Evaluation of electronic prescribing system

User acceptance perspective
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Abstract

The use of Electronic Prescribing Systems (EPS) has significant potential role in improving patient safety and reducing adverse drug events. However, the introduction of these systems can have negative outcome on delivery of care if healthcare providers are not utilizing regularly and accept it. This study aims to explore paediatrician’s attitude towards electronic prescribing systems as well as understand the possible factors affecting user acceptance at tertiary care using the Technology Acceptance Model (TAM). A qualitative research methodology was applied. Semi-structured interviews were developed according to TAM model and used as primary source of collecting empirical data. Seven research participants were interviewed. The findings of this study had identified factors that are important for paediatrician’s acceptance of EPS systems. Although paediatricians are positive to the usefulness of EPS, it appears that there are some acceptance problems due to ease of use concerns and usability issues of the system. The acceptance of EPS can be improved by leveraging ease of use as well as enhancing training.

Keywords: electronic prescribing systems, paediatrician acceptance, technology acceptance model
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List of Abbreviations and terms

ADE          Adverse Drug Event
ALCH         Astrid Lindgren Children's Hospital
EPS          Electronic Prescribing Systems
HIS          Health Information Systems
HIT          Health Information Technology
ICT          Information and Communication Technology
IOM          Institute of Medicine
IS           Information Systems
PEOU         Perceived Ease of Use
PU           Perceived Usefulness
TAM          Technology Acceptance Model
TAM2         Extended Technology Acceptance Model
TPB          Theory of Planned Behaviour
TRA          Theory of Reasoned Action
UTAUT        Unified Theory of Acceptance and Use of Technology
Paediatrician A medical doctor who treats infants, neonates, newly born, babies and children. Paediatricians work both in hospitals, particularly those working in its specialized subfields such as neonatology (Wikipedia definition).
Chapter 1. Introduction

The introduction chapter provides a brief background about use of health information systems followed by description of research problem, scope and purpose of the study. It also discusses the formulated research question with justifications for undertaking this study.

1.1 Background

The use of Health Information Systems has been increasingly viewed as a tool to improve patient safety, enhance quality and efficiency of healthcare systems (Jha et al. 2008), it can also offer tremendous benefits for both healthcare organization and professionals. However, Schlotzer & Madsen (2010) noted that these type of computer systems are complex systems due to their unique problems such as user acceptance, flexibility, portability, semantic interoperability, scalability and performance. Schlotzer et al. (2010) also added that user acceptance and performance “are features that are unlikely to be met unless a full requirement specificaiton is developed prior a new systems is purchased”. A Health Information Systems (HIS) can be defined as “the application of information processing involving both computer hardware and software that deals with the storage, retrieval, sharing and use of healthcare information, data, and knowledge for communication and decision making” (Holden & Karsh 2010, p.161). Such systems have some unique requirement elicitation and implementation issues, for instance the implementation and adoption of electronic prescribing systems is a challenging task for healthcare delivery enterprises (Schlotzer & Madsen 2010). Paediatric electronic prescribing system is one of healthcare application that is used to prescribe, dispense, administer and monitor paediatric drugs. This system has the potential to reduce medication error, generate real time alert for variety of prescribing issues such as drug-allergies and drug-drug interactions. However, a study reported by Berg (2001) indicated despite the many benefits, there are numerous stories describing health Information Systems failure than success stories, one of the reasons for IS implementation failure is lack of user acceptance and ineffective usage of these systems (Ketikidis et al. 2012). In addition, some information technologies have not been accepted because software developers did not pay attention to key factors underlying user acceptance (Hulse et al. 2006).

In health information systems, the term evaluation refers to “the act of measuring or exploring properties of a health information systems in planning, development, implementation, or operation the result of which informs a decision to be made concerning that system in a specific context” (Ammenwerth et al. 2004, p.480). The main purpose of evaluation research is to improve existing system, to learn from experience, to assist top level healthcare managers either to make decision on further introduction of systems or get proof about whether local systems is safe for both end users and patients.
It follows from this, evaluation of user acceptance is important to elicit potential problem areas and to document application areas with a satisfied users of healthcare information systems (Zviran 1992). Ammenwerth (2010) in her research stated that Health Information Systems has the potential to support healthcare organizations and clinicians in delivering care as well as enhance the efficiency, effectiveness and appropriateness of well being. However, the introduction of these systems can have negative outcome on delivery of care if healthcare providers are not utilizing regularly and accept it. Ammenwerth et al. (2003) has explained that user acceptance and their attitude towards the use of health information systems is often seen as an indicator if an information systems support end users in their clinical working processes. Furthermore, user acceptance is generally seen as a crucial factor for overall successful implementation of information systems (Davis et al. 1989).

In modern healthcare, prescription of medication is the most common applied methods of medical treatment and health care professional’s acceptance of newly implemented system ensures successful adoption of computerized prescribing systems. However, lack of user acceptance and negative attitude will likely increase resistance to adoption (Guchelaar and Kalmeijer 2003). A large number of healthcare computer systems are often not used as anticipated (Miller, Gardner et al. 2005; Anderson and Aydin 2005; Guchelaar et al. 2003, Ammenwerth, Kaiser et al. 2003). Literature indicates that despite demonstrated benefits of health IT systems, clinicians can rebel against the implemented systems and show negative attitude towards these systems by circumventing its use such as by turning off the decision support feature or even breakdown the system if they don’t like it (Richards et al. 2005). Electronic prescribing systems has the potential to reduce prescribing errors; however, clinician’s resistance has been one of the major impediments to the successful implementation of electronic prescribing (Baysari et al. 2012).

Baysari and his colleague et al., 2012 examined doctors’ perceptions of prescribing systems, and identified that keeping prescribers informed about their prescribing errors and the quality improvement may lead to greater acceptance of and satisfaction with an e-prescribing system. Another study by Hu et al., 1999, examined the acceptance of telemedicine technology among physicians using TAM. The authors reported that physician’s positive attitude of the technology's usefulness was crucial, which in turn fostered individual intentions to use telemedicine technology. However, the telemedicine technology was not relevant to their daily practice.

User acceptance research publications have highlighted possible reasons why healthcare professionals are unwilling to use available healthcare IT systems. Some of these factors are: anxiety and fear due to lack of information (Kaya 2011), use of such systems is time consuming or require extra effort, introduction of the systems can interrupt end user’s
clinical workflow due to higher priority of patient case (Yarbrough & Smith 2007), lack of perceived clinical usefulness (Richards et al. 2005) and poor usability of health IT systems. Although electronic prescribing systems is widely used in healthcare organizations, there is low acceptance and the usage is not high as expected (Riccioli et al. 2011) due to healthcare professionals’ resistance.

1.2 Statement of the problem

A recent study published by Middleton et al. (2013) has contended the use of health information technology may cause adverse effects or could have unintended consequences and even can harm the patient. That is, HIT implementation have unintended consequences and these unintended consequences can account for non use, inappropriate use and destructions. Han et al. (2005) in his cohort research for commercially sold electronic prescribing in United States paediatric hospital reported unexpected increased children mortality due to poor implementation of electronic prescribing and poor workflow integration. In spite of careful planning and implementation, there are associated unintended consequences mostly are people issue that occur after system implementation such as user acceptance. Several healthcare information technology literatures noted that electronic prescribing systems have the potential to improve quality and outcome of healthcare, particularly in terms of medication error reduction (Jani, Barber et al. 2011; Miller, Gardner et al. 2005). However, resistance by end users and health professionals is a widespread problem (Holden and Karsh 2010; Davis et al., 1989). The main reasons for the slow adoption were: some of the healthcare providers are not always using electronic prescribing system’s functionality in their daily work routines, because users believe they are familiar with the drugs which they prescribe. Also, users of the system stated that they are accustomed to calculate drug doses manually and by mind. Some user said they use the system only when ordering complicated drug type such as immune suppressions. There is low usage of this system as most junior paediatricians prefer to further consult senior colleague instead of using the system and senior paediatricians are not using the system which is made available for them. Further, there is usage variation among senior and junior paediatrician and some of the prescribing systems feature such as searching were not easy to use. Venkatesh et al. (2000) stated that even though end users perceive system use is organizationally mandated, acceptance vary because some users are unwilling to comply such mandates. Another study by Ammenwerth et al. (2003) reported that HIT are essential in improving healthcare delivery, however, if health information systems imposed upon clinicians by organizational policy or as a result of even higher policy decision, then clinicians tend to frustrate and may result in inefficiency of use. Thus, the widespread unwillingness leads to develop resistance among paediatricians and if these problems are not identified they can compromise the use and acceptance of electronic
prescribing systems or jeopardise successful implementation of prescribing systems rather than fostering it. As such, it is crucial to evaluate users’ technology acceptance in order to inform top level managers, improve local systems and maximize actual usage of the system. Anderson & Aydin (2005) asserted that it is important to determine issues related to system’s ease of use, usefulness and end users need in order to see what causes the use of healthcare computer system.

According to TAM model, user acceptance of information systems is primarily influenced by perceived usefulness (PU) and perceived ease of use (PEOU) of a system, TAM postulates that these two significant determinants have influence on user’s attitude toward a system which can also elucidate behavioral intention (acceptance) to use the system. This study utilized Technology Acceptance Model (TAM) framework which theorizes that user acceptance of information systems is primarily influenced by perceived usefulness (PU) and perceived ease of use (PEOU) of a system (Davis et al. 1989). TAM framework was selected to explore paediatrician’s acceptance and attitude towards the use of electronic prescribing system. This is mainly because: a) TAM framework helps the evaluator not to overlook important issues and provides a set of constructs to be investigated (Anderson & Aydin 2005). b) TAM is specifically developed in IT context to provide an adequate explanation about end user’s IT acceptance. c) TAM is well researched and it has accumulated ample empirical support (Hu et al. 1999). d) TAM is flexible for measuring user acceptance, examining and evaluating strategies to promote user acceptance (Hsiao et al. 2011). Other user acceptance models such as TAM2 and UTAUT are more complex than original TAM (Day et al. 2007).

1.3 Scope and limitation

The scope of present study will only evaluate user acceptance of electronic prescribing systems, it will not include the impact of current system on paediatrician’s workflow. In addition, it will not include hypothesis testing and theory evaluation. Lack of enough research participants is the limitation for this study.

1.4 Purpose statement

The purpose of this study is to explore paediatrician’s attitude towards the use of electronic prescribing systems as well as better understand the significant possible factors affecting user acceptance. The overall research objective is to empirically tease out key factors that assist or hinder paediatrician’s acceptance of electronic prescribing systems. The study by Holden & Karsh (2010) contend that understanding these factors can promote technology acceptance and thus enhance use of information systems by healthcare providers as well as pursue appropriate corrective steps.
1.5 Research questions

The research questions which will be addressed in this study are:

a. How do paediatricians perceive the use of electronic prescribing system?

b. What are the perceived key factors affecting [paediatricians’] the use of electronic prescribing systems?

1.6 Justifications

The slow adoption of health information technology can lead to unsuccessful implementation. Understanding the way in which healthcare staffs react to healthcare systems is a research priority for information systems field (Ketikidis et al. 2012). This study is important and needed for several reasons. First, exploring attitude and the way in which end users react towards using various aspects of their information systems is an important part of making these systems successful (Gardner & Lundsgaarde 1994) and it also enhance subsequent use as well as an effective information systems implementation (Burkes 1991). Second, from research perspective the majority of user acceptance research publications have been quantitative (Lee et al. 2003), the qualitative findings will provide insight and in-depth understanding about paediatricians acceptance of electronic prescribing systems. A study by Hu and his colleague (1999) explained that examining technology acceptance can provide insights and implications that are relevant to health IT acceptance research. Third, this study will address the need for technology acceptance research in healthcare setting specifically in paediatrics hospital by extending the theoretical validity and empirical applicability of TAM model. Aside from this, it will address the gap exists in technology acceptance by paediatricians and wider understanding of issues related to the technology acceptance.

From practical stance, this evaluation study will provide some evidence and identify paediatrician’s propensity to use electronic prescribing systems as well as the potential factors influencing acceptance in the context of technology acceptance model. In another term, this study will attempt to better understand use and adoption of electronic prescribing systems in the context of Swedish healthcare system. Banderker & Van Belle (2009) noted that identifying these factors will help to find out how health IT solutions should be designed, developed, implemented and tease out the key factor in the adoption process. Finally, the findings of this study will support the decision to take appropriate corrective steps with regard to further improve the electronic prescribing systems and also will have implications for future researchers who wish to research or determine key considerations that affects electronic prescribing system user acceptance. This study is important in identifying unintended consequences of electronic prescribing system’s use as unintended consequences are often not researched and well studied.
Chapter 2. Review of the literature

Chapter 2 explains implementation of healthcare information systems and provide an overview of an existing literature in the area of health information technology acceptance. Elements of Swedish strategy for e-health and electronic prescribing systems are introduced in this chapter. It also thoroughly describes Technology Acceptance Model (TAM).

2.1 Introduction

The implementation of computerized healthcare systems can increase accessibility of clinical data, enhance patient care by saving time and enabling data sharing to facilitate communication among different healthcare professionals (Chow et al. 2012). However, implementation of electronic prescribing systems is a challenging task for any hospital. Care provider’s resistance has been one of the major impediments to the successful implementation of electronic prescribing (Baysari et al. 2012). A successfully implemented healthcare information systems means “if it does what it supposed to do and people are willing and able to use it” (Schlotzer & Madsen 2010, p.157). The study by Davis (1993) revealed that user acceptance has often been an obstacle to the success of new information systems and it is known to be pivotal factors which determine success or failure of an information systems projects. The term technology acceptance, according to Yarbrough & Smith (2007), refers to voluntary or mandatory use of a particular technology. A recent article released by Ketikidis et al. (2012, p.125) described “technology acceptance and use is conceptualized as an extension of human behaviour, and attitude is one of the aspects that govern the human behaviour as it has the potential to extend and understand issues of technology acceptance”. The targeted healthcare technology in this thesis is the electronic prescribing system. This study is a post-implementation evaluation of user acceptance of paediatric electronic prescribing system at children hospital. Information Systems literature commonly termed “user resistance” as user acceptance. Davis et al. (1989) defined resistance as a refractory behaviour of end users towards the use of Information Technology.

Healthcare are sensitive organization with important social implications, making it mandatory to investigate user acceptance issues (Zhang et al. 2010). “User acceptance can encompass both user satisfaction and the actual use of the system by those for whom it was intended” (Travers & Downs 2000, p.853). It is one of the critical challenges towards wide implementation of healthcare computer systems. Having a healthcare computer system does not automatically imply that physicians and nurses are using the available systems. Many experienced or professional clinicians are concerned about the quality of interaction, usefulness of the system, user friendliness, intuitiveness of data
entry and user interface design. For novice clinicians, acceptance of newly implemented system is dependent on the training and education they receive and on a large degree to the expectations of its users. Such complaints lead to what collectively known as issues of acceptance and ease of use (Iakovidis 1998). The acceptance of an electronic prescribing by the prescriber is expected to occur if they perceive that the system is useful to increase pharmacological safety (Baysari et al. 2012) and “if it does what it is supposed to do” (Schlotzer & Madsen 2010, p.157). Davis (1989) in his seminal article described that the key factor affecting the successful adoption of technology lies in user acceptance. This can imply that a successful health information systems implementation should be evaluated from various users’ perspectives such as physicians, nurses and their skills, general experience of health information systems (Hsiao et al. 2011). Health care systems can yield positive benefits only when users are willing to both accept and adopt the system in their daily work routines. The TAM is a useful model to deal with user acceptance (Davis 1993).

2.2 Healthcare Information Systems

The use of Information systems plays a key role in transforming healthcare delivery organizations while reducing cost by mitigating unwanted redundancies and variations. It has significant potential to improve quality and safety of medical care while reducing healthcare expenditure. The development of healthcare information systems was begun in the 1960s. The health care environment mainly characterized by an intensive information, it consists of highly personal information and multidisciplinary professionals, and it is influenced by regulations and competition. The main objective of Healthcare Information Systems (HIS) is to manage clinical and administrative data that healthcare providers need to carry out their tasks effectively and efficiently. In another terms, HIS helps the communication, integration of information, and coordinate action among various healthcare professionals. Moreover, it assists in storage and organization of information, and support record keeping as well as reporting functions (Shortliffe & Cimino 2006).

Early HIS applications were primarily developed and mainly used for administrative functions such as billing and managerial tasks. A modern healthcare enterprise consists of two types of health information systems: clinical information systems and administrative information systems. The former is most valuable asset for health information systems than the latter because to manage patient specific data, care givers need to collect, store, protect, and deliver it for both primary and secondary uses (Schlotzer & Madsen 2010). For instance, healthcare enterprises need to implement electronic prescribing systems than using the paper prescription; therefore HIS can reduce erroneous drug prescription and medication errors which ultimately increase the quality of healthcare service. Both clinical and administrative health information systems consist of technology (computers,
databases, and input device), people (such as patient, healthcare professionals) and the organization (such as goals, functions, policies, constraints, resources) (Schlotzer and Madsen 2010). Some of the areas of clinical medicines where clinical information systems used are: laboratory information systems, drug information systems, electronic health record, computerized physician order entry, telemedicine etc. Healthcare organizations are complex systems; they require high budget and have slow adoption by its users. Countries around the world have unique healthcare delivery system. Thus, understanding the supply and demand of the patients and the healthcare professionals is of high priority. A healthcare system is defined as arrangements among hospitals, physicians and other provider organization that involve direct ownership of assets on the part of the parent system (Shortell and Kaluzny 2000). The purpose of healthcare systems is to reduce continually the burden of illness, injury, and disability and to improve the health status and function of people (Berwick 2002). It is essential and fundamental for modern healthcare organizations to use and implement Health information technology in order to enhance the quality and safety of clinical care delivery. According to Institute of Medicine IOM (2001), the main goal of properly implemented HIT should provide a healthcare that is:

A) **Safe**: Patients ought to be as safe in healthcare facilities as they are in their own homes (Berwick, 2002). In other words, avoiding injuries to patients from the care that is intended to help them (IOM, 2001).

B) **Timely**: Reducing waiting times and harmful delays for both patients and those who give care (Berwick, 2002).

C) **Effective**: Providing services based on scientific knowledge to all who could benefit and refrain from providing services to those unlikely to benefit. That is, avoiding both underuse of effective care and overuse of ineffective care (IOM, 2001).

D) **Efficient**: Reducing total cost of care, including for example, waste of supplies, equipment, space, capital, idea, and human sprit (Berwick, 2002).

E) **Equitable**: Providing care that does not vary in quality because of the personal characteristics such as gender, ethnicity, geographic location and socioeconomic status (IOM, 2001).

F) **Patient-centered**: Providing responsive and respectful care to individual patient’s preference, need, and choice, and ensuring that patient values guide all clinical decisions (Berwick, 2002).

To sum up, the potential benefits and use of health information systems are: reducing cost of healthcare delivery, enhance productivity, improve quality of care and regulatory compliance (Shortliffe & Cimino 2006). Paediatric health information technology can expedite the delivery of paediatric medicine by bringing all required information to the
point of care. Paediatric HIT has direct effect on the six dimensions of healthcare system quality illustrated above. The primary functional role of HIT is to help collect, store and visualize patient’s medication history, drug information, and laboratory results in electronic health records. So, documentation of the care process such as diagnosis, treatment and prescription is often the focus of information system design (Zuckerman 2009). Most healthcare providers have implemented prescribing decision support systems with the aim of managing medication process and to avoid potential errors.

2.3 E-health strategy in Sweden

Establishing a national e-health framework is important to enable healthcare service accessible for all citizens. Such strategies are also needed to support care providers and health information systems communicate with each other. E-health strategies consist of national and international standards as well as agreed policies and methods (Hovenga 2010). The term e-health refers to “the use of modern information and communication technologies (ICT) or other electronic media to disseminate health related information or services” (Gustafson & Wyatt 2004). An article by Hovenga et al. (2010) described that the adoption of e-health strategies have an impact on healthcare providers. The adoption of these technologies will better manage health information with in the e-health strategy in order to achieve significant efficiency and productivity. This will enable clinicians to provide safer, higher quality and accessible care which ultimately produce better health outcome.

Sweden has introduced a national e-health strategy since 2005 with the focus of providing best use of ICT to support citizens, patients and relatives to access rapid and reliable health information. To ensure patient safety, the e-health strategy also included that care providers need to have access to efficient and an interoperable e-health application. In the Swedish Strategy for eHealth, the major focuses are divided into six action areas. The following figure illustrates element of Swedish strategy for e-health (Johansson et al. 2009).
Figure 1. The Swedish strategy for e-health.
(Source: http://www.eppractice.eu/files/)

The Swedish e-health strategy is classified into six action areas. These are: making information and health service accessible for citizens, supporting access to information across organizational boundaries, facilitating interoperable ICT systems, setting up a common technical infrastructure, creating a common information structure, bringing laws and regulations with the use of ICT (Johansson et al. 2009). At national level, the main focus of e-health action area is to create the conditions for secure, safe, and efficient use of ICT in health and social care.
2.4 Technology Acceptance Model (TAM)

TAM is one of the Information Systems (IS) fields’ own theory used for evaluating IS acceptance particularly how users come to accept and use technology (Hsiao et al. 2011). The main objective of TAM is to explain “determinants of computer acceptance that is general and capable of explaining user behaviour” Davis et al. (1989). There are many prominent (technology) acceptance models developed in Information Systems (Ammenwerth et al. 2003). However, of the different theories that examined user’s technology acceptance such as Theory of Reasoned Action (TRA) and Theory of Planned Behaviour (TPB), TAM is one of the most powerful, promising and seminal model (Hu et al. 1999). TAM is an intention-based model originally developed by Davis et al. (1989) to better understand user’s potential acceptance of information technology for both compulsory and voluntary IT usage. “TAM model has been well tested and validated and proven to be reliable when used in the evaluation of user acceptance studies” (Banderker & Van Belle 2009, p.41).

TAM has gone through many changes and updates, for instance Venkatesh & Davis (2000) developed the extended TAM also known as TAM2, this model theorizes that social determinants and cognitive instrumental processes have significant influence on user acceptance of technology. A more recent extended TAM version is called Unified Theory of Acceptance and Use of Technology (UTAUT), this model has similarity with the original TAM model (Holden & Karsh 2010), and it unified the following theories: TRA, TPB, TAM, motivational model, model of PC utilization, innovation diffusion theory, social cognitive theory and combined TPB and TAM (Zheng et al. 2011).

Why TAM?

The present study will use the leading and seminal model called Technology Acceptance Model (TAM) as theoretical framework in order to elicit paediatrician’s acceptance and attitude towards the use of electronic prescribing system at children hospital. TAM was selected mainly because it helps the evaluator not to overlook important issues and provide a set of constructs to be investigated (Anderson & Aydin 2005). Although TAM was not specifically developed for healthcare context, yet many literature revealed as a pertinent model for healthcare context (Holden & Karsh 2010). Of the different IT acceptance models, the author has chosen TAM over other IT acceptance models for the following reasons: first, compared with other theoretical models, TAM is specifically developed in IT context to provide an adequate explanation about end user’s IT acceptance. Second, TAM is well researched and it has accumulated ample empirical support (Hu et al. 1999). TAM is flexible for measuring user acceptance, examining and evaluating strategies to promote user acceptance (Hsiao et al. 2011). In addition, TAM
accounts for 30-40% of variance in user technology acceptance as well as simplicity (Holden & Karsh 2010) and the constructs are easy to use (Lee et al. 2003), unlike TAM2 and UTAUT which are more complex than the former (Day et al. 2007).

According to TAM model, user acceptance of information systems is primarily influenced by perceived usefulness (PU) and perceived ease of use (PEOU) of a system, TAM postulates that these two significant determinants have influence on user's attitude toward a system which can also elucidate behavioral intention (acceptance) to use the system. That is, PU and PEOU are most important factors in explaining systems use. Perceived usefulness refers to “the degree to which a user believes that using a particular system would increase his or her job performance”, on the other hand perceived ease of use indicates “the degree to which a user believes that using a target system to be free of effort” (Davis et al. 1989, p.985). With this regard, prescribers will accept electronic prescribing system and view them positively if they recognize the limitation of paper based prescribing and see electronic systems as useful in addressing some of these limitations (Baysari et al. 2012). The following figure illustrates the TAM model.

**Figure 2.** Technology Acceptance Model (TAM).

Source: (Davis et al. 1989, p.985)

The rectangles depicted in the above Figure 2 represents TAM construct, the arrows into the boxes from left are determinant. The external variables that can intervene and indirectly affect perceived usefulness or perceived ease of use are: training, prior use, experience, user support, documentation, development process, and system characteristics or features such as menu, screens, mice, or icons. Perceived ease of use is determined by external factors; whereas perceived usefulness is affected by perceived ease of use and various external variables. Attitude towards using a system is jointly determined by perceived usefulness and perceived ease of use. Behavioral intention is jointly determined by the user attitude and perceived usefulness. “The most proximal
antecedent to information technology use is behavioral intention to use it” and it is commonly referred as acceptance (Holden & Karsh 2010, p.160). Lastly, the ultimate objective of TAM model is to elucidate actual system use (Legris et al. 2003) and it is determined by behavioral intention (Davis et al. 1989).

Davis et al. (1989) claim that perceived usefulness of a system is the primary determinant of user’s technology acceptance, mainly because end users are more willing to deal with the challenges of use if they believe that the system is useful and can improve their job performance. However, researchers have been applied the original TAM model to evaluate user acceptance and the results from Legris et al. (2003) publication indicates that numerous empirical research using TAM are not consistent and subtle with regard to factors that affect attitude and acceptance of healthcare systems. Hu et al. (1999) examined physician’s decision to accept telemedicine technology; the study found that perceived usefulness was the main factor that determined the attitude and acceptance. A qualitative TAM study by Karsh et al. (2006) showed that the adoption of using error reporting systems were influenced by perceived usefulness, perceived ease of use and subjective norm. Conversely, the qualitative study by Day et al. (2007) revealed that even though users deemed that use of video phones was useful, they perceive that it was not easy to use due to low technical quality and difficulty to use, thus perceived ease of use was the main factor that determined acceptance. A similar study by Ketikidis et al. (2012) evaluated the acceptance of health information technology and found that perceived ease of use has a direct effect on the usage of this system. In a qualitative study by Banderker & his colleague (2009) have identified that if physicians believe that ICT is useful and relevant to their clinical work routine, then it is more likely they use the available systems. Accordingly, as these research publications illustrate, the significant factors that affect the use of healthcare technology differ from one setting to another and also depends on type of end users of the health information systems.

The limitation of TAM is that it does not take into account the social cognitive effects (such as effects of colleague, superiors and boss) and the cognitive instrumental process. The other critique that researchers from health information system raised is that TAM is not specifically developed for health care and it may not fit the healthcare environment, as argued by (Handy et al. 2001) healthcare professionals may show resistance to use healthcare systems even if they perceive the system is useful and easy to use, there are other factor which affects clinicians acceptance of technology such as security of information and potential use of information. Even though organizational factors have little influence on technology acceptance, TAM does not consider organizational or contextual factors such as training and support. In other word, the original TAM only examines end user’s perception of system characteristics (PU and PEOU) (Handy et al. 2001). This study will attempt to examine applicability of TAM using the qualitative
approach in the context of paediatricians acceptance of electronic prescribing system and it eventually contribute to empirical applicability of TAM model for this particular health Information technology, end users and healthcare setting.

Ammenwerth et al. (2003) has described that user acceptance is one of the factor that helps to better understand whether an information systems is considered to be successful or not. The term attitude refers to “individual’s positive or negative feelings about performing the target behaviour, for e.g. using a system” (Davis et al. 1989). According to Succi & Walter (1999) evaluating physician’s attitude towards healthcare information systems is important mainly for two reasons. First, most literature indicated that unlike non professionals and other professionals, physicians show slow acceptance of health information technologies due to privileges such as prestige, autonomy and institutional power. Second, investigating the attitudes of physicians towards information technology plays a vital role in the process of adopting information systems because healthcare organizations hope this will reduce healthcare cost. The other reason that this study attempted to examine paediatrician’s attitude instead of actual use primarily because the EPS is characterized by limited adoption and “what derives people’s intention to use (accept) IT applications is their attitude towards those applications” (Davis et al. 1989). He also argued end users form attitude and intention towards trying to learn to use the new technology due to nature of new technologies as it tend to be complex and an element of uncertainty exists. Furthermore, the key to increase use is first to increase acceptance of HIT and focusing on actual use may require longitudinal research (Holden et al., 2010). Lastly, in discussing the TAM theoretical model (Chow et al. 2012) noted that TAM focuses on attitude towards information technology use by evaluating the user perception.

2.5 Electronic Prescribing Systems

In modern healthcare, prescription of medication is one of the most common applied methods of medical treatment (Guchelaar & Kalmeijer 2003). The first electronic system was developed in 1970s with the purpose of reducing cost of formularies. Electronic prescribing (e-prescribing) systems are computerized medical systems that can provide the creation, transmission, dispensing, and monitoring of pharmacological therapies Miller et al. (2005). Another more recent definition of electronic prescribing systems states that it is “the utilization of electronic systems to facilitate and enhance the communication of a prescription or medication order, aiding the choice, administration and supply of a medicine through knowledge and decision support and providing a robust audit trial for the entire medicines use process” Caldwell & Power (2012, p.124). Paediatrics e-prescribing system is used to order medication for neonates, new born infants, babies and children who are equal to or under 18 years old. It also suggests doses
based on child’s age and body weight and it provides an overview of previous medication history of the patient. This system comprises an internal element known as clinical decision support system which can help prescribers to check for dosage errors, drug-drug interaction and contraindications such as allergies. It also generates a real time alert and gives warnings for the presence of drug-drug interactions and drug allergies. The pop up alerts has the potential to improve patient safety and reduce drug injury occurred from overdose or under dosage. Bell and his colleague (2004) model the prescription medication process in to five major phases/activities. The following figure describes the electronic prescribing process for a general hospital healthcare setting.

![Diagram of Hospital medication process and its components.](image)

**Figure 3.** Hospital medication process and its components.

Source: Bell et al.(2004, p.64).

In the above figure, each box has input that involves people, technology and information flow. The first phase is “prescribing”, here the prescriber assess the patient’s need and conditions, and the need for prescription of medication. He/she will use the electronic prescribing system to order prescription, access drug information and patient history. The output from this activity is a completed written prescription. The next step is the “transmitting” order to the pharmacist; mostly the patient delivers the completed order/prescription for fulfilment. The “dispensing” activity involves dispensing the drug in its required form and dose. Pharmacists use a pharmacy system to retrieve prescribed medication information. The forth phase is “administering” the medication where the clinician administer the drug to recipient taking the drug treatment. The last activity is “monitoring”, it involves mainly patient. Clinicians observe the effect of the medication and make assessment as well as determine if changes is needed. The present study will focus on the first component of the Bell model i.e. “prescribing” of medication at the paediatrician office.
Currently, at Astrid Lindgren Children’s hospital, it is mandatory to use the electronic prescribing system in order to prescribe medications for paediatric patients. The electronic prescribing system was initially implemented on 2008 and the end users are paediatricians, nurses, resident physicians, paediatrics surgeons, and neonatologist.

The EPS system is a client server medication system integrated with the “TakeCare” electronic health record systems and it has the following functional specifications:

A- An electronic drug module which help users to check if the dose is within the recommended range. It also checks overdose or under-dose of prescribed medications.

B- The “Favorit” functionality comprised a partly prefilled of approximately 1,000 medication order.

**Figure 4.** ‘Favaritor’ screen display. This is an electronic drug module and it consists of 1000 prefilled order, specific drug database and dosing help. All possible drug lists is populated.

C- Paediatrics medication dosing: this functionality suggests dose or prescriptions based on paediatric patient’s age and body weight.

**Figure 5.** Dose range control screen display. This screen displays calculated drug dose according to child’s weight and age.
D- A clinical decision support feature which generate alerts and reminders.

**Figure 6.** A prescribed drug sheet screen. If the dose is outside the range, an alert will be displayed for the paediatrician.
Chapter 3 Methodology

This chapter provides detailed description about research method including empirical data collection, how data were analyzed, and potential ethical issues.

3.1 Research approach

Friedman & Wyatt (2006) in their book have described two prevailing philosophical bases for evaluation studies in healthcare systems: the subjectivist (qualitative) and objectivist (quantitative) approaches. The subjectivist approach to evaluation refers to exploring the properties of health information systems in planning, development, and operation (Ammenwerth (2010) call this aspect qualitative approach). The objectivist approach to evaluation refers to measuring the properties of health information systems in planning, development and operation (Ammenwerth (2010) call this aspect quantitative approach).

The subjectivist approach is derived from intuitionist-pluralist paradigm and “it uses an inductive reasoning for understanding the world” (Moehr 2002, p.119). Further, it focuses on explaining and describing a situation and it mainly depends on qualitative data derived from qualitative methodology. Conversely, the objectivist approach is derived from logical-positivist philosophical world view as it assumes that “a valid model of the worldview is exists and the knowledge of its components allows to explain the whole” (Moehr 2002, p.114). This paradigm uses statistical analysis and experimental designs, and it rely on quantitative data derived from quantitative questionnaires (Friedman & Wyatt 2006).

This prospective study employed the subjectivist (qualitative) research approach to uncover end user acceptance and attitude towards electronic prescribing system, and positive and negative effects of using the system. The selected qualitative approach helps to properly understand the views of paediatricians. That is, the qualitative studies will hold the promise of illuminating more richly information about electronic prescribing use. The main purpose of qualitative research is to explore, understand the world and explain participants meaning (Creswell 2009).

The main reason for conducting qualitative study is that not much is known or written about paediatrician’s use of electronic prescribing systems at ALCH. The investigator seeks to listen to participants and build an understanding based on what is heard.

Thus, the present study will not involve theory evaluation and hypothesis testing, rather it will anticipate explaining and teasing out possible significant factors influencing the acceptance of electronic prescribing system as well as identify the attitude of the end users. The subjectivist evaluation approach will be employed since it assumes that the evaluator seeks illumination instead of giving judgment and attempts to represent the
view points of the end users regarding health information systems (Friedman & Wyatt 2006). Besides, “it is clear that ease of use can not really be self reported, it is far more enlightening to observe users making use of a product. Therefore it is better to ask end user about the features they use most often” (Renaud et al. 2008, p.214).

The main reason that I did not select the objectivist (quantitative) approach because self assessment or the completion of a survey questionnaire by end users may not provide substantial data about factors affecting technology acceptance, however, the subjectivist (qualitative approach) allows to collect rich data as it seek to better understand end user’s social and cultural context in which the technology acceptance can occur (Banderker & Van Belle 2009). In the context of this study, the subjectivist approach will enable the researcher gain an in-depth understanding of paediatricians attitude towards the electronic prescribing systems, and identify possible factors influencing technology acceptance through TAM model and an article by Lee et al (2003) stated that the qualitative study using the TAM model is more useful alternative to determine richer information with small number of research participants. Moreover, this methodology entail a basic descriptive foundation to understand and elucidate the potential factors affecting acceptance of an information systems (Banderker & Van Belle 2009). Considering the limited time provided and resources allocated to complete the thesis, Moehr (2002) mentioned that subjectivist (qualitative) approach is very economical in that it can be adjusted to the necessary degree of certainty and detail which make it time efficient. Although qualitative TAM study can be informative by providing brief and practical information about PU, PEOU and attitude (Holden & Karsh 2010), it can prevent mismatch of assumptions and enhance the chance of meeting objective of the study (Patton, 2002). Unlike the quantitative approach, the selected methodology does not measure clinician’s attitude through self assessment or self reported usage which may not be an appropriate surrogate for actual use as users are poor estimators of aspects of their own behaviours (Zheng et al. 2005). The use of standardized questionnaire format such as Likert type scales questionnaire can easily result in misleading of research findings due to well known biases such as the halo effect, socially desirable response sets, yeasaying, end aversion and question order effects (Mead & Moseley 2001).

The objectivist approach (quantitative) approach has serious problems for the evaluation of healthcare information systems, some of these drawbacks are: it requires intensive resources, funds, personnel and it consumes much time. The other critique of this approach is the effect of research instrumentation on research question due to longer time to get the result. Epistemologically, the objectivist paradigm is rigid, i.e. if there are relevant new questions raised during the study, the questions cannot be tackled (Moehr 2002). Even though a quantitative survey using Likert scale are commonly used in information systems to evaluate user acceptance and are tend to be brief with strong
reliability and sensitivity, generally this approach lack standardization and it has low or weak validity (Babbie, 1990). The other disadvantage of using survey questionnaire is that they do not allow for flexible interaction between the interviewer and research participant when something important or unclear issues happened (Ammenwerth et al. 2003).

### 3.2 Research Method

Holden & Karsh (2010) mentioned two ways of evaluating end user’s acceptance of healthcare computer systems: the first method is to measure end user satisfaction such as using survey instruments, and the second method is to solicit or ask healthcare professionals about their acceptance. The latter method can reliably explain actual use where as the former method is difficult to measure since acceptance is the only measured outcome, in addition acceptance is influenced by user’s attitude towards using information systems.

### 3.2.1 Study setting

The main setting for this study was Astrid Lindgren Children’s Hospital (ALCH) located in Stockholm county council. ALCH is a tertiary care opened in 1996 as part of Karolinska Hospital to provide paediatric care for children suspected of physical or psychiatric disorders, asthma, allergies, gastrointestinal diseases, urinary tract infections, psychosomatic disease, chronic disease, infants with acute infections, childhood epilepsy, and disabilities. ALCH has twelve paediatric clinics. ALCH provide care for children who are referred by general practitioners.

### 3.2.2 Selection of participants and size

Research participants were recruited from Astrid Lindgren Children’s hospital that are currently using the system. Since the available number of participants is less than ten, participants were recruited based on purposive sampling procedure for those who have good experience, overview, and knowledge about electronic prescribing systems as well as those who best help the researcher to understand the problem and answer the research questions. All participants initially contacted by email and through telephone. Prior to the interview session the purpose of the study was described for the recruited subjects and their participation will not be obligatory. Participants could also withdraw at any time with out giving any reason.

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1 www.karolinska.se
The author first approached head of paediatrician who is the researcher’s contact in the hospital and received telephone & email contacts of the participants. Possible participants were identified by head of paediatrician. Then an email invitation was sent to selected participant who are currently using the system describing the general information and purpose of research study as well as interview process. Among invited participants, seven participants consented to be interviewed. Two of physicians were unavailable. Interviews with two participants were cancelled and re-scheduled into alternative day due to arrival of emergent patients.

The following table shows characteristics of key participants who have participated in this empirical study.

**Table 1. Description of research participants**

<table>
<thead>
<tr>
<th>Study elements</th>
<th>Profession</th>
<th>Experience of using EPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0011</td>
<td>Paediatrician</td>
<td>2-3</td>
</tr>
<tr>
<td>0012</td>
<td>Paediatrician</td>
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<td>0013</td>
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<td>0014</td>
<td>Paediatrician</td>
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<tr>
<td>0015</td>
<td>Paediatrician</td>
<td>2-3</td>
</tr>
<tr>
<td>0016</td>
<td>Paediatrician</td>
<td>4</td>
</tr>
<tr>
<td>0017</td>
<td>Resident physician</td>
<td>2-3</td>
</tr>
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</table>

The interviewed participants have broad prospective and understanding about EPS. An attempt was made to take into account and equally interview both experienced and non experienced users, however, among the invited research participant very few novice users were responded to be interviewed in this study.

### 3.2.3 Data collection

The purpose of this study is to explore paediatrician’s attitude towards electronic prescribing systems and identify the factors that affect user acceptance. To achieve the objectives and answer the research questions of this study, semi-structured interviews were used as the primary source of collecting empirical data as it enables the researcher to cover the themes in sequence manner. The semi structured interview is one type of qualitative data collection where the interviewer asks participants a series of predetermined but open-ended questions (Given, 2008). Semi structured interview questions were designed based on technology acceptance model constructs so that all relevant and required data will be captured. The interview question consists of basic demographic as well as open –ended questions.
A face to face interview was directly conducted with the tertiary care paediatricians who are currently using on the system. Creswell (2009) noted that semi-structured interview allows the researcher to control over the topics of the interview questions and enables to obtain views and opinions from the participants. Accordingly, semi-structured interviews “are useful in research question where the concepts and relationships among them are relatively understood” (Given 2008, p.811). The interviewer has avoided leading questions; this will ensure interpretive validity (Given 2008).

A written interview guide was developed to be followed and used for asking questions during interview, as it is recommended for beginner researchers who do not have experience in conducting interview in order not to miss important questions. At the time of interviewing, the interviewer was taking interview notes. With participant’s permission, all of the interviews were audio taped. Research participants voluntarily participated in this study, a written informed consent was obtained from the interviewee prior to the interview session. All information and data which are directly collected from paediatricians were the primary material for making data analysis and interpreting study findings.

Prior to data collection, a pilot interview test was carried out with a paediatrician and lasted for 45 minutes in order to assess the understanding of the questions and the comprehensiveness of language. Following the test interview, minor changes and update were made on some interview question. All interviews with paediatricians were conducted in English language for approximately 30 minutes in their workplace in ALCH and Karolinska university hospital using the interview questions in Appendix A.

### 3.2.4 Data Analysis

Data analysis is an integral part of qualitative research and involves making sense out of interview transcripts and field notes (Creswell 2009). “The purpose of the qualitative research interview is to depict the description and interpretation of themes in the participant’s lived world, hence a continuum exists between description and interpretation” (Kvale 1996, p.187). The process of qualitative data analysis is an ongoing process which starts parallel with gathering data. Also, it constitutes combing through the data, i.e. identifying themes, concepts and ideas from the information supplied by participants (Creswell, 2009).

The collected raw data obtained for this study were analyzed, discussed and interpreted in light of the TAM framework. The primary collected data were analyzed, described and interpreted using manual thematic analysis described by Creswell (2009). The basic qualitative data analysis processes were the following: a) verbatim transcription of audio recorded interviews and organizing textual materials such as interview texts b) initial reading through all collected interview transcripts and field data c) manual coding of the
manuscripts, this refers to “process of organizing the material into chunks or segments of text and assigning a word or phrase before bringing meaning to information” (Creswell, 2009, p.186). Accordingly, a Microsoft Excel table or record was developed i.e. qualitative codebook was created in order to contain a list of predetermined and emerging codes. Initially an attempt were made to use colour coding schemes, however it was time consuming and laborious.

Figure 7. Qualitative code book snapshot.

In addition to pre determined codes that addressed theoretical perspective in this research, the researcher has also looked for emerging information collected from participants. d) Categorization and generating themes for analysis. The identified themes appeared as major findings and used to create headings in the result section. E) Theme description. Lastly, f) interpreting the meaning of the data by asking what lessons were learned and conclusions were drawn for interpreted data. Also, the result discussed and compared with other findings found in past literatures.

3.3 Validity and Reliability

Establishing validity and reliability in qualitative research is important in order to get consistent, reliable, useful and trustworthy findings. A qualitative validity refers to “checking for the accuracy of the findings by employing certain procedures” (Creswell,
2009, p.190). Accordingly, collected data will be validated to ensure accuracy of this study by applying the following validity strategies described by Creswell (2009):

A. Taking the final report or themes back to research participants and determine whether they feel that is accurate. This strategy is called member checking.
B. The researcher will comment and clarify biases while interpreting the findings.
C. Use peer debriefing: this strategy is to locate a friend who will review the manuscript and ask questions.
D. The researcher will present and describe negative or discrepant information that runs counter to the themes.

On the other hand, a qualitative reliability indicates that “a particular approach is consistent across different researchers and different projects” (Creswell, 2009, p.190). For this study, the researcher will check the transcripts for obvious mistakes made during transcribing audio interviews (Creswell, 2009).

### 3.4 Ethical considerations

Anticipated ethical issues will be identified and addressed in all phases of this study. Initial verbal and written informed consent will be obtained from all participants prior to conducting the interview. Participant’s identity will be anonymous at the time of interview, data analysis, writing research findings and final thesis report. During and after each interview, participant’s name will be numerically coded. Gaining initial informed consent will ensure that participants would not feel coerced in to this study and they will freely and comfortably share their view points and experience about the electronic prescribing systems. The interview with the participants will be audio-taped (after informed consent). All participants will be guaranteed the freedom to withdraw at any phase of the research either before or after the interview if they felt the need to do so.

This user acceptance evaluation study will not require an ethical permit from Astrid Lindgren Children’s Hospital or Linnaeus University Research Ethics Committee as it is not involve interviewing patients. To avoid any patient data exposure, the interviewer will not have access to the integrated electronic prescribing system. All responded empirical data, including recorded interview files, transcribed interviews will be confidential and be accessed only by the author of this study.
Chapter 4. Results

This chapter presents major results and themes from recording of research conversations on the paediatrician’s attitude and possible key factors affecting user acceptance of EPS and narrated in the following sections.

4.1 The Use and benefits of Electronic prescribing system

All participants stated the most important purpose of the EPS system is to prescribe drug for children and sometimes to evaluate doses. This includes using the electronic drug module functionality known as ‘Rimlighets Kontrollen’ which checks for over and under dosing of prescribed drug. Similarly the EPS had enabled paediatricians to use the partly prefilled drug order called ‘Favorite’ as this functionality makes it easier to select the right medicine from the drug database and write prescription in standardized way. Overall, the EPS offers solid information of specific drug for paediatricians for ordering and administering of drugs. Participants also saw the purpose of EPS to order medications based on child's current age, body weight and alerts them for any drug contraindications or interactions. One participant, however, indicated that sometimes he dismiss alerts of the system because the drug interaction is irrelevant to the paediatric patient.

“The main purpose is to prescribe medicines, to control doses between medications and in some cases to check the Rimlighets i.e. the dose control ... whether it is too much or not. But in my position it is not always possible, because I give in some cases ... we give very high doses of some medications and then ... we cannot regard the warning is over ruled in some cases .... When we order ... when we make a prescription for antibiotics for instance then we get a warning dosages will be too high. We can’t consider this warning because we have special situation in our patient”. (Participant D)

Most paediatricians reported that they use the drug prescribing systems every time particularly the ‘Favoriter’ prefilled order functionality. However, ‘Rimlighets Kontrollen’ (electronic drug module) feature is not so often used by participant during drug prescriptions. The study subjects indicated that they don’t use ‘Rimlighets Kontrollen’ because they are familiar with the drugs which they prescribe and or they used to do the calculations by mind, they use this functionality only when issuing immune suppressions drug types.

“I know about Rimlighets Kontrollen, I use Rimlighets Kontrollen not so often... may be a few times every month because most of the time I know the drugs...so I know approximately how much I should give. I use the ‘Favoritor’ all the time” (Participant B)
“I am aware of Rimlighets Kontrollen, I use for the medicines that I know, I usually don’t use it that much... it’s for when more complicated drugs like immune suppressions medications and so on... I use it only for drugs that I am not familiar with” (Participant E)

“Though I am aware of Rimlighets Kontrollen, I am not that often using it really... because I am so used to do the calculation in my head.... And I won’t do severe mistake... but maybe I should use it more ... but it’s not that often it was when all the time when this alert system” (Participant F)

When asked regarding benefits of the EPS participants stated that using the systems has improved patient safety, though there was no study carried out on patient safety to confirm this. The study elements also recognised benefit in using the system for accessing drug information, and reduce adverse drug events (ADE). Compared to paper based prescription, the EPS has a number of benefits such as saving time for paediatricians and it is clearer, easily accessible and available all the time.

“I think it is always available wherever I am in this office.... And I can go to another office and I can turn on the computer and I can see what medicines the patient should have. Before we could go around ... we did not know where the papers? ....where it’s very good advantage and as we said before, I like the ‘‘Favorite’’ very much and it’s standardized also” (Participant C)

“This is clearer than it was before. When we just wrote it on the paper prescription and now we can ... even though I say it can be hard to find what drug have been treated with, find more easily and it’s much more clearer and you can easily see that it is how much it is supposed to have and you see also that it’s milligram and the units” (Participant F)

Even though participants have appreciated that the EPS was safe, easy and fast, one of participant said the system is not a complete system for every prescription and some of the functionalities need to be improved.

“It shouldn’t be possible if you write the prescription that will last for one month then the prescription should also stop in the computer. It should be visible that this antibiotic has been stopped now. But in the system as it is right now ... it can now the antibiotic seems to go on and on for the entire alternative” (Participant B)

Other participants have highlighted some shortcomings of using the system such as inflexibility of the system, it takes some time to learn the system, lack of system and drug
information update and the system doesn’t handle drugs for all paediatric departments of the hospital.

“It’s about the Inhalations ... it is not easy to change if the patient should have the inhalation every forth hours and I want to give it every sixth hour. It’s very difficult to change such things in the system” (Participant C)

“I would say is that sometime there is slow development in these things and with regard to sort of developing new ‘‘Favorite’’, those kinds of things. I think that the process could sometime be faster, but then again it’s because I like the ‘‘Favorite’’ ... so I would like them to be able to happen for all of the drug that I work with not only most the drugs” (Participant G)

“Well, this system is not suitable to handle prescriptions at the Intensive Care Unit and these two systems don’t communicate with each other. If you have changes in the prescriptions half hour, then this system is useless” (Participant D)

4.2 Attitude towards Electronic prescribing system

The overall sentiment was that all study subjects demonstrated more favourable attitude toward the EPS. They were greatly positive to the idea of having ‘Dosage Control’ and ‘Instruktion’ functionalities. Also they were more positive about EPS simplicity and time saving in spite of the fact that it requires much scrolling through some screens.

“I was positive because I felt it worked better than the previous one so it was a visible improvement of the other system and the ‘Instruktion’ are a big help since we’ve got them”. (Participant B)

However, a negative sentiment was expressed by one of the participant as the EPS was not satisfactory at the present.

“The system in general I am not that big fun of, but I would say that the dosage control and what it’s great and the ‘Instruktion’ you can get is very good too ... yeah.. That’s faster mostly”. (Participant A)

Most participants reported that the use of the system has changed the way they carry out their prescription task, as it does not require them to do calculations by hands to identify low or high doses and it makes things much easier and they believe it significantly saves time while ordering prescriptions.
“Now I have an ability to check, before I was sitting with the calculator much more... and sometime I was sitting with my cell phone... or there was no calculator ... and also sitting and trying to do mathematical calculations with varying results. So, I would say that now I use this instead of that for a lot of things”. (Participant G)

4.2.1 First reaction towards EPS

Participants were asked about their reaction or impression toward EPS in issuing drug prescription for paediatric care. Though the respondents showed a mixed reaction toward EPS, most of paediatricians still like the system and consider it as reliable system.

“At the first days I thought it was rather difficult ... and I was scared and how should it go but it was easier than believed. And I think, it is reliable and I trust it”. (Participant C)

Conversely, some paediatrician expressed that they were uncertain and frustrated when using the system in some department of the hospital such as the emergency room. To avoid this uncertainty, paediatricians further double check what they have prescribed by asking their senior colleagues and consider this a more accurate than the system.

“Well, in the beginning it was only active on something. So I would say that ... I did have a positive reaction, but I also knew about it and I am working with patient safety ...and I know that medical errors are one of the biggest risks that we have. So I am a bit biased in that sense ... then it was a bit frustrating on emergency room of the paediatric care. I feel the system is really helpful, but sometimes I don’t trust myself. So, it’s still sometime that sort of double check and so on, now I feel big confidence. But in a practical sense to be quite honest I trust my senior physician opinion, because it is more accurate than the system”. (Participant G)

4.3 Factors affecting acceptance of EPS

4.3.1 Perceived usefulness of EPS

The interviewed paediatricians stated that the EPS is very useful to order medication and it has enhanced their job performance i.e. as a prescriber this system has helped them much better to accomplish their job more quickly and they can view patient’s medication history. The electronic dose module (Rimlighets Kontrollen) and ‘Favorite’ modules were also perceived most useful as it prevents for over and under dosing and it contributes to efficiently order prescriptions respectively. Also users of the EPS perceived that it has much facilitated ordering of medication with less time.

“I can always see what medicines the patient having given, so the system has increased my job performance”. (Participant C)
Other participant stated:
“Its very quick ... it has really done a tremendous good thing to facilitate my work, and it takes much less time to make the prescriptions than before”. (Participant F)

“The ‘Favourite’ are the most that affected me most, because that’s give me ... makes me more efficient when using the system. I don’t have to push in the dose variable I don’t have to make how it should be given”. (Participant E)

One participant, however, expressed that the security steps may be avoided to speed up the medication procedure more quickly.

“I think, it’s good to have this standardized prescription system, but still believe that some security steps can be avoided may be to speed up the procedure”. (Participant D)

Although participants perceive that the EPS had increased their performance, they felt unsecure at the time of ordering medications such as ‘extempore’ prescriptions i.e. if a drug is not listed out in the ‘Favorite’, and when the EPS system does not allow the paediatricians make prescriptions according to their need. One of the participant said that he prefers to seek advice from senior colleague instead of using the EPS.

“When I do ‘extempore’ prescriptions, extempore you know when it is not in the ‘Favorite’ ... when I have to write in my own. Then, sometime I don’t see exactly how the prescription will be without sending it ... and then when I have sent it ... I can look how did it look, and then I say oh! This is not working, it is wrong ... and then I have to rewrite ... so then I feel a little insecure”. (Participant B)

Moreover, other issues that negatively affect the usefulness of the EPS is that the system is not flexible enough to make change or modify medications, which is sometimes is needed to order patient specific drug types.

“If a patient has inhalations, it’s rather difficult to change between inhalation every fourth hour to every six hour ... it was easier before”. (Participant C)

The participants generally perceived that the EPS was useful for enhancing quality of drug prescribing (pharmacological safety such as reduced medication and prescription error, making it possible to correct prescription error and trustworthiness of the prescription).

“It has increased the performance and the quality of drug prescribing in paediatric care”. (Participant B)

“The system is suitable to correct prescriptions that are incorrect”. (Participant D)
Even though participants perceive that the EPS improves the quality of drug prescribing, one participant indicated that the EPS is a bit annoying in some situation such as difficulty of viewing an updated patient’s drug history.

“I think, the system makes safer prescription and it’s more trustworthy. The thing that is a bit annoying is that you can see all drugs that have been prescribed... and usually it's sort of contingency but may be it has just been for shorter period. So if you have like antibiotics and you see a kid taking antibiotics for 10 days, and then you see them like 6 months later and still there ... so you can sort of imagine that can make me an error ... that you think the one drug still treated with the same drug, because it has not ... it should be some way where it should be disappear or we should may be better to really put the end date which we don’t always do”. (Participant F)

4.3.2 EPS Perceived ease of use

When asked about the ease of use for EPS, most participants repeatedly stated that compared to other prescribing systems or paper based systems, the EPS in most cases is easy to use, learn, clear and understandable.

“Before we just use paper ..... I think it’s easier when compared to paper prescription”. (Participant F)

“For me it’s easy to use the system and in most cases it is clear and understandable”. (Participant D)

However, not all interviewee share the above views, paediatricians in this study had strong concern and issues regarding the ease of use of this prescribing system, they commented that it requires lots of clicking to navigate the system, it is not intuitive, it is difficult to view or read the overview and changes that has been made in prescription particularly for chronic patients and it has a complicated interface and ungrouped information. In addition to this, prescribers worried about whether the prescriptions are easily understandable by several nurses. Nurses might not understand what paediatricians have ordered in the system due to complicated screens and they might unable to differentiate or view current medications and which medicine the patient should have. Despite of these mixed perceptions most of the paediatricians found that using the EPS not difficult to use.

“It’s rather easy. I think, it’s very easy and understandable, but the weakness is the overview. I think, it can be rather hard to see if a patient how long has the patient and when has changes has been done ... so I have to go ... it’s rather good when the patient gets the medicine and we give it. But, if the patient is a chronic disease and receives medicine for years and there are many changes, then it is rather hard to get an overview. So, I have to remember between these overviews, when I look at this, then it’s for me ...
and then I want to check often what to the nurses is it ok, when the nurses can see, and then perhaps I want to look at this to see what medicines are going and what medicines should the patient have. So, perhaps medicines that are not given to the patient should be in another colour or something when I finish the medication”. (Participant C)

“I don’t feel it’s very easy to use. It is not extremely hard. I mean, I use it but there could be a lot of things with regarding the information, how it is displayed ... and so on. That could be grouped I think”. (Participant G)

“I think, it’s very difficult to understand this ... to me it’s very difficult to understand the way ... and I know that there are several nurses that think this interface here is more complicated for them to read”. (Participant F)

Some participants said the system is not intuitive also they expressed that issues that affect ease of use of the system might be due to insufficient system training and lack of education, they recommend that it is useful to learn and train more on it and potential improvements is needed for the system.

“It is easy to use and navigate, if you know how to use it ... It is not only you need to train ... you need to learn, you need to work with it .... So it is not intuitive in the way that is not web based intuitive system, so you need to work a little bit with it”. (Participant B)

4.3.2.1 Factors that affect ease of use

The interviewed paediatricians in this study were asked to describe barriers they encountered while using the EPS system in paediatric care. One respondent said the graphical interface has been problematic and it was not intuitive and user centered. They indicated that they were unable to read some of the text found in the EPS screen, which further required the user make changes and use the manual way. Furthermore, the interfaces are not flexible and simple when it comes to make changes for some type of medication such as intravenous doses. Poor user friendly GUI display or usability of the system and human interface design making paediatricians dissatisfied with the EPS system and misperceive the benefit of the system.

“The automatically produced text is really not easily readable, so I usually change that I usually go manual and I will write. We have quite a big problem with the system, that if you don’t use .....if you just push this ongoing it says ‘tilsdreongoin’ ...then you have the Penicillin for until next time someone looks in the system that could be for a couple of years in the computer not for the child. So, when you come into the hospital next time people would think you have been eating Penicillin three years. Moreover, changing IV fluids or other electrolyte or parental nutrition and so on that’s quite difficult work to do
Another paediatrician complained about the variations or inconsistency of the ‘Favorite’ file entry or selecting a wrong folder in file entry as they switch (navigate) from one medical unit to another unit, the participant fear that such problem could increase the likelihood of ordering an erroneous prescription.

“If you switch wards, you can sometimes…. I mean, last time I was actually in to the system, I was at the Emergency room (ER) and now I am here at the Neontology Unit, then you can have sort of somewhere else, so you are in Karolinska but you are actually not at Neontology. So that’s what we encountered a little bit problems with that because you can have other ‘Favorites’ pop up with in your own. There is still a ‘Favorite’, but it could be like ‘Favorite’ from another institution…. Or problems with the directory with the wrong sort of the wrong hierarchy in the file entry they are not at Karolinska” (Participant G)

“I need to be sure that I am in the right folder (the file entry) because that I have no medical error but sort of I have prescribed …. Sort of the wrong favourite for a patient there was different folder paediatrics and neonatology” (Participant F)

The other issue is a fragmented display or ineffective presentation of drug information. Paediatricians said they had difficulty to view and read overview of medications particularly intravenous doses from the EPS screen. Other challenge was that, lack of quick medication overview of paediatric patient and the display print out of the medication contains large volume about drug information, this has created difficulty in picking up significant and relevant medication information during data entry and print out.

“I think that I have like infusions to get a good overview with them that are important to me especially on a ward like where there are a lot of infusions and pumps and so on” (Participant G)

“Well, I think when you want to write or to print the list, sometimes it’s quite so huge and it can’t really find it. It could be a better way when you want to print it, that it could be more comprehensive and lack easier. When you want to the patient then sometime you get 5 sheet of paper and so much information. So if it was possible to just take some more of it, maybe it is …. I haven’t really found that out” (Participant F)
Chapter 5. Discussion

In this section, chapter 5 analyses and compare the qualitative results with previous literature. It also presents the discussion about the method used as well as applied conceptual framework. Finally it elaborates limitation as well as validity and reliability of the study design.

5.1 Discussion of result

This qualitative study used the original TAM as theoretical model to understand paediatricians attitude and identify the primary factors that assist or hinder acceptance of electronic prescribing systems in tertiary care. In order to evaluate user’s acceptance, the author has selected one of the method described by Holden & Karsh (2010) to assess or ask users about their acceptance rather than measuring end user satisfaction. This is because the former method can reliably explain behavioural intention to use (acceptance).

The following section will consider and discuss the findings as interpreted through TAM. By using TAM model I have evaluated the attitude of paediatricians that primarily affect acceptance of EPS and its possible factors.

The qualitative analysis of this study showed that paediatricians were satisfied with the EPS system, as most study participants conceded that the electronic module allows them to check for over and under dosing of medications. Generally, the prescribing system has enabled paediatricians to order and administer medication. However, some participants ignore to use the alert given by the system because the alert messages are clinically insignificant or irrelevant for the paediatric patient. Ignoring system’s alert might limit the use of EPS system. Further study is needed to determine in what conditions and how often do physicians ignore these alerts and their reason. This could help to improve alerting and increase patient safety as well as acceptance of the system.

Paediatricians were enthusiastic about the benefit of utilizing EPS system for ordering paediatric medications, however there are drawbacks linked to lack of flexibility, lack of system and drug information updates, the system is not suitable to handle drugs for all units. This findings indicates a need to overcome and address these drawbacks through improving the current system; otherwise it will hinder the acceptance of EPS system

With regard to attitude toward EPS system, the results indicated that paediatricians showed more favourable attitude towards the use of the EPS, this may have been due to functionalities like ‘Dosage Control’, ‘Instruktion’ and its time saving. In contrast, some paediatrician may seem have negative attitude due to much scrolling which appear in some of the EPS screen. The TAM model described by Davis et al. (1989) regarded
attitude toward using IT systems is jointly determined by usefulness and ease of use of a system. It would appear that paediatricians tended to have negative attitude due to poor usability issues and ease of use of the system which in this case may affect the acceptance of the EPS system.

In general, a positive perception of EPS usefulness by paediatrician was evident as it enhanced their job performance, prevents from over and under dosing of medications and performing the prescription task more quickly. Even though some of the users felt insecure at the time of ordering ‘extempore’ drugs and some other users get annoyed while reviewing medication history, in such cases this did not allow them to accomplish their job more quickly. Paediatrician’s use of the EPS system indicates that they perceived the prescribing decision support system as useful (enhancing their job performance, quick access to drug information). These replies reveal that users of EPS have moderate level of perceived usefulness for the system, but it was more amenable toward positive. In order to better understand perceived usefulness of EPS, there are other determinants that exert their influence through perceived usefulness and ultimately enhance usefulness. The original TAM can not explain this and future research should determine which factors affect perceived usefulness of EPS either applying the extended TAM or UTAUT models.

Although the EPS system is easy to use and understandable, results of the interview indicates that paediatricians were generally complaining and dissatisfied with the current ease of use of the system because they found that it contains complicated screens, it is difficult to view and read drug overview of the patient, it requires many clicks to navigate the system, and it is not intuitive. In addition, it is difficult to view changes made in the prescription and it has ungrouped information that make reading prescription more difficult. Accordingly, paediatrician responses about attitude toward ease of use of EPS were mostly negative. Day et al. (2007) stated that in the context of TAM, perceived ease of use refers to actual screens of interfaces of a system. The user interface is the main gate in which end users interact with the system and take actions. An efficient and easily intractable screen can help medical staff easily input, manipulate drug data and easily learn the system.

In paediatric care setting, a clear and understandable overview of drug information is important for all users of the EPS and not only for paediatricians, for instance quick medication overview are essential for nurses to administer medications for paediatric patient safely. However, according to Nykänen et al. (2011) if clinical users unable to see important medication information, then the healthcare computer system is ill-functioning and end users may administer incorrect drug doses for patients or induce medical error due to the glitches that show faulty displays of the EPS, or having negative outcome and an impact on the patient safety. Thus, high attention and effort needed to be given to have
an intractable drug overview screens and enhance usability issues such as menus, making navigation easier and displaying drug data in clear and understandable way for all end users.

It was evident in the interview participants clearly would like an additional ongoing training and education about the system in order to mitigate ambiguity on the use of the system. The finding is inline with previous research by Davis et al. (1989) who contend that training is one of external factor that may affect PEOU. The findings of perceived ease of use in this study are in keeping with those of Aarts (2011) who indicate that unsatisfactory user interface was problematic for prescribers of electronic prescribing system and he suggested that electronic prescribing systems should have medication information which is meaningful, unambiguous and prompts for the right action. As it appear in this study, customizing the user interface in the context of prescribers and specific patients is very crucial for a successful system and user acceptance. Redesigning a user friendly screen is important to bring changes of perceived ease of use and enhance the usefulness of the system which in turn leads to higher acceptance (Ketikidis et al. 2012). Failure to improve ease of use of the EPS system with user friendly screens as well as quick overview can limit the usefulness of EPS system (Day et al. 2007). However, other author stated that perceived ease of use is more important at early stage of system implementation and it becomes no longer important to acceptance over time because of increased system experience (Holden & Karsh 2010). According to TAM (Davis et al. 1989) a positive PU exerts a direct effect on acceptance of IT while a negative PEOU can impede acceptance of healthcare IT. In the context of this study setting, the analysis of the result imply that perception of ease of use of the system may strongly affects paediatricians acceptance of EPS than Perceived Usefulness because users have raised many concerns about ease of use, ultimately this has influence on the usefulness and acceptance of the EPS. Nevertheless, this findings is not consistent with Chismar & Wiley-Patton (2002) who reported that perceived ease of use did not affect paediatrician’s acceptance of internet-based health applications like Electronic Health Record, e-prescribing, while perceived usefulness was the primary construct that strongly determined technology acceptance. Even if participants agree that the system is useful, the study findings indicate that paediatricians encountered challenges related to the use of EPS. Some of the challenges were: a fragmented display or ineffective presentation of drug information, the graphical user interface is not intuitive and inconsistency of the ‘Favorite’ file entry. Poor screen can make end users misperceive the usefulness and dissatisfied about the system.

Lastly, perceived ease of use is the main factor for the acceptance of EPS system mainly because the current system is not easy to use, it contains complicated screens, and it is difficult to read and view patient medication history, it requires many clicks to navigate and it is not intuitive. To sum up so far, perceived ease of use (PEOU) can be the factor
that determines the acceptance of EPS system in this healthcare setting. The study result generally corroborated other previous findings of Day et al. (2007) who reported that PEOU appeared more dominant factor for the acceptance of health IT. The following table summarizes important factors identified by the current study.

Table 2. Key factors identified by the current research.

<table>
<thead>
<tr>
<th>Influencing key factor</th>
<th>Supports literature</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PU</td>
<td>Feeling insecure while issuing ‘extempore’ types of drugs</td>
<td>No</td>
</tr>
<tr>
<td>PEOU</td>
<td>Too much scrolling through some screen</td>
<td>Davis et al., 1989 Day et al., 2007</td>
</tr>
<tr>
<td></td>
<td>Lots of clicking to navigate the system</td>
<td>Davis et al., 1989 Day et al., 2007</td>
</tr>
<tr>
<td></td>
<td>It is not intuitive</td>
<td>Davis et al., 1989 Aarts 2011</td>
</tr>
<tr>
<td></td>
<td>It is difficult to view or read the overview and changes that has been made in prescription</td>
<td>Nykänen et al., 2011</td>
</tr>
<tr>
<td></td>
<td>Issued prescriptions are not understandable by other users like nurses etc…</td>
<td>Nykänen et al., 2011</td>
</tr>
<tr>
<td></td>
<td>Insufficient systems training</td>
<td>Davis et al., 1989</td>
</tr>
<tr>
<td></td>
<td>Not user friendly interfaces</td>
<td>Aarts 2011</td>
</tr>
</tbody>
</table>
The above table summarized key factors related to PEOU and PU and whether they are relevant to existing studies. Besides, it provides a quick overview of key results with regard to previous TAM studies.

### 5.2 Discussion of methods

Using the qualitative method was deemed appropriate for this study, despite the fact that only seven participants were participated in the interview session. Nevertheless, the sample sizes were representative in that it has included end users of different ages and gender. According to Patton (2002) a qualitative research can prevent mismatched assumptions and enhance the chance of meeting objective of the research. However, even if quantitative research designs often are valuable in measuring the clinician’s attitude, they are less helpful mainly because self assessment or self-reported usage may not be an appropriate surrogate for actual use because users are poor estimators of aspects of their own behaviours Zheng et al. (2005) and Likert-type scale questionnaires can easily result in misleading of research findings due to well known biases such as the halo effect, socially desirable response sets, yea-saying, end aversion, framing and question order effects (Mead & Moseley 2001). Qualitative methods typically are used to understand the perception of health information systems by its end users as there are host factors such as characteristics of individuals, technology, and organizational context which affects user acceptance (Anderson & Aydin 2005). The qualitative approach employed an inductive method of analysis in which it allowed the researcher begin with data and then develop conclusions by undertaking repeated cycles of data collection and analysis. It also allows changing research question and use different data collection methods such as interview,
observation and open ended questions. Furthermore, qualitative TAM study can be informative by providing brief and practical information about PU, PEOU and attitude (Holden & Karsh 2010). The alternative method for doing this research could be the quantitative method with survey data collection. The quantitative research design may be useful as it enables not only to test the relationships between TAM constructs but also to measure the variables itself for this particular healthcare setting. Even though a survey has strong reliability than qualitative interviews or observations, the results can have weak validity.

The technology acceptance model is a widely studied model and it includes findings accumulated from over a decade of IS research. It is one of prominent IS tool used to evaluate the acceptability of computer systems both in the design and implementation phase of system development life cycle. TAM is widely used and applied in different types of technologies to understand user acceptance. However, TAM doesn’t elicit the impact of IT design characteristics; it only focuses on individual users’ beliefs (Davis et al, 1989). Also, TAM was unable to take into account the social and cognitive influences. It was evident in the interview that some users of EPS perceived that they can get better advice from senior colleagues in ordering drugs rather than consulting the EPS, so TAM can’t identify the significance of social influence. Although TAM was not specifically designed for healthcare (Holden and Karsh 2010), yet this study has expanded empirical applicability of existing literature and supported that applying TAM in tertiary healthcare setting was helpful in understanding paediatrician’s acceptance of EPS. Hence, TAM can advance the understanding of healthcare professional’s HIS acceptance and continues to be the most frequently employed and more useful tool in studying IS phenomena.

5.3 Validity and Reliability

In qualitative study, assessing or establishing reliability and validity for research is important in order to get consistent, reliable, useful and trustworthy findings. A qualitative validity is referred as “checking for the accuracy of the findings by employing certain procedures” (Creswell, 2009, p.190). Validity in qualitative research addresses the necessarily subjective nature of data collection and analysis, the main reason is that the researcher is the instrument for collecting and analyzing data as well as the study is subjective in the sense of being different for different researchers (Anderson & Aydin 2005). In this study, a valid and reliable semi structured interview was developed. To attain the validity of interview questions, the interview protocol was presented and critiqued by pediatric expert. A week before actual interview, mock up interview was conducted with a user who is currently working on the system, after this, a final refinement was done to the first version of the interview guide. To validate the findings
and determine the accuracy of the information, the following procedures were employed as described by Creswell (2009):

a- Through member checking: providing the final report or themes back to the participants.
b- By identifying and analyzing negative or discrepant information.
c- Peer debriefing and
d- Clarifying all study bias that the researcher brings.

A qualitative reliability indicates that “a particular approach is consistent across different researchers and different projects” (Creswell, 2009, p.190). In order to maintain the reliability of this study, a common approach used in qualitative research stated by Creswell (2009) were followed i.e. through checking the transcripts and making sure that the content of the transcripts does not contain obvious mistakes. For this study, the reliability checks of the audio recorded interviews were carefully transcribed by re-listening to the recordings and checking for noticeable mistakes made during initial transcription, and at the time of transcribing some of poor or doubtful recorded data or information was deliberately excluded from further data analysis. Moreover, incomplete and missing data were also left out from further analysis in order to support reliability of this study.

5.4 Research limitation

This qualitative research has some limitations: first, the small size of participants will have impact on reliability of the findings. The purposeful sampling consists of mostly experienced paediatrician and few junior paediatricians who responded to participate in this research, there could be information gathered from resident paediatricians if more were recruited. The participants were limited to paediatricians, other current users of the EPS systems such as nurses, pharmacists and physician assistant were not recruited. It would be advisable to include them in future research. However, the sample sizes were representative in that it has included participants from different ages and both gender. Secondly, the interview instrument used in this study was subjective, Davis et al. (1989) stated that most subjective measures which used in practice are un-validated and their relationship to system usage is unknown.

Thirdly, at the time of transcribing the audio taped interviews, there were Swedish words which are correctly transcribed and included. However, few information was excluded during data analysis phase, as the transcriber is non-Swedish speaker. The omission of some of these Swedish words might alter the message conveyed by the participant.
Chapter 6 Conclusion

This last chapter presents conclusion of the conducted study as well as future research.

This thesis paper aimed to evaluate paediatrician’s acceptance and use of electronic prescribing systems at Astrid Lindgren Children’s Hospital. The study demonstrated that an understanding of the acceptance of Electronic Prescribing System among paediatricians is crucial for overall successful implementation of health information systems. Electronic Prescribing Systems has significant potential role in improving patient safety and reducing adverse drug events, however, not much is known or written in literature about paediatrician’s use of medication management (e-prescribing) at Swedish paediatrics settings. Applying Technology Acceptance Model framework at tertiary care paediatrics hospital has enabled to get an empirical and practical illustration of paediatricians’ attitude and acceptance of prescribing system.

In conclusion, this study has identified factors that are important for paediatrician’s acceptance of Electronic Prescribing System. Although paediatricians are positive to the usefulness of prescribing system, it appears that there are some acceptance problems due to ease of use concern and usability issues of the system. The study participants believe that the system is easy to use and clear when compared to the previous manual paper based prescription. However, paediatricians were discouraged by their perception that the system is not secure while issuing ‘extempore’ types of drugs, lack of intuitive screens, not user friendly interfaces, fragmented drug information display and lack of quick medication overview of paediatric patient. It becomes essential and worthy to address the raised key factors affecting perceived ease of use and perceived usefulness concerns in order to achieve successful use of the system and increase user acceptance. Clearly, the Electronic Prescribing System requires further improvements, this need to be carried out in collaboration and involving all users of the systems. Further, paediatricians desire a flexible system and they anticipate future improvements about the current prescribing system. In addition to this, providing proper training session and education can help end users to effectively use the system, as well as increasing its usage and acceptance. The findings are encouraging, and future study need to be confirmed through evaluation with a more representative data sets of end users not only paediatricians but also nurses and other paediatric clinicians. Finally, this study attempted to describe the acceptance of paediatric electronic prescribing systems by paediatricians at Swedish tertiary care through prominent model using Technology Acceptance Model and the acceptance of prescribing systems may be improved by leveraging usability as well as enhancing training.
**Future research**

Future research could be to investigate human factor issues related to the use of the EPS system and usability evaluation to gain illumination of EPS’s effect on paediatrician’s workflow. Follow up evaluation research of user acceptance might be complemented with several participants using quantitative data collection such as questionnaire questions; this might provide detailed understanding of paediatricians need. A similar study could be carried out by including other end users like non-physicians (nurses) and applying a recent user acceptance model such as the Extended Technology Acceptance Model (TAM2) as well as Unified Theory of Acceptance and Use of Technology (UTAUT). Even though UTAUT model is more complex than TAM, it can capture more information than using TAM.
References


Appendices

Appendix A. Interview Guide

Section I: Demographic data
Direction: Please fill out each item and select the item that best describe you.
Interview questionnaire number: ______
Date of interview: ___ / ___ / ___
Place: _______
Interviewer: ______

1. How old are you:
   □ ≤ 29 years  □ 30 – 39 years  □ 40 – 49 years  □ 50 – 59 years  □ ≥ 60 years

2. Sex:
   □ Female    □ Male

3. What is your profession?
   □ Resident Physician  □ Pediatrician
   □ Neonatologist       □ Pediatrics surgeon
   □ Nurse               □ If other please specify ________________.

4. How many years have you been working in your current profession? ______ years.

5. How long have you been working in ALCH? _____ years.

6. How long have you been using the electronic prescribing systems?
   □ Less than or equal to 6 month.
   □ More than 6 months or less than a year.
   □ More than 1 year or less than 2 years
   □ More than 2 years or less than 3 year.
   □ More than 3 years or less than 4 year.
   □ More than 4 years.

Section II. Semi-structured interview questions
The following interview questions were developed and formulated based on TAM key determinants i.e. (PU, PEOU and Attitude) in order to capture the relevant data for this study.

Brief description of Electronic prescribing system (EPS)
Prescription of medications is one of the common clinical tasks and EPS can assist clinicians to check for dosage errors, drug-drug interactions, and other prescribing
contraindications such as allergy (Coiera, 2003). The EPS is an integrated system with the “TakeCare” Electronic Health Record System and the main functionalities are: it consists of approximately thousands of prefilled order, a drug database, and an electronic drug module which checks for over and under dosing of prescribed drug as well as checking that the dose is within the recommended range. The drug module also generates safer computer calculated doses for paediatric patients by taking into account the dose form, dose limit, weight, age of the child then the entered value will be assessed against age related normal values and if the dose is outside the range an alert will be displayed for the paediatrician.

**Purpose of the study**
The purpose of this study is to explore paediatrician’s attitude towards the use of electronic prescribing systems as well as better understand the significant possible factors affecting user acceptance.

**Main interview questions**

1. For what purpose do you use the system?
2. In terms of pharmacology safety and supporting patient safety … what are the advantages do you perceive from using electronic prescribing system?
3. In your opinion, what are the disadvantages do you perceive from using electronic prescribing system?
4. Can you describe how the electronic prescribing system has affected your ability to issue prescription and job performance in terms of easier work process and better quality of care?
   [In this study job performance refers to how the electronic prescribing system helps you to accomplish a better job as a prescriber]
5. Do you think using EPS allows you to prescribe drugs for children more easily, quickly and accurately?
6. Have you ever felt unsecure when you issue prescription?
7. Can you describe whether the EPS improved or decreased the quality of drug prescribing in paediatric care?
   [Quality indicates increasing pharmacological safety such as reduced medication and prescription error, making it possible to correct prescription error, increase trustworthiness of the prescription etc … ]

8. Do you perceive that using the EPS is easy to use? To what extent do you find it easy or difficult to get the EPS what you want it to do?
8.1 Can you easily navigate among the different windows and interfaces?
8.2 Do you think using the EPS is clear and understandable?
9. What was your first impression or reaction toward EPS in issuing drug prescription?
10. What is your opinion about the EPS? Why do you think you feel like that way?
11. Can you recall a time when you felt you were having difficulty in using the electronic prescribing systems? Tell me about it, what made it so difficult
Thank you very much for participation in this study research.

Appendix B. Informed consent form

Dear Research Participant:

You are invited to take part in a research study that will attempt to understand end user’s acceptance and attitude regarding the new fully implemented Electronic Prescribing Systems (EPS) at Astrid Lindgren Children's Hospital (ALCH). The EPS is part of the “TakeCare” system which assists clinicians issue prescription, check for dosage errors, drug-drug interactions. This system particularly consists of 1000 prefilled order, specific drug database, dosing help and an electronic drug module. Being in the study will help the researcher better understand technology acceptance of EPS in pediatrics care. The following information is provided in order to help you make an informed decision whether or not you would like to participate. If you have any questions please do not hesitate to ask the researcher at any time. You are being invited to take part in this interview because you are a pediatrician who has been familiar with EPS and using the current prescribing systems in ALCH, so your opinion is important.

Research Topic: Evaluation of electronic prescribing system

Researcher: Abdurahman Omar, Master Program in Information Systems, Linnaeus University.

Purpose of the research: This research is a master’s research study. The purpose of the research will explore end user’s attitude towards electronic prescribing systems and to understand the factors that influence the acceptance. The interview will be used as data for thesis research paper.

Study Procedures: You will be asked to participate for an interview. The interview will take approximately 30 minutes of your time. It will be audio-taped (with permission) and will take place in ALCH. During this interview you will be asked a series of questions. These questions are designed to allow you to share your attitude toward EPS use.

Potential risks and/or discomforts: There are no anticipated physical, emotional risks, or discomforts associated for participating in this interview. Some person might consider some of the questions sensitive. You can decide not to participate. If you decide to participate in this study, you can opt out/withdraw or indicate that you do not wish to answer posed questions at any time, during and following the interview.
**Potential benefits:** The information gained from this study will make contribution to understand technology acceptance and will provide a wider understanding of issues of EPS user acceptance in pediatric care. Participating in this interview, may or may not have any benefits. Exploring with another person issues that are of mutual interest could be an enjoyable experience for you.

**Confidentiality:** you will not be identified by name in any reports of the completed study. The raw data will be identified by other identifier such as codes during interviewing. The Audio tapes will only be used to transcribe interview. Only the researcher will access and use them. The information obtained during this study may be published in master thesis research paper in summarized form, however the data will be prepared as aggregate data and your responses would be totally confidential.

**Remuneration/Compensation:** you will not receive any type of compensation for participating in this study.

**Opportunity to ask questions:** you may ask any questions or desire further information concerning this research and have those questions answered before agreeing to participate or during the study. You may contact the researcher via amokp09@student.lnu.se.

**Freedom to opt out/withdraw:** You are free to decide not to enroll in this study or to withdraw at any time. Your decision will not result in any loss of benefits to which you are otherwise entitled.

**Consent:** If you wish to participate in this study, you will be interviewed. You are voluntary making a decision whether or not to participate in this research study. Your signature below indicates that you have decided to participate having read and understand the information presented. You will be given a copy of this consent form to keep.

_____________________________  ____________________
Signature of participant  Date

I hereby give consent to audio record my interview.

_____________________________  ____________________
Initials of participant  Date

In my judgment I am voluntary and knowingly giving informed consent and possess the legal capacity to give informed consent to participate in this research study.

**Researcher Name:** Abdurahman Omar

_____________________________  ____________________
Signature of researcher  Date