00:03:26	2,20%
Open instrument trays	T	1	00:01:24	0,90%
Calling	V	0	00:00:00	0,00%
Asking extra colleague	V	0	00:00:00	0,00%
Chattering	V	0	00:00:00	0,00%
Watching	V	0	00:00:00	0,00%
On mobile phone	V	0	00:00:00	0,00%
Discuss with colleague	V	1	00:00:58	0,62%
Have a break	V	0	00:00:00	0,00%
Shift change with colleague	V	0	00:00:00	0,00%
	Total			**33,04%**
	Technical			**8,68%**
	Patient-related			**23,75%**
	Remaining			**0,62%**

Figure B.9: The category, the frequency, the total duration and the percentage of the total task time to the total duration of the procedure are given for each task of the scrub and circulating nurses in procedure 2. The percentage of all tasks and for each category are displayed. P is patient-related task, T is technical task and V is remaining task.

Duration of procedure	02:39:26			
Scrub nurse				
	Type	**Frequency**	**Total duration**	**% of time**
Handout surgical gowns and gloves	P	6	00:05:12	3,26%
Disinfect operating table	P	0	00:00:00	0,00%
Check number of gauzes	P	0	00:00:00	0,00%
Hand over/change material and equipment	P	46	00:22:55	14,37%
Take material and equipment of circulating nurse	P	11	00:04:19	2,71%
Instruct circulating nurse	P	1	00:00:13	0,14%
Keeping operating table organized	P	0	00:00:00	0,00%
Tidy up	P	0	00:00:00	0,00%
Preparing back table	P	16	00:27:49	17,45%
Perform patient related tasks commissioned by surgeon	P	0	00:00:00	0,00%
Positioning patient	P	2	00:00:40	0,42%
Place sterile drapes & continuous monitoring of sterility	P	2	00:01:00	0,63%
Put on surgical gown	P	1	00:00:56	0,59%
Take care of wounds	P	1	00:01:45	1,10%
Clean laparoscopic instrument	T	4	00:02:51	1,79%
Connect and install equipment	T	0	00:00:00	0,00%
Connect laparoscopic instrument	T	7	00:11:00	6,90%
Assemble laparoscopic instrument	T	10	00:10:02	6,29%
Hold and adjust trocars and instruments (assistance)	P	10	00:06:57	4,36%
Calling	V	0	00:00:00	0,00%
Asking extra colleague	V	0	00:00:00	0,00%
Chattering	V	0	00:00:00	0,00%
Watching	V	0	00:00:00	0,00%
On mobile phone	V	0	00:00:00	0,00%
Discuss with colleague	V	0	00:00:00	0,00%
Have a break	V	0	00:00:00	0,00%
Shift change with colleague	V	0	00:00:00	0,00%
	Total			**59,99%**
	Technical			**14,98%**
	Patient-related			**45,01%**
	Remaining			**0,00%**

Circulating nurse				
	Type	**Frequency**	**Total duration**	**% of time**
Administration & registration of important data of surgical procedure	P	1	00:02:50	1,78%
Accept & send collected tissue	P	1	00:00:15	0,16%
Check number of gauzes	P	0	00:00:00	0,00%
Offer assistance at anaesthetist/scrub team	P	0	00:00:00	0,00%
Offer assistance in putting on surgical gown	P	4	00:01:08	0,71%
Hand over material and equipment to scrub nurse	P	14	00:04:35	2,87%
Move furniture	P	3	00:00:41	0,43%
Bring (new) material and equipment	P	3	00:04:29	2,81%
Tidy up	P	0	00:00:00	0,00%
Preparing back table	P	8	00:16:49	10,55%
Positioning patient	P	1	00:00:08	0,08%
Place sterile drapes & continuous monitoring of sterility	P	2	00:00:35	0,37%
Attach diathermy plate on patient	T	0	00:00:00	0,00%
Perform instructions of scrub nurse	P	2	00:00:33	0,34%
Connect laparoscopic instrument	T	2	00:01:21	0,85%
Connect and install equipment	T	17	00:18:26	11,56%
Move equipment	T	4	00:02:07	1,33%
Open instrument trays	T	2	00:02:37	1,64%
Calling	V	1	00:00:26	0,27%
Asking extra colleague	V	0	00:00:00	0,00%
Chattering	V	0	00:00:00	0,00%
Watching	V	0	00:00:00	0,00%
On mobile phone	V	0	00:00:00	0,00%
Discuss with colleague	V	1	00:02:20	1,46%
Have a break	V	0	00:00:00	0,00%
Shift change with colleague	V	0	00:00:00	0,00%
			Total	**37,22%**
			Technical	**15,38%**
			Patient-related	**20,10%**
			Remaining	**1,74%**

Figure B.10: The category, the frequency, the total duration and the percentage of the total task time to the total duration of the procedure are given for each task of the scrub and circulating nurses in procedure 3. The percentage of all tasks and for each category are displayed. P is patient-related task, T is technical task and V is remaining task.

Duration of procedure	03:17:50			
Scrub nurse				
	Type	**Frequency**	**Total duration**	**% of time**
Handout surgical gowns and gloves	P	3	00:04:25	2,23%
Disinfect operating table	P	0	00:00:00	0,00%
Check number of gauzes	P	0	00:00:00	0,00%
Hand over/change material and equipment	P	53	00:33:07	16,74%
Take material and equipment of circulating nurse	P	14	00:03:35	1,81%
Instruct circulating nurse	P	3	00:00:28	0,24%
Keeping operating table organized	P	0	00:00:00	0,00%
Tidy up	P	0	00:00:00	0,00%
Preparing back table	P	14	00:19:50	10,03%
Perform patient related tasks commissioned by surgeon	P	0	00:00:00	0,00%
Positioning patient	P	0	00:00:00	0,00%
Place sterile drapes & continuous monitoring of sterility	P	3	00:03:18	1,67%
Put on surgical gown	P	1	00:00:57	0,48%
Take care of wounds	P	1	00:00:24	0,20%
Clean laparoscopic instrument	T	6	00:03:30	1,77%
Connect and install equipment	T	0	00:00:00	0,00%
Connect laparoscopic instrument	T	7	00:05:46	2,91%
Assemble laparoscopic instrument	T	15	00:26:29	13,39%
Hold and adjust trocars and instruments (assistance)	P	2	00:00:44	0,37%
Calling	V	0	00:00:00	0,00%
Asking extra colleague	V	0	00:00:00	0,00%
Chattering	V	3	00:14:08	7,14%
Watching	V	0	00:00:00	0,00%
On mobile phone	V	0	00:00:00	0,00%
Discuss with colleague	V	2	00:01:06	0,56%
Have a break	V	0	00:00:00	0,00%
Shift change with colleague	V	0	00:00:00	0,00%
	Total			**59,54%**
	Technical			**18,07%**
	Patient-related			**33,77%**
	Remaining			**7,70%**

Circulating nurse				
	Type	**Frequency**	**Total duration**	**% of time**
Administration & registration of important data of surgical procedure	P	4	00:08:05	4,09%
Accept & send collected tissue	P	1	00:01:04	0,54%
Check number of gauzes	P	0	00:00:00	0,00%
Offer assistance at anaesthetist/scrub team	P	8	00:13:06	6,62%
Offer assistance in putting on surgical gown	P	5	00:01:27	0,73%
Hand over material and equipment to scrub nurse	P	15	00:08:32	4,31%
Move furniture	P	9	00:02:19	1,17%
Bring (new) material and equipment	P	3	00:01:54	0,96%
Tidy up	P	2	00:03:36	1,82%
Preparing back table	P	4	00:12:24	6,27%
Positioning patient	P	0	00:00:00	0,00%
Place sterile drapes & continuous monitoring of sterility	P	3	00:01:02	0,52%
Attach diathermy plate on patient	T	0	00:00:00	0,00%
Perform instructions of scrub nurse	P	1	00:00:30	0,25%
Connect laparoscopic instrument	T	1	00:00:39	0,33%
Connect and install equipment	T	22	00:26:50	13,56%
Move equipment	T	8	00:05:06	2,58%
Open instrument trays	T	3	00:02:14	1,13%
Calling	V	1	00:01:37	0,82%
Asking extra colleague	V	0	00:00:00	0,00%
Chattering	V	3	00:14:08	7,14%
Watching	V	0	00:00:00	0,00%
On mobile phone	V	0	00:00:00	0,00%
Discuss with colleague	V	1	00:00:42	0,35%
Have a break	V	0	00:00:00	0,00%
Shift change with colleague	V	4	00:04:15	2,15%
			Total	**55,35%**
			Technical	**17,60%**
			Patient-related	**27,29%**
			Remaining	**0,82%**

Figure B.11: The category, the frequency, the total duration and the percentage of the total task time to the total duration of the procedure are given for each task of the scrub and circulating nurses in procedure 4. The percentage of all tasks and for each category are displayed. P is patient-related task, T is technical task and V is remaining task.

Duration of procedure	02:29:34							
Scrub nurse					**Circulating nurse**				
	Type	**Frequency**	**Total duration**	**% of time**		**Type**	**Frequency**	**Total duration**	**% of time**
Handout surgical gowns and gloves	P	3	00:03:11	2,13%	Administration & registration of important data of surgical procedure	P	1	00:01:42	1,14%
Disinfect operating table	P	0	00:00:00	0,00%	Accept & send collected tissue	P	0	00:00:00	0,00%
Check number of gauzes	P	2	00:02:52	1,92%	Check number of gauzes	P	2	00:00:19	0,21%
Hand over/change material and equipment	P	41	00:27:07	18,13%	Offer assistance at anaesthetist/scrub team	P	1	00:03:59	2,66%
Take material and equipment of circulating nurse	P	13	00:04:59	3,33%	Offer assistance in putting on surgical gown	P	2	00:00:21	0,23%
Instruct circulating nurse	P	5	00:00:33	0,37%	Hand over material and equipment to scrub nurse	P	12	00:06:18	4,21%
Keeping operating table organized	P	0	00:00:00	0,00%	Move furniture	P	3	00:01:11	0,79%
Tidy up	P	0	00:00:00	0,00%	Bring (new) material and equipment	P	4	00:03:56	2,63%
Preparing back table	P	20	00:28:21	18,95%	Tidy up	P	2	00:00:17	0,19%
Perform patient related tasks commissioned by surgeon	P	0	00:00:00	0,00%	Preparing back table	P	6	00:10:45	7,19%
Positioning patient	P	0	00:00:00	0,00%	Positioning patient	P	1	00:00:11	0,12%
Place sterile drapes & continuous monitoring of sterility	P	4	00:03:40	2,45%	Place sterile drapes & continuous monitoring of sterility	P	3	00:00:56	0,62%
Put on surgical gown	P	1	00:01:26	0,96%	Attach diathermy plate on patient	T	1	00:00:32	0,36%
Take care of wounds	P	1	00:00:37	0,41%	Perform instructions of scrub nurse	P	1	00:00:20	0,22%
Clean laparoscopic instrument	T	10	00:05:57	3,98%	Connect laparoscopic instrument	T	0	00:00:00	0,00%
Connect and install equipment	T	0	00:00:00	0,00%	Connect and install equipment	T	14	00:06:58	4,66%
Connect laparoscopic instrument	T	4	00:03:38	2,43%	Move equipment	T	11	00:04:13	2,82%
Assemble laparoscopic instrument	T	8	00:08:33	5,72%	Open instrument trays	T	0	00:00:00	0,00%
Hold and adjust trocars and instruments (assistance)	P	16	00:15:28	10,34%	Calling	V	1	00:01:35	1,06%
Calling	V	0	00:00:00	0,00%	Asking extra colleague	V	0	00:00:00	0,00%
Asking extra colleague	V	0	00:00:00	0,00%	Chattering	V	2	00:11:55	7,97%
Chattering	V	0	00:00:00	0,00%	Watching	V	0	00:00:00	0,00%
Watching	V	0	00:00:00	0,00%	On mobile phone	V	6	00:05:12	3,48%
On mobile phone	V	0	00:00:00	0,00%	Discuss with colleague	V	2	00:01:05	0,72%
Discuss with colleague	V	0	00:00:00	0,00%	Have a break	V	0	00:00:00	0,00%
Have a break	V	0	00:00:00	0,00%	Shift change with colleague	V	2	00:02:59	1,99%
Shift change with colleague	V	0	00:00:00	0,00%					
	Total			**71,12%**		**Total**			**43,28%**
	Technical			**12,12%**		Technical			**7,83%**
	Patient-related			**58,99%**		Patient-related			**20,23%**
	Remaining			**0,00%**		Remaining			**15,22%**

Figure B.12: The category, the frequency, the total duration and the percentage of the total task time to the total duration of the procedure are given for each task of the scrub and circulating nurses in procedure 5. The percentage of all tasks and for each category are displayed. P is patient-related task, T is technical task and V is remaining task.

Duration of procedure	01:58:11			
Scrub nurse				
	Type	**Frequency**	**Total duration**	**% of time**
Handout surgical gowns and gloves	P	6	00:01:56	1,64%
Disinfect operating table	P	2	00:02:56	2,48%
Check number of gauzes	P	0	00:00:00	0,00%
Hand over/change material and equipment	P	24	00:09:28	8,01%
Take material and equipment of circulating nurse	P	10	00:04:08	3,50%
Instruct circulating nurse	P	0	00:00:00	0,00%
Keeping operating table organized	P	0	00:00:00	0,00%
Tidy up	P	0	00:00:00	0,00%
Preparing back table	P	11	00:10:13	8,64%
Perform patient related tasks commissioned by surgeon	P	0	00:00:00	0,00%
Positioning patient	P	0	00:00:00	0,00%
Place sterile drapes & continuous monitoring of sterility	P	4	00:03:07	2,64%
Put on surgical gown	P	1	00:01:27	1,23%
Take care of wounds	P	1	00:05:49	4,92%
Clean laparoscopic instrument	T	1	00:00:10	0,14%
Connect and install equipment	T	0	00:00:00	0,00%
Connect laparoscopic instrument	T	6	00:09:14	7,81%
Assemble laparoscopic instrument	T	9	00:12:05	10,22%
Hold and adjust trocars and instruments (assistance)	P	5	00:40:54	34,61%
Calling	V	0	00:00:00	0,00%
Asking extra colleague	V	0	00:00:00	0,00%
Chattering	V	0	00:00:00	0,00%
Watching	V	0	00:00:00	0,00%
On mobile phone	V	0	00:00:00	0,00%
Discuss with colleague	V	0	00:00:00	0,00%
Have a break	V	0	00:00:00	0,00%
Shift change with colleague	V	0	00:00:00	0,00%
	Total			**85,84%**
	Technical			**18,18%**
	Patient-related			**67,66%**
	Remaining			**0,00%**

Circulating nurse				
	Type	**Frequency**	**Total duration**	**% of time**
Administration & registration of important data of surgical procedure	P	3	00:01:14	1,04%
Accept & send collected tissue	P	0	00:00:00	0,00%
Check number of gauzes	P	0	00:00:00	0,00%
Offer assistance at anaesthetist/scrub team	P	4	00:01:09	0,97%
Offer assistance in putting on surgical gown	P	4	00:02:16	1,92%
Hand over material and equipment to scrub nurse	P	11	00:05:28	4,63%
Move furniture	P	3	00:00:34	0,48%
Bring (new) material and equipment	P	1	00:00:20	0,28%
Tidy up	P	2	00:00:20	0,28%
Preparing back table	P	7	00:08:35	7,26%
Positioning patient	P	3	00:00:48	0,68%
Place sterile drapes & continuous monitoring of sterility	P	2	00:00:35	0,49%
Attach diathermy plate on patient	T	0	00:00:00	0,00%
Perform instructions of scrub nurse	P	0	00:00:00	0,00%
Connect laparoscopic instrument	T	1	00:00:17	0,24%
Connect and install equipment	T	14	00:12:31	10,59%
Move equipment	T	10	00:03:14	2,74%
Open instrument trays	T	2	00:01:46	1,49%
Calling	V	5	00:04:45	4,02%
Asking extra colleague	V	0	00:00:00	0,00%
Chattering	V	3	00:11:04	9,36%
Watching	V	0	00:00:00	0,00%
On mobile phone	V	1	00:00:43	0,61%
Discuss with colleague	V	0	00:00:00	0,00%
Have a break	V	0	00:00:00	0,00%
Shift change with colleague	V	4	00:04:05	3,46%
	Total			**50,54%**
	Technical			**15,06%**
	Patient-related			**18,04%**
	Remaining			**17,44%**

Figure B.13: The category, the frequency, the total duration and the percentage of the total task time to the total duration of the procedure are given for each task of the scrub and circulating nurses in procedure 6. The percentage of all tasks and for each category are displayed. P is patient-related task, T is technical task and V is remaining task.

Duration of procedure	01:50:55								
Scrub nurse					Circulating nurse				
	Type	Frequency	Total duration	% of time		Type	Frequency	Total duration	% of time
Handout surgical gowns and gloves	P	6	00:03:27	3,11%	Administration & registration of important data of surgical procedure	P	1	00:00:43	0,65%
Disinfect operating table	P	0	00:00:00	0,00%	Accept & send collected tissue	P	2	00:04:34	4,12%
Check number of gauzes	P	1	00:00:15	0,23%	Check number of gauzes	P	0	00:00:00	0,00%
Hand over/change material and equipment	P	28	00:14:21	12,94%	Offer assistance at anaesthetist/scrub team	P	4	00:05:58	5,38%
Take material and equipment of circulating nurse	P	16	00:07:17	6,57%	Offer assistance in putting on surgical gown	P	4	00:01:04	0,96%
Instruct circulating nurse	P	3	00:01:02	0,93%	Hand over material and equipment to scrub nurse	P	12	00:10:54	9,83%
Keeping operating table organized	P	0	00:00:00	0,00%	Move furniture	P	5	00:01:28	1,32%
Tidy up	P	0	00:00:00	0,00%	Bring (new) material and equipment	P	0	00:00:00	0,00%
Preparing back table	P	14	00:16:56	15,27%	Tidy up	P	3	00:00:53	0,80%
Perform patient related tasks commissioned by surgeon	P	1	00:00:37	0,56%	Preparing back table	P	3	00:08:12	7,39%
Positioning patient	P	0	00:00:00	0,00%	Positioning patient	P	0	00:00:00	0,00%
Place sterile drapes & continuous monitoring of sterility	P	2	00:01:19	1,19%	Place sterile drapes & continuous monitoring of sterility	P	1	00:00:31	0,47%
Put on surgical gown	P	1	00:01:16	1,14%	Attach diathermy plate on patient	T	0	00:00:00	0,00%
Take care of wounds	P	2	00:02:51	2,57%	Perform instructions of scrub nurse	P	1	00:00:35	0,53%
Clean laparoscopic instrument	T	1	00:00:18	0,27%	Connect laparoscopic instrument	T	2	00:01:55	1,73%
Connect and install equipment	T	0	00:00:00	0,00%	Connect and install equipment	T	14	00:15:51	14,29%
Connect laparoscopic instrument	T	8	00:08:26	7,60%	Move equipment	T	7	00:01:48	1,62%
Assemble laparoscopic instrument	T	7	00:08:53	8,01%	Open instrument trays	T	2	00:01:23	1,25%
Hold and adjust trocars and instruments (assistance)	P	4	00:02:02	1,83%	Calling	V	2	00:01:25	1,28%
Calling	V	1	00:00:14	0,21%	Asking extra colleague	V	0	00:00:00	0,00%
Asking extra colleague	V	0	00:00:00	0,00%	Chattering	V	0	00:00:00	0,00%
Chattering	V	0	00:00:00	0,00%	Watching	V	0	00:00:00	0,00%
Watching	V	0	00:00:00	0,00%	On mobile phone	V	0	00:00:00	0,00%
On mobile phone	V	0	00:00:00	0,00%	Discuss with colleague	V	4	00:06:57	6,27%
Discuss with colleague	V	0	00:00:00	0,00%	Have a break	V	0	00:00:00	0,00%
Have a break	V	0	00:00:00	0,00%	Shift change with colleague	V	0	00:00:00	0,00%
Shift change with colleague	V	0	00:00:00	0,00%					
		Total		62,42%			Total		57,87%
		Technical		15,88%			Technical		18,89%
		Patient-related		46,33%			Patient-related		31,44%
		Remaining		0,21%			Remaining		7,54%

Figure B.14: The category, the frequency, the total duration and the percentage of the total task time to the total duration of the procedure are given for each task of the scrub and circulating nurses in procedure 7. The percentage of all tasks and for each category are displayed. P is patient-related task, T is technical task and V is remaining task.

Scrub nurse																
Duration of procedure: 01:31:24			11%	9%	5%	6%	59%	2%	7%	11%	9%	5%	6%	59%	2%	7%
	Frequency	Total duration	PO	A&SP	CO2	IAP	SP	FC&I	CUP	PO	A&SP	CO2	IAP	SP	FC&I	CUP
Handout surgical gowns and gloves	2	00:02:04		00:02:04							2,26%					
Disinfect operating table	2	00:02:15	00:02:04	00:00:11						2,26%	0,20%					
Check number of gauzes	0	00:00:00														
Hand over/change material and equipment	25	00:12:13		00:00:14	00:00:14	00:02:21	00:08:33	00:00:32	00:00:19		0,26%	0,26%	2,57%	9,35%	0,58%	0,35%
Take material and equipment of circulating nurse	10	00:01:56			00:00:07	00:00:28	00:00:42		00:00:39			0,13%	0,51%	0,77%		0,71%
Instruct circulating nurse	3	00:00:48					00:00:39		00:00:09					0,71%		0,16%
Keeping operating table organized	0	00:00:00														
Tidy up	0	00:00:00														
Preparing back table	15	00:15:37	00:07:23	00:01:38	00:01:31		00:02:06		00:02:59	8,08%	1,79%	1,66%		2,30%		3,26%
Perform patient related tasks commissioned by surgeon	0	00:00:00														
Positioning patient	0	00:00:00														
Place sterile drapes & continuous monitoring of sterility	3	00:03:23		00:01:38		00:01:45					1,79%		1,91%			
Put on surgical gown	1	00:00:59	00:00:59							1,08%						
Hold and adjust trocars and instruments (assistance)	8	00:04:23					00:04:23							4,80%		
Take care of wounds	1	00:00:55							00:00:55							1,00%
Clean laparoscopic instrument	7	00:02:30			00:00:27		00:02:03					0,49%		2,24%		
Connect and install equipment	0	00:00:00														
Connect laparoscopic instrument	4	00:03:40		00:02:08			00:01:18		00:00:14		2,33%			1,42%		0,26%
Assemble laparoscopic instrument	6	00:06:08				00:01:03	00:04:24		00:00:41				1,15%	4,81%		0,75%
Calling	0	00:00:00														
Asking extra colleague	0	00:00:00														
Chattering	0	00:00:00														
Watching	0	00:00:00														
On mobile phone	0	00:00:00														
Discuss with colleague	0	00:00:00														
Have a break	0	00:00:00														
Shift change with colleague	0	00:00:00														
	Total		00:10:26	00:07:53	00:02:19	00:05:37	00:24:08	00:00:32	00:05:56							
	Total patient & technical		00:10:26	00:07:53	00:02:19	00:05:37	00:24:08	00:00:32	00:05:56							
	Total%		100%	94%	48%	97%	45%	30%	94%							
	Patient-related		100,00%	72,94%	80,58%	81,31%	67,89%	100,00%	84,55%							
	Technical		0,00%	27,06%	19,42%	18,69%	32,11%	0,00%	15,45%							
	Remaining		0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%							

Figure B.15: The frequency, the total duration of the task for the entire procedure and for each phase and the percentage of the total task time to the total duration of the phase are given for each task of the scrub nurse in procedure 1. The patient-related tasks are depicted in yellow, the technical tasks in blue and the remaining tasks in pink. The total duration of all tasks, the total time of the patient-related and technical tasks, the percentage of the total time of the patient-related and technical tasks to the duration of the phase for each phase are given. For each phase, the percentage of the total duration of the all tasks in the corresponding category to the total duration of all tasks is displayed.

Circulating nurse																
Duration of procedure: 01:31:24	**Frequency**	**Total duration**	**11%** **PO**	**9%** **A&SP**	**5%** **CO2**	**6%** **IAP**	**59%** **SP**	**2%** **FC&I**	**7%** **CUP**	**11%** **PO**	**9%** **A&SP**	**5%** **CO2**	**6%** **IAP**	**59%** **SP**	**2%** **FC&I**	**7%** **CUP**
Administration & registration of important data of surgical procedure	3	00:01:43					00:01:43							1,88%		
Accept & send collected tissue	1	00:00:06					00:00:06							0,11%		
Check number of gauzes	0	00:00:00														
Offer assistance at anaesthetist/scrub team	0	00:00:00														
Offer assistance in putting on surgical gown	2	00:00:22	00:00:11	00:00:11						0,20%	0,20%					
Hand over material and equipment to scrub nurse	7	00:03:07				00:00:58	00:01:37		00:00:32				1,06%	1,77%		0,58%
Move furniture	1	00:00:42				00:00:42							0,77%			
Bring (new) material and equipment	2	00:02:09				00:01:00	00:01:09						1,09%	1,26%		
Tidy up	1	00:00:30				00:00:30							0,55%			
Preparing back table	3	00:10:35	00:07:20				00:03:15			8,02%				3,56%		
Positioning patient	0	00:00:00														
Place sterile drapes & continuous monitoring of sterility	2	00:00:44		00:00:05	00:00:39						0,09%	0,71%				
Perform instructions of scrub nurse	0	00:00:00														
Attach diathermy plate on patient	1	00:00:39	00:00:39							0,71%						
Connect laparoscopic instrument	2	00:01:55		00:00:55			00:01:00				1,00%			1,09%		
Connect and install equipment	15	00:13:21		00:02:57	00:01:52	00:00:12	00:04:23		00:03:57		3,23%	2,04%	0,22%	4,80%		4,32%
Move equipment	4	00:02:18				00:01:27	00:00:23		00:00:28				1,59%	0,42%		0,51%
Open instrument trays	3	00:03:36					00:03:36							3,94%		
Calling	3	00:01:33	00:00:46				00:00:47			0,84%				0,86%		
Asking extra colleague	0	00:00:00														
Chattering	0	00:00:00														
Watching	0	00:00:00														
On mobile phone	0	00:00:00														
Discuss with colleague	0	00:00:00														
Have a break	0	00:00:00														
Shift change with colleague	2	00:03:01	00:00:36				00:02:25			0,66%				2,64%		
	Total		00:09:32	00:04:08	00:02:31	00:04:49	00:20:24	00:00:00	00:04:57							
	Total patient & technical		00:08:10	00:04:08	00:02:31	00:04:49	00:17:12	00:00:00	00:04:57							
	Total%		78%	49%	52%	84%	32%	0%	78%							
	Patient-related		78,85%	6,45%	25,83%	65,74%	38,40%	0,00%	10,77%							
	Technical		6,82%	93,55%	74,17%	34,26%	45,92%	0,00%	89,23%							
	Remaining		14,34%	0,00%	0,00%	0,00%	15,69%	0,00%	0,00%							

Figure B.16: The frequency, the total duration of the task for the entire procedure and for each phase and the percentage of the total task time to the total duration of the phase are given for each task of the circulating nurse in procedure 1. The patient-related tasks are depicted in yellow, the technical tasks in blue and the remaining tasks in pink. The total duration of all tasks, the total time of the patient-related and technical tasks, the percentage of the total time of the patient-related and technical tasks to the duration of the phase for each phase are given. For each phase, the percentage of the total duration of the all tasks in the corresponding category to the total duration of all tasks is displayed.

Scrub nurse																
Duration of procedure: 02:36:00			8%	6%	5%	2%	69%	4%	6%	8%	6%	5%	2%	69%	4%	6%
	Frequency	Total duration	PO	A&SP	CO2	IAP	SP	FC&I	CUP	PO	A&SP	CO2	IAP	SP	FC&I	CUP
Handout surgical gowns and gloves	5	00:03:09	00:02:10		00:00:30		00:00:29			1,39%		0,32%		0,31%		
Disinfect operating table	0	00:00:00														
Check number of gauzes	1	00:00:16							00:00:16							0,17%
Hand over/change material and equipment	43	00:20:09		00:00:09	00:03:50	00:00:47	00:14:06	00:00:42	00:00:35		0,10%	2,46%	0,50%	9,04%	0,45%	0,37%
Take material and equipment of circulating nurse	14	00:02:16		00:00:20	00:00:12	00:00:15	00:01:08		00:00:21		0,21%	0,13%	0,16%	0,73%		0,22%
Instruct circulating nurse	4	00:00:37					00:00:37							0,40%		
Keeping operating table organized	1	00:01:33		00:01:33							0,99%					
Tidy up	1	00:00:22							00:00:22							0,24%
Preparing back table	16	00:16:54	00:09:02	00:02:37	00:00:56		00:03:45	00:00:11	00:00:23	5,79%	1,68%	0,60%		2,40%	0,12%	0,25%
Perform patient related tasks commissioned by surgeon	0	00:00:00														
Positioning patient	0	00:00:00														
Place sterile drapes & continuous monitoring of sterility	2	00:01:48	00:01:24	00:00:24						0,90%	0,26%					
Put on surgical gown	1	00:00:45	00:00:45							0,48%						
Hold and adjust trocars and instruments (assistance)	5	00:02:50					00:02:50							1,82%		
Take care of wounds	3	00:02:15						00:00:45	00:01:30						0,48%	0,96%
Clean laparoscopic instrument	8	00:03:20		00:00:12	00:00:11		00:02:00	00:00:57			0,13%	0,12%		1,28%	0,61%	
Connect and install equipment	0	00:00:00														
Connect laparoscopic instrument	8	00:12:40		00:04:45	00:00:23		00:02:00		00:05:32		3,04%	0,25%		1,28%		3,55%
Assemble laparoscopic instrument	2	00:04:51					00:04:51							3,11%		
Calling	0	00:00:00														
Asking extra colleague	0	00:00:00														
Chattering	0	00:00:00														
Watching	0	00:00:00														
On mobile phone	0	00:00:00														
Discuss with colleague	0	00:00:00														
Have a break	0	00:00:00														
Shift change with colleague	0	00:00:00														
	Total		00:13:21	00:10:00	00:06:02	00:01:02	00:31:46	00:02:35	00:08:59							
	Total patient & technical		00:13:21	00:10:00	00:06:02	00:01:02	00:31:46	00:02:35	00:08:59							
	Total%		112%	99%	81%	31%	30%	40%	95%							
	Patient-related		100,00%	50,50%	90,61%	100,00%	72,14%	63,23%	38,40%							
	Technical		0,00%	49,50%	9,39%	0,00%	27,86%	36,77%	61,60%							
	Remaining		0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%							

Figure B.17: The frequency, the total duration of the task for the entire procedure and for each phase and the percentage of the total task time to the total duration of the phase are given for each task of the scrub nurse in procedure 2. The patient-related tasks are depicted in yellow, the technical tasks in blue and the remaining tasks in pink. The total duration of all tasks, the total time of the patient-related and technical tasks, the percentage of the total time of the patient-related and technical tasks to the duration of the phase for each phase are given. For each phase, the percentage of the total duration of the all tasks in the corresponding category to the total duration of all tasks is displayed.

Circulating nurse																
Duration of procedure: 02:36:00	**Frequency**	**Total duration**	**8%**	**6%**	**5%**	**2%**	**69%**	**4%**	**6%**	**8%**	**6%**	**5%**	**2%**	**69%**	**4%**	**6%**
			PO	**A&SP**	**CO2**	**IAP**	**SP**	**FC&I**	**CUP**	**PO**	**A&SP**	**CO2**	**IAP**	**SP**	**FC&I**	**CUP**
Administration & registration of important data of surgical procedure	2	00:04:46					00:03:46	00:01:00						2,41%	0,64%	
Accept & send collected tissue	2	00:04:09						00:01:18	00:02:51						0,83%	1,83%
Check number of gauzes	0	00:00:00														
Offer assistance at anaesthetist/scrub team	1	00:01:00					00:01:00							0,64%		
Offer assistance in putting on surgical gown	5	00:00:47	00:00:47							0,50%						
Hand over material and equipment to scrub nurse	13	00:05:40		00:01:17	00:00:19	00:00:27	00:02:26		00:01:11		0,82%	0,20%	0,29%	1,56%		0,76%
Move furniture	8	00:03:04	00:00:16	00:00:29	00:00:42		00:01:37			0,17%	0,31%	0,45%		1,04%		
Bring (new) material and equipment	2	00:03:55				00:00:58	00:02:57						0,62%	1,89%		
Tidy up	1	00:00:52							00:00:52							0,56%
Preparing back table	4	00:10:04	00:07:53	00:01:07				00:01:04		5,05%	0,72%				0,68%	
Positioning patient	0	00:00:00														
Place sterile drapes & continuous monitoring of sterility	2	00:00:37		00:00:07			00:00:30				0,07%			0,32%		
Perform instructions of scrub nurse	2	00:02:09					00:02:09							1,38%		
Attach diathermy plate on patient	1	00:01:03	00:01:03							0,67%						
Connect laparoscopic instrument	1	00:00:50		00:00:50							0,53%					
Connect and install equipment	11	00:06:49		00:02:48	00:00:47		00:01:39	00:01:34			1,81%	0,50%		1,06%	1,00%	
Move equipment	7	00:03:26	00:00:08	00:01:33	00:00:53		00:00:52			0,09%	0,99%	0,57%		0,56%		
Open instrument trays	1	00:01:24					00:01:24							0,90%		
Calling	0	00:00:00														
Asking extra colleague	0	00:00:00														
Chattering	0	00:00:00														
Watching	0	00:00:00														
On mobile phone	0	00:00:00														
Discuss with colleague	1	00:00:58					00:00:58							0,62%		
Have a break	0	00:00:00														
Shift change with colleague	0	00:00:00														
	Total		**00:10:07**	**00:08:12**	**00:02:41**	**00:01:25**	**00:19:18**	**00:04:56**	**00:04:54**							
	Total patient & technical		**00:10:07**	**00:08:12**	**00:02:41**	**00:01:25**	**00:18:20**	**00:04:56**	**00:04:54**							
	Total%		**85%**	**81%**	**36%**	**43%**	**17%**	**76%**	**52%**							
	Patient-related		88,30%	36,59%	37,89%	100,00%	74,70%	68,24%	100,00%							
	Technical		11,70%	63,41%	62,11%	0,00%	20,29%	31,76%	0,00%							
	Remaining		0,00%	0,00%	0,00%	0,00%	5,01%	0,00%	0,00%							

Figure B.18: The frequency, the total duration of the task for the entire procedure and for each phase and the percentage of the total task time to the total duration of the phase are given for each task of the circulating nurse in procedure 2. The patient-related tasks are depicted in yellow, the technical tasks in blue and the remaining tasks in pink. The total duration of all tasks, the total time of the patient-related and technical tasks, the percentage of the total time of the patient-related and technical tasks to the duration of the phase for each phase are given. For each phase, the percentage of the total duration of the all tasks in the corresponding category to the total duration of all tasks is displayed.

Scrub nurse																	
Duration of procedure: 02:39:26			8%	20%	5%	7%	63%	2%	9%	8%	20%	5%	7%	63%	2%	9%
	Frequency	Total duration	PO	A&SP	CO2	IAP	SP	FC&I	CUP	PO	A&SP	CO2	IAP	SP	FC&I	CUP
Handout surgical gowns and gloves	6	00:05:12	00:02:39	00:00:18			00:02:15			1,66%	0,19%			1,41%		
Disinfect operating table	0	00:00:00														
Check number of gauzes	0	00:00:00														
Hand over/change material and equipment	46	00:22:55		00:00:34	00:02:13	00:02:29	00:16:21	00:00:56	00:00:22		0,36%	1,39%	1,56%	10,26%	0,59%	0,23%
Take material and equipment of circulating nurse	11	00:04:19				00:00:29	00:03:04	00:00:17	00:00:29				0,30%	1,92%	0,18%	0,30%
Instruct circulating nurse	1	00:00:13				00:00:13							0,14%			
Keeping operating table organized	0	00:00:00														
Tidy up	0	00:00:00														
Preparing back table	16	00:27:49	00:13:00	00:01:21	00:00:33		00:06:37	00:00:21	00:05:57	8,15%	0,85%	0,34%		4,15%	0,22%	3,73%
Perform patient related tasks commissioned by surgeon	0	00:00:00														
Positioning patient	2	00:00:40			00:00:27	00:00:13						0,28%	0,14%			
Place sterile drapes & continuous monitoring of sterility	2	00:01:00	00:00:54	00:00:06						0,56%	0,06%					
Put on surgical gown	1	00:00:56	00:00:56							0,59%						
Hold and adjust trocars and instruments (assistance)	10	00:06:57					00:06:57							4,36%		
Take care of wounds	1	00:01:45							00:01:45							1,10%
Clean laparoscopic instrument	4	00:02:51		00:00:55	00:00:20		00:01:36				0,57%	0,21%		1,00%		
Connect and install equipment	0	00:00:00														
Connect laparoscopic instrument	7	00:11:00		00:04:50			00:03:20		00:02:50		3,03%			2,09%		1,78%
Assemble laparoscopic instrument	10	00:10:02			00:01:12		00:08:50					0,75%		5,54%		
Calling	0	00:00:00														
Asking extra colleague	0	00:00:00														
Chattering	0	00:00:00														
Watching	0	00:00:00														
On mobile phone	0	00:00:00														
Discuss with colleague	0	00:00:00														
Have a break	0	00:00:00														
Shift change with colleague	0	00:00:00														
	Total		00:17:29	00:08:04	00:04:45	00:03:24	00:49:00	00:01:34	00:11:23							
	Total patient & technical		00:17:29	00:08:04	00:04:45	00:03:24	00:49:00	00:01:34	00:11:23							
	Total%		130%	94%	62%	30%	49%	64%	75%							
	Patient-related		100,00%	28,72%	67,72%	100,00%	71,90%	100,00%	75,11%							
	Technical		0,00%	71,28%	32,28%	0,00%	28,10%	0,00%	24,89%							
	Remaining		0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%							

Figure B.19: The frequency, the total duration of the task for the entire procedure and for each phase and the percentage of the total task time to the total duration of the phase are given for each task of the scrub nurse in procedure 3. The patient-related tasks are depicted in yellow, the technical tasks in blue and the remaining tasks in pink. The total duration of all tasks, the total time of the patient-related and technical tasks, the percentage of the total time of the patient-related and technical tasks to the duration of the phase for each phase are given. For each phase, the percentage of the total duration of the all tasks in the corresponding category to the total duration of all tasks is displayed.

Circulating nurse																
Duration of procedure: 02:39:26	**Frequency**	**Total duration**	**8%** **PO**	**20%** **A&SP**	**5%** **CO2**	**7%** **IAP**	**63%** **SP**	**2%** **FC&I**	**9%** **CUP**	**8%** **PO**	**20%** **A&SP**	**5%** **CO2**	**7%** **IAP**	**63%** **SP**	**2%** **FC&I**	**9%** **CUP**
Administration & registration of important data of surgical procedure	1	00:02:50					00:02:50							1,78%		
Accept & send collected tissue	1	00:00:15							00:00:15							0,16%
Check number of gauzes	0	00:00:00														
Offer assistance at anaesthetist/scrub team	0	00:00:00														
Offer assistance in putting on surgical gown	4	00:01:08	00:01:08							0,71%						
Hand over material and equipment to scrub nurse	14	00:04:35			00:00:20	00:00:19	00:02:54	00:00:16	00:00:46			0,21%	0,20%	1,82%	0,17%	0,48%
Move furniture	3	00:00:41				00:00:17	00:00:24						0,18%	0,25%		
Bring (new) material and equipment	3	00:04:29					00:04:29							2,81%		
Tidy up	0	00:00:00														
Preparing back table	8	00:16:49	00:09:57	00:00:54					00:05:58	6,24%	0,56%					3,74%
Positioning patient	1	00:00:08					00:00:08							0,08%		
Place sterile drapes & continuous monitoring of sterility	2	00:00:35	00:00:03		00:00:32					0,03%		0,33%				
Perform instructions of scrub nurse	2	00:00:33				00:00:33							0,34%			
Attach diathermy plate on patient	0	00:00:00														
Connect laparoscopic instrument	2	00:01:21		00:01:05					00:00:16		0,68%					0,17%
Connect and install equipment	17	00:18:26	00:00:56	00:03:45	00:01:16	00:00:15	00:07:44		00:04:30	0,59%	2,35%	0,79%	0,16%	4,85%		2,82%
Move equipment	4	00:02:07		00:00:22	00:00:59	00:00:29	00:00:17				0,23%	0,62%	0,30%	0,18%		
Open instrument trays	2	00:02:37					00:02:37							1,64%		
Calling	1	00:00:26				00:00:26							0,27%			
Asking extra colleague	0	00:00:00														
Chattering	0	00:00:00														
Watching	0	00:00:00														
On mobile phone	0	00:00:00														
Discuss with colleague	1	00:02:20				00:02:20							1,46%			
Have a break	0	00:00:00														
Shift change with colleague	0	00:00:00														
	Total		**00:12:04**	**00:06:06**	**00:03:07**	**00:04:39**	**00:21:23**	**00:00:16**	**00:11:45**							
	Total patient & technical		**00:12:04**	**00:06:06**	**00:03:07**	**00:01:53**	**00:21:23**	**00:00:16**	**00:11:45**							
	Total%		**90%**	**71%**	**41%**	**17%**	**21%**	**11%**	**78%**							
	Patient-related		92,27%	14,75%	27,81%	24,73%	50,27%	100,00%	59,43%							
	Technical		7,73%	85,25%	72,19%	15,77%	49,73%	0,00%	40,57%							
	Remaining		0,00%	0,00%	0,00%	59,50%	0,00%	0,00%	0,00%							

Figure B.20: The frequency, the total duration of the task for the entire procedure and for each phase and the percentage of the total task time to the total duration of the phase are given for each task of the circulating nurse in procedure 3. The patient-related tasks are depicted in yellow, the technical tasks in blue and the remaining tasks in pink. The total duration of all tasks, the total time of the patient-related and technical tasks, the percentage of the total time of the patient-related and technical tasks to the duration of the phase for each phase are given. For each phase, the percentage of the total duration of the all tasks in the corresponding category to the total duration of all tasks is displayed.

Scrub nurse																
Duration of procedure: 03:17:50	**Frequency**	**Total duration**	**7% PO**	**6% A&SP**	**4% CO2**	**3% IAP**	**76% SP**	**1% FC&I**	**3% CUP**	**7% PO**	**6% A&SP**	**4% CO2**	**3% IAP**	**76% SP**	**1% FC&I**	**3% CUP**
Handout surgical gowns and gloves	3	00:04:25	00:02:46	00:00:29			00:01:10			1,40%	0,24%			0,59%		
Disinfect operating table	0	00:00:00														
Check number of gauzes	0	00:00:00														
Hand over/change material and equipment	53	00:33:07		00:01:06	00:00:54	00:00:58	00:28:56		00:01:13		0,56%	0,45%	0,49%	14,63%		0,61%
Take material and equipment of circulating nurse	14	00:03:35		00:00:12		00:01:09	00:01:50		00:00:24		0,10%		0,58%	0,93%		0,20%
Instruct circulating nurse	3	00:00:28		00:00:05			00:00:23				0,04%			0,19%		
Keeping operating table organized	0	00:00:00														
Tidy up	0	00:00:00														
Preparing back table	14	00:19:50	00:07:00	00:02:15	00:00:12		00:06:59		00:03:24	3,54%	1,14%	0,10%		3,53%		1,72%
Perform patient related tasks commissioned by surgeon	0	00:00:00														
Positioning patient	0	00:00:00														
Place sterile drapes & continuous monitoring of sterility	3	00:03:18	00:02:34	00:00:44						1,30%	0,37%					
Put on surgical gown	1	00:00:57	00:00:57							0,48%						
Hold and adjust trocars and instruments (assistance)	2	00:00:44					00:00:44							0,37%		
Take care of wounds	1	00:00:24							00:00:24							0,20%
Clean laparoscopic instrument	6	00:03:30		00:01:21			00:02:09				0,68%			1,09%		
Connect and install equipment	0	00:00:00														
Connect laparoscopic instrument	7	00:05:46		00:03:55		00:00:26	00:01:02		00:00:23		1,98%		0,22%	0,52%		0,19%
Assemble laparoscopic instrument	15	00:26:29				00:00:26	00:24:45	00:01:18					0,22%	12,51%	0,66%	
Calling	0	00:00:00														
Asking extra colleague	0	00:00:00														
Chattering	3	00:14:08					00:14:08							7,14%		
Watching	0	00:00:00														
On mobile phone	0	00:00:00														
Discuss with colleague	2	00:01:06			00:00:24		00:00:42					0,20%		0,35%		
Have a break	0	00:00:00														
Shift change with colleague	0	00:00:00														
	Total		**00:13:17**	**00:10:07**	**00:01:30**	**00:02:59**	**01:22:48**	**00:01:18**	**00:05:48**							
	Total patient & technical		**00:13:17**	**00:10:07**	**00:01:06**	**00:02:59**	**01:07:58**	**00:01:18**	**00:05:48**							
	Total%		**100%**	**91%**	**13%**	**44%**	**45%**	**96%**	**97%**							
	Patient-related		100,00%	47,94%	73,33%	70,95%	48,35%	0,00%	93,39%							
	Technical		0,00%	52,06%	0,00%	29,05%	33,74%	100,00%	6,61%							
	Remaining		0,00%	0,00%	26,67%	0,00%	17,91%	0,00%	0,00%							

Figure B.21: The frequency, the total duration of the task for the entire procedure and for each phase and the percentage of the total task time to the total duration of the phase are given for each task of the scrub nurse in procedure 4. The patient-related tasks are depicted in yellow, the technical tasks in blue and the remaining tasks in pink. The total duration of all tasks, the total time of the patient-related and technical tasks, the percentage of the total time of the patient-related and technical tasks to the duration of the phase for each phase are given. For each phase, the percentage of the total duration of the all tasks in the corresponding category to the total duration of all tasks is displayed.

Circulating nurse																	
Duration of procedure: 03:17:50	**Frequency**	**Total duration**	**7%**	**6%**	**4%**	**3%**	**76%**	**1%**	**3%**	**7%**	**6%**	**4%**	**3%**	**76%**	**1%**	**3%**
			PO	**A&SP**	**CO2**	**IAP**	**SP**	**FC&I**	**CUP**	**PO**	**A&SP**	**CO2**	**IAP**	**SP**	**FC&I**	**CUP**
Administration & registration of important data of surgical procedure	4	00:08:05				00:01:31	00:06:34						0,77%	3,32%		
Accept & send collected tissue	1	00:01:04					00:01:04							0,54%		
Check number of gauzes	0	00:00:00														
Offer assistance at anaesthetist/scrub team	8	00:13:06					00:13:06							6,62%		
Offer assistance in putting on surgical gown	5	00:01:27	00:00:59				00:00:28			0,50%				0,24%		
Hand over material and equipment to scrub nurse	15	00:08:32		00:01:34		00:01:56	00:04:02	00:00:20	00:00:40		0,79%		0,98%	2,04%	0,17%	0,34%
Move furniture	9	00:02:19	00:00:15	00:00:57			00:01:07			0,13%	0,48%			0,56%		
Bring (new) material and equipment	3	00:01:54					00:01:54							0,96%		
Tidy up	2	00:03:36					00:03:36							1,82%		
Preparing back table	4	00:12:24	00:07:22				00:05:02			3,72%				2,54%		
Positioning patient	0	00:00:00														
Place sterile drapes & continuous monitoring of sterility	3	00:01:02	00:00:05		00:00:26		00:00:31			0,04%		0,22%		0,26%		
Perform instructions of scrub nurse	1	00:00:30		00:00:30							0,25%					
Attach diathermy plate on patient	0	00:00:00														
Connect laparoscopic instrument	1	00:00:39		00:00:39							0,33%					
Connect and install equipment	22	00:26:50		00:03:47	00:02:03	00:01:03	00:15:29		00:04:28		1,91%	1,04%	0,53%	7,83%		2,26%
Move equipment	8	00:05:06		00:02:06	00:00:29	00:01:29	00:01:02				1,06%	0,24%	0,75%	0,52%		
Open instrument trays	3	00:02:14					00:02:14							1,13%		
Calling	1	00:01:37		00:01:37							0,82%					
Asking extra colleague	0	00:00:00														
Chattering	3	00:14:08					00:14:08							7,14%		
Watching	0	00:00:00														
On mobile phone	0	00:00:00														
Discuss with colleague	1	00:00:42					00:00:42							0,35%		
Have a break	0	00:00:00														
Shift change with colleague	4	00:04:15					00:00:28							0,24%		
	Total		**00:08:41**	**00:11:10**	**00:02:58**	**00:05:59**	**01:11:27**	**00:00:20**	**00:05:08**							
	Total patient & technical		**00:08:41**	**00:09:33**	**00:02:58**	**00:05:59**	**00:56:09**	**00:00:20**	**00:05:08**							
	Total%		**65%**	**86%**	**36%**	**88%**	**37%**	**25%**	**86%**							
	Patient-related		100,00%	27,01%	14,61%	57,66%	52,34%	100,00%	12,99%							
	Technical		0,00%	58,51%	85,39%	42,34%	26,24%	0,00%	87,01%							
	Remaining		0,00%	14,48%	0,00%	0,00%	21,41%	0,00%	0,00%							

Figure B.22: The frequency, the total duration of the task for the entire procedure and for each phase and the percentage of the total task time to the total duration of the phase are given for each task of the circulating nurse in procedure 4. The patient-related tasks are depicted in yellow, the technical tasks in blue and the remaining tasks in pink. The total duration of all tasks, the total time of the patient-related and technical tasks, the percentage of the total time of the patient-related and technical tasks to the duration of the phase for each phase are given. For each phase, the percentage of the total duration of the all tasks in the corresponding category to the total duration of all tasks is displayed.

Scrub nurse																
Duration of procedure: 02:29:34	**Frequency**	**Total duration**	**9%**	**13%**	**2%**	**4%**	**64%**	**2%**	**6%**	**9%**	**13%**	**2%**	**4%**	**64%**	**2%**	**6%**
			PO	**A&SP**	**CO2**	**IAP**	**SP**	**FC&I**	**CUP**	**PO**	**A&SP**	**CO2**	**IAP**	**SP**	**FC&I**	**CUP**
Handout surgical gowns and gloves	3	00:03:11	00:02:36	00:00:17			00:00:18			1,74%	0,19%			0,20%		
Disinfect operating table	0	00:00:00														
Check number of gauzes	2	00:02:52					00:00:14		00:02:38					0,16%		1,76%
Hand over/change material and equipment	41	00:27:07		00:07:45	00:01:06	00:01:26	00:14:37	00:00:31	00:01:42		5,18%	0,74%	0,96%	9,77%	0,35%	1,14%
Take material and equipment of circulating nurse	13	00:04:59		00:00:05		00:00:33	00:03:52		00:00:29		0,06%		0,37%	2,59%		0,32%
Instruct circulating nurse	5	00:00:33			00:00:18	00:00:11	00:00:04					0,20%	0,12%	0,04%		
Keeping operating table organized	0	00:00:00														
Tidy up	0	00:00:00														
Preparing back table	20	00:28:21	00:10:02	00:03:49	00:01:03		00:08:03	00:01:36	00:03:48	6,71%	2,55%	0,70%		5,38%	1,07%	2,54%
Perform patient related tasks commissioned by surgeon	0	00:00:00														
Positioning patient	0	00:00:00														
Place sterile drapes & continuous monitoring of sterility	4	00:03:40	00:02:41	00:00:24		00:00:10	00:00:25			1,79%	0,27%		0,11%	0,28%		
Put on surgical gown	1	00:01:26	00:01:26							0,96%						
Hold and adjust trocars and instruments (assistance)	16	00:15:28					00:15:28							10,34%		
Take care of wounds	1	00:00:37							00:00:37							0,41%
Clean laparoscopic instrument	10	00:05:57		00:00:57	00:00:49		00:04:11				0,64%	0,55%		2,80%		
Connect and install equipment	0	00:00:00														
Connect laparoscopic instrument	4	00:03:38		00:01:42			00:01:56				1,14%			1,29%		
Assemble laparoscopic instrument	8	00:08:33				00:00:24	00:07:17		00:00:52				0,27%	4,87%		0,58%
Calling	0	00:00:00														
Asking extra colleague	0	00:00:00														
Chattering	0	00:00:00														
Watching	0	00:00:00														
On mobile phone	0	00:00:00														
Discuss with colleague	0	00:00:00														
Have a break	0	00:00:00														
Shift change with colleague	0	00:00:00														
	Total		**00:16:45**	**00:14:59**	**00:03:16**	**00:02:44**	**00:56:25**	**00:02:07**	**00:10:06**							
	Total patient & technical		**00:16:45**	**00:14:59**	**00:03:16**	**00:02:44**	**00:56:25**	**00:02:07**	**00:10:06**							
	Total%		**118%**	**77%**	**105%**	**45%**	**59%**	**93%**	**113%**							
	Patient-related		100,00%	82,31%	75,00%	85,37%	76,25%	100,00%	91,42%							
	Technical		0,00%	17,69%	25,00%	14,63%	23,75%	0,00%	8,58%							
	Remaining		0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%							

Figure B.23: The frequency, the total duration of the task for the entire procedure and for each phase and the percentage of the total task time to the total duration of the phase are given for each task of the scrub nurse in procedure 5. The patient-related tasks are depicted in yellow, the technical tasks in blue and the remaining tasks in pink. The total duration of all tasks, the total time of the patient-related and technical tasks, the percentage of the total time of the patient-related and technical tasks to the duration of the phase for each phase are given. For each phase, the percentage of the total duration of the all tasks in the corresponding category to the total duration of all tasks is displayed.

Circulating nurse																
Duration of procedure: 02:29:34	**Frequency**	**Total duration**	**9%**	**13%**	**2%**	**4%**	**64%**	**2%**	**6%**	**9%**	**13%**	**2%**	**4%**	**64%**	**2%**	**6%**
			PO	**A&SP**	**CO2**	**IAP**	**SP**	**FC&I**	**CUP**	**PO**	**A&SP**	**CO2**	**IAP**	**SP**	**FC&I**	**CUP**
Administration & registration of important data of surgical procedure	1	00:01:42					00:01:42							1,14%		
Accept & send collected tissue	0	00:00:00														
Check number of gauzes	2	00:00:19					00:00:09		00:00:10					0,10%		0,11%
Offer assistance at anaesthetist/scrub team	1	00:03:59					00:03:59							2,66%		
Offer assistance in putting on surgical gown	2	00:00:21	00:00:21							0,23%						
Hand over material and equipment to scrub nurse	12	00:06:18		00:00:05	00:00:37	00:01:05	00:04:18		00:00:13		0,06%	0,41%	0,72%	2,87%		0,14%
Move furniture	3	00:01:11		00:01:05			00:00:06				0,72%			0,07%		
Bring (new) material and equipment	4	00:03:56		00:02:31			00:01:25				1,68%			0,95%		
Tidy up	2	00:00:17	00:00:04				00:00:13			0,04%				0,14%		
Preparing back table	6	00:10:45	00:05:56	00:00:37					00:04:12	3,97%	0,41%					2,81%
Positioning patient	1	00:00:11	00:00:11							0,12%						
Place sterile drapes & continuous monitoring of sterility	3	00:00:56	00:00:43	00:00:13						0,48%	0,14%					
Perform instructions of scrub nurse	1	00:00:20					00:00:20							0,22%		
Attach diathermy plate on patient	1	00:00:32	00:00:32							0,36%						
Connect laparoscopic instrument	0	00:00:00														
Connect and install equipment	14	00:06:58		00:03:01		00:00:26	00:03:06		00:00:25		2,02%		0,29%	2,07%		0,28%
Move equipment	11	00:04:13	00:00:03	00:01:24	00:00:53	00:00:03	00:01:50			0,03%	0,94%	0,59%	0,03%	1,23%		
Open instrument trays	0	00:00:00														
Calling	1	00:01:35					00:01:35							1,06%		
Asking extra colleague	0	00:00:00														
Chattering	2	00:11:55					00:11:55							7,97%		
Watching	0	00:00:00														
On mobile phone	6	00:05:12				00:01:32	00:03:40						1,03%	2,45%		
Discuss with colleague	2	00:01:05					00:01:05							0,72%		
Have a break	0	00:00:00														
Shift change with colleague	2	00:02:59					00:02:59							1,99%		
	Total		**00:07:50**	**00:08:56**	**00:01:30**	**00:03:06**	**00:38:22**	**00:00:00**	**00:05:00**							
	Total patient & technical		**00:07:50**	**00:08:56**	**00:01:30**	**00:01:34**	**00:17:08**	**00:00:00**	**00:05:00**							
	Total%		**55%**	**46%**	**48%**	**26%**	**18%**	**0%**	**56%**							
	Patient-related		92,55%	50,56%	41,11%	34,95%	31,80%	0,00%	91,67%							
	Technical		7,45%	49,44%	58,89%	15,59%	12,86%	0,00%	8,33%							
	Remaining		0,00%	0,00%	0,00%	49,46%	55,34%	0,00%	0,00%							

Figure B.24: The frequency, the total duration of the task for the entire procedure and for each phase and the percentage of the total task time to the total duration of the phase are given for each task of the circulating nurse in procedure 5. The patient-related tasks are depicted in yellow, the technical tasks in blue and the remaining tasks in pink. The total duration of all tasks, the total time of the patient-related and technical tasks, the percentage of the total time of the patient-related and technical tasks to the duration of the phase for each phase are given. For each phase, the percentage of the total duration of the all tasks in the corresponding category to the total duration of all tasks is displayed.

Scrub nurse																
Duration of procedure: 01:58:11	**Frequency**	**Total duration**	**7% PO**	**10% A&SP**	**5% CO2**	**2% IAP**	**67% SP**	**3% FC&I**	**6% CUP**	**7% PO**	**10% A&SP**	**5% CO2**	**2% IAP**	**67% SP**	**3% FC&I**	**6% CUP**
Handout surgical gowns and gloves	6	00:01:56		00:01:11	00:00:17				00:00:28		1,00%	0,24%				0,39%
Disinfect operating table	2	00:02:56	00:01:20	00:01:36						1,13%	1,35%					
Check number of gauzes	0	00:00:00														
Hand over/change material and equipment	24	00:09:28			00:01:16	00:00:13	00:06:07	00:01:43	00:00:09			1,07%	0,18%	5,18%	1,45%	0,13%
Take material and equipment of circulating nurse	10	00:04:08			00:00:30	00:00:18	00:02:30		00:00:50			0,42%	0,25%	2,12%		0,71%
Instruct circulating nurse	0	00:00:00														
Keeping operating table organized	0	00:00:00														
Tidy up	0	00:00:00														
Preparing back table	11	00:10:13	00:04:49	00:01:40	00:01:56		00:01:06	00:00:42		4,08%	1,41%	1,64%		0,93%	0,59%	
Perform patient related tasks commissioned by surgeon	0	00:00:00														
Positioning patient	0	00:00:00														
Place sterile drapes & continuous monitoring of sterility	4	00:03:07		00:03:07							2,64%					
Put on surgical gown	1	00:01:27	00:01:27							1,23%						
Hold and adjust trocars and instruments (assistance)	5	00:40:54					00:40:54							34,61%		
Take care of wounds	1	00:05:49							00:05:49							4,92%
Clean laparoscopic instrument	1	00:00:10					00:00:10							0,14%		
Connect and install equipment	0	00:00:00														
Connect laparoscopic instrument	6	00:09:14		00:04:05			00:04:34	00:00:35			3,46%			3,86%	0,49%	
Assemble laparoscopic instrument	9	00:12:05					00:11:44		00:00:21					9,93%		0,30%
Calling	0	00:00:00														
Asking extra colleague	0	00:00:00														
Chattering	0	00:00:00														
Watching	0	00:00:00														
On mobile phone	0	00:00:00														
Discuss with colleague	0	00:00:00														
Have a break	0	00:00:00														
Shift change with colleague	0	00:00:00														
	Total		**00:07:36**	**00:11:39**	**00:03:59**	**00:00:31**	**01:07:05**	**00:03:00**	**00:07:37**							
	Total patient & technical		**00:07:36**	**00:11:39**	**00:03:59**	**00:00:31**	**01:07:05**	**00:03:00**	**00:07:37**							
	Total%		**90%**	**101%**	**69%**	**19%**	**85%**	**91%**	**101%**							
	Patient-related		100,00%	64,95%	100,00%	100,00%	75,45%	80,56%	95,40%							
	Technical		0,00%	35,05%	0,00%	0,00%	24,55%	19,44%	4,60%							
	Remaining		0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%							

Figure B.25: The frequency, the total duration of the task for the entire procedure and for each phase and the percentage of the total task time to the total duration of the phase are given for each task of the scrub nurse in procedure 6. The patient-related tasks are depicted in yellow, the technical tasks in blue and the remaining tasks in pink. The total duration of all tasks, the total time of the patient-related and technical tasks, the percentage of the total time of the patient-related and technical tasks to the duration of the phase for each phase are given. For each phase, the percentage of the total duration of the all tasks in the corresponding category to the total duration of all tasks is displayed.

Circulating nurse																
Duration of procedure: 01:58:11	**Frequency**	**Total duration**	**7%**	**10%**	**5%**	**2%**	**67%**	**3%**	**6%**	**7%**	**10%**	**5%**	**2%**	**67%**	**3%**	**6%**
			PO	**A&SP**	**CO2**	**IAP**	**SP**	**FC&I**	**CUP**	**PO**	**A&SP**	**CO2**	**IAP**	**SP**	**FC&I**	**CUP**
Administration & registration of important data of surgical procedure	3	00:01:14			00:00:52				00:00:22			0,73%				0,31%
Accept & send collected tissue	0	00:00:00														
Check number of gauzes	0	00:00:00														
Offer assistance at anaesthetist/scrub team	4	00:01:09		00:00:26			00:00:43				0,37%			0,61%		
Offer assistance in putting on surgical gown	4	00:02:16	00:00:55	00:01:21						0,78%	1,14%					
Hand over material and equipment to scrub nurse	11	00:05:28			00:00:51	00:00:03	00:03:09		00:01:25			0,72%	0,04%	2,67%		1,20%
Move furniture	3	00:00:34					00:00:34							0,48%		
Bring (new) material and equipment	1	00:00:20					00:00:20							0,28%		
Tidy up	2	00:00:20					00:00:10		00:00:10					0,14%		0,14%
Preparing back table	7	00:08:35	00:04:48	00:02:04			00:01:21		00:00:22	4,06%	1,75%			1,14%		0,31%
Positioning patient	3	00:00:48	00:00:19	00:00:10	00:00:19					0,27%	0,14%	0,27%				
Place sterile drapes & continuous monitoring of sterility	2	00:00:35	00:00:19			00:00:16				0,27%			0,23%			
Perform instructions of scrub nurse	0	00:00:00														
Attach diathermy plate on patient	0	00:00:00														
Connect laparoscopic instrument	1	00:00:17	00:00:17							0,24%						
Connect and install equipment	14	00:12:31	00:00:20	00:01:48	00:00:36		00:06:42		00:03:05	0,28%	1,52%	0,51%		5,67%		2,61%
Move equipment	10	00:03:14		00:01:03	00:01:00		00:01:07		00:00:04		0,89%	0,85%		0,94%		0,06%
Open instrument trays	2	00:01:46					00:01:46							1,49%		
Calling	5	00:04:45	00:00:19			00:00:28	00:03:58			0,27%			0,39%	3,36%		
Asking extra colleague	0	00:00:00														
Chattering	3	00:11:04					00:11:04							9,36%		
Watching	0	00:00:00														
On mobile phone	1	00:00:43					00:00:43							0,61%		
Discuss with colleague	0	00:00:00														
Have a break	0	00:00:00														
Shift change with colleague	4	00:04:05					00:04:05							3,46%		
	Total		**00:07:17**	**00:06:52**	**00:03:38**	**00:00:47**	**00:35:42**	**00:00:00**	**00:05:28**							
	Total patient & technical		**00:06:58**	**00:06:52**	**00:03:38**	**00:00:19**	**00:15:52**	**00:00:00**	**00:05:28**							
	Total%		**82%**	**60%**	**63%**	**11%**	**20%**	**0%**	**73%**							
	Patient-related		87,19%	58,50%	55,96%	40,43%	17,60%	0,00%	42,38%							
	Technical		8,47%	41,50%	44,04%	0,00%	26,84%	0,00%	57,62%							
	Remaining		4,35%	0,00%	0,00%	59,57%	55,56%	0,00%	0,00%							

Figure B.26: The frequency, the total duration of the task for the entire procedure and for each phase and the percentage of the total task time to the total duration of the phase are given for each task of the circulating nurse in procedure 6. The patient-related tasks are depicted in yellow, the technical tasks in blue and the remaining tasks in pink. The total duration of all tasks, the total time of the patient-related and technical tasks, the percentage of the total time of the patient-related and technical tasks to the duration of the phase for each phase are given. For each phase, the percentage of the total duration of the all tasks in the corresponding category to the total duration of all tasks is displayed.

Scrub nurse																
Duration of procedure: 01:50:55	**Frequency**	**Total duration**	**9%**	**5%**	**10%**	**1%**	**62%**	**2%**	**11%**	**9%**	**5%**	**10%**	**1%**	**62%**	**2%**	**11%**
			PO	**A&SP**	**CO2**	**IAP**	**SP**	**FC&I**	**CUP**	**PO**	**A&SP**	**CO2**	**IAP**	**SP**	**FC&I**	**CUP**
Handout surgical gowns and gloves	6	00:03:27	00:01:49		00:00:28		00:01:10			1,64%		0,42%		1,05%		
Disinfect operating table	0	00:00:00														
Check number of gauzes	1	00:00:15						00:00:15							0,23%	
Hand over/change material and equipment	28	00:14:21		00:00:07	00:02:31	00:00:39	00:06:29	00:00:42	00:03:53		0,11%	2,27%	0,59%	5,85%	0,63%	3,50%
Take material and equipment of circulating nurse	16	00:07:17		00:01:10	00:01:01	00:00:07	00:03:53	00:01:00			1,05%	0,92%	0,11%	3,59%	0,90%	
Instruct circulating nurse	3	00:01:02			00:00:44		00:00:05		00:00:13			0,66%		0,08%		0,20%
Keeping operating table organized	0	00:00:00														
Tidy up	0	00:00:00														
Preparing back table	14	00:16:56	00:07:21	00:01:18	00:01:03		00:05:22		00:00:52	6,63%	1,17%	0,95%		5,74%		0,78%
Perform patient related tasks commissioned by surgeon	1	00:00:37					00:00:37							0,56%		
Positioning patient	0	00:00:00														
Place sterile drapes & continuous monitoring of sterility	2	00:01:19	00:00:28		00:00:51					0,42%		0,77%				
Put on surgical gown	1	00:01:16	00:01:16							1,14%						
Hold and adjust trocars and instruments (assistance)	4	00:02:02					00:02:02							1,83%		
Take care of wounds	2	00:02:51							00:02:51							2,57%
Clean laparoscopic instrument	1	00:00:18			00:00:18							0,27%				
Connect and install equipment	0	00:00:00														
Connect laparoscopic instrument	8	00:08:26		00:02:32	00:01:41		00:01:25		00:02:48		2,28%	1,52%		1,28%		2,52%
Assemble laparoscopic instrument	7	00:08:53		00:00:53			00:07:35		00:00:25		0,78%			6,84%		0,39%
Calling	1	00:00:14					00:00:14							0,21%		
Asking extra colleague	0	00:00:00														
Chattering	0	00:00:00														
Watching	0	00:00:00														
On mobile phone	0	00:00:00														
Discuss with colleague	0	00:00:00														
Have a break	0	00:00:00														
Shift change with colleague	0	00:00:00														
	Total		**00:10:54**	**00:05:59**	**00:08:37**	**00:00:46**	**00:29:58**	**00:01:57**	**00:11:03**							
	Total patient & technical		**00:10:54**	**00:05:59**	**00:08:37**	**00:00:46**	**00:29:44**	**00:01:57**	**00:11:03**							
	Total%		**106%**	**113%**	**81%**	**72%**	**43%**	**76%**	**90%**							
	Patient-related		100,00%	43,18%	76,98%	100,00%	69,19%	100,00%	70,74%							
	Technical		0,00%	56,82%	23,02%	0,00%	30,03%	0,00%	29,26%							
	Remaining		0,00%	0,00%	0,00%	0,00%	0,78%	0,00%	0,00%							

Figure B.27: The frequency, the total duration of the task for the entire procedure and for each phase and the percentage of the total task time to the total duration of the phase are given for each task of the scrub nurse in procedure 7. The patient-related tasks are depicted in yellow, the technical tasks in blue and the remaining tasks in pink. The total duration of all tasks, the total time of the patient-related and technical tasks, the percentage of the total time of the patient-related and technical tasks to the duration of the phase for each phase are given. For each phase, the percentage of the total duration of the all tasks in the corresponding category to the total duration of all tasks is displayed.

Circulating nurse																
Duration of procedure: 01:50:55	**Frequency**	**Total duration**	**9%**	**5%**	**10%**	**1%**	**62%**	**2%**	**11%**	**9%**	**5%**	**10%**	**1%**	**62%**	**2%**	**11%**
			PO	**A&SP**	**CO2**	**IAP**	**SP**	**FC&I**	**CUP**	**PO**	**A&SP**	**CO2**	**IAP**	**SP**	**FC&I**	**CUP**
Administration & registration of important data of surgical procedure	1	00:00:43					00:00:43							0,65%		
Accept & send collected tissue	2	00:04:34							00:04:34							4,12%
Check number of gauzes	0	00:00:00														
Offer assistance at anaesthetist/scrub team	4	00:05:58					00:04:42		00:01:16					4,24%		1,14%
Offer assistance in putting on surgical gown	4	00:01:04	00:01:04							0,96%						
Hand over material and equipment to scrub nurse	12	00:10:54		00:01:20	00:00:46	00:00:15	00:07:42	00:00:51			1,20%	0,69%	0,23%	6,94%	0,77%	
Move furniture	5	00:01:28	00:00:17		00:00:28		00:00:43			0,26%		0,42%		0,65%		
Bring (new) material and equipment	0	00:00:00														
Tidy up	3	00:00:53			00:00:06		00:00:26		00:00:21			0,09%		0,39%		0,32%
Preparing back table	3	00:08:12	00:07:39		00:00:16	00:00:17				6,90%		0,24%	0,26%			
Positioning patient	0	00:00:00														
Place sterile drapes & continuous monitoring of sterility	1	00:00:31			00:00:31							0,47%				
Perform instructions of scrub nurse	1	00:00:35					00:00:35							0,53%		
Attach diathermy plate on patient	0	00:00:00														
Connect laparoscopic instrument	2	00:01:55			00:00:57				00:00:58			0,86%				0,87%
Connect and install equipment	14	00:15:51		00:01:35	00:04:08		00:07:01		00:03:07		1,43%	3,73%		6,33%		2,81%
Move equipment	7	00:01:48			00:00:31	00:00:26	00:00:34		00:00:17			0,47%	0,39%	0,51%		0,26%
Open instrument trays	2	00:01:23					00:01:23							1,25%		
Calling	2	00:01:25					00:01:25							1,28%		
Asking extra colleague	0	00:00:00														
Chattering	0	00:00:00														
Watching	0	00:00:00														
On mobile phone	0	00:00:00														
Discuss with colleague	4	00:06:57		00:00:36			00:06:21				0,54%			5,73%		
Have a break	0	00:00:00														
Shift change with colleague	0	00:00:00														
	Total		**00:09:00**	**00:03:31**	**00:07:43**	**00:00:58**	**00:31:35**	**00:00:51**	**00:10:33**							
	Total patient & technical		**00:09:00**	**00:02:55**	**00:07:43**	**00:00:58**	**00:23:49**	**00:00:51**	**00:10:33**							
	Total%		**87%**	**55%**	**73%**	**91%**	**35%**	**33%**	**86%**							
	Patient-related		100,00%	37,91%	27,43%	55,17%	47,02%	100,00%	58,61%							
	Technical		0,00%	45,02%	72,57%	44,83%	28,39%	0,00%	41,39%							
	Remaining		0,00%	17,06%	0,00%	0,00%	24,59%	0,00%	0,00%							

Figure B.28: The frequency, the total duration of the task for the entire procedure and for each phase and the percentage of the total task time to the total duration of the phase are given for each task of the circulating nurse in procedure 7. The patient-related tasks are depicted in yellow, the technical tasks in blue and the remaining tasks in pink. The total duration of all tasks, the total time of the patient-related and technical tasks, the percentage of the total time of the patient-related and technical tasks to the duration of the phase for each phase are given. For each phase, the percentage of the total duration of the all tasks in the corresponding category to the total duration of all tasks is displayed.

B.2. Interviews

B.2.1. Quotes of interviewees

Impact of technological developments

KP: "*How much influence do technological developments have on your work during MIS?*"

P2: "It has become more technical."

P4: "If you only need standard things then it has little influence."

P11: "...compared to open it has become simpler."

P1: "In open surgery also other equipment that you have to connect, which may or may not work and may have defects. For laparoscopic procedures, you do have a little more equipment.[...] I now notice that in recent years we have had a lot of problems with data storing. Equipment for taking pictures and screens. That's where the problems arise."

P9: "There are more technical actions now that sometimes can cause problems, but you also have to be able to find a solution. This sometimes leads to irritation during the procedure."

P8: "You need more equipment, more technical actions and in terms of working during the procedure, it is less interesting as a perioperative nurse."

P5: "...a very big difference in your task with a minimally invasive and an open procedure.[...] The peak moments are different, and then you also have the Da Vinci, which is also minimally invasive, which does have some influence."

P13: "Ultimately, everyone has to learn to work with it *(robot surgery)*, but it is still quite specific. There is kind of a select few who do that.[...] It's not like laparoscopy, how we do it now, anyone can do it."

P14: "I think it is crazy from a student to think about it, I am not used to anything else. I am used to being trained to work with a robot."

P3: "But we have that in our education, so we are trained for minimally invasive surgery in the same way that we do open surgery."

P12: "...so I was educated with all those technological developments.[...] Well, it has a lot of influence, but it has always had an influence."

KP: "*What percentage do you spend on technology compared to the total duration of MIS?*"

P9: "As a scrub nurse, you are at the operating table, so you don't have to take many technical steps. As a circulating nurse, you have all the connections, then you have to connect everything."

P13: "During the procedure, you are also working on the diathermy, and new equipment all the time.[...] have different settings, lower or higher, lamp on and off again, you are constantly working on it."

KP: "*How much workload (physical and mental) do you experience within your function?*"

P14: "I am part of the generation that grew up with computers and technology. Things that renew very quickly, telephones, etc. Nothing mental."

P9: "I must honestly say with the arrival of the robot, that is also a minimally invasive surgery, you notice a lot of workload. Through technical actions, you can see that it is a lot. It's not difficult but you just have to know everything exactly."

P6: “I can stand up for myself, there are things I just don’t do.”

P10: “That is more that it differs a lot by how long you have been here, how you trust you are with the equipment.”

P1: “Except that you have less distraction sometimes, which leads to physical workload.”

KP: “*Which of the following two options do you experience the most during the entire MIS procedure?*”

P14: “Once the equipment is installed, you don’t really have to do much anymore, until you have to close or there will be a complication of course.”

P8: “Most minimally-invasive ones are not very exciting, it only gets exciting when something goes wrong.”

P5: “Physically it is fairly constant, but mentally it is somewhat variable.”

P2: “It also depends on what kind of procedure you do.”

KP: “*To what extent have technological developments contributed to this increased workload?*”

P7: “...if there is a new development that is not working quite well causing a strange situation, then it *(workload)* is a lot.”

P6: “Then I sometimes think that technology, I also like it, but it does give stress.”

P11: “You are a little more afraid than saying that you are demolishing something, that is a bit more expensive.”

P1: “I notice that older colleagues, for example, find that more difficult. That they are more concerned about if the device does not work, what should I do, computer technically I don’t know how to fix it, or how to start it at all.”

P13: “Also, like the robot, that pressure that comes down to you. Because you know, you are the expert, everyone goes full-on you, I don’t know, what about now?”

KP: “*How many more repetitive movements do you make and how often are you standing in the same uncomfortable position for a long time due to the technological developments (as a scrub/circulating nurse)?*”

P13 (*as scrub nurse*): “That arm sometimes gets in the way, then you are in a different way, I wanted to say. Then you are somewhere else because that arm is in the way, and then you have to go around it, things like that.[...] They are a bit wider because of the long instruments you have, then they still want to have a cable plugged in, and then you have to go all the way around it. That’s different. At an open procedure, they use short instruments and they also hand over it in a different way.”

P6: “As scrub nurse you always try to get the easiest position.”

P5 (*as circulating nurse*): “Think a little more physically that you have to hold things in a certain way and that you have to get around them more. A trickier attitude to plug something in or out, that.”

P11 (*as circulating nurse*): “Can I have a pedal?, yes that’s good, ehm I’ll be on my knees on the floor again.”

P2: “It is that you can sit down more, sometimes that is not always convenient.”

P8 (*as scrub nurse*): “You have to look at the screen, but you have to sit down.”

P9 (*as scrub nurse*): “I also often sit on a stool when there is nothing to do.”

P14: “As a circulating nurse when everything is ready and installed, you can sit and wait for things to be done.”

KP: “*How much more physical load is requested to perform tasks because of technological developments (as a scrub/circulating nurse)? ”*

P8: “We have two ORs with a large fixed column and you have to squeeze more in them than a column that you can turn towards you and connect everything to it.”

P14 (*as scrub nurse*): “...that’s because the devices are still large and the ORs here are relatively smaller, so you sometimes stand in a corner afterward with some tables and a lot of turning and making sure that the surgeon has his instruments.”

P13 (*as circulating nurse*): “It is heavier because you are twisting in different turns.”

P9 (*as circulating nurse*): “...the tower has to be moved. The equipment has to move from one place to another.”

P10: “When you consider that ergonomics can be more annoying when you have nothing to do because it makes you think about other things. If you are just busy and you are in a nasty position and you are constantly focused on something else then it is less annoying to be in that position than if you are bored. I don’t like scopes as much and maybe that way it’s more ergonomic than just being busy and sometimes your back in a certain position. Sitting can also be annoying in the long run.”

KP: “*To what extent are your more limited in performing the technical tasks due to a lack of knowledge about the instruments and equipment.*”

P2: “In the start-up phase you will have it when the instrument is new.”

P1: “We do have other equipment that we use now and then, you sometimes find that you have to figure out how it works. New equipment is equally difficult to assemble.”

P5: “...we know little about problem- solving. If there is a problem with a device, our knowledge ends often.”

P6: “Well then age plays a role.[...] You miss that knowledge.”

P11: “You also learn a lot from the surgeons and that is very nice.”

KP: “*To what extent are your more limited in performing the technical tasks due to the complexity of the instruments and equipment?*”

P9: “When we get a new instrument, we always get an explanation. Then you have few limitations, but everything that is new you just have to work with it a few times.”

P13: “In minimally invasive not. [...] with robots, that is constantly changing, that is so new and then you work with new instruments.”

P6: “It is considered that it is idiot-proof.”

P2: “Look if you have the knowledge, the complexity is also less.”

KP: "*How many more time do you need extra help of a colleague to install and adjust equipment or to assemble a (laparoscopic) instrument?*"

P9: "If something does not work [...] then I ask the circulation for a new one..."

P10: "But I am someone who is not afraid that the pliers will break or something [...] well because you use the equipment, more can go wrong."

P5 (*about instruments*): "Then you ask a colleague or it stops."

P5 (*about equipment*): "It is also not that you have to do it very often, it is more when it happens then it stops immediately, then you cannot do anything yourself.[...] You still check all plugs, but it really ends there."

P13 (*about instruments*): "With the robot I am the specialist myself, so everyone comes to me instead of the other way around. "

P13 (*about equipment*): " ... if it doesn't work, you will try it yourself first and if necessary I will bring in a colleague if it really doesn't work. Suppose that it still does not work, then we bring it to the technical service."

P2: "It depends on which equipment you use."

P13: "We do not know the technical aspect of how such a robot works."

P4: "I don't know how to fix it, but it often works out. That is not technical knowledge, but it is just logical thinking, just doing something and usually, it will be fine. But if you really have an error and the device really doesn't work. [...] I often have to call the technical service.[...] but you cannot simply adjust some devices."

Responsibilities of scrub and circulating nurse

KP: "*Which main tasks belong to the desired responsibilities of your positions for MIS?*"

P11: "What I prefer to do is operate, the rest not. I just want to operate."

KP: "*Which main tasks are performed to the current responsibilities of your position?*"

P3: "In urology, we regularly sit alone at the operating table during a robotic procedure. The surgeons sit behind the console and that we suck and assist with the procedure. These are things that have been added to our list of responsibilities."

P2: "More and more things are being taken over from us by logistics. Ensuring the availability of medical devices is no longer our task."

P5: "I think it does happen that managing and monitoring are more that we make sure that it is checked on time and that if it is not, that we take it somewhere. But not that we do anything with it ourselves."

KP: "*What percentage of the time do you perform administrative tasks during the surgical procedure?*"

P10: "The time differs for each specialism"

P14: "It becomes more digital and you notice that it does not always work well and that you, therefore, spend more time on it."

P8: "It *(digital administration)* is also useful, but it is much easier to forget than filling in a form. You can see that and then you know you still have to do it."

Responsibilities scrub and circulating nurse MIS versus OS

KP: "*Would you specify for each task whether the task requires more time during MIS compared to OS?*"

P7: "It depends on the equipment you are going to use. Sometimes you use the same. [..] I think starting in minimally invasive takes a little longer than in open, but not terrifying."

P9: "With minimally invasive surgery as a circulating nurse, you are actually doing more work."

P11: "With minimally invasive, you simply have more equipment that you use."

P13: "But I think laparoscopic, you also spend a lot of time setting up and connecting. There you have, you have to do a lot more with it. And it takes longer to close, because with the open procedure, removing it is in principle faster. Ultimately, it *(duration of the procedure)* will be the same."

KP: "*If you had the choice between MIS or OS procedures, how much more time would you like to perform an OS procedure instead of a MIS procedure?*"

P6: "That variety is nice. [...] for us it is more interesting to do open procedure."

P8: "In terms of work it is less interesting."

P9: "Open surgery is much more fun for us, then you have a lot more to do as a scrub nurse."

P5: "Combination actually. As an circulating nurse is minimally invasive actually not that much fun and as a scrub nurse it really depends on which procedure it is. The scrub nurse is actually more fun when open than a minimally invasive one. "

P13: "I like it much more open. It's so much more boring that minimally invasive."

P14: "Open is also what you are looking for, that is what you do this work for. "

KP: "*What is the ratio of technical and patient-related tasks in MIS at this moment? *"

P10: "I don't really think you spend long on those technical tasks. Turn on the monitor and connect those cables."

KP: "*What is the desired ratio of technical and patient-related tasks in MIS?*"

P4: "With a robot, I think it is out of proportion, but with laparoscopy, I think it is not too bad.[...] Robot is also difficult, is also new, no one has been properly trained, therefore, I also think that it *(the ratio)* will eventually decrease automatically "

P10: "I am always more into technology, I always like that. "

P7: "It can't be much less, you need those devices. It must always be aimed at the patient, but that is what those devices are for."

KP: "*What percentage of your time do you perform physical actions for MIS or RAS and OS as a scrub nurse?*"

P7: "With open you use many more instruments."

P2: "In general, you are changing less *instruments* compared to open. "

KP: "*What percentage of your time do you perform physical actions for MIS or RAS and OS as a circulating nurse?*"

P8: "The more blood loss, the greater the surgical procedure, the more you have to do as a circulating nurse."

P5: "With minimally invasive there is a peak moment and then it usually stops."

P5: "Here *(LUMC)* robot procedures take all day, then you are really busy 25% of the time."

C

Interpretation of results

C.1. Main responsibilities of perioperative nurses

In part II of the interview, the perioperative nurses were asked to mention the five main responsibilities of their role. Providing care was the core role of the perioperative nurse in which placing sterile drapes & continuous monitoring of sterility (14%), anticipating (13% in core role 2 and 6% in core role 5), connecting and installing equipment (11%) and positioning patient (7%) were included. Monitoring and ensuring the availability and functionality of medical devices (e.g.,instruments, gauzes, disposables, suture needles) was another important task which had to perform by the perioperative nurse presented in core roles 1 (6%), 2 (6%) and 4 (6%).

The duration of placing sterile drapes, connecting and installing equipment and positioning the patient could be measured in the video analysis. Monitoring and ensuring the availability and functionality is measured in check number of gauzes, preparing back table, bring (new) material and equipment, open instrument trays and hand over material and equipment to scrub nurse, take material and equipment of circulating nurse and assembling and cleaning laparoscopic instrument. Anticipating is not a task which could be measured through video analysis.

As shown in Figure 3.3 and Figure 3.4 and given in Table 3.4 and Table 3.5, the mean percentage of placing sterile drapes was 2.11% for the scrub nurse and 0.55% for the circulating nurse. The mean percentage of connecting and installing equipment and connecting laparoscopic instrument was 0.07% and 5.82% for the scrub nurse and for the circulating nurse 9.97% and 0.69%, respectively. Monitoring and ensuring represented 27.06% of the total duration of the average procedure for the scrub nurse and 14.27% for the circulating nurse according to the mentioned tasks.

The most important task according to the perioperative nurses took a small amount of time according to the video recordings. Monitoring and ensuring the availability was measured a high percentage of the total duration of the procedure. More research has to be performed to the importance of a task and the amount of time of the procedure the task is performed.

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