Improving the process performance of the outpatient surgery by managing information quality

A case study at Danderyd’s University Hospital

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SE-100 44 STOCKHOLM
Förbättra processprestandan av dagkirurgin genom att hantera informationskvalitet - En fallstudie på Danderyds Sjukhus

av

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Abstract

Development in medicine has enabled surgical procedures, previously considered to be advanced and required the patient to be hospitalized, to be conducted as outpatient surgeries, meaning that the patients are able to return home the same day. Due to the major benefits associated with outpatient surgeries, such as enhanced effectiveness and efficiency, the demand for these types of surgeries is continuously increasing. Therefore, it is considered to be necessary to improve the process performance of outpatient surgeries to meet both current and future demands.

Studies have shown that the major issues in healthcare is related to the quality of the information that controls the processes, which has in turn been found to have a direct impact on the process performance of organizations. Thus, the purpose of this study was to investigate how the process performance of outpatient surgeries could be improved by managing information quality. By the identified improvement areas within the quality of the information which control the process performance of the outpatient surgery, the findings from this study could be used as a basis for enhancing the process performance, thereby enabling a better healthcare.

To achieve the purpose of this study, a single-case study was conducted at the women’s department at Danderyd’s University Hospital, which is one of the largest public hospitals in Sweden. The empirical data, gathered from interviews, observations, survey and internal documents, was together with the literature review the constitution for the analysis, with the aim of achieving the purpose of this study. Poor information quality across all dimensions were identified, where combinations of lacking quality dimensions contributed to six different types of waste activities. Thus, this confirmed previous research on the negative impact of poor information quality on process performance, and also showed its specific impact on the investigated outpatient surgery.
Furthermore, the analysis presented two factors influencing the overall poor information quality in the outpatient surgery. Firstly, the information provided to the surgical staff, which controls the work inside the theatre, was not updated accordingly to the specific preferences of the operating surgeon. Secondly, interconnections between the different dimensions of information quality were identified, where one specific dimension were found to be the root cause of the overall poor information quality. Conclusively, identifying potential improvement areas by knowing what influences the information quality and how this affects the process performance is believed to provide the foundation for improving the outpatient surgery.

**Key-words:** Information quality, waste, process performance, outpatient surgery, healthcare.
Sammanfattning

Den medicinska utvecklingen har möjliggjort att kirurgiska ingrepp, som tidigare ansetts vara avancerade och krävt att patienten blivit inlagd, kunnat genomföras som dagkirurgi, vilket innebär att patienten kan återvända hem samma dag. På grund av de stora fördelarna som associeras med dagkirurgi, som exempelvis en mer effektiv sjukvård, ökar ständigt behovet för dessa typer av operationer. Det anses därför vara nödvändigt att förbättra prestandan hos processerna inom dagkirurgi för att kunna möta nuvarande och framtida behov.

Studier har visat att det största problemet inom sjukvård är relaterat till kvaliteten av informationen som styr processerna, vilket i sin tur har visat ha en direkt inverkan på prestandan av processerna inom organisationerna. Syftet för denna studie är därför att undersöka hur prestandan av processerna inom dagkirurgi kan förbättras genom att hantera informationskvaliteten. Genom att identifiera de dimensioner av informationskvalitet som styr prestandan av processerna inom dagkirurgi, kan resultaten från denna studie användas som grund för att förbättra prestandan av processerna och därmed även möjliggöra en bättre sjukvård.

För att kunna uppnå syftet till denna studie har en fallstudie genomförts på kvinnokliniken på Danderyds universitetssjukhus, vilket är ett av de största offentliga sjukhusen i Sverige. Den empiriska data som samlats in från intervjuer, observationer, enkätundersökning och interna dokument, har tillsammans med en litteraturstudie varit grunden för analysen, och avsett att besvara studiens frågeställning och därmed uppnå syftet. Resultaten visar dålig informationskvalitet inom alla dimensioner vilket, i olika kombinationer, bidrog till sex olika typer av icke-värdeskapande aktiviteter. Detta bekräftade tidigare studier om den negativa påverkan av dålig informationskvalitet på prestandan av processerna, men även visade på vilket sätt detta påverkar dagkirurgi.
Resultaten från analysen visar dessutom två faktorer som påverkar den övergripande informationskvaliteten inom dagkirurgin. För det första, att informationen, som operationspersonalen blivit försedda med och som styr arbetet inne i operationssalen, inte varit uppdaterad enligt den opererande kirurgens preferenser. För det andra, sammankopplingar mellan de olika dimensionerna av informationskvalitet, där en av dimensionerna identifierades som roten till den övergripande dåliga informationskvaliteten. Att veta vad det är som bidrar till dålig informationskvalitet och hur detta påverkar prestandan av processerna, tros kunna användas som grund för att kunna förbättra dagkirurgi.

**Nyckelord:** Informationskvalitet, slöseri, processprestanda, dagkirurgi, sjukvård.
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Meliha Sölen & Louise Weilenmann
Abbreviations
CIF - Clinical Innovation Fellowship
KI - Karolinska Institutet
KTH - Royal Institute of Technology (Kungliga Tekniska Högskolan in Swedish)
OR-staff – Operating room staff
OR-system – Operating room system
TPS - Toyota Production System

Glossary
Orbit – The computer system used at Danderyd’s University Hospital for managing surgery scheduling.
Surgical staff - The surgical team inside the operating theatre, consisting of a surgical nurse and an assistant nurse.
Hysteroscopy – An examination of the uterine cavity with an optical instrument called hysteroscope.
Diagnostic hysteroscopy with bettocchi - A hysteroscopy performed with a hysteroscopic instrument called bettocchi.
Hysteroscopic sterilizations - A surgical procedure for sterilizing patients by using a hysteroscope.
Hysteroscopic resection - A surgical procedure for extracting fibroids from the uterus by using a hysteroscope.
Hysteroscopic myomectomy - A less invasive surgical procedure for extracting fibroids from the uterus.
Conization - A surgical procedure for excision of abnormal cells in the cervix uteri.
Loop diathermy - A conization performed with a heated metal wire called loop diathermy.
Laser excisional - A conization performed with laser.
OR-staff – All personnel inside the operating theatre, including operating staff, surgeon, anesthesia nurse and anesthesia.
1. Introduction

The following chapter presents the background, problematization, purpose and research questions of this study. Furthermore, the study delimitations are also presented, as well as the thesis outline.

1.1 Background

The purpose of this study is to investigate how the process performance of outpatient surgeries can be improved by managing information quality. In healthcare, the major experienced issues are not related to the quality of the implementation of a process, such as surgery, but are rather related to the quality of the information that controls the process. Thus, the quality of information is of great importance as it has a major impact on the organizational performance across industries (Wickramasinghe et al., 2014). Currently, the amount of data and information is exponentially growing, thereby creating difficulties of maintaining a high quality of information in organizations (Borek et al., 2013). This entails a considerable risk in healthcare, where low information quality has the potential of resulting in fatal consequences (Welzer et al., 2005; Mettler et al., 2008; Hausvik, 2017). In the United States, problems with poor information quality constitute the eighth largest cause of death in healthcare services, where the total costs caused by medical errors exceeds $17 billion a year (Su & Shen, 2010).

In 1996, a two months old pediatric patient received a fatal overdose at the outpatient clinic of Hermann Hospital in Houston due to a misplaced decimal point. The tragic incident was not considered to be a single person’s mistake, but was instead a devastating result of a systematic error which allowed a ten times larger dose to be injected unnoticed (Belkin, 1997). Unfortunately, there are many more examples of devastating consequences caused by the lack of information quality, where wrong decisions have been made, incorrect surgeries have been performed, and tests results have been mixed up, among others (Al-Hakim, 2014). Hence, the quality of information has been found to have a direct impact on the safety and care that is provided to patients (Welzer et al., 2005; Ratnamningtyasa & Surendro, 2013). Therefore, it is of great importance to recognize the issues related to information quality (Wickramasinghe et al., 2014).

With the rapidly growing amount of data and information, causing a risk of poor information quality, it is also vital to understand how organizational processes are affected. A multi-disciplinary literature review of 71 articles indicated a direct impact of information quality on the process performance in organizations, thus emphasizing the importance of “modelling processes to be IQ-aware” (Hausvik, 2017). Furthermore, commonly known waste activities have been identified in healthcare as a consequence of poor information quality. These are such as the unnecessary repetition of a surgery, delayed performance of a task, excessive movements, wasted time in communications, and the search for additional information or items (Al-Hakim, 2014).

During the last two decades, developments in medicine have begun to allow for previously advanced surgical procedures to be performed with minimal invasion. As a result, a shift has
occurred from inpatient to outpatient surgeries, as less patients are required to be hospitalized and stay overnight after having surgery (Emery & Paraiso, 2015). The magnitude of change has been substantial in Sweden, where the number of outpatient surgeries has between 2005 and 2015 increased by approximately 113%, see Figure 1 (Socialstyrelsen, 2017).

![Figure 1 – The development of outpatient surgeries between 2005 and 2015 (Socialstyrelsen, 2017).](image)

Surgery is considered as the high cost and revenue service of hospitals. Hence, optimizing the effectiveness and efficiency of the operating theatre is believed to be essential (Su & Shen, 2010). The movement from inpatient to outpatient surgeries has allowed for major costs savings, as surgical procedures are performed in a less resource intensive environment (Emery & Paraiso, 2015). Based on a study conducted by Tiainen and Lindelius (2016), the increase of outpatient surgeries in Sweden has saved approximately 14% of the total costs associated with surgeries. In addition to this, 738 hospital beds have been released within the surgical functions from 2005 to 2013, which is a 9% decrease. The shift to performing more outpatient surgeries was in turn responsible for 80 of these hospital beds, which corresponds to around 11% of the total release of hospital beds (Tiainen & Lindelius, 2016).

Due to the great increase and potential of outpatient surgeries, it is important to improve the process performance to meet both current and future demand of outpatient surgeries, and to continue to improve the efficiency of healthcare (Tiainen & Lindelius, 2016).

1.2 Problematization

Danderyd’s University Hospital is one of the largest hospitals in Stockholm, where women’s health and childbirth represents its main operating area. Each year, thousands of women are operated at the women’s department at Danderyd’s University Hospital. The process of surgery
is highly time and resource consuming, where a great need for process improvements has been experienced, ensuring patient safety as well as minimizing unnecessary expenses (Töpfer et al., 2017).

The outpatient surgery at the women’s department is mainly constituted by one operating theatre which holds around 7-10 surgeries each day. The types of conducted surgeries vary greatly, where hysteroscopies, conizations, abortions, and sterilizations are some of the most commonly performed surgeries. This implies a great variation in surgical preparations as well in terms of tools, equipment, and local anesthesia for the different types of surgeries. Consequently, the work inside the operating theatre in between surgeries is quite intensive due to the number of surgeries that are required to be performed each day and the large differences in preparations of the various surgeries. Thus, disruptions of the workflow inside the operating theatre often occurs, which in turn causes delays and generates waste in terms of rework and discard of unused disposable items. Therefore, the outpatient surgery at the women’s ward is in great need of increasing the efficiency of its processes. This is to advance the working environment and economical effects as well as to meet the continuously growing demand of outpatient surgeries.

1.3 Purpose and research questions

The purpose of this study is to investigate how the process performance of outpatient surgeries can be improved by managing information quality. Thus, the aim is to identify improvement areas within the quality of the information which control the process performance of the outpatient surgery. Given the purpose and aim of this study, the two following research questions are formulated:

**RQ1:** What are the implications of poor information quality on waste in the outpatient surgery?

**RQ2:** Which factors influence the information quality in the outpatient surgery negatively?

The first research question establishes the relationship between poor information quality and waste activities. By doing so, parts of the surgical process that includes non-value adding activities caused by poor information quality can be identified, together with the lacking quality dimensions. This in turn highlights the improvement areas in the process performance of the outpatient surgery at the women’s ward at Danderyd’s University Hospital. The second research question, on the other hand, identifies the factors influencing the quality of information in the outpatient surgery negatively to find possible solutions that have the potential of improving the process performance.
1.4 Thesis Outline
The outline of this thesis is presented in Figure 2 below.

<table>
<thead>
<tr>
<th>Chapter 1 - Introduction</th>
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<tbody>
<tr>
<td>Presents the background, problematization, purpose and research questions of this study, as well as the delimitations and thesis outline.</td>
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<tr>
<th>Chapter 2 - Literature Review</th>
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<tr>
<td>Presents relevant theories and previous research in the field of healthcare, information quality, and waste.</td>
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<th>Chapter 3 - Method</th>
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<tr>
<td>Describes the methodology used in this study, including the overall research approach, a detailed description of the literature review and case study, as well as the quality of analysis.</td>
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<th>Chapter 4 - Analysis</th>
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<tr>
<td>Presents the empirical findings and analysis of the study based on the two research questions, thereby describing the outpatient surgery, the implications of information quality on waste, and the factors influencing information quality.</td>
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<th>Chapter 5 - Conclusion</th>
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<tr>
<td>Presents the conclusions based on the two research questions, and thus also the purpose of this study.</td>
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<th>Chapter 6 - Discussion</th>
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<tr>
<td>Presents the discussion of the findings, contribution of this study, as well as the limitations and potential future work.</td>
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*Figure 2 – Thesis outline for the report.*
2. Literature review

This chapter presents a review on literature, consisting of previous research and theories in the field of healthcare and outpatient surgery, information quality, and waste. These are in turn, together with the conducted empirical study, used as a basis for answering the two research questions of this study.

The literature review consists of three main parts: healthcare and outpatient surgeries, information quality and waste. The combination of these three parts, together with the conducted empirical study, will be used for analyzing the correlation of information quality and waste in the outpatient surgery, as well as for identifying how process performance of outpatient surgeries can be improved by managing information quality, see Area 1 in Figure 3. The first section of this chapter, Characteristics of Healthcare and Outpatient Surgery, presents an introduction to the context of this study. The section aims to provide an understanding of the characteristics of the context to, in the following sections, adapt the choice of theories and previous research for the specific context. This is followed by the section Information Quality that describes the different definitions and dimensions of the concept in different contexts, and also presents how information quality is applied in healthcare, symbolizing Area 2. Thereafter, the seven types of waste identified in lean are presented together with their corresponding translation in healthcare services in the section Waste in Healthcare, see Area 3. Finally, previous research on the influence of information quality on process performance and waste is presented in the section Implications of Information Quality, representing Area 4.
2.1 Characteristics of Healthcare and Outpatient Surgery
The work in healthcare is very complex and dynamic (Buchbinder & Thompson, 2009). When comparing to a manufacturing context, the patients are considered as both products and customers which not only contributes to several characteristics that distinguish the healthcare setting for other more traditional industrial environments, but also makes these processes much more complex and dynamic (Wickramasinghe et al., 2014).

Every patient is unique. Although two patients seem to experience the same complaint, these might still be treated differently. The uniqueness of patients also appears during treatments, as one patient might respond differently to the same treatment in comparison to another, which in turn might result in unexpected complications. Patients do not only differ in physical attributes, but also in behavior. An example of this is the risk of patients cancelling a surgery or treatment (Gong, 2009). The work in healthcare is thus much complex, where every patient must receive an individual medical assessment, planning and treatment. The healthcare industry is therefore largely dependent on human involvement and thereby the knowledge and experience that the personnel possesses (Cabitza & Batini, 2016). This is a great difference from other industries where automatization is common and the human involvement is preferably minimized to the greatest extent as possible (Wickramasinghe et al., 2014).

The time required to perform a specific part of the process, also known as cycle time, often varies greatly in a healthcare context. This is mainly due to the uniqueness of each patient which makes it almost impossible to predict the cycle time. The complexity of the setting also entails a difficulty in measuring performance of the healthcare personnel and in predicting the success of the treatment (Al-Hakim, 2006). Furthermore, waiting time, that in other industries often is considered to not create any value and aimed to be minimized, is in healthcare sometimes an essential activity. This can be seen, for example during surgery, where the anesthesia nurse and anesthetist, after performing their work in the beginning of the surgery, monitor the patient’s values during the surgery to ensure the safety and health of the patient (Gong, 2009).

The mentioned characteristics above apply for both patients having inpatient or outpatient surgeries. What distinguishes outpatient surgeries is that the treatment or surgery does not require the patient to be hospitalized and stay overnight, meaning that patients arrive and return home on the same day (Garduño-Chávez et al., 2016). The patients who are referred to outpatient surgery have previously been either at a general practitioner or a specialist doctor (Gong, 2009; Danderyds Sjukhus, 2017.a), which implies that there is a possibility that the patient has not met the operating physician until the day of surgery. Furthermore, the operating room staff (OR-staff) relies on provided information, together with their competence and previous experience, to fulfill their complex tasks (Cabitza & Batini, 2016).

2.2 Information Quality
The term information has been widely adopted in different ways, referring to different aspects in different settings (Stvilia et al., 2007). Similarly, there is no general understanding of the
dimensions of information quality which varies depending on the context and the intended use of information (Lee et al., 2001). Thus, the following sections presents the different attempts on defining information quality and its dimensions, and lastly, concludes the definition and dimensions of information quality chosen for this study.

2.2.1 Defining Information Quality

Before defining information quality, three basic concepts are required to be defined - data, information, and quality. Accordingly to the Oxford English Dictionary (OED) (2017) information is defined as “facts provided or learned about something or someone” or “what is conveyed or represented by a particular arrangement or sequence of things”. Another general definition of information is provided by Belkin and Robertson (1997) who described information as “the structure of any text [data] which is capable of changing the image-structure of a recipient”. Here, structure simply is referred to as order and text is defined as a “collection of signs purposefully structured by a sender with intention of changing the image-structure of a recipient.” Moreover, Higgins (1999) follows the theoretic tradition of information by defining it as data with “recognizable patterns of meaning” which allows for uncertainty to be reduced for decision makers.

In contrast to previous general definitions, Taylor (1986) attempts to establish a more clear distinction between data, information, and knowledge. Thus, data is defined as a sequence of symbols, information as data with relations, and lastly knowledge as information that has been selected, analyzed, concluded, organized and stored for future possible use when informing or making decisions. Despite Taylor’s efforts on distinguishing data from information, where the view of information as data in context has been adopted by many (Wiig, 1993; Davenport, 1997; Lilrrank, 2003), these two concepts are often used interchangeably (Baškarada, 2009). Consequently, what is considered as data by one person can be considered as information by another (Redman, 1992). Hence, in light of these definitions and for the purpose of this study, data is henceforward defined as a sequence of symbols and information as data in a context for which it is interpreted and/or used.

In similarity to the various definition of information, several attempts on defining information quality have been made. Definitions of quality in general as well as information quality in specific often put great emphasis on user needs. Therefore, quality is often based on the degree of its usefulness, most commonly referred to as the “fitness for use” (Juran, 1992), in a particular context and/or for a specific task. This implies that the quality of information is based on the subjective perception of its usefulness. Consequently, a piece of information could be considered appropriate or insufficient based on the user and the context of its intended use (Hausvik, 2017). The “fitness for use” along with other similar definitions of quality, such as “conformance to requirements” (Crosby, 1979) and “user satisfaction” (Rieker, 1983), highlights the importance of identifying and satisfying user needs. These needs are in turn believed to be mainly shaped by the action or task for which the user is required to perform and vice versa (Stvilia et al., 2007). Hence, Taylor (1991) argued that people’s professions and thereby professional activities constitutes their long-term information needs. Accordingly, this study adopts the vision of information quality as “fitness for (intended) use”, and will therefore
be considered based on the context of healthcare and the characteristics and needs of the users in conjunction with outpatient surgeries.

2.2.2 Dimensions of Information Quality
Information quality is a multi-dimensional concept (Hausvik, 2017) and has been divided into different components that together constitute the quality of information. In a research conducted by Li et al. (2005), information quality is referred to as accuracy, adequacy, credibility and timeliness of the information. Other researchers such as DeLone and McLean do not mention adequacy or credibility but instead acknowledge the importance of relevancy as a dimension of information quality, while another researcher, McCormack, consider availability as an additional dimension (Zhou et al., 2013). Several other researchers such as Wand and Wang, Jarke and Vassiliou, Zmud and Goodhue, amongst others have also contributed with dimensions of information quality (Lee et al., 2001) and in total have more than 70 different dimensions been identified (Eppler, 2006). Furthermore, as mentioned in the previous section, information quality varies depending on the user’s need and context. Consequently, to analyze the information quality and answer the research questions, the dimensions are required to be adjusted and determined for the context of this study.

Previous studies where the dimensions of information quality in the context of outpatient surgeries are defined were not found. Thus, the dimensions chosen for this study are based on the literature and studies on information quality dimensions in similar contexts. In the book by Cabitza and Batini (2016), the dimensions of information quality in healthcare were defined as accuracy, currency (up-to-date), completeness, readability, reliability, usefulness, cost-effectiveness and confidentiality (availability). These dimensions were considered to be suitable for healthcare in general and were based on the aspects commonly mentioned in the medical and medical information literature. In another study conducted by Ratnaningtyas et al. (2013) that focused on inpatient healthcare, the dimensions of information quality were in great similarity to the former mentioned study. However, this study did not include reliability or cost-efficiency as dimensions of information quality but instead added the dimension of flexibility. The researchers Al-Hakim (2014) conducted a study on information quality in emergency departments, where the dimensions were based on Juran’s (1992) definition of “fitness for use” and were therefore customized to the specific context. In similarity to Ratnaningtyas et al. (2013), Al-Hakim (2014) also excluded the dimension of cost-efficiency, but included coherency instead. The dimensions mentioned by the three studies are summarized in Table 1.
Table 1 – Dimensions of information quality in healthcare.

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<tr>
<td>Accuracy</td>
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<td>Currency (up-to date)</td>
<td>Timely</td>
<td>Timeliness</td>
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<td>Completeness</td>
<td>Completeness</td>
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<td>Readability</td>
<td>Clearly</td>
<td>Ease of understanding</td>
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<tr>
<td>Usefulness</td>
<td>Exactly</td>
<td>Relevancy</td>
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<tr>
<td>Confidentiality (availability)</td>
<td>Accessibility</td>
<td>Accessibility/availability</td>
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<td>Reliability</td>
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<tr>
<td></td>
<td>Flexibility</td>
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</tbody>
</table>

When comparing the dimensions presented in the different studies, it is clear that these are very similar to each other. The dimensions in the first seven rows in Table 1 are mentioned in two or all three studies, which confirms that these dimensions are indeed vital components of information quality in the context of healthcare. Therefore, these dimensions are chosen for this study as they are considered to be appropriate for the study context. Furthermore, the remaining three dimensions, besides only being mentioned by a single author, are considered to be abstract and difficult to measure objectively. Cost-efficiency implies that the “cost” for retrieving a piece of information (e.g. the discomfort of the patient) should be lower than the perceived value of that information, which is believed to be difficult if not impossible to measure. In similarity, the dimensions flexibility and coherency implies that a piece of information is interpreted equally by everyone involved, and are associated with the same difficulties as recently mentioned. Difficulties with measuring these three dimensions objectively in combination with the fact that they were only mentioned by a single author, resulted in their exclusion from this study. A description of the chosen dimensions for the context of outpatient surgeries in this study can be found in Table 2.
Table 2 – Description of the dimensions of information quality chosen for outpatient surgery.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>The information is correct.</td>
</tr>
<tr>
<td>Timeliness</td>
<td>The information is up-to-date.</td>
</tr>
<tr>
<td>Completeness</td>
<td>The information is sufficient and no other information is needed.</td>
</tr>
<tr>
<td>Ease of understanding</td>
<td>The information is easy to comprehend.</td>
</tr>
<tr>
<td>Relevancy</td>
<td>The information is of relevance for the context.</td>
</tr>
<tr>
<td>Accessibility</td>
<td>The information can quickly be retrievable and is easy to obtain.</td>
</tr>
<tr>
<td>Believability</td>
<td>The information is credible by the persons involved.</td>
</tr>
</tbody>
</table>

2.3 Wastes in healthcare

Waste can appear in many different contexts and shapes (Jylhä & Suvanto, 2015), and is mainly characterized as a non-value adding activity, process step or product feature (Daultini et al., 2015). Lean is a quality improvement philosophy that seeks to enhance customer value. This is achieved by either maximizing the value creation for customers at the same cost, or eliminating waste through the use of certain tools and techniques, thereby reducing the associated costs (Hines et al., 2004; de Koning et al., 2006). Although lean philosophy originated from the Toyota Production System (TPS) in the 1950s, it has been widely adopted in both manufacturing and service organizations ever since (Guimarães & Carvalho, 2012; Suárez-Barraza et al., 2012). However, in difference to production systems, service organizations pose great challenges due to the presence of customers (or patients, as it is in healthcare) in the system (Patwardhan & Patwardhan, 2008). Nevertheless, the adoption of lean in healthcare services has rapidly increased over the last decade (Burgess & Radnor, 2013), resulting in both tangible and intangible benefits such as reduced costs, increased quality, patient safety and efficiency (Jimmerson et al., 2005; D’Andreamatteo, et al., 2015), as well as improved patient and employee satisfaction (Fillingham, 2007).

There are seven types of waste identified in lean, namely transportation, inventory, motion, waiting, overproduction, overprocessing and defect. Along with the adoption of lean philosophy in healthcare services, the seven types of waste have been translated and adjusted to the context of healthcare. These are further described in the sections below.

Transportation involves all unnecessary movement of people, equipment, materials, tools, parts or finished products that may cause not only excessive movement, but also double-handling (Ohno, 1988; Liker & Meier, 2006). In healthcare, unnecessary movements are such as when medical staff are walking to the other end of a ward to retrieve notes, or when walking to and from a central equipment store to retrieve commonly used items that are not located nearby their point of use (NHS, 2007). Waste is also created when patients are transported from one place to another. Although the transportation of patients are necessary and thus cannot be
avoided, the negative impact of it can be reduced considerably by for instance having the preoperative area nearby the operating room (Al-Hakim, 2014).

*Inventory* includes excess of material and work-in-process, which constitutes a risk of hiding problems or causing delays and excess transportation (Ohno, 1988; Liker & Meier, 2006). The equivalents for inventory in healthcare are such as unused storerooms with excess stock, delayed discharge of patients or long waiting lists for getting medical assessment, special treatment, or surgery (NHS, 2007; Al-Hakim, 2014).

In similarity to transportation, *motion* involves the movement of people or equipment that is not needed to perform the processing, such as reaching or searching for materials, tools or information (Ohno, 1988; Liker & Meier, 2006). Examples of unnecessary movements in a healthcare context are such as medical staff searching for essential papers (e.g. drug sheets) or materials. Furthermore, extra physical efforts and movements required for performing everyday tasks such as not storing syringes and needles within a close range, or lacking basic equipment in each one of the examination rooms are all factors that contribute to excessive movements (NHS, 2007; Al-Hakim, 2014).

*Waiting* refers to idle time of equipment or employees caused by processing delays or resource bottlenecks (Ohno, 1988; Liker & Meier, 2006). In healthcare, the delay in performing an activity is often caused by the wait for patients, trolleys to move patients, medical staff, test results, prescriptions or medicines (NHS, 2007; Al-Hakim, 2014). Furthermore, the waiting for doctors to discharge their patients also cause additional waste as increase in inventory (Al-Hakim, 2014).

*Overproduction* occurs when items are produced in higher quantities than needed or ahead of demand, which in turn generates additional waste such as inventory (Ohno, 1988; Liker & Meier, 2006). Identified sources of overproduction in healthcare are such as requesting unnecessary and excessive tests (e.g. repeating x-rays or medical tests), reserving examination rooms and extra beds in discharge room ‘just in case’ as well as not switching off lights or air conditioning after operating hours (NHS, 2007; Al-Hakim, 2014).

*Overprocessing*, on the other hand, occurs when items are inappropriately, unnecessarily or excessively processed, which also may cause additional waste in terms of unnecessary motion or produced defects (Ohno, 1988; Liker & Meier, 2006). Thus, overprocessing is the unnecessary repetition of an action. Consequently, actions such as repeatedly recounting instruments, requesting for patients’ details and clerking of patients are considered as waste in healthcare. These may in turn also cause an increase of inventory as information is duplicated and irrelevant information is stored (NHS, 2007; Al-Hakim, 2014).

Lastly, *defects* refers to all mistakes and errors in products that require the performance of other waste activities, such as inspection, rework and replacement (Ohno, 1988; Liker & Meier, 2006). As healthcare involves patients and not products, common defects are such as errors in medical assessment or treatment, readmission of a patients due to wrongful discharges, adverse
drug reactions, repeated testing as a consequence of incorrect or inadequate provided information (NHS, 2007; Al-Hakim, 2014).

The above examples of waste in healthcare provided by NHS (2007) are summarized in the table below.

Table 3 - Examples of waste in healthcare services.

<table>
<thead>
<tr>
<th>Waste</th>
<th>Healthcare service examples (NHS, 2007)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transportation</td>
</tr>
<tr>
<td></td>
<td>• Staff walking to the other end of a ward to pick up notes</td>
</tr>
<tr>
<td></td>
<td>• Central equipment stores for commonly used items instead of items located where they are used</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inventory</td>
</tr>
<tr>
<td></td>
<td>• Excess stock in storerooms that is not being used</td>
</tr>
<tr>
<td></td>
<td>• Patients waiting to be discharged</td>
</tr>
<tr>
<td></td>
<td>• Waiting lists</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Motion</td>
</tr>
<tr>
<td></td>
<td>• Unnecessary staff movement looking for paperwork, e.g. drug sheets not put back in the correct place</td>
</tr>
<tr>
<td></td>
<td>• Storing syringes and needles at opposite ends of the room</td>
</tr>
<tr>
<td></td>
<td>• Not having basic equipment in every examination room</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Waiting</td>
</tr>
<tr>
<td></td>
<td>• Waiting for</td>
</tr>
<tr>
<td></td>
<td>• Patients, theatre staff, results, prescriptions and medicines</td>
</tr>
<tr>
<td></td>
<td>• Doctors to discharge patients</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overproduction</td>
</tr>
<tr>
<td></td>
<td>• Requesting unnecessary tests from pathology</td>
</tr>
<tr>
<td></td>
<td>• Keeping investigation slots 'just in case'</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overprocessing</td>
</tr>
<tr>
<td></td>
<td>• Duplication of information</td>
</tr>
<tr>
<td></td>
<td>• Asking for patients’ details several times</td>
</tr>
<tr>
<td></td>
<td>• Repeated clerking of patients</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Defects</td>
</tr>
<tr>
<td></td>
<td>• Readmission because of failed discharge</td>
</tr>
<tr>
<td></td>
<td>• Adverse drug reactions</td>
</tr>
<tr>
<td></td>
<td>• Repeating tests because correct information was not provided</td>
</tr>
</tbody>
</table>

2.4 Implications of Information Quality
The quality of information is considered to be of great importance for the competitive advantage of organizations (Abdullah & Azim, 2015). Lacking information quality has resulted in major implications in terms of process performance and creation of waste, which will be further discussed in following sections.

2.4.1 Information Quality and Process Performance
Studies have shown a strong connection between the management of information quality and the performance of an organization (Porter & Tanner, 2004; Redman, 1998; Slone, 2006; Eppler
& Helfert, 2004; Fisher & Kingma, 2001). For instance, in production processes of manufacturing organizations, if products are not delivered on schedule and do not meet the customer needs, the customers will most likely be unsatisfied which in turn will damage the organization’s business. The same goes for information management processes. If the information is not up-to-date and does not meet the user needs, the information cannot be considered as relevant, thus leaving the users unsatisfied and will most likely lead to systematic errors and damage the organizational performance (Clikeman, 1999).

According to previous research, an adoption of quality improvement initiatives has proven to reduce costs while increasing productivity, thereby resulting in an increased profitability (Wisner & Eakins, 1994; Hausvik, 2017). Poor information quality, on the other hand, has indicated an adverse effect on the competitiveness of an organization (Redman, 1992). A study based on a literature review of 71 research articles shows that information quality has a direct and exclusive impact on process performance (Hausvik, 2017), where the lack of quality has resulted in errors and adverse events in healthcare processes (Clark et al., 2013). A connection between the quality of information and the performance of surgery processes has also been found, where variations in information accuracy, timeliness and completeness have affected the operating time, cost of operation process, capacity utilization, and lastly, length of waiting queues (Su & Shen, 2010).

Redman (1998) identified and structured the different negative impacts that lacking information quality might have on an organization. These are presented in three business layers - operational, tactical, and strategic, see Figure 4 below. Although all three business levels are of great importance to understand the true extent and impact of poor information quality, this study will mainly focus on the operational level.

Figure 4 – The impact of poor information quality on each of the three business layers in organizations (Redman, 1998).

Lacking information quality at the operational level causes dissatisfaction among both customers (patients) and employees (OR-staff), as well as increasing the operational costs
(Redman, 1998). Firstly, the dissatisfaction among customers is believed to arise due to unmet expectations in terms of accuracy, completeness, relevancy, timeliness and such (Redman, 1998; Wang et al., 1998). The main driver of the dissatisfaction of employees, on the other hand, is believed to be the lack of fulfilling the user’s needs which are based on their professional duties (Stvilia, et al. 2007; Taylor, 1991), and the disappointment of not meeting the customers’ expectations (Redman, 1998). Lastly, the operational costs arise not only due to operational inefficiencies, but also due to resources being spent on identifying and correcting errors (Redman, 1998; Eppler & Helfert, 2004).

2.4.2 Information Quality and Waste

Only a few previous research has explored the implications of poor information quality on the seven types of identified waste. A study conducted by Jylhä and Suvanto (2015), consisting 130 interviews and workshops with four case organizations and their customers, investigated how the service processes in facility management were influenced by poor information quality. The results of this study confirmed the hypothesis of that poor information quality generates a great amount of waste, where three major impacts were found based on the cross-case analysis. Firstly, a lot of time was wasted searching for information due to two reasons. One, the low accessibility caused by either non-standardized distribution channels or a flood of information which decreases the relevancy of information provided and obstructs the use of necessary information. Two, the incompleteness of the information provided which in turn also requires the search for needed information. Thus, the low accessibility and relevancy and the incompleteness of information lead to employees being required to spend time searching for necessary information, thereby generating waste in terms of motion as it causes unnecessary staff movement. (Jylhä & Suvanto, 2015)

Secondly, lacking information quality generated extra work, as employees were required to perform additional activities to enhance the reliability, validity, completeness and readability of the information. The reliability of information was perceived as low as necessary information was not delivered on time, thus also having low accuracy, and as the interpretation of data was not transparent. As a result, employees were required to search for the original information (overprocessing, motion) to interpret it themselves and anticipate the time of delivery, often causing delays (waiting). In similarity, challenges with the validity of information also generated additional activities, such as checking to identify possible errors and double-processing to correct detected errors. Consequently, low reliability, accuracy and validity generated the waste types overprocessing, motion and waiting. Furthermore, the incompleteness of information was caused by delayed updates (low timeliness), which in turn generated additional waste activities. An example of this was that employees conducted analyses and based decisions on information that was incomplete and out-of-date, which were all required to be redone (defects, overprocessing) once the information was completed. Moreover, the provided information was often considered to be difficult to understand (low ease of understanding) as it was not adjusted for the receivers, thereby leading to additional work to interpret and understand the information (motion). Thus, the lack of completeness, timeliness and ease of understanding generated waste in terms of defects, overprocessing and motion. (Jylhä & Suvanto, 2015)
Lastly, the study showed that poor information quality also resulted in a loss of potential, where the lost potential is referred to as information that has been invested in, but eventually not used. Based on the conducted cross-case analysis, three main reasons were identified for the loss of potential. One, although time and effort were invested to produce the information, it was not delivered on time (low timeliness) and could therefore not be used to the fullest, resulting in an overproduction of information. Two, great volumes of information were distributed among the employees, including both relevant and irrelevant information. Due to the excessive amount of information, irrelevant information prevented relevant information to be seen and used, thereby leading to a loss of potential. Three, information was sometimes deliberately ignored as it was not considered to be in the right form. Consequently, low relevancy and timeliness caused the waste types overproduction and inventory, as redundant and unnecessary information was produced and stored. (Jylhä & Suvanto, 2015)

Based on the case study evidence presented above, Jylhä and Suvanto (2015) argue that poor information quality has a direct impact on waste activities. Conclusively, quality of information is required to be improved to minimize waste. An empirical study conducted by Al-Hakim (2014) investigated the impact of information quality on waste activities in emergency departments due to the lack of previous empirical evidence on the relationship between quality of information and disruptions. The research consisted of four months of observations at two Chinese emergency departments, including activities of 19 emergency doctors and 28 nurses. As a result, the study presented strong empirical evidence on the implications of poor information quality on disruptions and waste activities caused in emergency departments. While approximately 16% of the observed emergency doctors’ time was spent on waste activities as a result of poor information quality, the corresponding figure for emergency nurses’ time was more than 29%. Among generated waste, roughly 42% was caused by the lack of availability and timeliness of information. Furthermore, the incompleteness and irrelevance of information caused about 15.5% respectively 16% of the generated waste. An additional 11% of the total waste occurred in form of prolonged emergency services, caused by inaccuracy of information. Lastly, with less than 5% effect on identified waste, the dimensions ‘ease of understanding’ and ‘believability’ of information were not considered to be an issue.

Accordingly to Al-Hakim (2014), the empirical findings indicated that approximately 24% of the time in emergency departments can be saved by improving the quality of information. Based on a comprehensive literature review and thus to the best of our knowledge, there is a clear lack of empirical evidence on the implications of poor information quality on waste activities in the distinctive context of outpatient surgeries, which this study aims to further investigate.
3. Method

The following chapter describes the methodology used in this study. Initially, the overall research approach of the study is presented followed by a description of the literature review and case study. Lastly, the quality of analysis is presented.

3.1 Research Approach

The purpose of this study is to investigate how the process performance of outpatient surgeries can be improved by managing information quality. Thus, the aim is to identify improvement areas within the quality of the information which control the process performance of the outpatient surgery.

As the study intends to investigate a phenomenon that is unique for a specific real-life context, a case study is considered to be appropriate and therefore chosen to be pursued (Collis & Hussey, 2014). Yin (2009) emphasizes the distinction between case studies and other research methods by defining case studies to be of specific importance for when the boundaries between phenomenon and context are not clearly evident. This is believed to support the choice of research method based on the distinctive study characteristics. By conducting a case study, phenomenon in complex human and social systems can be observed and analyzed as a single, integrated whole. This is enabled by the holistic approach of case studies which allow for detailed descriptions of situations and events to be produced, as well as provides in-depth understanding of interactions and elements involved (Gagnon, 2010). However, there are also several challenges related to case research, such as being time consuming, requiring skilled interviewers, and causing difficulties in drawing generalizable conclusion from a restricted number of cases and establishing rigorous research. Nevertheless, it is the same set of characteristics that allow for the in-depth analysis and understanding of a specific phenomenon (Voss et al., 2002).

The number of case studies is also believed to have an impact on the degree of experienced challenges and opportunities of case research. While fewer case studies are to be preferred for greater in-depth observations for a limited set of available resources, these also entail greater risks for misjudgments of single occasional events and exaggeration of collected data (Voss et al., 2002). Consequently, the generalizability of conclusions is aggravated by single case studies (Leonard-Barton, 1990). Conducting multiple case studies have the potential of reducing these risks by comparing events and data across cases, however, at the expense of reducing the depth of the study (Voss et al., 2002). Based on the purpose and aim of this study, a more in-depth research is to be preferred and thereby a single case study chosen to be pursued.

3.2 Literature Review

A literature review is defined as a critical evaluation and analysis of existing knowledge within a topic that is of relevance for the study area (Blomkvist & Hallin, 2015). Thus, the purpose of the conducted literature review was to obtain insights in information quality and waste by critically studying theories and models within the subject area to answer the research questions and thereby achieve the purpose of this study. In addition to providing knowledge within the
chosen field of study, the literature review also facilitated the positioning of the study in relation to previous research (Collis & Hussey, 2014).

The literature review was conducted throughout the research process. At first, a divergent approach was maintained by reviewing and evaluating a broad field of knowledge. The literature mainly consisted of books, articles and reports. These were in turn systematically summarized, where key findings were extracted from each and categorized accordingly to themes to facilitate the review process and following analysis of the literature (Collis & Hussey, 2014). Afterwards, when a broader understanding of existing literature and a deeper understanding of the phenomenon and its context were obtained, a more convergent approach was pursued. The literature review was thereby narrowed down incrementally along the research process (Blomkvist & Hallin, 2015).

When conducting the literature review, similarities and differences among existing literature and in relation to the study findings were analyzed. Tying together similar literature and findings, as well as addressing literature that conflicts with the study findings induced a more creative thinking and deeper insights. This in turn increased both the validity and quality of the study findings (Voss et al., 2002).

Books, articles and reports were obtained from the search engines Google Scholar and KTHB Primo which gave access to content from publishers such as Emerald Insight, Wiley Online Library, Springer Link, Elsevier and SAGE. The search terms information quality, process performance, waste, lean, healthcare, hospital, outpatient surgery and management were all used in different combinations, both in Swedish and English, when searching for relevant literature.

3.3 Case Study
The case study was pursued in parallel to the literature review to collect empirical data. The case study included the five main stages recommended by Collis and Hussey (2014). The stages, selecting the case, preliminary investigations, data collection, data analysis and writing the report are described in detail in the upcoming sections.

3.3.1 Selecting the Case
The case was noticed by a team from Clinical Innovation Fellowship (CIF). CIF is a program initiated by Karolinska Institutet (KI), Royal Institute of Technology (KTH) and EIT Health with the purpose of identifying clinical needs with the final objective of improving the healthcare (KTH, 2017). A multidisciplinary team consisting of an engineer, an economist, a physician and an industry designer identified several problem areas at Danderyd’s University Hospital. The problem areas were reviewed by the team and a reference group from Danderyd’s University Hospital which together chose the problematization of this thesis, among others, to be further investigated (Franzén et al., 2017).
Since the case was noticed CIF and not selected based on the study, there is a possibility that this case is not the most suitable for the purpose of this study. However, it is considered to be appropriate as it covers the research area and as the problem area is thoroughly chosen by the multidisciplinary team (Collis & Hussey, 2014). Moreover, since the personnel at the hospital have experienced the problem it facilitated the gathering of data as they were willing to dedicate their time, which also is important to considerer (Voss et al., 2002). Furthermore, the operation unit is a part of one of the largest public hospitals in Sweden, meaning it has similar practices and approaches as many other hospitals within the public sector in Sweden. Thus, the findings of this project could potentially be applicable to other public hospitals in Sweden as well and make a great contribution.

3.3.2 Preliminary Investigations
The study was initiated through a pre-study of the operation unit at the women’s department, Danderyd’s University Hospital. The preliminary investigations were conducted to gain insights and a deeper understanding of the context of the study (Collis & Hussey, 2014). It mainly consisted of multiple observations, informal discussions with personnel at Danderyd’s University Hospital to understand the current situation at the operation unit. This in turn enabled problems with focus on information quality and waste to be surfaced, analyzed and evaluated based on their critical nature and impact on the overall flow within the operation unit. Additionally, the literature study was conducted in parallel to the initial empirical data gathering. This was to relate possible theories to the identified problem areas.

The information gathered from the preliminary investigations and literature review was the foundation of the problematization which in turn was the basis for the purpose and research questions. They were formulated in a discussion with the supervisor from both Danderyd’s University Hospital and KTH.

3.3.3 Data Collection
According to Yin (2009), using different methods for gathering data is required when conducting a case study. Furthermore, triangulation, i.e. using different methods and sources, increases both reliability and validity of the study findings (Collis & Hussey, 2014; Voss et al., 2002). Hence, primary data was gathered from observations in combination with interviews with semi-structured and structured questions and a survey. Obtaining unbiased quantitative data should be a part of a case study even though it often is associated with qualitative data (Voss et al., 2002). Thus, the quantitative data from the survey was gathered to validate the qualitative data and thereby avoid biased interpretations of the observations and answers from the interviews (Jick, 1979). The secondary data, on the other hand, was gathered from internal documents and external publications. The triangulation method is illustrated in Figure 5, where the different parts are described more in detail in the sections below.
The work in healthcare is dynamic, where unpredictable events resulting in a decreased process performance occur. This could for instance be complications during surgery or other delays and issues concerning the patients. However, only information regarding events that could be predicted are included and investigated in this study. Thus, other events damaging process performance will be delimited from the study during the observations, interviews, survey and document review.

Observations
There are different degrees of participation in an observation. The researcher can be completely participating in the activities or not even positioned in the same location and thereby a complete observant. There are both advantages and disadvantages with all different levels of participation. For this study, the most suitable levels of participation were to conduct observations as both participant-as-observant and observant-as-participant. In the participant-as-observant a more participant role was taken which gave the opportunity to ask questions about the observed situation, enabling a deeper understanding of the events which was appropriate for the chosen purpose (Gerrish & Lacey, 2010; Bryman, 2004). However, these types of observations have a risk of affecting the events and thereby decreasing the validity. Therefore, this type of observation was conducted in combination with observations where an observant-as-participant role was taken interfere of the situation was avoided. Consequently, both a high level of understanding of the situation and an accurate perception of the situation were thereby obtained (Gerrish & Lacey, 2010).

During the empirical data gathering, 53 surgeries were observed. The observations consisted not only of observing surgeries, but also observations and discussions in the operation unit and lunch room and in total were 344 hours spent at Danderyd’s University Hospital. During the
observations, the influencing factors of information quality and the occurring waste were examined and analyzed, which was later used to answer both research questions.

Notes were taken during all observations, where the events and reflections were transcribed. The notes were taken separately and thereafter compared and discussed to cover as much as possible of the event and to reduce the risk of misinterpretations and thereby increased validity of the findings from the observations.

Due to the sensitive nature of the information managed in a hospital, a confidentiality agreement was signed before any observations. This agreement implied that no patient information should be discussed or shared and stay confidential. This agreement had no negative impact on the study since patient information was not a part of this study. Instead, it enabled participation during the entire operating flow and thereby contributed to a better understanding that was useful for the study.

**Interviews**

To collect the empirical data needed to answer the research questions, 16 semi-structured interviews were in total conducted. During a semi-structured interview, the questions are predetermined but the researchers still have the opportunity to ask supplementary questions (Collis & Hussey, 2014). This enabled a deeper understanding of the answers and of the subject which was considered to be suitable with the purpose of this study.

To obtain high validity and to obtain an accurate perception of the situation, it is important to have many interviews. However, due to the restricted amount of time for this project, the number of interviews had to be limited to be able to conduct an analysis of high quality (Voss et al., 2002). The observations suggested that surgeons and the surgical staff possessed knowledge in different areas. The former group possessed deeper knowledge regarding the influential factors controlling the information provided to the latter group, which in turn possessed deeper knowledge of its implication on the work inside the operating theatre. Therefore, nine interviews were conducted with the surgical staff with the purpose to advance the knowledge regarding the work and information quality inside the surgical theatre and how this affected waste activities, see Table 4. The questions from these interviews can be found in Appendix A.1. Furthermore, seven interviews were conducted with surgeons with the aim of investigating the factors influencing information quality. The questions from these interviews can be found in Appendix A.2. The answers from all interviews aimed to confirm and validate the observations and thereby increase validity and reliability.
### Table 4 – Summary of the conducted interviews.

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Main work tasks</th>
<th>Duration</th>
<th>Answering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assistant Nurse 1</td>
<td>Prepare operating theatre, assist during surgery with tools and equipment and clean.</td>
<td>40 min</td>
<td>RQ1</td>
</tr>
<tr>
<td>Assistant Nurse 2</td>
<td>Prepare operating theatre, assist during surgery with tools and equipment and clean.</td>
<td>1h 15 min</td>
<td>RQ1</td>
</tr>
<tr>
<td>Assistant Nurse 3</td>
<td>Prepare operating theatre, assist during surgery with tools and equipment and clean.</td>
<td>30 min</td>
<td>RQ1</td>
</tr>
<tr>
<td>Assistant Nurse 4</td>
<td>Prepare operating theatre, assist during surgery with tools and equipment and clean.</td>
<td>25 min</td>
<td>RQ1</td>
</tr>
<tr>
<td>Surgical Nurse 1</td>
<td>Prepare operating theatre, assist surgeon during surgery and, after surgery, handle the medicinal preparations and tools.</td>
<td>30 min</td>
<td>RQ1</td>
</tr>
<tr>
<td>Surgical Nurse 2</td>
<td>Prepare operating theatre, assist surgeon during surgery and, after surgery, handle the medicinal preparations and tools.</td>
<td>25 min</td>
<td>RQ1</td>
</tr>
<tr>
<td>Surgical Nurse 3</td>
<td>Prepare operating theatre, assist surgeon during surgery and, after surgery, handle the medicinal preparations and tools.</td>
<td>40 min</td>
<td>RQ1</td>
</tr>
<tr>
<td>Surgical Nurse 4</td>
<td>Prepare operating theatre, assist surgeon during surgery and, after surgery, handle the medicinal preparations and tools.</td>
<td>40 min</td>
<td>RQ1</td>
</tr>
<tr>
<td>Surgical Nurse 5</td>
<td>Prepare operating theatre, assist surgeon during surgery and, after surgery, handle the medicinal preparations and tools.</td>
<td>25 min</td>
<td>RQ1</td>
</tr>
<tr>
<td>Surgeon 1</td>
<td>Read patient record and/or consultation report, talk to the patient and plan and perform the surgery.</td>
<td>1h 10 min</td>
<td>RQ2</td>
</tr>
<tr>
<td>Surgeon 2</td>
<td>Read patient record and/or consultation report, talk to the patient and plan and perform the surgery.</td>
<td>30 min</td>
<td>RQ2</td>
</tr>
<tr>
<td>Surgeon 3</td>
<td>Read patient record and/or consultation report, talk to the patient and plan and perform the surgery.</td>
<td>55 min</td>
<td>RQ2</td>
</tr>
<tr>
<td>Surgeon 4</td>
<td>Read patient record and/or consultation report, talk to the patient and plan and perform the surgery.</td>
<td>40 min</td>
<td>RQ2</td>
</tr>
<tr>
<td>Surgeon 5</td>
<td>Read patient record and/or consultation report, talk to the patient and plan and perform the surgery.</td>
<td>40 min</td>
<td>RQ2</td>
</tr>
<tr>
<td>Surgeon 6</td>
<td>Read patient record and/or consultation report, talk to the patient and plan and perform the surgery.</td>
<td>30 min</td>
<td>RQ2</td>
</tr>
</tbody>
</table>
The purpose of the interviews, together with the questions were e-mailed to the interviewees in advance. This implied that the interviewees could think about the answers and came prepared (Voss et al., 2002). Additionally, this contributed for interviewees to feel more comfortable. According to Easterby-Smith et al. (2008), feeling comfortable and to trust the interviewing is very important to obtain the desired answers. The interviews were conducted face-to-face in a familiar environment for the interviewees which also contributed to them feeling comfortable (Collis & Hussey, 2014). Furthermore, the ethical guidelines recommended by Collis and Hussey (2014) were followed and all interviewees were informed that they would be kept anonymous in the report and how their responses would contribute to the research.

There were two who interviewed which increased the confidence of the findings (Voss et al., 2002; Collis & Hussey, 2014). One had the responsibility of asking the questions whilst the other took notes and asked supplementary questions. After obtaining approval from the interviewees, all interviews were recorded. This enabled the possibility to listen to parts of interview once more if there were any uncertainties. However, this is very time consuming and was avoided if possible.

As recommended by Voss et al. (2002), the funnel model was used and the interviews started with broad questions but were them narrowed down and became more detailed. A disadvantage with semi-structured interviews is that since the answers could vary from each interviewee, they could be difficult to compare (Collis & Hussey, 2014). Thus, a survey consisting of structured questions was conducted to complement the insights obtained from the interviews, and enable comparisons between the answers gathered from the different interviewees. However, to evaluate which structured questions that were most suitable for the survey, and to obtain qualitative comments and insights around the structured questions, these were also included during the interviews in combination with semi-structured questions. During the interviews, qualitative answers in conjunction to quantitative data was initially obtained to ensure the appropriateness of the structured questions, which in turn increased their validity. Furthermore, besides enabling comparisons between different answers, the quantitative data from the interviews also reduced the risk of biased interpretations of the answers while still allowing qualitative reflections and explanations regarding the interviewees choices.

**Survey**

To obtain a larger amount of quantitative data and thereby increasing the reliability, some of the structured questions asked during the interviews were also handed out as a survey to all surgical staff working with the outpatient surgery at the women’s ward at Danderyd’s University Hospital. The answers obtained from the interviews suggested that three dimensions of information quality were not suitable to investigate during the survey and were therefore excluded, these were ease of understanding, relevancy and timeliness. Ease of understanding and relevancy were at first sight interpreted differently by the interviewees and needed a context...
and discussion. Furthermore, the survey was conducted among the surgical staff, which based on the interviews were not aware of the quality dimension timeliness. Additionally, the accessibility of the information in Orbit, the computer system managing the planning and scheduling of surgeries, was evaluated during the observations. Thus, this dimensions did not need further investigation of validation through the survey and was therefore also excluded. Finally, all questions regarding local anesthesia were also excluded since it became clear during the interviews that this information was never included in Orbit and could therefore not be evaluated in a survey.

The survey was answered by 16 of the surgical staff. This in turn increases the overall reliability of the answers obtained from the structured questions during both the interviews and the survey among the surgical staff. However, since the survey was answered by 16 out of 23 of the surgical staff, the approximately 70% response rate is not sufficient to state the opinions from all surgical staff working with outpatient surgery at the case company’s women’s department but gave an indication (Arvidsson, 2016).

**Document Review**
The surgical staff at the case company were provided with a printout from their computer system, Orbit. The purpose of this printout was to provide the surgical staff with the information needed to prepare the operating theatre. This document, was studied to evaluate what information that was provided, and its quality.

**3.3.4 Data Analysis**
The data analysis was conducted iteratively and in parallel to the data collection. There are mainly two different approaches of analyzing data, namely within-case analysis or cross-case analysis (Collis & Hussey, 2014). Since this study only consists of a single case, a within-case analysis was pursued to identify possible patterns in the gathered data. The data analysis was in turn conducted accordingly to a three-step process; data condensation, data display, and conclusion drawing and verification (Miles et al., 2014).

Firstly, the condensation of data refers to the process of extracting, selecting and focusing empirical material. The process of condensing data occurs continuously throughout the research process, from the choice of conceptual framework to the organization of empirical data. It enables gathered empirical material to become robust by allowing conclusions to be drawn from organized and focused data (Miles et al., 2014). Through this study, both proactive and reactive approaches for condensing data have been pursued. For instance, interview questions have been thoroughly formulated to prevent possible misinterpretations or misunderstandings. This approach proactively reduces the risk of receiving excessive and unnecessary data and thereby increases the rate of relevant data. Furthermore, interviews were throughout the research process summarized, analyzed, extracted on key findings and organized accordingly to themes that were based on identified patterns, which corresponds to a more reactive approach of condensing data.
Secondly, after the condensation of data, the second part of the data analysis process follows, namely the display of data. Data display refers to the visualization of data in terms of graphs, charts and such. The visualization of data facilitates the information-processing and increases the robustness of qualitative analysis by assembling organized information into a clear and accessible form. Based on the displayed data, either justified conclusions can be drawn or a foundation for further analysis can be established (Miles et al., 2014). For instance, results from the survey were organized and visualized in charts by using Microsoft Excel to provide a structured and clear foundation to draw conclusions from and base further analysis on, see Appendix B.

Lastly, the third activity of data analysis consists of drawing and verifying conclusions. This is realized through a continuous process of coding, storing, and retrieving field notes which gradually allows for generalizations to be developed (Miles et al., 2014). Hence, empirical material was throughout this study reviewed, coded, sorted, stored and retrieved. Once retrieved, these were compared to other empirical findings and also to existing literature to find supporting or conflicting arguments. This in turn allowed generalizations to be developed iteratively and research questions to be answered.

3.3.5 Writing the Report
The report was structured according to the recommendations by Blomqvist and Hallin (2015) with some minor adjustment. The writing of the report was an interactive and continuous process throughout the project. The research design for this project, including the five stages of the case study and literature review, which can be seen in Figure 6 – The study research design.

3.4 Research Quality
The quality of analysis is discussed based on its validity and reliability. For investigating the rigorousness of a case study, Gibbert et al. (2008) have developed a framework consisting of
four criteria; internal validity, construct validity, external validity, and reliability. Each of these are discussed in detail in the sections below, followed by a summary accordingly to Gibbert et al.’s (2008) framework.

3.4.1 Internal Validity

The internal validity of a study refers to the data analysis phase and depends on the extent to which causal relationships can be established between variables and results. Thus, it requires researchers to provide logical arguments and reasoning to defend (Gibbert & Wicki, 2008; Voss et al., 2002). There are three measures for enhancing internal validity; clear research framework, pattern matching, and theory triangulation.

Firstly, to establish a causal relationship where a variable x is proven to lead to an outcome y (Yin, 2009), a clear research framework is required to be formulated (Gibbert & Wicki, 2008). Although causality is one of the central concepts in science, it is hard if not impossible to define (Hansson, 2007). Some argue that causal connections are purely a mental construction that derives from repetitive and succeeding observations on two or more events. Hence, it is argued that the connections that defines “x causes y” as “if x then always y” are the only ones required within the scientific concept of cause. Consequently, through repeated observations, one can only identify what one can observe, which is the correlation between two variables or events x and y (Hansson, 2007). The causality, on the other hand, cannot be established as it is not possible to observe but will instead require an interference with assumptions, thereby contaminating the empirical findings (Hansson, 2007; Yin, 2009). Based on this, in combination with the complex real-life setting of outpatient surgeries, the causal relationships between different external factors, information quality dimensions and types of waste could not be established. However, the purpose and the research questions of this study do not seek to explain any causal relationships between different variables. Instead, it aims to explore the implications and influences of different factors and thereby find correlations rather than causal relationships.

Secondly, to enhance the internal validity of the study, researchers are encouraged to conduct a comparative analysis between observed patterns and either predicted ones or established patterns from previous research and in different contexts (Gibbert & Wicki, 2008). In this study, the patterns found between different information quality dimensions and waste activities were compared to those identified in previous research described in Information Quality and Waste. The first identified was in the context of service processes in facility management and the other one in the context of emergency departments. However, although a detailed description of the impact of certain poor information quality dimensions on specific waste activities was presented in the first mentioned study, the second mentioned study presented a rather general and comprehensive analysis of the implications of poor information quality on waste in emergency departments. Nevertheless, the combination of the two researches enabled a comparative analysis between these and the study findings to enhance the internal validity of the study.

Thirdly, theory triangulation is required to verify research findings as it allows the researchers to adopt multiple perspectives when analyzing the gathered data (Gibbert & Wicki, 2008). In the literature review, multiple perspectives of different information quality dimensions within
healthcare were adopted when analyzing the information quality in the outpatient surgery. By doing so, the analysis of the information quality in the outpatient surgery could be based on suitable dimensions, as these were supported by several perspectives, thereby increasing the internal validity of the study. However, as the different adopted perspectives of information quality dimensions in healthcare were almost identical with the exception of one or two single differences, the study might be criticized for restrictively using theory triangulation. Although, it might also support the appropriateness of the dimensions chosen and analyzed for this specific context.

3.4.2 Construct Validity

Construct validity refers to the extent of how accurate the study investigates what it aims to investigate and how well it reflects the reality. Obtaining construct validity should be considered when gathering data, where the two approaches described by Gibbert et al. (2008) have been used in this study. First, establishing a chain of evidence was used to ensure construct validity. This was done through providing the reader with a description of the process from the initial research questions to the final conclusions.

Second, triangulation has also been used to further enhance the construct validity of this study. There are different types of triangulation which contribute to a higher construct validity. In this study, three different triangulations were used, namely data triangulation, methodology triangulation, and investigator triangulation. Data triangulation was used by collecting data from several different sources. This was achieved by for instance conducting interviews with several different interviewees. Methodology triangulation, on the other hand, refers to data that are collected through different methodologies such as interviews, observations and internal documentation. Lastly, during the observations, investigator triangulation was used as notes were taken independently which enabled different investigators to study the same situation (Easterby-Smith et al., 2008). Consequently, a chain of evidence was established and triangulation has been used throughout the study which contributed to a high construct validity.

3.4.3 External Validity

The external validity occurs in the research design phase of the study and refers to the generalizability of the research findings beyond the specific context to which the case study has been conducted in. Since the research only consists of a single case study, the research findings cannot be generalized into other contexts (Gibbert & Wicki, 2008; Voss et al., 2002). However, as the case study was conducted in one of the largest Swedish public hospitals, it can be argued the research findings is to some extent generalizable in relation to other Swedish public hospitals as they most likely have similar routines and protocols. Furthermore, multiple methods for gathering empirical data, both qualitative and quantitative, have been used for increasing the accuracy and generalizability of the research findings (Shah & Corley, 2006). To establish the external validity of the research findings, similar studies either in other Swedish public hospitals or different case studies in Danderyd’s University Hospital are required to be conducted (Yin, 2009).
3.4.4 Reliability

A study is considered to have a high reliability if it can be repeated, with the same methodology, and reach the same findings (Collis & Hussey, 2014). According to Gilbert et al. (2008), the most important components in achieving reliability is transparency and replication. The transparency of this study is considered to be high due to the detailed method chapter and attached interview questions. This allows other researchers to repeat the method and thereby contributing to a higher reliability. The replication of the study is also considered to be high since the documentation from all observations and interviews were saved in a case study database which also facilitates for the study to be replicated. However, due to ethical reasons and legislations in healthcare, this is not attached in this report.

As the findings from this study mainly are based on interpretations of qualitative data, the risk that a different result would be obtained if the study would be replicated increases. Moreover, the supplementary questions were different in each interview which meant that the answers varied. These questions are not included in the appendix which lowers the transparency but are documented in the case study database. The use of qualitative data increases the risk of a lower reliability but was considered necessary to achieve the in-depth knowledge that was required to answer the research questions. However, as mentioned earlier, using the quantitative data from the interviews aimed to avoid misinterpretations and the reliability was strengthened. (Gibbert & Wicki, 2008)
3.4.5 Summary
The study has used several different approaches to obtain a high quality and rigorousness. These are summarized in Table 5, seen below.

Table 5 – Summary of the approaches to obtain high quality and rigorousness.

<table>
<thead>
<tr>
<th>Internal validity</th>
<th>Construct validity</th>
<th>External validity</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>A comparative analysis conducted between previous research and the empirical findings.</td>
<td>Establish a chain of evidence.</td>
<td>Use both qualitative and quantitative methods.</td>
<td>Transparency with detailed method chapter.</td>
</tr>
<tr>
<td>Theory triangulation by adopting multiple perspectives of information quality dimensions.</td>
<td>Data triangulation through using different sources when collecting data.</td>
<td>However, not considered to be high due to the nature of a single-case study.</td>
<td>Achieving replication through a case study database</td>
</tr>
<tr>
<td>However, no clear research framework established for investigating the causal relationship between different variables, as this was not intended to be investigated.</td>
<td>Methodology triangulation by collecting empirical data through interviews, observations, survey and internal documents.</td>
<td>Investigator triangulation through independently taking notes during observations.</td>
<td></td>
</tr>
</tbody>
</table>
4. Results and Analysis

The following chapter presents the results and analysis of this study, and is divided into three parts. The first part describes the outpatient surgery at the women’s ward at Danderyd’s University Hospital, while the second and third part present the results and analysis of RQ1 and RQ2 respectively.

4.1 The Outpatient Surgery

In this section, the operation unit at the women’s department at Danderyd’s University Hospital is presented. It also gives a work description for the OR-staff and the information provided in Orbit.

During the time spent at the women’s department at Danderyd’s University Hospital, the staff performed between seven and ten outpatient surgeries on an average day. The surgeries had varying durations, which resulted in the different number of surgeries performed each day. Commonly occurring surgeries were such as hysteroscopies, conizations, abortions and sterilizations. All outpatient surgeries were normally performed in operating theatre six, see Figure 7. This operating theatre was one of the smaller ones, thus a lot of the equipment and tools used during the outpatient surgeries were not permanently placed in adjacent to, or in, the operating theatre itself, but stored in the storage room for central equipment. There was also a separated storage for anesthesia where the staff retrieved the local anesthesia needed for the surgeries. As seen in the figure, there were other operating theatres at the department as well and to maintain a manageable overview of the personnel and surgeries, a board was kept in the hallway with the operation schedule.

Figure 7 – The outpatient surgery at the women’s department at Danderyd’s University Hospital.

The work in the operating theatre was a cooperation between the OR-staff consisting of a surgeon, surgical nurse, assistant nurse, anesthesia nurse and anesthetist. The surgeon was the physician who performed the surgery and was responsible to, prior to the surgery, read the
patient record and/or consultation report, talk to the patient and plan the surgery. Once the surgery was performed, the surgeon dictated, wrote referrals and prescribed medication. The surgical staff, constituted by the assistant nurse and the surgical nurse, prepared the operating theatre for surgery with the necessary equipment, tools and local anesthesia. During the surgery, the surgical nurse assisted the surgeon whilst the assistant nurse provided tools, controlled the equipment, retrieved additional tools or equipment and performed other necessities. After the surgery the surgical staff were responsible of cleaning the operating theatre and handling the medicinal preparations and tools that had been used. The anesthesia nurse and anesthetist were responsible for monitoring the health of the patient during the surgery and to ensure that a safe narcosis and sedation were performed.

The surgical staff were provided with a printout from the computer system, Orbit, which managed the planning of the surgeries. The purpose of the information in Orbit was to provide the surgical staff with all information needed to prepare the operating theatre. Furthermore, this information was also used by the surgical staff the night before surgery to collect and assemble different sets of surgical instruments for the surgeries the following day. During the interviews, when the surgical staff were asked about the practical information that was needed to perform their professional duties, the interviewees mentioned three pieces of information. First, what surgical procedure to perform. Second, if there were any additional tools or equipment expected to be used that were normally not included in the standard surgical set. Third and last, the surgical staff expressed that to complete the surgical preparations in the operating theatre, they also needed to know what local anesthesia would be used. Hence, these three types of information were closely investigated and analyzed throughout the empirical study. An example of how the printout typically look like can be seen in Figure 8. Note that this is not an actual schedule taken from the case company, but a mixture of real procedures from different days. This is due to confidentiality reasons to ensure no information could be traced to the patient.
<table>
<thead>
<tr>
<th>Planerad operationssal</th>
<th>Patient</th>
<th>Planerad tid</th>
<th>Operationskort</th>
<th>Planerad operator</th>
<th>Planerad varaktighet</th>
<th>Vårdsande enhet</th>
<th>Preliminära åtgärder</th>
<th>Info till Operationspersonal</th>
<th>Info till Anestesi</th>
</tr>
</thead>
<tbody>
<tr>
<td>KK Sal 6 56664</td>
<td>XX</td>
<td>8.15</td>
<td>Hysteroskopi - Bettochi (kk)</td>
<td>XX</td>
<td>00:30</td>
<td>Gyn mott</td>
<td>*LGA22 - Hysteroskopisk sterilisering</td>
<td>Kommer 07:30</td>
<td></td>
</tr>
<tr>
<td>KK Sal 6 56664</td>
<td>XX</td>
<td>9.15</td>
<td>Hysteroskopi - Resektion (kk)</td>
<td>XX</td>
<td>00:30</td>
<td>Gyn mott</td>
<td>*LCB25 – Hysteroskopi med extirpation av förändring</td>
<td>Kommer 07:30</td>
<td></td>
</tr>
<tr>
<td>KK Sal 6 56664</td>
<td>XX</td>
<td>10.15</td>
<td>Hysteroskopi - Resektion (kk)</td>
<td>XX</td>
<td>00:30</td>
<td>Gyn mott</td>
<td>*LCB25 – Hysteroskopi med extirpation av förändring, TLC00</td>
<td>Kommer 08:30</td>
<td></td>
</tr>
<tr>
<td>KK Sal 6 56664</td>
<td>XX</td>
<td>11.30</td>
<td>Konisering - slynga (kk)</td>
<td>XX</td>
<td>00:15</td>
<td>Gyn mott</td>
<td>*LDC03 Konisation med diatermi eller laser, LDA10 Abrasio av cervix uteri</td>
<td>Kommer 09:00</td>
<td></td>
</tr>
<tr>
<td>KK Sal 6 56664</td>
<td>XX</td>
<td>13.00</td>
<td>Konisering - slynga (kk)</td>
<td>XX</td>
<td>00:15</td>
<td>Gyn mott</td>
<td>*LDA10 Abrasio av cervix uteri, LDC03 Koniserings med diatermi eller laser</td>
<td>Kommer 12:30</td>
<td></td>
</tr>
<tr>
<td>KK Sal 6 56664</td>
<td>XX</td>
<td>13.40</td>
<td>Sen spontanabort &gt; v 12 (kk)</td>
<td>XX</td>
<td>00:10</td>
<td>Gyn mott</td>
<td>*MBR00 - Exeres med vakummaspiration vid missfall eller efter förlossning</td>
<td>Kommer 12:30</td>
<td></td>
</tr>
<tr>
<td>KK Sal 6 56664</td>
<td>XX</td>
<td>14.15</td>
<td>Tidig abort &lt; v 12 (kk)</td>
<td>XX</td>
<td>00:07</td>
<td>Gyn mott</td>
<td>*LCH00 - Exeres med vakummaspiration</td>
<td>Kommer 13:00</td>
<td></td>
</tr>
<tr>
<td>KK Sal 6 56664</td>
<td>XX</td>
<td>15.00</td>
<td>Tidig abort &lt; v 12 (kk)</td>
<td>XX</td>
<td>00:07</td>
<td>Gyn mott</td>
<td>*LCH00 - Exeres med vakummaspiration</td>
<td>Kommer 13:30</td>
<td></td>
</tr>
</tbody>
</table>

Figure 8 – An example of how the printout from Orbit typically looked like.

4.2 Implications of Information Quality on Waste

Based on the conducted empirical study, poor information quality was identified across all dimensions of quality. As a result, six of seven types of waste were identified in the outpatient surgery, namely transportation, motion, waiting, overproduction, overprocessing, and defects, whereas inventory was not found in this study. The absence of inventory might be explained with the delimitation of this study from events outside of, and not in connection to, the surgical theatre or because this waste did not occur. The implications of poor information quality on the identified waste activities will be presented in the following sections, thereby answering the first research question: What are the implications of information quality on waste in the outpatient surgery?

4.2.1 Transportation

As described in the literature study, transportation involves all unnecessary movements of people, equipment, and tools that might cause excessive movements and double-handling. Throughout the study observations, the waste of transportation occurred in mainly three ways: (1) when retrieving additional tools and equipment, (2) when retrieving a different set of surgical instruments, and (3) when retrieving local anesthesia. These transportations were either between the operating theatre and the central equipment store, or between the operating theatre and the central anesthesia store. The waste of transportation was in turn caused by lacking quality of accuracy, timeliness, and completeness.
Retrieving additional tools and equipment

First of all, based on the conducted observations, the surgical staff were required to retrieve additional tools and equipment, such as speculums and ultrasounds, every sixth surgery. This was in turn caused by the information provided in Orbit being inaccurate, out-of-date, and incomplete. The lack of accuracy and completeness of the information provided in Orbit regarding additional tools and equipment was also confirmed by the conducted survey, where the surgical staff were asked to assess these two quality dimensions with respect to supplementary items, see Figure 9.

Figure 9 – The accuracy and completeness of the information provided in Orbit regarding additional tools and equipment, on a scale one to five, where one is the lowest score and five is the highest score.

Un-notified additional tools and equipment in Orbit implies that no supplementary items are requested for the surgical procedure. Therefore, a later request for an additional tool or equipment in conjunction with the surgery indicates that the provided information in Orbit is inaccurate and out-of-date, as the physician has failed to update Orbit with his or her needs. Furthermore, if a supplementary tool or equipment is requested in Orbit, but the physician requests another item prior to the surgery, this demonstrates that the provided information in Orbit is incomplete.

During one of the observations, the surgeon requested an ultrasound when arriving to the operating room. Since this request was not notified in Orbit, the assistant nurse was required to walk back and forth along the hall to retrieve the ultrasound, causing the waste activity of transportation. This occurred not once, but twice in a row due to inaccurate information provided and lacking communication in between surgeries. Consequently, the assistant nurse was required to retrieve and return the ultrasound twice instead of leaving the equipment inside the theatre after the first time. Afterwards, while speaking to this assistant nurse, she explained that it is easy to get it wrong when it is not included in Orbit, as the surgical staff depends on the information provided in Orbit when performing their duties prior to surgeries. Nevertheless, the request of an ultrasound prior to a surgery without any notification in Orbit occurred repeatedly throughout the observations, more precisely every eleventh surgery. Furthermore, in all conducted interviews with surgical nurses and assistant nurses, the interviewees confirmed that requests of supplementary items are almost never notified in Orbit, but only arises in conjunction with the surgeon’s arrival to the operating room.
Retrieving different sets of surgical instruments

Secondly, although not as often, surgeons also tend to request for an entirely different set of surgical instruments when changing the planned surgical procedure. As an example, 30% of all observed hysteroscopic resections were changed to hysteroscopic myomectomies by the surgeon. This change of surgical procedure required an entirely different set of surgical instruments, which the surgical staff were required to retrieve from the central equipment store. Another example of an even more common change of procedure is from a diagnostic hysteroscopy with bettocchi to a hysteroscopic resection. Consequently, this also causes the waste of transportation as the surgical staff are required to walk back and forth between the operating theatre and the central equipment store to gather a different set of surgical instruments. The changes of surgical procedure indicate that the provided information in Orbit is inaccurate and out-of-date, as the physician has failed to notify his or her choice of action. Based on the conducted survey, the score shown in Figure 10 below represents the overall assessment of the surgical staff when asked for the accuracy of the information provided in Orbit regarding the surgical procedure.

<table>
<thead>
<tr>
<th>Surgical procedure</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

Figure 10 – The accuracy of the information provided in Orbit regarding the surgical procedure, on a scale one to five, representing the lowest and the highest score respectively.

Retrieving local anesthesia

Thirdly, since there are no established standards regarding use of local anesthesia for certain surgical procedures, the choice of local anesthesia varies depending on different physician’s preferences for different surgeries. Furthermore, as this piece of information is not notified in Orbit, the provided information regarding choice of local anesthesia is considered to be highly incomplete to the degree that it is non-existing. Consequently, it is also considered to be out-of-date, as the surgeon has failed to update Orbit with his or her choice of local anesthesia. Thus, the it is requested by the physicians upon his or her arrival to the operating theatre. Although the choice of local anesthesia is often anticipated by the surgical staff and therefore gathered during the morning preparations, wrongful assumptions are often made. As a result, this requires the assistant nurse to once again walk back and forth to the central anesthesia store to retrieve a different local anesthesia.

Summary

Based on the analysis above, the waste of transportation in the outpatient surgery is in accordance to existing literature of transportation waste in healthcare as it describes the unnecessary movement of medical staff when, for instance, walking back and forth to a central equipment store to retrieve commonly used items.
During the interviews with surgical nurses and assistant nurses, a great concern regarding deviations from Orbit in terms of both surgical procedure and supplementary tools and equipment was expressed. In addition to the generated extra workload, the surgical staff found it hard to perform their professional duties on schedule due to constant changes, and were therefore often required to work overtime. Furthermore, the inconsistency of the use of local anesthesia and the incompleteness of the information provided also contributed to waste activities and generated extra workload, which was confirmed through both observations and interviews. As an assistant nurse expressed during one of the interviews:

“The more information that is noted in Orbit, the better we can prepare for surgery. This way, we can save time and provide a better patient care” - Assistant Nurse 3.

Thus, the quality of the information provided is believed to be of great importance, where the dimensions accuracy, timeliness and completeness are considered to be the main contributors to the waste of transportation.

4.2.2 Motion
As mentioned in the literature study, the waste type of motion refers to the unnecessary movement of people or equipment while performing a task, and is therefore very similar to the waste of transportation. Based on the empirical study, the waste of motion was caused by poor information quality across all dimensions except for accessibility, which later on emerged and became a consequence of the former lacking quality dimensions. There were mainly three forms of motion that occurred periodically throughout the observations: (1) searching for the surgeon, (2) searching for additional tools and equipment, (3) searching, collecting and assembling a new set of surgical instruments, and (4) searching for another surgical nurse.

**Searching for the surgeon**
First of all, the surgical staff were often required to search for the surgeon mainly due to two reasons. First, the information provided in Orbit regarding the surgical procedure was incomplete, hard to understand, partly irrelevant, and thereby also out-of-date. Among these, the quality dimension completeness was assessed by the surgical staff in the conducted survey, see Figure 11.

<table>
<thead>
<tr>
<th>Surgical procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completeness</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

*Figure 11 – The overall experienced completeness of the information provided in Orbit regarding the surgical procedure, on a scale one to five, which represents the lowest and the highest score respectively.*

For instance, a conization is traditionally performed either through loop diathermy or laser excisional. The choice of surgical method depends on the experience and preference of the
surgeon, which was not always taken into account when scheduling in Orbit. Consequently, although the patient was appointed for specifically a loop diathermy conization or a laser excisional conization, an additional comment was added in Orbit, saying loop diathermy or laser excisional, see Figure 12.

Thus, the information regarding the intended surgical procedure was incomplete, hard to understand, partly irrelevant, and out-of-date as it did not clarify which surgical method to proceed and provided excessive information by stating two alternative procedures. This was in turn caused by the surgeon’s failed attempt to update the information in Orbit with his or her surgical plans. Therefore, the surgical staff were required to search for the surgeon by finding his or her number and then making a call to retrieve information regarding which surgical method to prepare for.

Based on observations and several interviews with surgical staff, having to search for the surgeon was considered as time consuming and irritating. This was since it was not always easy to find the right number to the right surgeon among the printed lists of the phone numbers to the many different surgeons periodically attending at the outpatient surgery. Thus, as a consequence of the initially provided information being incomplete, hard to understand, partly irrelevant, and out-of-date, the accessibility of the required supplementary information regarding which surgical procedure to proceed was considered to be low.
Second, the surgical staff were also required to search for the surgeon due to lack of believability, which is based on their previous experiences of certain surgical procedures. As an example, based on the observations and interviews, the surgical staff did not rely on the information regarding surgical procedure for when a diagnostic hysteroscopy with bettocchi was appointed. This was because of the previous experience of the surgical staff which indicates that it is extremely rare to only perform a diagnostic hysteroscopy without performing a resection or myomectomy. Hence, an appointed diagnostic hysteroscopy with bettocchi is often changed to a hysteroscopic resection or myomectomy, which requires an entirely different set of surgical instruments and preparations. In fact, during the conducted observations, 42% of all diagnostic hysteroscopy with bettocchi were changed to either a resection or myomectomy. As an assistant nurse expressed during one of the interviews:

“Over time, one has learned that you cannot rely on the operation program” - Assistant Nurse 4.

This was in turn further confirmed by the conducted survey, where the surgical staff were asked to assess the overall believability of the information provided in Orbit, see Figure 13.

![Figure 13](image)

*Figure 13 – The overall believability of the information provided in Orbit, on a scale one to five, representing the lowest and highest score respectively.*

**Searching for additional tools and equipment**

Secondly, the surgical staff were required to search for additional tools and equipment in conjunction with the surgery due to information that was inaccurate, out-of-date, and incomplete. Referring to the first example of transportation waste, the poor quality of the provided information regarding supplementary tools and equipment also generates the waste of motion for when surgical staff were required to search for these items, in addition to retrieving them. For instance, based on the conducted observations and interviews, when requested for an ultrasound in conjunction with the surgery, the assistant nurse do not have instant knowledge of where to retrieve the equipment. Currently, there are two ultrasound equipment that are shared between six operating theatres. Although the use of an ultrasound might not be equally common in all six theatres, it is not entirely uncommon that the equipment is occupied elsewhere or left in another theatre as it is not reserved for the outpatient surgery. In some occasions, the location of the ultrasound might be notified on the operation schedule board in the hallway, but most of the time, the assistant nurse is required to search for the equipment around the department. Thus, as the surgeon has failed to update the information regarding supplementary tools and equipment in Orbit, it becomes inaccurate and incomplete as a consequence of being out-of-date.
Searching, collecting and assembling a new set of surgical instruments
Thirdly, the waste of motion also occurs as the surgical staff are required to search, collect and assemble a new set of surgical instruments due to poor quality of the dimensions accuracy and timeliness. This time, referring to the second example of transportation waste, a change of surgical procedure requires a change of surgical instruments. Each surgical procedure has its own set of surgical instruments which are, as mentioned earlier, organized and assembled the night before based on the following day’s surgeries. Since the information provided in Orbit also controls the preparations made the night before, the consequences of it being inaccurate and out-of-date are tremendous for the operating personnel the day after. Instead of only retrieving an already prepared set of surgical instruments, the surgical staff are now required to search, collect and assemble an entirely new set from scratch, thereby also causing the waste of motion.

Searching for another surgical nurse
Fourthly, the incompleteness and untimeliness of information regarding the choice of local anesthesia have also shown to generate the waste type motion. Once again referring to the section of transportation waste, but this time highlighting the third and last example, the retrieval of local anesthesia in conjunction with the surgery also causes the waste of motion. Although it is the assistant nurse’s duty to retrieve any necessities in conjunction with the surgery, she or he does not have access to the central anesthesia store and is therefore required to borrow an access card from a surgical nurse. However, the access card of the surgical nurse in the operating theatre is occupied as it is used to sign in into the operating room system (OR-system), where certain critical events are logged during every surgery. Consequently, when requested for a different type of local anesthesia in conjunction with a surgery, the assistant nurse is required to search for another surgical nurse at the ward who is currently not in surgery. Due to the general scarcity of surgical staff, the search for an available surgical nurse can be quite challenging and time consuming.

Summary
In accordance with previous research and based on the study observations and interviews, the waste of motion in the outpatient surgery mainly occurred as unnecessary movements due to search for people, tools and equipment. The excessive movements were caused by poor information quality across all dimensions, although lack of the dimensions accuracy, timeliness and completeness were more recurring. Consequently, these last mentioned dimensions were considered to be the major contributors to the waste type of motion.

4.2.3 Waiting
As presented in the literature study, waiting refers to the idle time of people or equipment. Based on the conducted empirical study, the waste of waiting in the outpatient surgery occurred in mainly two ways. First, when the OR-staff were required to wait for the assistant nurse to retrieve additional tools, equipment, or another local anesthesia, and second, when the surgical staff waited to reach the surgeon to confirm a surgical procedure before making any preparations. The former was caused by poor information quality of the dimensions accuracy,
timeliness, and completeness, while the latter was caused by the lack of all quality dimensions, except for accuracy.

**Waiting for additional tools, equipment, or another local anesthesia**

During the study observations, the waste of waiting in the operating theatre occurred while waiting for the assistant nurse to retrieve either additional tools and equipment, or another local anesthesia. As described in the first example of waste in transportation, and the second corresponding example of waste in motion, the unplanned retrieval and search for additional tools and equipment in conjunction to the surgery was caused by the inaccuracy, untimeliness, and incompleteness of the information provided. Based on the study observations, the act of waiting was significantly prolonged when the assistant nurse was not only required to retrieve the requested supplementary item, but was also required to search for it as it could not initially be found. Additionally, accordingly to interviews conducted with surgical staff, supplementary items such as ultrasounds could be occupied which resulted in further delays of the activities in the operating theatre. This was even more common just a couple of months ago when there was only one ultrasound equipment shared between the six operating theatres. Furthermore, once the equipment was retrieved, additional waste occurred while waiting for the equipment to start and be installed correctly. Based on the observations, the startup and installment of the ultrasound could alone take up to five minutes, which consequently caused an additional five minutes’ disruption of the activities in the operating theatre.

The overall consequence experienced by the surgical staff regarding waste generated due to changes occurring in additional tools and equipment, including transportation, motion, and waiting, was in turn assessed during the conducted survey, see Figure 14.

<table>
<thead>
<tr>
<th>Additional tools and equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consequence</td>
</tr>
<tr>
<td><img src="image" alt="Consequence Scale" /></td>
</tr>
</tbody>
</table>

*Figure 14 – The overall experienced consequence due to changes in additional tools and equipment in conjunction to surgery, on a scale one to five, which represents the lowest and the highest score respectively.*

As described in the third and fourth example of waste in transportation and motion respectively, the unplanned retrieval of local anesthesia and the following search for another surgical nurse were also caused by the lack of the dimensions accuracy, timeliness, and completeness of the information provided. Based on conducted interviews with surgical staff, the delay caused by the surgeon’s request for another local anesthesia in conjunction to the surgery becomes even greater in those occasions where an available surgical nurse cannot be found. According to one of the assistant nurses who has been working at the women’s ward at Danderyd’s University Hospital for a longer period of time:
“If you can’t find an available surgical nurse to borrow their access card from, you are required to take out and use the one inserted in the computer instead. This is very problematic as it takes a long time for the computer to log in again. That’s why we always try to find another available access card first” - Assistant Nurse 1.

Thus, the waste of waiting is prolonged once an available access card cannot be found and the assistant nurse is instead required to extract and use the one inserted into the OR-system to get access to the central anesthesia store.

Waiting to reach the surgeon
As described in the first example of the waste type motion, the surgical staff were often required to search for the surgeon. This was either because the information regarding the surgical procedure was incomplete, hard to understand, partly irrelevant, and out-of-date, or because the surgical staff simply did not believe the information provided in Orbit. Either way, the surgical preparations could not be made until further instructions were obtained from the surgeon, which consequently resulted in the waste of waiting. Based on the study observations and confirmations obtained from conducted interviews, the surgical staff also tend to wait for the surgeon to arrive to the operating theatre, instead of searching for him or her, as the information is considered to be hard to obtain. According to a surgical nurse during an interview:

“It takes time to find the right phone number to the specific surgeon among all the lists. Besides, most of the time the surgeon actually arrives to the operating theatre before I even had the chance to call him or her” - Surgical Nurse 3.

Hence, the low accessibility of information that the surgeon possesses is considered to be a direct contributing factor to the waste type of waiting.

Summary
Based on the analysis above, the waste of waiting in the outpatient surgery is mainly constituted by the idle time of surgical staff, either while waiting for additional tools, equipment, another local anesthesia, or reaching the surgeon. These are in turn caused by poor information quality across all dimensions. The responsibilities and duties of the surgical staff include all activities performed in the operating theatre in conjunction with surgery. Hence, the idle time of surgical staff have major implications on the overall process performance in the outpatient surgery, where patients might need to be sent home and rescheduled for surgery due to delays in performing activities.

4.2.4 Overproduction
In healthcare, based on the literature review, overproduction refers to the unnecessary and excessive request of tests, as well as the reservation of examination rooms and extra beds “just in case”. Based on the conducted empirical study, the waste of production in the outpatient surgery mainly occurred as the surgical staff retrieved and stored multiple local anesthesia in the operating theatre, and also as they prepared for more than one possible surgical procedure. The former was caused by poor information quality of the dimensions timeliness, completeness,
and accessibility, while the latter was caused by lack of the quality dimensions timeliness, completeness, ease of understanding, relevancy, accessibility and believability.

**Retrieving and storing multiple local anesthesia**

As mentioned before, the assistant nurse is often required to run back and forth the hallway to retrieve different local anesthesia from the central anesthesia store when requested in conjunction to surgery. Additionally, the assistant nurse is required to search for an available access card, and when it is not found, the access card inserted into the OR-system is instead extracted and used for gaining access to the local anesthesia store. Consequently, as described in the analyses above, the request of a different local anesthesia in conjunction to surgery have the potential of causing waste in terms of transportation, motion, and waiting. Thus, to avoid these consequences, the surgical nurse often tends to retrieve multiple local anesthesia from the central anesthesia store in the morning, and store these in the operating theatre over the day. However, since an excess of local anesthesia is retrieved, most of these are not used but only stored “just in case”, thereby resulting in an overproduction. During the interviews, when asked upon the standard morning routines before surgery, following statements were made:

> “I usually lay out a buffet of local anesthesia for the surgeon to choose from” - Surgical Nurse 2.

> “I usually gather a couple of each sort of local anesthesia in the morning and store these in the operating theatre during the day” - Surgical Nurse 4.

> “The surgical nurse normally gathers a bunch of different local anesthesia in the morning just in case so I do not have to run back and forth and search for another surgical nurse to get more” - Assistant Nurse 4.

> “The surgical nurse often gets a bunch of different local anesthesia and stores these in the operating theatre during the day” - Assistant Nurse 1.

Based on conducted observations and interviews, the overproduction in terms of retrieving and storing an excessive amount of local anesthesia in the operating theatre were caused by the incompleteness, untimeliness, and inaccessibility of information. The incompleteness and untimeliness refers to the fact that the choice of local anesthesia is not clarified or updated in the information provided to the surgical staff, which in turn controls the activities performed in the operating theatre. The inaccessibility, on the other hand, refers to the action required to retrieve the necessary information from the surgeon, which is to find his or her phone number in the printed lists and make a phone call to receive further instructions.

**Preparing for more than one possible surgical procedure**

In addition to retrieving and storing multiple local anesthesia, the surgical staff also overproduces by sometimes prepare for more than one possible procedure. Based on the study observations, this usually occurs in conjunction with conization or hysteroscopy surgery. As mentioned in the first part of the first example of motion waste, the information regarding which
specific surgical method to proceed, whether a loop diathermy or laser excisional is to be performed, does not appear when scheduled for a conization surgery. Hence, in those occasions, the information provided in Orbit regarding the specific surgical procedure is considered to be incomplete, hard to understand, partly irrelevant, and out-of-date. To confirm which surgical procedure to prepare for, the surgical staff are required to either search for the surgeon, or wait until he or she arrives to the operating theatre to obtain further instructions. Either way, the former does not only have a low accessibility, but also causes the waste of motion, while the latter does not require any further actions but causes the waste of waiting. Consequently, with the aim of streamlining the process of the outpatient surgery, the surgical staff sometimes tend to prepare for both loop diathermy and laser excisional, although only one surgical procedure is to be performed. This was confirmed through both observations and interviews. The conversation below occurred in between two subsequent conization surgeries and demonstrates an example of the overproduction in the outpatient surgery:

Assistant Nurse: “Should we take out the diathermy machine?”
Surgical Nurse: “No just let it stay, you’ll never know if they’ll want it or not”

In similarity, overproduction also occurs in conjunction to hysteroscopy surgeries. However, this was instead caused by the lack of accessibility and believability. Referring to the second part of the same example of motion waste, the previous experiences of the surgical staff implies that a scheduled diagnostic hysteroscopy with bettocchi is often changed to a hysteroscopic resection. Due to the low accessibility of obtaining supplementary information from the surgeon, the low believability of the information provided in Orbit, and the aim of streamlining the process of the outpatient surgery, the surgical staff tend to prepare for both presumed procedures of hysteroscopy.

**Summary**

The analysis of waste in terms of overproduction in the outpatient surgery indicates that overproduction mainly occurs as the surgical staff aims to avoid other waste activities, such as transportation, motion and waiting. Furthermore, all three sources of overproduction, being (1) completeness, timeliness, and accessibility, (2) completeness, ease of understanding, relevancy, timeliness and accessibility, and (3) believability and accessibility, have the lacking quality dimension accessibility in common. Thus, not only is the primary source of information lacking, but in addition to this, the secondary source of information, being the surgeon, has low accessibility and cannot currently be reached without causing the waste of motion.

**4.2.5 Overprocessing**

As described in the literature review, overprocessing in healthcare refers to the unnecessary repetition of an action, such as repeatedly recounting instruments or requesting for patients’ details. In addition, it might also cause further waste in terms of excessive motion or defects. The waste of overprocessing in the outpatient surgery mainly occurred as the surgical staff repeatedly asked for supplementary information from the surgeon. This in turn was mainly caused by poor information quality across the dimensions timeliness, completeness, ease of understanding, relevancy, and believability.
Repeatedly asking for supplementary information from the surgeon
As mentioned in the first example of motion, there are mainly two reasons for why the surgical staff searches for the surgeon. First, due to the lack of completeness, ease of understanding, relevancy, and timeliness of the information provided, as when the surgical procedure is not clarified or updated in Orbit. Second, due to the lack of believability, as when a specific surgery is scheduled in Orbit for which the surgical staff have experience of being changed right before it is intended to be performed. Although the information regarding which surgical procedure to perform is somewhat provided in both examples, the poor quality of information causes the surgical staff to repeatedly ask for supplementary and clarifying information from the surgeon.

As a surgical nurse expressed during an interview regarding the quality of the information provided in Orbit:

“*I get insecure when a surgery that we normally do not perform is scheduled, such as a diagnostic hysteroscopy with betocchi. When that happens, it is better to call and ask just to be sure*” - Surgical Nurse 3.

Summary
Based on the conducted observations and in accordance to previous research, the overprocessing in the outpatient surgery also generates additional waste in terms of excessive motion. This is due to that the surgical staff are required to search for the surgeon to obtain supplementary and clarifying information.

4.2.6 Defects
*Defects* in healthcare, as presented in the literature review, refer to all mistakes and errors that occurs in conjunction to the care of patients, and do also have the tendency of causing other additional waste activities, such as rework and replacement as mentioned in a manufacturing context. In the outpatient surgery, there were mainly two errors that occurred rather frequently. First, the surgical staff prepared for the wrong surgical procedure, and second, the surgical staff also prepared the wrong local anesthesia. The former was caused by poor information quality of the dimensions accuracy, timeliness, completeness, ease of understanding, and relevancy, while the latter was caused by the lack of completeness and timeliness.

Preparing for the wrong surgical procedure
During the study observations, surgeries were prepared wrongfully due to information being inaccurate, out-of-date, incomplete, hard to understand, and partly irrelevant. These errors mainly occurred in conjunction to two specific surgeries, namely conizations and hysteroscopies. Firstly, the errors occurring in conjunction to conizations were mainly associated with poor information quality of the dimensions completeness, ease of understanding, and relevancy. For instance, based on conducted observations, a patient could be scheduled for a loop diathermy, but then after all the surgical preparations were made, be rearranged to a laser excisional instead. Although a minor comment is added in Orbit, saying loop diathermy or laser excisional, this piece of information is often neglected in two ways. The surgical staff either oversees this piece of additional information as other excessive and
irrelevant information also might be added in the same comment field, or assumes that this comment that is provided by the prescribing physician has already been noted and taken into account before the day of the surgery by the operating surgeon. Either way, the surgical preparations are based on the incomplete, hard to understand, and partly irrelevant information provided in Orbit, which in turn often leads to defects.

Secondly, the errors occurring in conjunction to hysteroscopies are in turn caused by the inaccuracy and untimeliness of information, as the surgeon has failed to update the information in Orbit regarding his or her choice of surgical procedure. During the observations, this became clear when changes from a hysteroscopic resection to a hysteroscopic myomectomy, or from a diagnostic hysteroscopy with bettocchi to a hysteroscopic resection were made by the surgeon upon his or her arrival to the operating theatre. Consequently, defects occur when the surgical staff relies on the inaccurate and untimely information provided in Orbit when preparing for surgery. By wrongfully preparing for a surgery, regardless if it is a conization or hysteroscopy, not only are all the preparatory activities performed pure waste, but the surgical staff are also required to undo the preparations made and redo them all over again for another surgical procedure. Furthermore, some tools are disposable items and cannot therefore be repacked, but are instead discarded without being used. During the interviews, when asked upon the occurring changes of surgical procedures, following statements were obtained:

“It is very problematic when the scheduled surgeries in Orbit are not correct. The preparations of surgeries in terms of tools, equipment, and also the patient can differ greatly between different surgical procedures. A change of surgical procedure after the preparations are already made, can therefore mean a lot of extra work where we sometimes have to redo everything again. It might even cause that we don’t manage to finish all the scheduled surgeries of the day, even though we work overtime” - Surgical Nurse 2.

“It causes a lot of extra work and irritation that you just can’t get clear instructions right from the beginning” - Surgical Nurse 5.

“This means that the surgical staff are required to redo all the preparations again. It becomes a stressor for everyone involved” - Surgical Nurse 1.

While another surgical nurse also expressed her concern regarding the unnecessary discard of unused disposable items:

“The fact that the information provided in Orbit is not correct does not only mean extra work and longer preparation time, but also more unnecessary costs in terms of wasted resources” - Surgical Nurse 4.

When asked for assessing the overall experienced consequence of all waste activities caused by changes occurring in the planned surgical procedure, the following score was obtained from the surgical staff, see Figure 15.
Preparing the wrong local anesthesia
Defects also occur when local anesthesia is wrongfully prepared, which is caused by poor information quality of the dimensions completeness and timeliness. During the study observations, the surgical nurses based their choice of local anesthesia on their previous experiences of the specific surgery and surgeon, as it may differ depending on both factors. However, due to the large staff and rotating schedules at the women’s ward, where both surgeons and surgical staff rotate between different posts each day, it becomes quite challenging for the surgical nurses to keep track of the surgeon's different preferences of local anesthesia. As a result, based on this and the incompleteness and untimeliness of the information provided in Orbit to the extent that it is non-existent regarding the surgeon’s different preferences of local anesthesia, wrongful preparations of local anesthesia are sometimes made. Consequently, when requested for another local anesthesia by the surgeon in conjunction to the surgery, the surgical nurse was required to discard the already prepared syringe and redo the preparations for another local anesthesia.

Summary
Based on the empirical evidence, the defects occurring at the outpatient surgery are when preparing for the wrong surgical procedure or the wrong local anesthesia. Both defects generate additional waste in terms of transportation, motion, and overprocessing as rework is required. Furthermore, the defect of wrongfully preparing a local anesthesia also caused the additional waste of waiting when the other requested medical substance could not be found in the operating theatre, and the assistant nurse were required to retrieve it. Nevertheless, the additional waste activities caused by the defect of wrongfully preparing for a surgical procedure were far more extensive and damaging. This was because it required redirection of both tools, equipment, and also possibly local anesthesia and the patient depending on the change of surgical procedure. Consequently, a great concern regarding these defects were expressed during the conducted interviews, as the surgical staff believed that this increased stress and the risk of making further mistakes which might decrease the quality of patient care:

“All correct preparations lead to a better patient care” - Assistant Nurse 3.

In accordance to previous research of waste in healthcare, defects in the outpatient surgery occurred in terms of repeated actions as a consequence of incorrect or inadequate information provided. Hence, the identified lacking quality dimensions were accuracy, timeliness, completeness, ease of understanding, and relevancy.
4.2.7 Summary
Based on the analyses presented above, six types of waste were identified and generated due to combinations of poor information quality across all dimensions. The waste types generated by the contribution of each quality dimension are in turn presented in Table 6 below.

Table 6 - The contribution of each information quality dimension for the different types of generated waste.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Generated waste types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>Transportation, motion, waiting, and defects.</td>
</tr>
<tr>
<td>Timeliness</td>
<td>Transportation, motion, waiting, overproduction, overprocessing, and defects.</td>
</tr>
<tr>
<td>Completeness</td>
<td>Transportation, motion, waiting, overproduction, overprocessing, and defects.</td>
</tr>
<tr>
<td>Ease of understanding</td>
<td>Motion, waiting, overproduction, overprocessing, and defects.</td>
</tr>
<tr>
<td>Relevancy</td>
<td>Motion, waiting, overproduction, overprocessing, and defects.</td>
</tr>
<tr>
<td>Accessibility</td>
<td>Waiting and overproduction.</td>
</tr>
<tr>
<td>Believability</td>
<td>Motion, overproduction, and overprocessing.</td>
</tr>
</tbody>
</table>

4.3 Factors influencing Information Quality
The conducted observations and interviews indicated two major factors influencing the information quality in the outpatient surgery, causing the waste activities. First, the operating surgeon’s preferences, which determines the work inside the operating theatre, did not appear in the information provided to the surgical staff through Orbit. Second, interconnections between the different dimensions of information quality were found to influence each other, where lacking quality in one dimension caused a decrease of quality in another dimension. Hence, this section presents the empirical findings and analysis of these two major influencing factors on the quality of information, thereby answering the second research question: Which factors influence the information quality in the outpatient surgery?

4.3.1 The Different Preferences of Surgeons
The work in healthcare is, as mentioned in the literature review, characterized by the uniqueness of each patient and the need of human involvement. The patients are different and the medical assessments and treatments are complex, and therefore depending on the knowledge and experience of the staff. However, it was noticed during the conducted observations and interviews that every surgeon possessed dissimilar preferences based on three reasons: (1) knowledge, (2) experiences and (3) interests and therefore chose different surgical methods, tools, equipment and local anesthesia. This in turn contributes to the complex and dynamic environment of outpatient surgeries. During an interview, as the interviewee was asked about
what information was needed to perform the dedicated task in the operating theatre, the surgical nurse answered:

“To prepare the operating theatre correctly, I need to know which surgeon that I will be working with since all surgeons have different preferences.” - Surgical Nurse 5.

Similar statements, where the interviewees expressed that the work inside the operating theatre was entirely depending on the preferences of the surgeon, were found in all interviews with the surgical staff.

The varying knowledge and experiences of the surgeons were shown to be a crucial determinant for the choices made by the surgeons. As mentioned in the section Implications of Information Quality, there were several occasions where the surgeon for instance requested an ultrasound when arriving to the operating theatre. The interviews and discussions during the observations with the surgeons suggested that this request was done based on two reasons. Firstly, if the surgeon considered that the condition of the patient required this equipment or secondly, due to the experience of the surgeon. According to one of the interviewed surgeons and several of the surgical staff, ultrasounds are often used by surgeons that do not posses experience in performing a certain kind of surgical procedure, where the ultrasound is used to ensure a successful surgery. Another occasion where knowledge and experience influenced the choices made by the surgeon was when a patient was appointed for a loop diathermy conization, which right before the surgery, was changed to a laser excisional conization, and vice versa. The interviews suggested that a surgeon who is experienced and highly skilled in performing one or the other preferred continuing using the same surgical procedure that he or she was comfortable with and knew to be successful. This was also applied for when a surgeon was asked about the choice of local anesthesia:

“The anesthesia that I normally use works fine for me so why should I change something that I know works?” - Surgeon 5.

Furthermore, the choices made by the surgeons were not only based on the knowledge and experiences, but also on interests. In a discussion during one of the observations, a surgeon expressed the need of using different surgical procedures and equipment for practice. In other more complicated surgeries, more advanced equipment is required, and for these surgeries, it is vital to have practiced and developed the skills for when truly needed. Another surgeon also mentioned that a change is occurring due to the ongoing technical development, where the surgeons are in great need of practicing to master these new methods. An example of this was seen during the observations when a surgeon changed the surgical method to hysteroscopic myomectomy from a hysteroscopic resection to practice on the former mentioned surgical procedure.

Based on the conducted empirical study, the surgical routines at the department required the surgical staff to be well aware of the preferences of the surgeons to perform their tasks in the best possible way. Many members of the surgical staff who had worked at the women’s
department with the same surgeons for a longer period of time mentioned that, due to their experiences, they have developed knowledge regarding the various preferences of the different surgeons. Consequently, they knew how to prepare the operating theatre based on who the operating surgeon was. However, they also mentioned the difficulties in being newly employed and not being aware of the surgeons’ different preferences. It was also stated that these issues did not only appear when someone in the surgical staff was newly employed, but could also occur for more experienced surgical staff:

“The surgeons want it in different ways and if you haven’t worked with a specific surgeon for a while, there is a risk that you forget what they normally use. It is therefore important that it is written down.” - Surgical Nurse 4.

Another member of the surgical staff also expressed the difficulties when a new surgeon is employed. Even if the surgical staff have great experiences of working at this department, their lacking experience of working with that specific new surgeon makes it difficult to perform their professional duties.

Thus, the observations and interviews clearly showed that the experiences, knowledge, and interests, i.e. the surgeon’s preferences, vary between different surgeons and was the parameter determining the work performed inside the operating theatre. As mentioned in the literature review, a characteristic of an outpatient surgery is that a patient prescribed to the outpatient surgery is often assessed and scheduled by another physician than the one performing the surgery. Consequently, the physician who scheduled and the physician who performed the surgery did not always have the same preferences. However, the information provided to the surgical staff was rarely updated in accordance with the preferences of the physician performing the surgery, which resulted in an overall decreased quality of the information provided in Orbit.

4.3.2 Interconnections Between the Information Quality Dimensions
The day before surgery, a surgical planning meeting is held which is intended for the OR-staff to review tomorrow's schedule together and make changes if needed. However, the surgeons for the outpatient surgery rarely attended to these meetings. During the interviews, the surgeons expressed that they did not have time scheduled to attend to this meeting and had no other opportunity to plan and possibly change the surgical plans before the day of surgery either. Accordingly, the majority of surgeons arrived to the operating theatre the same morning and, not until then, provided information to the surgical staff regarding changes in surgical procedure or additional information regarding local anesthesia, tools and equipment. Consequently, a poor quality of the dimension timeliness was obtained for the information provided in Orbit. This was not only mentioned by the surgeons when asked about their daily routines in the outpatient surgery, but also by many members of the surgical staff:

“Many surgeons read about the patients the same morning, which can make them change things that they think suits better” - Surgical Nurse 1.
However, some surgeons worked overtime to plan and thereby had the ability to add and change information in Orbit the day before surgery. In these occasions, the information quality was considerably improved, resulting in a better operating flow and process performance with reduced number of waste activities.

As illustrated in the example above and in several other examples in the section *Implications of Information Quality*, the different information quality dimensions seem to be interrelated to each other. In the above example, the surgeon’s update of the information provided in Orbit led to an overall enhanced information quality, as it was in accordance to his or her surgical preferences. As well as an improved quality dimensions can lead to an increased quality of other dimensions, the opposite is also true, when lacking information quality in one dimension can cause an overall poor information quality across other dimensions. The latter mentioned situation can be found on those examples where the poor quality of information has generated waste activities in the outpatient surgery. Here, the common denominator was found to be the lack of timeliness, which was the main contributor to all identified waste activities. The interrelations between the different information quality dimensions are illustrated in Figure 16.

![Figure 16 – The interconnection between the different dimensions of information quality.](image)

First of all, the surgical staff found it hard to believe the information provided in Orbit, as it often had showed to be inaccurate. The inaccuracy of information was in turn caused by its untimeliness, as the surgeon who determines the activities performed in the operating theatre had failed to update the information in Orbit with his or her surgical plans. This often occurred when the surgeon decided to change the appointed surgical procedure in conjunction to the scheduled start, as he or she did not agree upon the initial plan. Furthermore, the incompleteness of critical information in combination with the inclusion of irrelevant information, also made it hard to understand. For instance, when the specific surgical procedure to perform was not clarified in Orbit in conjunction to conizations, where both loop diathermy and laser excisional
was presented as possible options. In similarity to the cause of inaccuracy, the lack of the dimensions completeness and relevancy, thereby also ease of understanding, were likewise considered to be caused by the untimeliness of the information provided in Orbit. As previously mentioned, this was due to the surgeon’s failed attempt to update and clarify the information with his or her intended surgical plans. Lastly, when the surgical staff attempted to retrieve supplementary information from the surgeon for when they not believe or understand the provided information, a low accessibility was experienced. However, this would not have been necessary if the information provided in Orbit were timely to begin with.

4.3.3 Summary
The physicians have different experiences, knowledge and interests. This implies that the surgeons have different preferences regarding the use of surgical procedure, equipment, tools and local anesthesia. Therefore, the physician who assessed and prescribed the surgery often had different opinions and preferences in comparison to the physician performing the surgery. However, since the information provided to the surgical staff through Orbit was rarely updated accordingly to the preferences of the operating surgeon, the overall quality of information became poor. Furthermore, the interrelations among the different quality dimensions have also been found to influence the overall quality of the information provided in Orbit. Here, the lacking quality in timeliness in specific has been found to cause a poor information quality across all other dimensions. Consequently, the dimension timeliness has been identified as the common denominator for the overall experienced poor information quality, and thereby also the generated waste activities, at the outpatient surgery.
5. Conclusions

The following chapter presents the conclusions of this study, which are based on the two research questions RQ1 and RQ2. By answering the two research questions, the purpose of this study is achieved, which also is presented below together with the conclusions for each research question.

**RQ1: What are the implications of information quality on waste in the outpatient surgery?**

Based on the empirical findings and conducted analysis, poor information quality has been identified across all analyzed dimensions. These have, in different combinations, been found to generate waste activities in terms of transportation, motion, waiting, overproduction, overprocessing, and defects. First of all, the waste of transportation was caused by different combinations of the information quality dimensions accuracy, timeliness, and completeness. These in turn caused transportation in terms of retrieving additional tools and equipment, retrieving different sets of surgical instruments, and retrieving local anesthesia, respectively.

Secondly, combinations of all dimensions except for accessibility were found to generate the waste of motion. This occurred in terms of searching for the surgeon, addition tools and equipment, or for another surgical nurse, and also when searching, collecting and assembling a new set of surgical instruments. Thirdly, the waste of waiting was caused by combinations of poor information quality across all dimensions, as the OR-staff were required to wait for either additional tools, equipment, another local anesthesia, or the surgeon. Fourthly, overproduction occurred due to poor information quality among all dimensions except for accuracy, as when the surgical staff were required to retrieve and store multiple local anesthesia in the operating theatre, or prepare for more than one possible surgical procedure. Fifthly, lacking quality of the dimensions timeliness, completeness, ease of understanding, relevancy, and believability caused the waste of overprocessing in terms of repeatedly asking for supplementary information from the surgeon. Lastly, defects occurred in the outpatient surgery as a result of two combinations of poor information quality across the dimensions accuracy, timeliness, completeness, ease of understanding, and relevancy. The identified defects were in terms of preparing for the wrong surgical procedure, or the wrong local anesthesia.

**RQ2: Which factors influence the information quality in the outpatient surgery?**

There were mainly two factors identified to influence the information quality in the outpatient surgery. First, physicians have varying experience, knowledge, and interests which results in varying preferences regarding the use of different surgical procedures, tools, equipment, and local anesthesia. However, the surgical planning did not take these varying preferences of different operating surgeons into account. Consequently, the overall quality of the information provided to the surgical staff, which in turn controlled the work performed in the operating theatre, was decreased. Second, the interconnections amongst different dimensions of information quality influenced each other, resulting in a decreased quality of one dimension caused a decreased quality of another dimension. Ultimately, the lacking dimension timeliness
was found to be the main cause for the overall poor quality of the information provided in Orbit. This was in turn a result of the surgical planning not being updated accordingly to the operating surgeon’s preferences, which determines the activities performed in the operating theatre. Based on the empirical findings and conducted analysis, the lack of timeliness in the outpatient surgery led to information being inaccurate, incomplete, and irrelevant. While the inaccuracy of information caused the lack of its believability, the incompleteness and irrelevancy made it hard to understand. Lastly, these lacking quality dimensions resulting in a low accessibility of the information required to perform necessary activities in the operating theatre.

**Purpose:** The purpose of this study is to investigate how the process performance of outpatient surgeries can be improved by managing information quality.

The process performance of outpatient surgeries can be improved by enhancing the quality of the information which controls the work inside the operating theatre. Based on answers from RQ1 and RQ2, the process performance of the outpatient surgery at the women’s ward at Danderyd’s University Hospital can be improved by enhancing the quality of the dimension timeliness. This is in turn achieved by enabling the operating surgeons to update the information provided in Orbit with the intended surgical plans, including surgical procedure, additional tools and equipment, and choice of local anesthesia accordingly to their personal preferences.
6. Discussion

This chapter presents the discussion of this study. Firstly, the discussion of the findings is presented, where the findings for each research question, as well as the reflections on sustainability are discussed separately. Secondly, the study contributions are presented, including both conceptual and empirical contributions. Lastly, the limitations of this study together with recommendations on potential future work are presented.

6.1 Discussion of the Findings

The purpose of this study was to investigate how the process performance of outpatient surgeries can be improved by managing information quality. Thus, the aim was to identify improvement areas within information quality which control the process performance of the outpatient surgery. As mentioned in the introduction of this report, organizations are facing challenges in maintaining high information quality. The quality of information has in turn been found to have major implications on process performance. Thus, it is considered to be of great importance to investigate and increase knowledge about factors influencing information quality and how it affects the process performance of outpatient surgeries. Furthermore, only a few previous studies have investigated the correlations, and to the best of our knowledge, none in the context of outpatient surgery has been conducted. The findings from this study could be used as a basis of improving outpatient surgeries which is considered to be vital with the increasing demand of these types of surgeries.

6.1.1 Discussion of RQ1

From the analysis of the first research question it was concluded that poor information quality had a tremendous impact on waste activities and thereby also process performance. Furthermore, combinations of different information quality dimensions that contributed to different waste activities in the outpatient surgery were also found. Many of these correlations could also be found in the study presented in the literature review by Jylhä and Suvanto (2015), investigating the influence of poor information quality on the service processes in facility management. For instance, the inaccessibility, incompleteness and irrelevancy of the information provided to the employees in the cross-case analysis caused waste in terms of motion, as employees were required to spend time searching for necessary information, thereby creating unnecessary staff movement. Additionally, the lack of reliability also urged the employees to search for the original source of information, since the necessary information was not only hard to understand, but also out-of-date and thereby inaccurate as it was not delivered on time.

In the outpatient surgery, the surgical staff were required to search for the surgeon to obtain clarifying and supplementary information. This was in turn caused by poor information quality across the dimensions; completeness, ease of understanding, relevancy, timeliness, and believability, which were all confirmed by the study conducted by Jylhä and Suvanto (2015). Furthermore, the lack of accessibility was also found in the outpatient surgery while the surgical staff were searching for the surgeon. However, this was believed to be an indirect cause, as it would not have been caused if the initially provided information had a high information quality.
across the other previously mentioned dimensions. Lastly, in both studies, the waste of motion also generated waste in terms of waiting, as delays were caused due to the excessive movements, and also overprocessing, as individuals repeatedly requested for additional information.

Another correlation between poor information quality and waste presented by Jylhää and Suvanto (2015) was the creation of defects, and thereby also additional waste such as overprocessing, due to the lack of the dimensions; completeness and timeliness. This specific correlation was in turn also found in the outpatient surgery, which caused the defect of preparing the wrong local anesthesia. Conclusively, many similarities could be found between the two study findings, despite the great differences in the study contexts. This indicates that there is a possibility of that the correlations identified in this thesis between information quality and waste might not only be specific for the context of outpatient surgeries but in other contexts as well. Nevertheless, this needs to be further investigated before it could be stated since the external validity is not considered to be high due to the nature of a single case study.

One aspect that is important to take into account regarding the study findings of this thesis and also other similar researches is that the perception of poor information quality and waste is subjective. Meaning, one activity that is considered to be waste in one study, might not be agreed upon in another study. This implies that there might be significantly more or less correlations that have or have not been identified, as it was either not noticed or agreed upon during the empirical data gathering. Consequently, attempts of enhancing the internal validity of the study through comparative analyses might not be solid either, due to the highly qualitative nature of the study findings.

In addition to this, the low external validity, in other words the generalizability of the study, had certain significances to the conclusions of the first research question. Several different correlations between poor information quality dimensions and generated waste activities were identified during the empirical data gathering at the outpatient surgery. However, there might be additional correlations which were not identified in this study. Meaning that, since this was a single case study, there is a possibility that other correlations occur in conjunction to other gynecological outpatient surgeries that did not occur at the case company. For instance, this study found that lacking information quality across all dimensions except accessibility contributed to the waste activity motion. However, this does not suggest that low accessibility does not contribute to the waste of motion in outpatient surgeries, but only that it was not found as a contributing dimensions for motion in the outpatient surgery at the women’s ward at Danderyd’s University Hospital. Furthermore, all types of waste except for inventory was found at the outpatient surgery. This was as previously mentioned due to the delimitation of the study from the events outside of, and not in connection to, the surgical theatre. With that being said, this study does not exclude the possibility of that poor information quality could be a contributing factor to inventory waste, as it was not investigated in this study.
6.1.2 Discussion of RQ2

The conclusions based on the analysis of the second research question implies that surgeries that were not planned and scheduled accordingly to the operating surgeon’s preferences, were the underlying reason to the experienced poor information quality at the outpatient surgery. The study does not analyze whether the varying preferences of surgeons are positive or negative, but rather accepts and notes their existence and that the information provided to the surgical staff were not updated accordingly. As the information provided in Orbit controls the work inside the operating theatre, this contributed to the overall poor information quality. However, the findings could be seen from two perspectives. First, that the surgeons need and should be able to have different preferences and that there is an issue in how the planning and scheduling is managed. Second, that the information should not be required to be updated according to the surgeons’ preferences, and that it was the non-standardized working habit that was the underlying reason for the overall poor information quality at the outpatient surgery. Nevertheless, this study focused on the current way of working, meaning that different surgeons have different preferences, and did therefore not question their way of performing surgery as this was outside the study scope.

Another conclusion from the analysis of the second research question was the interrelations between different dimensions of information quality. As discussed in the section above, the low external validity implies that there might be other correlations between information quality dimensions and waste in outpatient surgeries than those found in this single-case study. The same argument also applies for the findings from the second research question regarding the interrelations between the different dimensions of information quality. The study does therefore not suggest that the identified interrelations between different quality dimensions are the same in all outpatient surgeries, or that other interrelations do not appear. The findings only establish the interrelations of quality dimensions occurring at the investigated outpatient surgery for this study. Thus, this is required to be further investigated in other case studies to establish the external validity.

Lastly, the vague definition of the different information quality dimensions together with the complex setting of outpatient surgeries could also have had an impact on the construct validity of the empirical findings. For instance, the extent for which a piece of information can be considered as accurate and up-to-date could be argued, where the answer is not always obvious. As an example, if the surgeon remembers to request for an ultrasound in conjunction to a surgery, is the information provided in Orbit regarding additional tools and equipment considered to be inaccurate and out-of-date, given that no supplementary items have been notified? In this study, we argue that this in fact does imply that the information provided in Orbit is inaccurate and out-of-date, as it could have been foreseen during the planning phase of the surgery. On the other hand, some might argue that the last minute request for an ultrasound is a consequence of the high human involvement in healthcare. Thus, it should not imply that the information provided in Orbit is either inaccurate or out-of-date, as it during the planning phase might as well have been the chosen course of action which later on was decided to be changed.
As the conducted observations and interviews proves that the surgeons did not have time to plan their own outpatient surgeries in advance, the study interpretation of inaccuracy and untimeliness seems more likely. Even though the lack of quality dimensions might in some cases indeed be caused by human factors, such as forgetfulness, these are not further analyzed in this study. Consequently, the construct validity of the empirical findings could be criticized, as it did not take any human factors into account when analyzing the different information quality dimensions, which is one of the major characteristics of healthcare. Instead, the verdict of each quality dimension was only based on whether or not the lack of information could have been foreseen in advance, and did therefore not make any assessment of whether or not it should have been foreseen in advance.

6.1.3 Reflections on Sustainability

The findings do not only enable a possibility of improvement of the process performance, but also have an impact on sustainability. The findings are, in this section, discussed in relation to the three pillars of sustainability, namely, ecological, economical and social.

During the observations, the surgical staff were occasionally required to throw unused disposables items and local anesthesia due to wrongful preparations. This defect was, as mentioned in the analysis, a result of poor information quality and occurred during several occasions. From an ecological perspective, throwing unused disposable items is not considered to be sustainable. Furthermore, the wastage is not only unsustainable seen from an ecological perspective, but also from an economical perspective. The equipment in healthcare is expensive and throwing unutilized disposables and local anesthesia is not economically sustainable either. Identifying the contributing factors to the poor information quality enables the possibility to improve the quality of the information causing the wastage and thereby improving the sustainability of healthcare from both an ecological and economical perspective. Reducing waste activities could imply time savings for the OR-staff since time spent on surgical preparations would be reduced. The surgical staff would not have to redo the preparations for surgery when the surgical procedure is changed or walk to the central equipment storage for retrieving additional tools and equipment on multiple occasions. The time savings create the possibility of a larger amount of outpatient surgeries performed each day as it enables the OR-staff to streamline their work, which could be an economical advantage for the hospital. However, the magnitude of the economical advantages has not been analyzed in this study, as it was considered to be outside its scope.

The number one priority in healthcare is to provide a safe patient care of high quality and thus, social sustainability is a crucial aspect. Some members in the surgical staff mentioned a larger risk of error if the information was not written down. Thus, improving information quality could contribute to a safer patient care, contributing to a sustainable healthcare from a social perspective. Furthermore, a major issue in healthcare is the shortage of staff. It is therefore vital to maintain a pleasant working environment to keep the personnel at the hospital and reduces the risk of them getting burned out which also could be considered as waste of highly skilled and valuable personnel. In the discussions during the observations and interviews, employees expressed that the poor information quality, and the waste that followed, contributed to
frustration and a stressful working environment. Thus, identifying the contributing factors of the waste activities could help improving the working environment for the OR-staff. The findings are therefore considered to be sustainable from all three perspectives.

6.2 Contributions
This section presents the contributions of this study. It is commenced with a description of the conceptual contributions, followed by the empirical contributions.

6.2.1 Conceptual Contribution
Three main conceptual contributions were identified for this study, namely knowledge regarding (1) the dimensions of information quality (2) waste in the context of healthcare and (3) correlations between information quality and waste. Firstly, the literature review presented previous research on which dimensions of information quality that seemed vital in different context of healthcare. These were compared and seven dimensions of information quality were chosen for analyzing the impact of information quality on the process performance of the outpatient surgery. The empirical data gathered in the study indicated poor information quality in all dimensions which contributed to waste activities. Hence, this study confirmed previous research of the importance of investigating these seven dimensions in outpatient surgery; accuracy, timeliness, completeness, ease of understanding, relevancy, accessibility and believability. This in turn contributed to research by getting closer to an agreement of which dimensions of information quality that are suitable for assessing the quality of information in healthcare and in the context of outpatient surgery.

Secondly, the lean philosophy is often associated with manufacturing, but adoption in healthcare has rapidly increased over the last decade. The healthcare industry has different characteristics than manufacturing, and studies have translated the seven waste to fit the context of healthcare. These waste activities, and examples described in previous research, were also found in this study and thereby confirms theories on waste in healthcare. For instance, the waste of retrieving items from the equipment store was found both in previous research and in the empirical study. Furthermore, the findings identified new examples of the different waste in healthcare and outpatient surgery and thereby provided a foundation for future research.

Finally, this study contributed to increased knowledge and understanding of how information quality and the dimensions are correlated with the seven waste. It contributed by confirming findings from previous research of the impact of information quality on process performance and relationships between information quality and waste. Some correlations, found in the study by Jylhä and Suvanto (2015), were also found in this study. First of all, it showed that incompleteness, reliability, relevancy, accuracy, timeliness and ease of understanding contributed to motion. Secondly, that reliability and accuracy contributed to the waste of waiting. Lastly, it showed that low completeness, timeliness and ease of understanding contributed to defects. Furthermore, the study contributed by identifying new correlations between dimensions of information quality and waste in a new context.
6.2.2 Empirical Contribution

The first chapter of the report describes the increasing demand for outpatient surgeries and the importance of improving the efficiency of healthcare. The findings from this study indicated the factors influencing the information quality in outpatient surgery and how the process performance is affected by poor information quality. Being aware where the issues lies is the first step to improve. Hence, knowing that a contributing factor to poor information quality was the physicians’ different preferences and that Orbit was not planned by the physician performing the surgery, could help to increase the process performance and to a safer patient care.

With the identified factors influencing the information quality, two possible actions, in managing information quality to improve process performance, can be recommended. The first recommendation would be to adjust the routines regarding planning of the surgeries. Since the study showed that surgeons have different preferences it would be considered to be preferable if the physician performing the surgery was included in planning and scheduling of surgeries. Conclusions from RQ2 also indicated that poor quality of the dimension, timeliness was the underlying cause of poor information quality of the remaining six dimensions. Consequently, if the planning and scheduling were managed differently and thereby succeeded in updating the information in Orbit in accordance with the preferences of the surgeon, the information quality is believed to be improved.

The second possible recommendation concerns standardization. If the surgeons did not have different preferences, the information would not have to be updated accordingly. This change is of a much larger magnitude and therefore might be more difficult to successfully implement. It requires the hospital to first agree on which working methods to use and thereafter to provide the training and support to the OR-staff to make this change. Furthermore, the hospital should be aware of and prepare for the possibility of facing adversities. Some resistance to change was discerned during the interviews. As mentioned in the analysis, it appeared that using procedures and local anesthesia the surgeon was comfortable with and skilled in was a usually occurring choice and no reason to change was seen. It should however be mentioned that a complete standardization does, based on the analysis, not seem possible. This could for example be seen in the example with the usage of ultrasound which was occasionally based on the experience of the surgeon. If the less experienced surgeons need this equipment for ensuring the success of the surgery whilst it is unnecessary for more experienced surgeons, it is impossible to always have a standard on which tools and equipment to use. Nevertheless, with some exceptions, a standardization should be able to be implemented to some extent. As discussed in the previous section, the different preferences might be the actual underlying reason, where this could help to improve the information quality and thus also the process performance.

6.3 Limitations and Future Work

The seven dimensions of information quality examined in this study were chosen based on previous research in healthcare presented in the literature review. However, there are more than 70 identified dimensions of information quality and the possibility exist that there are more than
the seven dimensions chosen for this study that are important and suitable in the context of outpatient surgery. The purpose of this study was not to evaluate and encounter new dimensions of information quality and this possibility was therefore not studied. Thus, other dimensions could also be a contributing factor to waste in outpatient surgeries. This is something that could be researched and used to further increase knowledge and understanding of information quality and waste in outpatient surgeries. Furthermore, this qualitative study was a single case study, conducted on one specific outpatient surgery and the results are therefore not considered to be generalizable. Thus, to confirm the findings, future research need to examine the correlation of information quality and waste in outpatient surgery in another location.

The findings from this study could also be used as a basis for examining if an implementation that improves the information qualities do reduce the waste activities that were identified. As mentioned in the method chapter, cause and effect relationships are difficult to establish and an implementation could further examine the identified correlations. The final suggestion for future research is to examine the possibility of standardization in healthcare. The findings from this study suggest that information not updated in accordance with the preferences of the surgeon is the underlying reason to the poor information quality. A suggestion for implementation would eliminate the different preferences and thereby standardize the work. This could be furthered investigated from for example an individual level where resistance to change, which could be discerned during this study, could be examined.
7. References


Gong, X., 2009. Identifying and minimising preventable delay within the operating theatre management process: an adapted lean thinking approach, Queensland: Faculty of business school of marketing and management.


8. Appendix

This chapter presents the appendices of this report, which consists of interview questions and results from the survey.

A. Interview questions

The following chapter presents the questions asked during the interviews. The questions were asked in Swedish and are therefore presented in the same language.

A.1 Interview questions for the surgical staff

This chapter presents the interview questions asked in the interviews with the surgical staff.

1. Hur länge har du arbetat här på KK med dagkirurgi?

2. Vilka är dina arbetsrutiner inne på operationssalen inför och efter operationer på dagkirurgi?
   a. I vilken ordning och i vilket skede?
   b. Vad anser du vara mest problematiskt? Ge exempel.

3. Vilken information behöver du för att kunna utföra dina arbetsuppgifter inne på operationssalen?
   a. Hur och när får du tag på den informationen?
   b. Hur lätt är informationen i Orbit att förstå?
   c. Hur relevant är informationen i Orbit?
   d. Hur uppdaterad är informationen?
   e. Hur komplett är denna information?

Operationsmetod:

1  2  3  4  5

Varför? Ge exempel.

Lokalbedövning:

1  2  3  4  5
Varför? Ge exempel.

Specialverktyg:

1  2  3  4  5

Varför? Ge exempel.

f. Hur väl stämmer den här information överens med det faktiska utfallet?
Operationsmetod:

1  2  3  4  5

Varför? Ge exempel.

Lokalbedövning:

1  2  3  4  5

Varför? Ge exempel.

Specialverktyg:

1  2  3  4  5

Varför? Ge exempel.

g. Hur stora konsekvenser innebär det för dig om det sker en förändring av X strax innan en operation:
Operationsmetod:

1  2  3  4  5

Varför? Ge exempel.

Lokalbedövning:

1  2  3  4  5
Varför? Ge exempel.

Specialverktyg:

1  2  3  4  5

Varför? Ge exempel.

A.2 Interview questions for the surgeons

This chapter presents the questions from the interviews with the surgeons.

1. Hur länge har du arbetat här på KK med dagkirurgi?

2. Vilka är dina arbetsrutiner inför och efter operationer på dagkirurgi?
   a. (I vilken ordning och i vilket skede?)
   b. Vad anser du vara mest problematiskt? Ge exempel.

3. På vilket sätt sker samarbetet mellan dig och resterande operationspersonalen inför operationer?

4. Vilken information behöver du framföra till operationspersonalen för att de ska kunna förbereda inför en operation?
   a. Varför är denna viktig?
   b. När och hur är det som denna framförs?

   Operationsmetod
   Lokalbedövning
   Specialverktyg

5. Vilken information använder du dig av för att avgöra operationsmetod?
   a. När tar du del av den här informationen? Varför?

   Hur komplett är denna information?
1 2 3 4 5
Varför? Ge exempel.

Hur uppdaterad är denna information?
1 2 3 4 5
Varför? Ge exempel.

Hur lätt är denna information att förstå?
1 2 3 4 5
Varför? Ge exempel.

Hur pålitlig är den här information?
1 2 3 4 5
Varför? Ge exempel.

b. Hur väl stämmer ditt val av operation och metod överens med det planerade utfallet i Orbit?
1 2 3 4 5
Varför? Ge exempel.

6. Vilken information avgör om och i sådana fall vilka verktyg utöver standard som planeras att användas under en operation?
7. Vilken information avgör om och i sådana fall vilken lokalbedövning som planeras att användas under en operation?
   a. När är det som detta beslut fattas? Varför?
   b. När är det möjligt att fatta detta beslut?
B. Results from survey
This appendix presents a diagram of the results from the survey conducted with the surgical staff. The standard deviation is also shown in the diagram.