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**Factors Influencing Attitudes towards, and the Use of,  
Information Technology in the Emergency Department**

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# ABSTRACT

**Background:** In order to make better use of information in the Emergency Departments (ED) various information systems have been developed. However, there are a number of factors that may influence the use of these systems. As there has been little research on the use of information technology (IT) in the ED, this research aims to investigate users' perceptions of Emergency Department Information Systems (EDIS) to determine various factors that may influence users' attitudes towards, and the use of, IT in this department.

**Methodology:** This research consisted of two studies. In the first study, a qualitative approach was applied. Data were collected using in-depth semi-structured interviews, and framework analysis was used to analyse data. A quantitative approach was adopted for the second study, and questionnaires were distributed in three EDs in England. Finally, between-methods triangulation was used to show how the results of the qualitative and quantitative studies confirmed and completed one another.

**Findings:** The results of the qualitative study showed that several factors could influence users' attitudes towards using IT in the ED and subsequent IT utilisation. These factors included the characteristics of users, their tasks, systems, the environment in which they worked, and the impact of technology. The quantitative study showed that the most important factors were the perceived individual impact of technology, perceived usefulness, perceived ease of use, subjective norm, and users' computer experience. These factors contributed to approximately 50% of variance in the users' attitudes.

**Conclusion:** A number of factors should be considered to improve users' attitudes towards using IT in the ED. The perceived individual impact of technology is the most important factor in determining user attitude towards using IT. ED staff are more likely to view IT systems positively and use the systems properly, if they can see direct benefits arising from their use.

## Keywords

Emergency Department, information systems, user acceptance, user attitude

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## GLOSSARY OF ACRONYMS

A&E	Accident and Emergency Department
CAB	Choose and Book
CDSS	Clinical Decision Support System
CEQ	Computer Expectations Questionnaire
CHC	Community Health Centre
CHEHR	Central Hampshire Electronic Health Records
CIS	Clinical Information System
CPOE	Computerised Physician Order Entry
DP&P	Digital Pen and Paper
DVT	Deep Vein Thrombosis
ECG	Electrocardiography
ED	Emergency Department
EDIS	Emergency Department Information System
EHR	Electronic Health Records
EM	Emergency Medicine
EMR	Electronic Medical Records
EPR	Electronic Patient Records
EPS	Electronic Prescription Service
ERDIP	Electronic Record Development and Implementation Programme
FITT	Fit between Individuals, Tasks, and Technology
GMS	General Medical Services
GP	General Practitioner
HCI	Human Computer Interaction
HELP	Health Evaluation through Logical Processing
HIS	Hospital Information System
HISS	Hospital Information Support Systems
ICRS	Integrated Care Record Service
ICU	Intensive Care Unit
IHA	Internet-based Health Applications
IT	Information Technology
LPfIT	London Programme for Information Technology

LSP	Local Service Provider
N3	National Network for the NHS
NHS	National Health Service
NHS CRS	NHS Care Records Service
NMEPfit	North, Midlands and East Programme for Information Technology
NPfit	National Programme for Information Technology
NSTS	NHS Strategic Tracing Service
PACS	Picture Archiving and Communication System
PAS	Patient Administration System
PDA	Personal Digital Assistant
PFIS	Patient Focus Information System
PHR	Public Health Registry
QMAS	Quality Management and Analysis System
QOF	Quality and Outcomes Framework
QUIS	Questionnaire of User Interaction Satisfaction
SCR	Summary Care Record
SPfit	Southern Programme for Information Technology
SPSS	Statistical Package for the Social Sciences
SUS	Secondary Uses Service
TAM	Technology Acceptance Model
TCP/IP	Transmission Control Protocol/ Internet Protocol
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
UTAUT	Unified Theory of Acceptance and Use of Technology
UIS	User Information Satisfaction

## GLOSSARY OF TERMS

Attitude	An individual's positive or negative feelings about performing the target behaviour (Fishbein and Ajzen 1975: 216).
Electronic Health Records	A longitudinal electronic record of patient health information generated by one or more encounters in any care delivery setting (Burns, 1998).
Electronic Patient Records	The computerised record of an episode of care provided to a patient mainly within one institution (Burns, 1998: 25).
Electronic Record Development and Implementation Programme	A national programme which was launched by the NHS in 2000. This programme was associated with the development and implementation of a variety of electronic records systems in different contexts including EDs and aimed to provide solutions which could be replicated across the country to establish the EHR (Folmer and Price, 2001).
Emergency Department Information System	Any type of clinical information systems that is used in the Emergency Department.
Emergency Medicine	Emergency Medicine is a field of practice based on the knowledge and skills required for the prevention, diagnosis, and management of the acute and urgent aspects of illnesses and injuries affecting patients of all age groups with (The College of Emergency Medicine, 2009).
National Programme for Information Technology	A national programme which was launched in October 2002, as a fundamental programme to create a comprehensive Electronic Health Records infrastructure, in which multimedia records would be accessible to the authorised users in all healthcare facilities (Department of Health, 2002).
Perceived ease of use	The degree to which a user believes that s/he can use the system free from effort (Davis et al., 1989).

Perceived usefulness	The degree to which a user believes that using the system will enhance her/his performance (Davis et al., 1989).
Perception	The process of becoming aware of objects by way of the sense organs (Preece et al., 1994: 717).
Subjective norm	A person's perception that most people who are important to her/him think s/he should or should not perform a given behaviour (Fishbein and Ajzen, 1975: 302)
User acceptance	A multifactor construction based on an affective and cognitive evaluation of all components surrounding and influencing the interaction process between a user and an information system (Despont-Gros et al., 2005: 247).
User satisfaction	Overall affective evaluation an end-user has regarding his or her experience with the information system (Chin and Lee, 2000: 556).

# CHAPTER 1: INTRODUCTION

## 1.1. Overview

The Emergency Department (ED)<sup>1</sup> has a complex environment, and providing care to patients in this department differs from other healthcare settings, for example, due to the speed of work, the number of patients, and the variety of patients' conditions. In order to make right decisions, the accessibility of the accurate and timely information is important, and helps to enhance patient care and staff performance. Therefore, to improve the accessibility and the availability of information a wide range of information technology (IT) is being used in the ED. This research has been designed to obtain a better understanding of using information systems in the EDs. This study aims to investigate users' perceptions of Emergency Department Information Systems (EDIS) to determine various factors that may influence users' attitudes towards, and the use of, information technology in this department. The researcher hopes the results contribute to the growing body of knowledge about using information technology in the EDs. The results can also help to design better information systems in the future.

In this chapter, the background to the research is presented in section 1.2. Sections 1.3 to 1.5 are devoted to the motivation for undertaking the research, the rationale for the study, and the aim and objectives of the research. This chapter continues with presenting the structure of the thesis in section 1.6 and a conclusion for the chapter in section 1.7.

## 1.2. Background to the research

The specialty of Emergency Medicine deals with a wide range of illnesses and treatments to save patients' lives and can be described as follows.

“Emergency Medicine is a field of practice based on the knowledge and skills required for the prevention, diagnosis, and management of the acute and urgent aspects of

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<sup>1</sup> In this research, the term Emergency Department (ED) has been used instead of Accident and Emergency (A&E) Department, as suggested by Davis and Pless (2001).

illnesses and injuries affecting patients of all age groups with full spectrum of undifferentiated physical and behavioural disorders. It is a specialty in which time is critical” (The College of Emergency Medicine, 2009).

Emergency Medicine is an information intensive speciality (Handler et al., 2004). In the EDs, patients’ problems have to be managed quickly and simultaneously, and the workload is often unpredictable. Therefore, immediate access to accurate information is critical for patient care, and emergency clinicians and their patients benefit greatly from having access to the information (Gottlieb et al., 2005). In recent years, the use of information technology in the EDs has increased to improve the accessibility of information. The use of information technology can also help to reduce errors in clinical practice, to eliminate documentation errors, and to improve the completeness of data (Harper, 2001). Some of these systems are stand-alone, and some of them work as part of a Hospital Information System (HIS) to be able to exchange data with other departments, such as laboratory and radiology (Feied et al., 2000).

However, evidence shows that although a variety of information systems have been deployed in the healthcare environment to date, a number of them have not been implemented successfully (Berg, 1999; Herbst et al., 1999; Kaplan and Shaw, 2004). In some cases, using the computerised systems has negatively affected staff workflow (Ammenwerth and Shaw, 2005), for example by their spending more time on data entry rather than on patient care (Ammenwerth et al., 2003a,b). Moreover, some of these systems have made routine tasks very difficult for users, while staff felt that they could do their job much more easily using the manual systems (Travers and Downs, 2000). As a result, users may resist using these systems and their resistance is regarded as one of the factors that may lead to the failure of a system (Saathoff, 2005).

Folmer and Price (2001) indicated that, apart from implementing technology, what is important is using the technology in an effective way. To achieve this, a number of technical and non-technical aspects should be taken into account, and paying attention to one aspect, such as technical issues, without considering other aspects, such as social and organisational issues, can contribute to the failure of a system (Handy et al., 2001). For example, user perception and user attitude are of high importance, as an *a priori* ‘good’ system can prove to be a ‘poor’ solution, if users judge it in this way (Despont-Gros et al.,

2005: 247). Such a perception may also result in clinicians' reluctance to use any other similar systems in their work environment. Therefore, along with developing and implementing information systems, understanding users' perspectives about information systems should be taken into account.

### **1.3. Motivation for undertaking the research**

There were two main reasons for undertaking this research. Firstly, the field of Emergency Medicine is one area in which guidance regarding applying information technology is scarce (Handler et al., 2004), and the literature review (Chapter 2) demonstrates that the published materials about using IT in the ED are limited.

Secondly, with respect to the characteristics of the ED, in terms of the variety of patients, the speed of care, and unpredictable workload, the researcher was interested in finding factors that might influence the use of IT in the ED from the users' point of view.

### **1.4. Rationale for the study**

The NHS in England is one of the healthcare organisations in the world that aims to use information technology at the national level (Humber, 2004). The use of information technology in the healthcare environment has been identified as a key solution to support different aspects of healthcare delivery by providing information whenever and wherever it is needed (Humber, 2004). In England, the aim of the National Programme for Information technology (NPfIT) is to implement a single Electronic Health Records (EHR) system for all healthcare professionals, including emergency care practitioners. However, in order to implement such a system successfully, a number of issues need to be taken into account. For example, emergency care providers may have different information needs compared to other healthcare providers (Clamp et al., 2002). Moreover, emergency care providers work under severe time limits, and deal with unexpected situations and a wide variety of patients. Although different sorts of information systems are currently in place in EDs, introducing a new system may still be a great challenge for the ED staff, since they first need to be

convinced of the potential value of using a new computerised system, such as an EHR system in their work environment (Clamp et al., 2002). Moreover, it is important to understand users' attitudes towards the current systems, if there are plans to implement a new system. Such an approach can help to obtain information that is needed to successfully shape users' perceptions towards the new systems and their reaction to change (Sicotte et al., 2009).

According to Brender et al. (2006), to develop and implement an information system successfully, factors that may influence the success or failure of the system should be investigated. A key factor to the success of information systems is user acceptance (Davis, 1993). Although a number of models and theories of user acceptance have been developed and tested (these are presented in Chapter 2), little research has been undertaken in the healthcare context. Some of the published studies have tested and modified an acceptance model in relation to a specific information system (Chismar and Wiley-Patton, 2002), and others have investigated the factors influencing the acceptance of a particular system in a clinical setting (Travers and Downs, 2000; Ammenwerth et al., 2003b; Sittig et al., 2006; Despont-Gros et al., 2007). Among these, few studies have focused on the factors that might influence the acceptance or use of the ED information systems. As stated above, the ability to identify, predict, and manage these factors will facilitate system implementation, and is necessary for the system ultimate success.

The proposed research intends to investigate users' perceptions of Emergency Department Information Systems (EDIS) to determine various factors that influence the use of IT in the ED. To achieve this goal, a qualitative study was initially conducted to explore these factors. Semi-structured interviews were used, as this method helps to gain an in-depth understanding of users' perceptions and experiences (Punch, 1998). Then, the results of the qualitative study were examined in a wider population using a quantitative study. Finally, the results were discussed in relation to the relevant models of user acceptance found in the literature.



## **1.5. Aim and objectives of the research**

The overall aim of this research was to explore factors that might influence users' attitudes towards, and the use of, IT in the ED. More specifically, the objectives of the research were as follows.

1. To identify the user, task, system, and environmental characteristics that might influence users' attitudes towards using IT in the ED
2. To identify the impact of technology on users' attitudes towards using IT in the ED
3. To identify the most important factors that influence users' attitudes towards using IT in the ED
4. To identify the association between the users' attitudes and the use of IT in the ED

## **1.6. Structure of the thesis**

The contents of this thesis are structured in seven chapters. The thesis starts with this introductory chapter which presents a background to the study and the rationale for the research. Chapter two examines the current literature in the field and highlights gaps in knowledge. The literature review is divided to eight sections, and includes the development of information systems within the NHS in England, the literature regarding the ED information systems, and the importance of investigating factors that may influence the use of IT in the clinical settings. Chapter three presents the methodological background to the research and outlines the qualitative and quantitative approaches and the reasons for adopting these methods.

The first phase of the research, which was a qualitative study, is reported in chapter four. In this chapter, the details of conducting the semi-structured interviews, the process of data collection and data analysis, the results, and the impact of the findings on the next phase of the research are discussed. In chapter five, the second phase of the research,

which was a quantitative study, is presented. The process of designing a questionnaire, data collection, data analysis and the results of the survey are presented in this chapter.

In chapter six, the results of the first and the second phases of the study are compared and discussed using between-methods triangulation. Moreover, the application of other types of triangulation, such as data and theory triangulation, is presented in this chapter. Chapter seven is the concluding chapter in which the research questions, which are presented in Chapter 2, are answered based on the findings of both qualitative and quantitative studies. The contribution of the research findings to current knowledge and the implications for policy and future research are also discussed in this chapter.

## **1.7. Conclusion**

In this chapter, characteristics of the ED and the importance of using IT in this department were presented. In the next chapter, the related literature is reviewed more in detail and the gap in knowledge is discussed.

# CHAPTER 2: LITERATURE REVIEW

## **2.1. Introduction**

As noted in Chapter 1, using information technology and information systems in the healthcare environment can help to improve different areas of healthcare delivery. These systems, for example, can help to enhance readability, availability, and quality of data which, in turn, can help to provide patients with better health care services (Roukema et al., 2006). However, the potential benefits of these systems have not always fully realised, mainly due to technical or non-technical issues, or both of these. This chapter provides a deeper insight into the use of information technology within the healthcare settings, particularly in the Emergency Departments (EDs), and factors that might influence the use of computerised information systems.

This chapter includes eight sections. After giving a brief introduction, the literature review methods and the search strategy are presented in section 2.2. In section 2.3, the existing literature related to information management and technology within the NHS in England is reviewed. In section 2.4, information management and technology in Emergency Medicine and Emergency Department (ED) is discussed. Section 2.5 presents the role of users in relation to the evaluation of clinical information systems. In this section, factors influencing the use of IT, user satisfaction, the theories and models of user acceptance, and related studies in healthcare are discussed. Section 2.6 presents a synthesis of the literature and section 2.7 discusses the existing gaps in the literature. A summary of the main points of the literature review is provided in section 2.8.

## **2.2. Literature review methods**

The references cited in this thesis were identified via a comprehensive literature search. Although a systematic review of the literature was not undertaken, a search strategy was developed, and used to identify relevant articles from different databases, e.g., Cinahl, Medline, Pubmed Central, ScienceDirect, Web of Knowledge and Scopus. The key words included Emergency Department, computer, information system, hospital information

systems, acceptance, and attitude. A combination of free-text and key words was also used, e.g., acceptance and clinical information systems, Emergency Department Information Systems. No restriction on date or study type was used. However, the search was restricted to English language, and computer-based training and education systems for healthcare professionals were excluded, as they are not directly related to patient care. As the number of papers related to the use of IT in the ED was limited, papers related to the use of clinical information systems in other departments were reviewed. These mainly included original research papers. A general internet search using Google was also applied. The citations for the key papers and references listed in these papers were selected to be searched for further study. The searches were originally conducted in 2006, and repeated in the major databases until the conclusion of the research. Journal alerts were also set up in Zetoc to identify the most recent papers.

### **2.3. Information management and technology within the NHS in England**

Investment in information and information technology within the NHS in England dates back to the 1970s (Jones, 2004). In this country, one of the most important earlier attempts was implementing the Hospital Information Support Systems (HISS) programme in 1988. This programme, which was carried out to promote the development of electronic records at the national level, focused on the NHS acute hospitals and aimed to connect Patient Administration Systems (PAS) with other clinical systems. In 1994, the Electronic Patient Records (EPR) programme was initiated which led to greater success in implementing hospital-wide systems. This success was mainly related to improving the clinical aspects of information systems and management-clinician partnership in the demonstrator sites (Jones, 2004). However, as Cross (2006a) indicated, the progress of modernising information technology in secondary care was hindered in the mid-1990s, since the global IT companies stopped their operations or bidding for contracts within the NHS, partly due to financial problems. At this time, the majority of the information systems had been developed to meet local needs (Lusignan et al., 2000). As a result, the incompatibility between information systems was a serious barrier to future development.

In 1997, improving the accessibility and availability of healthcare information was identified as an important factor to deliver better healthcare services. In 1998, the new British government established a ten-year plan to rebuild the NHS and one of the visions was to develop and apply information technology within the NHS. To achieve this, ‘Information for Health: an information strategy for the modern NHS’ was published. In this strategy, all aims, objectives, and targets of the ten-year plan were introduced. The main aim was to provide patients, carers, and the public with the information that they needed to improve healthcare delivery (Burns, 1998).

As this research was conducted in the EDs located in England, and the NHS is responsible for providing the clinical settings with the information technology that they need, it was important to review the NHS strategies and plans for developing information systems. This could help to understand the current situation of system development and using IT in the healthcare settings, including EDs. Therefore, in the next sections, the NHS IT strategies and plans along with the current challenges are reviewed.

### **2.3.1. Information for Health: an information strategy for the modern NHS**

According to ‘Information for Health: an information strategy for the modern NHS’ (Burns, 1998), the NHS would experience some changes in two main areas, namely, developing new information systems and applying a new direction for healthcare delivery that focused on patients, rather than on the organisations and the management processes (Drury, 2001). These changes were associated with one another, as the ‘Information for Health’ strategy intended to make healthcare information available and accessible, whenever and wherever it was needed, to improve the quality of care. For example, designing and running the first generation of “person-based Electronic Health Records (EHR)”, and “providing 24 hours emergency care access to the relevant information from the patient’s records” were two main targets of the information strategy that the NHS organisations had to achieve by 2005 (Burns, 1998:18).

However, implementing an Electronic Health Records (EHR) system, especially at the national level was more complicated than was expected in the strategy. While such a

system required paying more attention to details, the information strategy was very general, and more theoretical than practical. As Lusignan et al. (2000) highlighted, one of the main weaknesses of the NHS information strategy was a variety of tasks that had to be undertaken according to a timetable while their priorities were not clear. In addition, as Jones (2004) pointed out, in order to implement the 'Information for Health' strategy, each health authority was required to develop its own local implementation strategy within the framework of 'Information for Health'. This approach decentralised the implementation of the information strategy (Jones, 2004). As a result, a number of new systems with different definitions and contents of EHR were implemented in each demonstrator site (Protti, 2001). However, these systems were not compatible to be integrated to develop a single EHR.

Another weakness of 'Information for Health' was associated with how the information needs of the different groups of stakeholders, such as clinicians, the public, and patients would be met through implementing electronic records (Lusignan et al., 2000). For example, while "providing 24 hours emergency care access to the relevant information from the patient's records" was set as one of the main targets of the information strategy (Burns, 1998:18), it was not clear what type of information was necessary for which group of care givers. The NHS emergency care includes different services, such as ambulance services, Emergency Departments (EDs), and out-of-hour services; however, there was no specific detail about the information needs of clinicians and non-clinicians in these settings (Clamp et al., 2002). Therefore, in order to eliminate these weaknesses and to support the 'Information for Health', new documents, the NHS Plan (Department of Health, 2000) and 'Building the Information Core: Implementing the NHS Plan' (Department of Health, 2001a) were published which are discussed in the next sections.

### **2.3.2. The NHS Plan**

In 2000, the NHS Plan focused on the health service being designed around patient needs (Department of Health, 2000). Two main objectives of the NHS Plan were to provide high quality care and to improve communication between all healthcare providers (Fairey, 2000), and these objectives would be achieved by developing information and communication technology (Thorp, 2001). To provide the optimum level of quality in

healthcare delivery, information systems had to be capable of meeting the needs of care providers as well as those who receive healthcare services (Department of Health, 2001a). Although the NHS Plan helped to clarify the 'Information for Health' strategy, some of the ambiguous parts of the original strategy were left without any clarification. For example, although the NHS Plan announced that the NHS staff would take advantage of the investment in new information technology, by easy access to up-to-date and accurate information on patients' medical histories (Department of Health, 2000), it was not clear what information should be provided for which groups of healthcare professionals. This was an important issue, since different user groups may have different information needs. Moreover, taking advantage of information systems depends on the acceptance and use of these systems. As Fairey (2003) pointed out, although some clinicians are familiar with the benefits of clinical information systems and may accept using these systems, some clinicians do not have such a view, and introducing the change may affect the way that they work, for example, by spending more time on computers, rather than on patient care.

### **2.3.3. Building the information core - implementing the NHS plan**

To support 'the NHS Plan' and the 'Information for Health' strategy, 'Building the Information Core: Implementing the NHS Plan' was published (Department of Health, 2001a). It was an update to the 'Information for Health' strategy that not only reinforced the aims, objectives, and targets of 'Information for health', but also set out some measures for achieving targets of the original information strategy (Drury, 2001). In addition, this updated strategy introduced some new targets for the main objectives of the original information strategy (Thorp, 2001). It appeared that these targets would be more achievable, as they were explained in detail. For example, the updated strategy introduced using the information systems in specific areas, such as preventive care, self-care, primary and secondary care, and other NHS organisations more in detail (Department of Health, 2001a). However, extensive information was not provided on using information systems in the emergency care services, such as EDs.

It is worth noting that the main focus of the updated strategy, like the 'Information for Health' strategy and 'the NHS Plan', was on designing and implementing new

information systems for the NHS staff (Department of Health, 2001a). While some of the theoretical and financial aspects of implementing information systems across the NHS were addressed in this strategy, a number of issues, such as involving users in the process of design and implementation of information systems were missing. As the systems would be designed for the NHS staff and used by them, investigating users' perspectives should be regarded as an essential part of an IT project.

#### **2.3.4. Electronic Record Development and Implementation Programme (ERDIP)**

To support the NHS and the objectives of 'Information for Health', which dealt with implementing electronic records, the Electronic Record Development and Implementation Programme (ERDIP) was introduced as a National Programme in 2000 (Folmer and Price, 2001). This Programme was associated with the development and implementation of a variety of electronic records systems in different contexts (Protti, 2001), and aimed to provide solutions which could be replicated across the country to establish the EHR (Folmer and Price, 2001). In this programme, there were two types of pilots: four demonstrators were responsible for producing EHR-style solutions and fifteen organisational-based sites were responsible for working on Electronic Patient Records (EPR) projects (Pearce and Young, 2001). 'Information for Health' describes EPR as 'the record of the periodic care provided mainly by one institution', whereas EHR refers to the longitudinal patient's healthcare records from cradle to grave (Burns, 1998:25).

The specific objectives of ERDIP were to improve emergency and immediate care by providing round-the-clock access to information for healthcare professionals, to enable patients to become more involved in their care by having access to their information, and to provide a solution to support a wider sharing of information (Pearce and Young, 2001). In addition, as Folmer and Price (2001) highlighted, preparing the optimum level EHR and meeting the needs and expectations of users were other objectives of ERDIP. However, little has been published to show whether the implemented systems were able to meet users' expectations or not.



Moreover, although a number of NHS projects were associated with implementing information systems in the EDs, little has been published about these projects, and the evaluation reports are not comprehensive. For example, in the Central Hampshire Electronic Health Records (CHEHR) project, the electronic systems of three general practices, one hospital's ED, one hospital's emergency medical assessment unit, Hampshire NHS Direct, and Hampshire out-of-hours social services were linked to develop Electronic Health Records (EHR) (Sanderson et al., 2004). This project was evaluated by Sanderson et al. (2004) in terms of the clinical usefulness of EHR in supporting emergency and out-of-hours care. The participants were eight staff including two senior house officers, two nurse advisors, two practice managers, and two general practitioners. During the three-month evaluation, the participants who used the system were asked to complete an evaluation form at the end of their shifts. The respondents returned 148 evaluation forms which were related to using the system to access to patients' medical records. The results of the study showed that patient records were found only in 47% of attempts and some of them did not contain any useful information. The clinical staff were asked to rate the usefulness of patients' records for decision-making on a scale of 1-5 (not useful to very useful). The usefulness of 54% of records was scored  $\leq 2$  (not very useful) and 20% was scored  $\geq 4$  (useful or very useful) (Sanderson et al., 2004).

A limitation of Sanderson et al.'s (2004) study was that the number of participants was limited and the results were not representative of the staff views. Further research was needed to involve more users and evaluate the usefulness and acceptance of the system from their point of view. Moreover, the usefulness of an information system was only one of the characteristics of the system, and investigating other aspects, such as the system's ease of use and its interface design would have been useful to obtain more information about the system.

### **2.3.5. Delivering 21st century IT support for the NHS**

Implementing information strategies within the NHS, and at the national level, was more complex than was expected and encountered technical and non-technical challenges (Protti, 2001). Therefore, to support the previous information strategies, another strategy

for developing IT within the NHS, called ‘Delivering 21<sup>st</sup> century IT support for the NHS-a national strategic programme’ was published in June 2002 (Department of Health, 2002). In this strategy, information technology was identified as a support for the vision of a service designed around the patient’s needs. This was to happen by offering explicit choices, such as electronic booking systems and Electronic Health Records (EHR). In addition, the strategy aimed to link all information systems within the NHS, and to create an Integrated Care Record Service (ICRS) through the National Programme for Information Technology (NPfIT) (Department of Health, 2002).

### **2.3.6. The National Programme for Information Technology**

In October 2002, the National Programme for Information Technology (NPfIT), was launched as a fundamental programme to achieve one of the main aims of the NHS, namely, improving healthcare delivery through improving availability and accessibility of information (Department of Health, 2002). The National Programme is responsible for creating the most comprehensive electronic health records infrastructure, in which multimedia records will be accessible to the authorised users in all healthcare facilities to provide them with the information that they need (Cross, 2006a). In 2005, ‘NHS Connecting for Health’ was recognised as an agency to deliver NPfIT. In order to inform the public and the healthcare professionals about this programme, the ‘NHS Connecting for Health’ website was developed. When this research was conducted, little original research was available about NPfIT; therefore, the information provided by this website was used to gain better understanding of the National Programme.

In 2007, the National Programme was divided to three programmes, the North, Midlands and East Programme for IT (NMEPfIT), the Southern Programme for IT (SPfIT), and the London Programme for IT (LPfIT). The technical aspects of the system implementation are now supported by the Local Service Providers (LSPs) who are responsible for delivering a range of services from the integration of existing local systems to the implementation of new systems, where they are necessary. The LSPs work directly with the local NHS services in their area to deliver IT systems. The programmes of implementing information systems in each cluster are controlled by the National

Programme in order to achieve the intended goals at the national level. This programme also supports all NHS organisations to implement local modernisation plans relying on information technology. The main services and products which have been planned to be delivered by the National Programme are NHS Care Records Service (NHS CRS), Choose and Book (CAB), Electronic Prescription Service (EPS), National Network for the NHS (N3), Picture Archiving and Communications System (PACS), IT supporting GPs including the Quality Management and Analysis System (QMAS) and a system for GP to GP record transfer (GP2GP), and the NHSmail (NHS Connecting for Health Implementation Guidance team, 2007) which are discussed in the following sections.

### ***The NHS Care Records Service (NHS CRS)***

The implementation of Electronic Health Records (EHR) is the main aim of the National Programme. Granger (2003) suggested that one of the main services of the NPfIT, namely the NHS Care Records Service (NHS CRS), could help to provide a link between all NHS organisations, and to create 24-hour accessible Electronic Health Records (EHR) for every person across England. In order to share information, the main part of the NHS CRS, which is a central database called 'the Spine', stores patients' demographic data and a summary of their health data, known as Summary Care Record (SCR). These data could be available 24 hours in order to support healthcare services, such as EDs, with information that is needed at the point of care. This service appears to give patients access to a summary of their own health records across organisations. Therefore, patients could see their SCR on a secure website called HealthSpace, once it is created by their GPs. The spine could also support other programmes of NPfIT, such as Choose and Book and Electronic Prescription Service (EPS) (next sections). The Secondary Uses Service (SUS) is another part of NHS CRS which is designed to provide timely and anonymised information for other activities, such as management, clinical audit, and research. The implementation of NHS CRS began in 2007 and continues (NHS Connecting for Health Implementation Guidance team, 2007).

While there are a number of potential benefits in implementing such a system, the issues around the use of the system are challenging. For example, the perception of disruption to the consultation when clinicians are required to enter clinical information into the system, the confidentiality of patient information, data quality, and the interface design

are some of the concerns of clinicians (Eason, 2007). Moreover, such a system needs to be evaluated at a later stage to see whether it has met its objectives.

### ***Choose and Book (CAB)***

Choose and Book is another service of the NPfIT, in which the possibilities of electronic booking and choosing the time, date, and place are provided for patients making appointments in hospitals. Using this service, patients are able to choose a hospital, and set a date and time which is more convenient for them to visit a specialist (NHS Connecting for Health Implementation Guidance team, 2007). In primary care trusts, GPs are also able to use the service to make an appointment for their patients. The appointments can be changed by patients via online access or a telephone service. As the appointments are made online, patients can receive a confirmation for their appointments at the same time (NHS Connecting for Health, 2009b).

However, there is evidence that this service is not widely used by GPs, as for example, they believe that using the service is time-consuming or the service does not include information that they need about clinics (Eason, 2007; Rabiei et al., 2009). The results of a study conducted in a hospital in London also showed that patients referred to the hospital using choose and book did not experience the degree of choice that the service was designed to deliver (Green et al., 2008).

### ***Electronic Prescription Service (EPS)***

The Electronic Prescription Service (EPS) is a new system, whereby all the prescriptions issued by GPs and other primary care prescribers can be transferred electronically between the prescriber, the dispenser, and the reimbursement agency. This information can also be part of the patient care records. By completing the project, patients could be able to nominate a dispenser to which their prescription would be sent electronically (NHS Connecting for Health Implementation Guidance team, 2007). Some of the potential benefits of using this service might be reducing dispensing errors as the legibility of prescriptions could be improved and GPs would have to spend less time managing paper-based prescriptions, as the old ones could be saved into the Electronic Patient Records (EPR), and could be readily available.

However, the evaluation of pilot sites (Sugden, 2003) showed that GPs experienced an increased workload, especially for the repeated prescriptions, which accounted for approximately 80% of all prescribing, and GPs had to send an electronic request to repeat them. Moreover, despite initial suggestion that the EPS would reduce the waiting time for receiving medications in a pharmacy, the lack of experience of using the system caused an increase in patients' waiting time. The technical problems of the service, such as the system usability also negatively influenced GPs', practice managers', and pharmacists' attitudes towards using the system (Sugden, 2003).

### ***The National Network for the NHS (N3)***

In order to exchange electronic records and digital images and facilitate telemedicine services between all hospitals and GPs, the 'NHSnet' was proposed in 'Information for Health' as the main network (Burns, 1998). Later, the 'NHSnet' was changed to the 'National Network for the NHS' (N3). N3 is vital to the delivery of the National Programme for IT by providing the required infrastructure, voice services, broadband connectivity, and standards to facilitate communication between the NHS Trusts. This service appears to facilitate secure sharing of information between the NHS sites and quick access to the patient's records (NHS Connecting for Health Implementation Guidance team, 2007). For example, the speed of electronic data transmission, such as digital images via the new Picture Archiving and Communications System (PACS) appears to be increased using the national network, which could lead to providing quicker healthcare services.

### ***Picture Archiving and Communication System (PACS)***

This system is used for capturing and storing radiology films or digital images electronically. The electronic files can be shared and displayed on the computers in other workstations in a hospital. Using this system, the radiology test results can be made available at the point of care. This, in turn, has a significant effect on more accurate diagnosis and treatment, and can help to increase the speed of care. The images could be sent, shared, and viewed across several NHS hospitals (NHS Connecting for Health Implementation Guidance team, 2007).

According to Cross (2006b), PACS has generally been useful for patients and doctors, although there have been concerns about the quality of images. The system has also been useful for cash-releasing, since there is no need to pay for X-ray films and the saving can be spent on information technology or other healthcare services. Overall, it seems that PACS has been a successful system, and has been accepted by clinicians because of its benefits (Eason, 2007).

### ***Quality Management and Analysis System (QMAS)***

In 2004, the new General Medical Services (GMS) contract was introduced. The key part of this contract was the Quality and Outcomes Framework (QOF), which described the method of reward payments based on a GP's achievements. The GP's achievements were described according to the national targets and included four dimensions: clinical, organisational, patients' experiences, and additional services. To support the QOF and the GMS contract, the Quality Management and Analysis System (QMAS), a national IT system, was introduced as part of the National Programme. The focus of this system is on collecting national achievement data, computing national disease prevalence rates, and calculating points and the payment value for GPs (NHS Connecting for Health Implementation Guidance team, 2007).

### ***GP to GP record transfer (GP2GP)***

This service has changed the former process of transferring paper-based medical records from one GP to another, when a patient changes his/her GP. This process was time consuming previously, and now could be facilitated by the GP to GP records transfer service from one practice to another electronically. Using this service, better care could be provided for patients, as the required information is available at the point of need (NHS Connecting for Health Implementation Guidance team, 2007). However, there is limited information about the use of this service in practice and it is not clear whether this service has been successful to meet its objectives.

### ***NHSmail***

The variation in local email systems operating in the NHS caused variation in the quality and reliability of information sharing through emails. Although these systems

entailed more expenditure, the security and confidentiality of emails and shared information was threatened. Therefore, 'the NHSmail', was designed specifically for the NHS to manage clinical emails more securely. Using this service, clinical information could be exchanged securely between NHSmail accounts, and users could be able to send fax and SMS messages directly from email. This service is free of charge to NHS organisations in England and provides all NHS staff with an email address for the period that they work within the NHS (NHS Connecting for Health Implementation Guidance team, 2007).

### **2.3.7. Challenges in implementing NPfIT**

Although the services and products of NPfIT, presented in the previous section, may have some benefits, these benefits might not be achieved unless these services are designed and implemented successfully. The success of a system might be hindered by several challenges. The National Programme for IT, like any other IT projects, has encountered a number of technical and non-technical challenges that are discussed in the following sections. Developing effective strategies to deal with challenges can help to achieve success in the future IT development (Hendy et al., 2005).

#### ***2.3.7.1. Technical challenges***

So far, the integration of electronic systems and designing an acceptable interface for all NHS staff have been considered to be two complicated technical challenges that the National Programme for Information Technology has faced (Granger, 2003; Tackley et al., 2003; Ford, 2005; Hendy et al., 2007). These issues are discussed below.

#### ***Systems integration***

The integration of clinical information systems demands a concerted effort in terms of defining standards and applications. The national standards are the key elements for exchanging messages between Electronic Patient Records (EPR) and establishing Electronic Health Records (EHR) (Granger, 2003). As Hendy et al. (2005) indicated, the inadequacy of standards has been one of the reasons for delayed system implementation within the NHS hospitals. Therefore, defining the standards should be a priority for the

National Programme in order to overcome variations and to provide a stronger foundation for integrating information systems and implementing the NHS CRS (Tackley et al., 2003).

While systems integration is a step forward to improve the accessibility of information, healthcare professionals might be concerned about the impact of using these systems and the potential disruption in the current services (Shaw, 2005). For example, in critical care departments, such as ED or Intensive Care Unit (ICU), patients might be vulnerable to the consequences of system failures, either in terms of information flow or electrical power (Suntharalingam et al., 2005).

### *System features*

Ford (2005) indicated that the usability of the interface is one of the problems that the National Programme has encountered. Users like to work with an easy system that meets their requirements, and similar to the paper-based records, the electronic systems should be easy to use and easy to learn. Ford (2005: 1145) added that using a keyboard, when “many clinicians are one or two finger typist” could be time-consuming. Similarly, Walsh (2004) indicated that difficulties with data entry had been one of the reasons for the failure of electronic records. Therefore, designing an easier interface which is able to support clinical work as a social interactive process has been suggested (Walsh, 2004). This approach could encourage healthcare professionals to use the systems, and can ensure that a computerised system is not time-consuming, but useful in clinical practice (Tackley et al., 2003). To achieve this, the end users of the information systems should be strongly involved in the process of system design from the earliest stages (Penney, 2005). If this happens, a tailored system, which is based on users’ needs, is more likely to be accepted and used.

On the other hand, NPfIT is developing standard solutions to a large number of hospitals in which different systems are currently in place and local requirements are different. Due to this diversity, many hospitals have challenged the systems that they have been offered. Therefore, systems need to be flexible enough to be customised to suite local needs (Eason, 2007).



### *2.3.7.2. Non-technical challenges*

As Protti (2001) noted, the technical problems, such as systems integration and creating national standards, are not the only challenges that the National Programme has faced. Another group of challenges is the non-technical issues that have to be considered in implementing information technology within the NHS. Among them, inadequate communication with the NHS staff in designing and implementing information systems and the confidentiality of patient records are two main challenges.

#### *Communication with the NHS staff*

Healthcare professionals have a pivotal role to play in successful implementation of the National Programme. According to Humber (2004: 1145), they are one of the stakeholders who “can make or break the project”. However, poor communication and involvement of this group in the NPfIT projects has been reported (Skinner, 2004; Hendy et al., 2005; Hendy et al., 2007). In fact, the rapid implementation of information systems by the NPfIT meant there was little or no time for most NHS staff to express their perspectives and expectations regarding new information systems (Tackley et al., 2003). As a result, the designed systems might not be able to meet users’ requirements. This, in turn, may lead to a limited uptake of the systems to avoid the possibility of negative impact on users’ work and patient care (Eason, 2007). The little understanding of the NHS staff about the systems that they are being offered is another consequence of poor communication with the users, which can influence their attitudes towards the change (Eason, 2007).

To solve this problem, more attention must be paid to the involvement of healthcare professionals in implementing the National Programme and other IT projects. This may encourage them to play their roles as real ‘owners’ of the systems. The ‘ownership’ issue, as Grimson (2001) highlighted, is one of the main difficulties in implementing information systems within the NHS, since the degree of ownership for stakeholders has not been clearly determined. While attention to this aspect can help to decrease resistance to change and lead to success, a lack of ‘ownership’ may decrease the responsibility and the commitment of stakeholders to eliminate weaknesses. Therefore, defining the degree of ownership for different groups of stakeholders should be one of the priorities of the National Programme to encourage them to participate in the future plans.

The next step will be developing a culture of “listening to the real information and decision support needs of the clinical teams” (Skinner, 2004: 21) to give the NHS staff opportunities to express their opinions. It is notable that not only communication about the new systems, but also investigating users’ attitudes towards the current systems, is of importance to identify the positive and negative aspects of the current systems and improve them in the future developments. This approach can facilitate the acceptance of new information systems (Sicotte et al., 2009).

#### *Confidentiality of patient records*

Another challenging aspect of the NPfIT, which is regarded as one of the important issues in exchanging information, is the confidentiality of patient information. The confidentiality of information is a fundamental element in communication between patients and clinicians. However, information sharing may make them worry about who else may have access to this information (Oldfield, 2003). It seems that if patients and healthcare providers ensure that information is confidential, they are more likely to accept sharing their data. As a result, better use of patient information can be achieved to deliver benefits to the public (Protti, 2001).

A solution for patients, who are concerned about the confidentiality of their medical information, is the ‘opt out’ right which allows patients to withhold their health records from the NHS Care Records Service (Cross, 2006a). However, this approach can result in new challenges (Booth, 2003), which may damage the usefulness of information. For example, in public health investigations, the inadequacy or incompleteness of data may result in collecting incorrect statistics that can influence decision-making. To solve this problem, the National Programme needs to provide a secure environment for patients and care providers. This approach can encourage patients and healthcare professionals to share their information, and this can be useful for patient care and public health investigations.

#### **2.3.8. Summary**

In this section, the NHS plan and information strategies were reviewed to gain a better understanding of the NHS approaches to implement information technology within

the healthcare settings including EDs. These plans and strategies showed that implementing a single electronic health records system, especially at the national level, has been the main aim of the NHS. Such a system has to be able to meet users' expectations in different departments and specialities. However, the National Programme for IT in England, which is responsible for developing NHS IT systems, has focused less on the departmental and users' requirements. This programme has been surrounded by numerous technical and non-technical challenges that can influence the success or failure of the systems. A single EHR system has to be useful, easy to use, easy to learn, and acceptable to the users. To achieve these, involving users in the process of design can help to develop a system based on their requirements. Moreover, communication with users can be useful to prepare them for the process of change, since using information systems can lead to re-engineering work routines and eliminating paper-based records in some cases. Having reviewed the NHS information strategies and the NPfIT challenges, it was found that little information is available about the factors that might influence the implementation and use of clinical information systems in different settings, including EDs. It seems that investigating users' perspectives about the current information systems can help to gain a better understanding of the possible factors that might influence the use of these systems, and can help to design better systems in the future. In the next section, the literature related to the use of IT in the ED is reviewed.

## **2.4. Information management and technology in the Emergency Department**

The development of information technology and information systems has had great effects on organisational functions in terms of improving the accessibility of information and organisational performance (Gunasekaran et al., 2006). In healthcare institutions, similar to other organisations, the positive impact of using computer and information technology has been identified (Pare and Sicotte, 2001). For example, the use of information technology can be an effective way to provide healthcare professionals and patients with the information that they need at the point of care (Pose et al., 1996).

As mentioned in Chapter 1, EDs may benefit greatly from having access to clinical data to provide patients with better care. However, as Clamp et al. (2002) pointed out, the requirements and information needs of ED staff might be different from other clinical settings. This is of high importance, particularly when there is a plan for implementing a single EHR system at the national level. In this section, the ED characteristics and the role of information in this department are reviewed. In addition, the use of information systems in the EDs in England, some of the functions of ED information systems, the importance of integrating ED systems with other information systems, and the challenges of systems integration are presented.

#### **2.4.1. ED characteristics and the role of information**

Emergency Medicine has unique characteristics that distinguish it from other specialities (Walker, 1982). In this area of medicine, not only familiarity with critical illnesses is important, but also having adequate knowledge of evaluating every single episode of medical, surgical, or psychological problems is necessary. As a result, emergency clinicians may need to know more about different techniques in outpatient surgery, the interpretation of laboratory test results, new findings about drug interactions, and new methods of emergency treatments to provide patients with better emergency care (Lappa, 2005). The ED can be regarded as a small scale healthcare delivery system in terms of the processes of care and the categories of information that are needed (Feied et al., 2000). In this department, a variety of patients need to be evaluated and treated at the same time, for example, those who suffer from a cardiac arrest, a foreign body in the eye, or poisoning, whereas other specialities such as internal medicine or cardiology clinicians are responsible for treating patients with a more restricted range of diseases.

Walker (1982) also indicated that, in emergency care, patients' problems should be evaluated and managed as quickly as possible. As mentioned before, in this situation the accessibility of information at the point of care can be extremely important for improving the quality and speed of care.

At present, Emergency Medicine reflects a broader meaning of the nature of an ED to include not only delivering emergency care to patients, but also educating care givers,

conducting research, and managing disasters. Moreover, improving public health by identifying risk factors is another area that highlights the role of information in this speciality (Gillam et al., 2004). In other words, the ED has a crucial role to make healthcare decision-makers aware of what is happening to the public health by providing accurate and reliable data for them.

Amouh et al. (2005) indicated that emergency care is a complex process that requires the cooperation of many individuals, such as administrators, secretaries, nurses, doctors, laboratory and radiology department staff, and other professionals to work autonomously to deliver patient care. Each of these professional groups contributes to generate a large volume of data during the process of patient care, which has to be collected, interpreted, and applied for immediate clinical decision-making. Otherwise, a lack of information may affect the process of patient care, or may lead to prolonged stay in the ED and over-crowding (Rogoski, 2002).

The accessibility of patient information can also be useful for healthcare research, particularly in an academic ED (Teich, 1998). The process of data collection, as part of daily practice in an ED, can provide opportunities for further investigation about a number of issues, such as the quality of care, epidemiological research, public health investigations, interventions to prevent diseases or injuries and providing possibilities for cost control in healthcare organisations (Teich, 1998).

On the other hand, deficient information may affect the process of care. For example, according to Rogoski (2002), between 30% and 40% of an emergency clinician's time can be spent on non-clinical tasks, such as searching for medical histories, due to insufficient information. In addition, the quality of care may decrease and patient dissatisfaction increase, for example, due to medical errors, misdiagnoses, and repeated and unnecessary diagnostic tests and doctors' assessments.

Therefore, in order to make better use of information within the emergency care services, using information technology has been suggested and many information systems have been developed for this type of department to date (Travers and Parham, 1996; Smith and Feied, 1998; Rogoski, 2002; Barthell et al., 2004). These systems are able to provide emergency clinicians and patients with the information that they need and improve many

activities, such as data collection, clinical documentation, and information retrieval. Although it is claimed that using these system can help to enhance the quality and efficiency of care, similar to other systems, it is important to assess whether these benefits are realised in practice or not (Stoop and Berg, 2003). Section 2.4.2, describes studies in which some of the benefits of using IT in the ED have been discussed.

#### **2.4.2. Computerised information systems in the ED**

As noted earlier, medical records can play a crucial role as a source of information in the ED to provide patients with appropriate healthcare services. To improve the accessibility of information, patients' medical records can be stored in the computers and exchanged electronically. This approach can help to extract and transmit health information precisely and quickly, and improves the completeness of data (Townes et al., 2004). Other benefits of using computerised information systems in the ED have been addressed in different studies (Chan, 2000; White et al., 2004; Amouh et al., 2005), which are discussed below.

Chan (2000) suggested that a computerised information system in the ED can help to control queues in front of the admission office by providing clinicians with the previous demographic and clinical data for each patient. Another potential benefit of the system is reviewing the status of beds in the department. Moreover, laboratory and radiology test results can be easily available and there is no need to re-order clinical tests due to the unavailability of previous test results (Chan, 2000).

According to White et al. (2004), Emergency Medicine (EM) practice relies heavily on timely practice; however, taking patients to the radiology department, film reading, interpreting results, and sending x-ray reports to the ED are usually time-consuming. The use of digital radiology in the ED can help to provide these services more quickly. Moreover, this system can result in enhanced quality of patient care, reduction of errors, and increased ED efficiency.

Other potential benefits of using a computerised information system in the ED, as Harper (2001) indicated, can be related to reduce errors in clinical practice, to eliminate

documentation errors, and to improve patient and staff satisfaction by improving the accessibility of information.

### **2.4.3. ED Information systems in England**

The importance of the availability of needed information at the point of care, especially in the EDs, has received a great deal of attention within the NHS in England. The Department of Health (2001b) reported that the unavailability of information in the ED may cause duplication of tasks. Duplicating tasks, in turn, may result in consuming more time and resources, which could be used for caring for other patients. In addition, patients may suffer from repeated procedures, such as repeatedly being asked to give the same information to different members of staff in the ED (Department of Health, 2001b).

As mentioned in section 2.3, in 1998, in order to improve the availability of information at the point of care, 'providing 24-hour emergency care access to relevant information from patient's records' was set as one of the main aims of the NHS 'Information for Health' strategy (Burns, 1998). This was also addressed in other information strategies, such as 'the NHS Plan' (Department of Health, 2000) and the 'Building the Information Core: Implementing the NHS Plan' (Department of Health, 2001a), and would happen by implementing information systems within the NHS hospitals. However, these strategies focused on implementing a single EHR which included an ED module. To fulfil this aim, different projects, such as the Electronic Records Development and Implementation Programme (ERDIP) were implemented (Pearce and Young, 2001). However, 24-hour emergency care access to the needed information was not realised, as patient information was stored on disparate computerised systems which were not integrated (Tackley et al., 2003).

As discussed in section 2.3.6, the latest attempt of the NHS to improve the accessibility of information for all healthcare settings including emergency care services is to create the most comprehensive Electronic Health Records (EHR) infrastructure by implementing the National Programme for Information Technology (NPfIT) (Cross, 2006a). The National Programme is also responsible for implementing new information systems within the NHS. For example, a new ED system was implemented for the Queen's

Medical Centre in Nottingham (NHS Connecting for Health, 2009a). This system is able to track patients in the ED, to identify where the patient is, and what they need. Some clinicians believe implementing such a system is a transitional way towards using less paper-based records and might lead to improve the quality and speed of patient care. However, no evaluation report is available about this system or other ED systems implemented by the National Programme. Further investigations of such systems could be helpful to reveal the strengths and weaknesses of the systems.

Overall, it appears that although the NHS aims to provide round-the-clock access to information for all healthcare settings, such as EDs, little information is available regarding the use of information systems in this type of department. In particular, as this type of department has different characteristics from other clinical settings (as described in 2.4.1), users may have different requirements that need to be investigated to develop more acceptable and suitable systems for this department.

#### **2.4.4. Functions and capabilities of ED information systems**

The ED information systems, like other information systems in healthcare, need to be designed based on users' requirements. The system should be able to meet the information needs of different ED staff, such as doctors, nurses, and clerks, and improve the quality of care through improving the accessibility of information. However, as Hu et al. (2002) indicated, computerisation in the ED has been mostly limited to registration, ordering laboratory tests and x-ray images to save clinicians' time and improve the patient flow in the ED. Few EDs use a full computerised system to record chief complaint, present illness, past history, physical examinations, and medical orders into a computer. Hu et al. (2002) investigated the execution of some functions of a newly implemented system in a teaching hospital in Taiwan between January 1999 and June 2000. The researchers used 25 statistics forms to show the percentage of system use by each professional group in three different times after implementation. The results showed that the clerks used the system about 100%, and nurses' execution was relatively low at the beginning of the study, but gradually increased. Similarly, doctors were initially reluctant to use the systems, but gradually accepted using it.



A limitation of Hu et al.'s (2002) study was that although some of the reasons for the low execution of the system functions have been discussed, the main focus of the study was on the use of the selected items, i.e., monthly reports of 'time to be seen' or 'disposition status', which was part of patients' electronic records, rather than investigating factors that might influence the use of the system. Nevertheless, Hu et al. (2002) suggested that it is feasible to have a full computerisation in the ED, if the ED senior staff including directors and supervisors are willing to cooperate. In this section, some of the general features that can be considered for designing the ED systems are briefly discussed.

According to Harper (2001), one of the basic functions is *patient registration*. This process involves recording patients' demographic information at the time of arrival at a hospital, and is normally part of the main Hospital Information System, to avoid any duplication in the process of patient registration in a hospital (Chan, 2000). However, in the ED, in some cases, the process of treatment must occur before obtaining a patient's demographic information. For example, in a life-threatening situation, the process of patient registration has to be undertaken separately. In this case, the system should be able to create a patient identification number for the new patient or identify the patient from other encounters (Harper, 2001).

Another function of the system is storing *triage* data. Triage is a French word meaning 'sorting', and in the ED is a process to categorise patients based on the severity of their illnesses so that those in most need of treatment will be assisted first (Abad-Grau et al., 2008). During this process, useful data, such as the patient's heart rate, respiratory rate, blood pressure, and temperature are recorded which can be entered into the computer. However, due to the speed of work in the ED, the process of entering clinical data, such as triage information has to be easy, quick, and simple, for example, by using structured templates (Harper, 2001).

The design of a *patient tracking system* can be regarded as another capability of an ED information system (Righini, 2002), which helps keeping track of a large number of patients simultaneously (Teich, 1998). Traditionally, patient flow within the ED was tracked using a white board and magnetic strips; thereby the name of patients, persons who were caring for them, and the latest procedures which had been performed for them were recorded on the board. Recently, this traditional system has been developed further to

display this information electronically on monitors or big plasma screens in the EDs. Now, patient tracking is possible by entering real time data into the system manually or using infrared sensors worn by patients (Harper, 2001).

Another function of an ED information system can be *medical documentation* that can be designed in a structured template to collect more data in less time. The documentation process can be undertaken through the usual methods, such as typing, dictating and transcribing, or more recently through using voice recognition systems (Harper, 2001).

*Nurse charting* is another function that focuses more on nursing procedures and drug administration rather than on the history of a patient's present illness (Harper, 2001). However, nurses may still need to have access to the patients' medical histories for providing patients with better care services.

As Harper (2001) indicated, the *order entry system* is another function which helps physicians to order diagnostic tests or write prescriptions electronically. This system should be linked to other information systems in the pharmacy, radiology, and laboratory departments. This function can help to reduce errors as well as the time that is spent on the process of test ordering or prescribing. Hence, both healthcare staff and patients can benefit from this system (Harper, 2001). However, all order entry systems may not be equally usable. Therefore, attention should be paid to the design of such a system, as any difficulty in using the system may result in user errors, as well as inefficient use of time (Murff and Kannry, 2001).

Supporting the *discharge process* is another function of an ED information system. This function can help to manage and coordinate the discharge process more effectively through summarising patient information. Furthermore, the discharge instructions can be embedded into the patient's records in a quick and well-documented manner (Harper, 2001). The name of the hospital, the phone number of the ED and the follow up clinic's name can be added to provide a complete record. In addition, the system can help to provide a follow-up care plan by, for example, sending the laboratory test results to a patient or his primary care doctor after discharge (Righini, 2002). In this case, the system

needs to be supported by web-based reminders, secure emails, and message services to develop this connection (Harper, 2001; Teich, 1998).

Another feature that has been added to the ED system is having access to the relevant medical knowledge databases. ED clinicians may need to search for information regarding drug interactions, treatments, and diagnosis via the internet or appropriate databases; therefore, such a function can facilitate having access to the information that they need (Righini, 2002).

The above mentioned functions might be considered part of a hospital information system, or might be separately designed for the ED. For example, patient tracking systems might be designed and implemented as a separate system in the EDs. More advanced technology has offered the use of hand-held computers, often called Personal Digital Assistant (PDA), in the ED. With this technology, most of the above mentioned functions can be considered and the small size of these devices makes them portable. However, the initial cost of implementing this technology is high and there is a risk of losing data due to system malfunction, or a risk of missing devices (Bird et al., 2001).

Although the use of above-mentioned functions seems to support the departmental workflow in the ED, the systems should be designed to support the real requirements of users and their work in the ED. According to Hu et al. (2002), the success of the ED systems not only depends on the good design, but also on the attitudes of doctors, nurses and clerks. Therefore, users' perspectives need to be investigated to understand how their working processes and performance can be improved using the systems. Even if a system has worked effectively after installation, it may gradually lose its effectiveness, as the healthcare system around it can change. Therefore, with respect to the dynamic nature of healthcare environment, information systems should be evaluated from different aspects at different times (Wyatt and Wyatt, 2003).

#### **2.4.5. Improving the accessibility of information in the Emergency Department through systems integration**

Emergency physicians sometimes have no access to patients' clinical histories at the point of care (Gottlieb et al., 2005). This might be due to the patient's condition, or their relatives, who are not necessarily able to remember, or talk about, the patient's clinical history. Sometimes physicians may not be able to ask other institutions for this information, due to the speed of work, or having no information about the healthcare settings that the patient attended previously (Overhage et al., 2002). Another reason for the inaccessibility of needed information at the point of care can be storing information on disparate information systems which are not able to share data (Barthell et al., 2004). Hence, developing integrated information systems, which are able to share information, can be a solution for improving the accessibility of information for the emergency care services (Coonan, 2004).

One of the examples of the integrated systems is developing and implementing Electronic Patient Records (EPR) defined in section 2.3.4. The benefits of this system have been shown in a number of studies (Chan, 2000; Righini, 2002; Overhage et al., 2002; Finnell et al., 2003). Chan (2000) reviewed the progress of ED computerisation in Hong Kong and suggested that using an EPR can help to provide patients with better treatment, since comprehensive clinical records will be available to support the process of decision-making at the point of care. However, more empirical research was needed to evaluate different aspects of such a system in the EDs. Righini (2002) and Overhage et al. (2002) pointed out that using EPR in a hospital can improve the quality of patient care by improving the availability of information.

Overhage et al. (2002) conducted a pilot randomised control trial of providing information from a large computerised system to emergency physicians at two EDs in the United States. These researchers investigated the effect of the availability of information on charges, changes in test ordering, hospital admissions, repeat ED visits, and the opinions of the emergency physicians using the information. Patients were randomised at each ED and their information was delivered to the physicians either by means of online access or as a printed abstract. Patients in two EDs were divided into the control and intervention groups. For the intervention group, physicians had access to the computerised system and

could print the information that they needed. For the control group, system printed a report with no clinical information and ED personnel were responsible for attaching a printed abstract to the patient's chart. The results showed that the workflows and access to information was different at these two EDs, and the intervention could help to decrease charges for ED care at one hospital, but there was no effect on charges at the other hospital. There was no difference in admission rates or repeat visits to the ED. The emergency physicians thought that remembering their passwords and the time required to search for the information were significant barriers to accessing clinical information online. As the research was conducted in only two EDs, the results might not be representative of a wider population. Moreover, it was not clear whether having access to the patient information could improve clinical decision-making and the patient care.

Finnell et al. (2003) examined data from nine hospitals with the highest ED visit volumes in the United States to find out the pattern of ED usage. In their study, a central database provided all EDs with their needed information from other hospitals. During the study, patients' clinical and demographic information including date of visit, chief complaint, gender, hospital, and hospital medical record number were collected for the one year period. The results showed that 31% of the patients had more than one ED visit during one year of study. These nine hospitals represent five healthcare systems, and this study showed that 60% of patients had data in more than one system. Finnell et al. (2003) noted that such a database is able to reduce total care costs by decreasing redundant tests and services which are performed due to the unavailability of previous test results. While Finnell et al.'s (2003) study showed the pattern of ED usage among nine hospitals and the importance of exchanging information, it was not clear to what extent the database could be able to meet clinicians' and non-clinicians' information needs in the EDs.

In a broader context and, as was discussed in section 2.3.4, systems integration can be realised by implementing an Electronic Health Record (EHR) system (Drury, 2001). This technology appears to offer strong support for collecting all patients' data, apart from the location of healthcare settings, and can make information accessible to the authorised users in a city or across a country using web-based technology (Drury, 2001).

However, integrating information systems and implementing EHR has its own challenges. Given the experience of the NHS in England, regarding implementing EHR at

the national level (as described in section 2.3.7), it can be concluded that although systems integration can be useful to improve the accessibility of information and the quality of care, especially in the ED, it is a difficult task. Apart from the technical issues, an integrated system should be able to meet users' expectations in a way which is acceptable to all, and this is not easy, since different users have different requirements. For example, the requirements of the ED staff might be different from other clinical settings. Therefore, different user groups should be involved in the process of system design from the early stages to contribute to develop a system which is able to meet their requirements.

#### **2.4.6. Challenges of systems integration**

With respect to the characteristics of the ED, some studies have investigated the feasibility of integrating clinical information systems with the ED systems and related challenges (Overhage et al., 2002; Gottlieb et al., 2004). Some of these challenges were related to creating standards, change management, and data confidentiality (Teich, 1998; Overhage et al., 2002; Gottlieb et al., 2005). In this section, these challenges are discussed briefly.

##### ***Creating standards***

Generally, the issue of systems integration includes integrating two or more stand-alone information systems. In order to develop an integrated system, either integrating ED systems or other systems, the first step is developing standards to make the systems to be able to share data (Teich, 1998; Barthell, 1999; Coonan, 2004). Some of the standards are common in integrating information systems. For example, Transmission Control Protocol/Internet Protocol (TCP/IP) is a standard used to transmit data across networks. This protocol, which has been identified as a basic requirement for systems integration, facilitates the exchange of TCP/IP-based messages between information systems, such as ED systems (Barthell et al., 2004). Creating national standards is also needed to support both users' and policy-makers' requirements within a country, since requirements and technical infrastructures are diverse in different countries.

### *Change management*

According to Despont-Gros et al. (2004), although clinical information systems aim to improve the process of health care and the quality of care, this improvement is considered a real change within the organisation and may affect the healthcare providers' workflow and their relationships in different ways. In a study conducted by Overhage et al. (2002) (described in section 2.4.5), the researchers found that in the process of integrating the ED systems in two hospitals, changing work habits was not as easy as they had anticipated. The results showed that the ED staff sometimes did not enclose the printed abstract of patients' clinical histories with the patients' charts. Moreover, healthcare providers never used online access, since they believed that a printed abstract provided them with most of the information that they needed, and additional data were not necessary. Furthermore, as online access was not part of the physicians' routine tasks, sometimes physicians did not remember their passwords (Overhage et al., 2002).

Similarly, Arnoskey et al. (2008) described the experiences with an integrated computerised triage system which was able to exchange information with other ED systems, such as a patient tracking system and an electronic medical records (EMR) system. Arnoskey et al. (2008) indicated that despite the electronic availability of triage documents, clinicians preferred using the printed information added to the patients' records. Empirical studies were needed to identify the strengths and weaknesses of the system as well as users' perspectives. In these studies (Overhage et al., 2002; Arnoskey et al., 2008), it seemed that implementing an integrated system was the main focus and preparing the users to accept the change and to use the system received less attention. However, implementing change in the healthcare environment requires a strong change management agenda (Grimson, 2001). The change management agenda will be responsible for preparing healthcare professionals to accept the change in different stages of system implementation (Lorenzi, 2004).

It is worth noting that change management has been one of the main challenges of implementing information systems in the healthcare environment. For instance, Burns (1998) highlighted that the weakness of the management of change was one of the reasons that the NHS in England had previously failed in the implementation of information

systems. Therefore, appropriate change management strategies should be developed to introduce the change and new systems to the users.

### ***Data confidentiality***

The confidentiality of data when they are transmitted between different individuals in different institutions is another important challenge in integrating information systems. An example of this challenge is described by Gottlieb et al. (2005), who reviewed a clinical data exchange project. In this project, prescription claims data were used to deliver patients' medication history to the EDs. Gottlieb et al. (2005) indicated that one of the remarkable issues in this project was that the disclosure of information needed the patient's informed consent; however, the method of obtaining the consent was not clear in the health policies. Furthermore, the disclosure of all mental health medications, HIV/AIDS status, or substance abuse was prohibited and the ED clinicians were concerned about filtering sensitive drugs information that could restrict the usefulness of the data, either for treatment or for research. As mentioned in section 2.3.7.2, the issue of data confidentiality has also been identified as a challenge faced by the National Programme for IT within the NHS in England (Oldfield, 2003; Booth, 2003).

It is important to note that, although many different information systems have been implemented within the NHS, little information is available regarding the clinicians' and non-clinicians' perspectives about the confidentiality of data. For example, the characteristics of the ED may necessitate the accessibility of information for treating patients who might be in a critical condition. However, this may raise new concerns about the confidentiality of data for the patients and ED clinicians, which is worth further investigation.

### **2.4.7. Summary**

Many studies have revealed that having deficient information in emergency care affects clinical decision-making and patient care. Therefore, in order to improve the accessibility of information, the use of information technology in the ED has been recommended. These systems need to be designed based on the real needs of users, and



should be able to meet the information needs of different groups of users. In England, the NHS aims to improve the accessibility of information for all healthcare settings, such as emergency care services, by implementing NHS CRS. However, it seems that little information is available about the current ED systems and ED staff expectations and requirements of the future systems. Therefore, if the NHS aims to provide 24-hour access to information for all healthcare settings, such as EDs, further investigations are necessary to identify users' requirements, so that more acceptable systems are designed and developed. Investigating users' perceptions of the current information systems as well as identifying the strengths and weaknesses of these systems can also be useful for future development.

## **2.5. Evaluation of clinical information systems and the role of users**

Understanding the main causes of success or failure of information systems in different projects may help to improve the efficiency and effectiveness of these systems in future developments. The success or failure of a system is dependent on different factors, such as functional, organisational, economical, technical, and individual factors (Brender et al., 2006). As mentioned in the previous sections, although clinical information systems are developed to improve the process and quality of care, they may cause changes in the work habits that can significantly affect the healthcare providers' workflow (Despont-Gros et al., 2004). Consequently, users may resist using these systems, since such changes are not desirable for most of them (Saathoff, 2005). This resistance also shows that the system has not been accepted by users and has failed to meet their requirements (Brender et al., 2006). Given the limited research on the evaluation of ED information systems, as described in section 2.4.3, studies which have evaluated other clinical information systems from users' perspectives are presented in this section in order to develop a broader understanding of the issues.

This section starts with reviewing the literature related to the factors influencing the use of clinical information systems. In the next sections, evaluation of user satisfaction

with, and user acceptance of, clinical information systems, and theories and models of user acceptance are discussed.

### **2.5.1. User resistance**

Identifying the factors that can influence the use of a system is one of the major concerns in the development of information systems (Jiang et al., 2000). Among them, user resistance to change is an important factor that can make the implementation very difficult in different organisations. For example, in healthcare settings, as Rose et al. (2005) highlighted, clinicians' resistance is considered one of the major barriers to the implementation of Electronic Medical Records (EMR). The reasons for clinicians' resistance are different and may be due to the technical, organisational, or individual factors (Henderson and Deane, 1996). For example, the increased time and effort which has to be spent entering patients' data, the decreased interaction with patients, and the lack of integration between the system functions and the clinicians' workflow are some of the important reasons which may lead to user resistance (Rose et al., 2005; Apkon and Singhaviranon, 2001). Similarly, Karsh (2004) indicated that if the potential end users believe that, after using a system, either their jobs will change for the worse, their work will become worse relative to another group, the organisation is taking advantage of the new technology at their expense, or this change will be similar to previous unsuccessful changes, there is a likelihood that end users will reject the new technology.

Jiang et al. (2000) proposed three theoretical perspectives on user resistance, namely, people-oriented, system-oriented, and interaction theories. Based on people-oriented theory, resistance to an information system is created by the individual factors, such as age, gender, and the individual attitude towards the technology. The system-oriented theory discusses the role of external factors, such as the user interface or the system characteristics, as the main reasons for user resistance. Finally, the interaction theory deals with the notion that systems acquire different political and social meanings in different settings, and different users perceive the effects of the same system differently.

Another reason for user resistance, as Henderson and Deane (1996) highlighted, is user perception of a system. Preece et al. (1994: 717) defined perception as "the process of

becoming aware of objects by way of the sense organs". In addition, "perception is fundamental to interacting with computers", as users need to perceive the information that is presented on the interface (Preece et al., 1994: 75). For example, icons, images and other type of visual information should be easy to understand for all user groups. According to Henderson and Deane (1996), if a system fails to meet users' needs, the resulting poor perception of the system may lead to user resistance. Therefore, in order to overcome this resistance and prepare users to accept the new information technology, it is important to identify users' requirements and expectations before developing the system. Moreover, any unrealistic expectation should be addressed before implementing the system to avoid user resistance (Henderson and Deane, 1996).

In order to overcome user resistance, and to encourage users to use the system, some principles should be taken into account (Saathoff, 2005). One of these principles is becoming familiar with the users of a system and their tasks through task analysis (Saathoff, 2005). For example, in a hospital, the administrative staff are the most compliant group in using a system, since it forms the main part of their work. In contrast, nurses and doctors argue that they are responsible for patient care and entering data into the computer is not their jobs. As a result, they might be reluctant to use a system (Hu et al., 2002).

Interface design is another aspect that should be taken into account, as it can directly affect user acceptance (Saathoff, 2005). For instance, experienced users may have different expectations from inexperienced users, and they may look for a system that is able to meet their immediate expectations or preferences. In contrast, inexperienced users may look for a simplified interface which has been tailored to their routine tasks (Rose et al., 2005). Therefore, it is necessary to consider both groups' expectations and support them with adequate training.

The collaborative nature of clinical information systems, which is related to using a system by different users in an organisation, is another important principle which should be taken into account (Saathoff, 2005). As Rose et al. (2005) indicated, compared to the traditional interactions in a workplace, it is important for an information system to be able to support a variety of tasks. However, the complexity of unexpected situations in healthcare settings and traditional interactions between the healthcare professionals, are two major issues that may not be easily replaced with a computer. Therefore, in order to obtain

more information about why individuals use or do not use an information system, and how well a system works with particular users in a special setting, evaluation studies are necessary (Kaplan and Shaw, 2004). The opposite of resistance is acceptance. Factors that can improve the level of acceptance of technology can also influence the system success. In the literature, sometimes, studies have not clearly differentiated between user acceptance of, and user satisfaction with, an information system and have used them interchangeably (Despont-Gros et al., 2005). However, these two are slightly different in terms of definitions and theories (Despont-Gros et al., 2004), and these are discussed in the following sections.

### **2.5.2. User acceptance**

User acceptance, by definition, is the willingness of users to use the technology (Karsh, 2004). A more complete definition of user acceptance was given by Despont-Gros et al. (2005: 247) who defined user acceptance as “a multifactor construction based on an affective and cognitive evaluation of all components surrounding and influencing the interaction process between a user and an information system”. The concept of user acceptance of technology and factors that may influence the use of technology has been widely discussed in the literature. According to Roukema et al. (2006), user acceptance is a major barrier to the implementation of clinical information systems, since clinicians will face a change in their practice habits. Dillon and Morris (1996) indicated that information systems may deviate slightly from idealised usage in the actual environment of implementation; however, it is possible to predict the likely reasons for this deviation by measuring the user acceptance and its related factors. Moreover, user acceptance indicates whether an information system is able to support the characteristics of users, such as computer knowledge, and the characteristics of their tasks (Ammenwerth et al., 2003a). If an information system is unacceptable to users, their reactions might be to enter limited or incomplete data, or to exchange sensitive information using traditional methods, such as telephone or face to face communication (Handy et al., 2001). According to Ammenwerth et al. (2003b), even a low level of computer acceptance may make the introduction of computer-based systems difficult. Therefore, in order to design better systems and predict

how users will respond to the technology, it is important to find out why people accept or reject information technology (Dillon and Morris, 1996).

In order to increase the level of user acceptance of an information system, paying attention to the attitudes of users is an important issue and should be taken into account, either when a system is under development or under implementation (van der Meijden et al., 2001; Ward et al., 2008; Sicotte et al., 2009). In clinical settings, the attitude of junior staff might be different from senior staff. For example, in Lium et al.'s (2008) study, the junior staff were more positive about using Electronic Medical Records (EMR) than the senior staff. This might have been due to junior staff having more up-to-date knowledge and experience of computers. Moreover, users had different perceptions of system usefulness. While the junior staff agreed that the system was useful and was able to support their tasks, the senior staff thought that the system was less supportive and less useful for them. Ward et al. (2008) also indicated that the attitudes of professional groups towards using computerised systems might be different. While nurses and administrative staff might be more positive about using these systems, doctors might be less positive.

Clinicians may also accept the change, for example, using a new information system, when they realise that the change has positive impact on their work. Therefore, an information system should be capable of supporting individual tasks as well as the organisational workflow. Not only a good system design, but also the organisational changes, such as changing the work habits are needed to achieve the system benefits (Lium et al., 2008). This approach can be discussed in relation to fit between individuals, tasks, and technology (FITT) framework (Ammenwerth et al., 2006). In this framework, to improve fit between these three dimensions, different intervention strategies are suggested. For example, re-organisation of documentation processes may improve the fit between task and technology, IT training can improve the fit between technology and individuals, and adding new functions to the system may influence the fit between technology and task and between individual and technology by improving the usability (Ammenwerth et al., 2006).

Another factor that can influence user acceptance is communication between managers, system developers, and users (van der Meijden et al., 2003a). To increase the level of user acceptance, system designers need to understand the requirements of users, their work flow, and users' problems with the existing systems (Preece et al, 1994; Sicotte

et al., 2009). Similarly, users need to be involved in the process of change (Lium et al., 2008), and be informed about the purpose of a new information system, the potential benefits and impacts, any anticipated changes in their workflow, and the new policy which will be followed in the future (van der Meijden et al., 2003a). This approach can help to improve the level of acceptance and perceived usefulness of the new system among users (Ernstmann et al., 2009), and facilitates the process of system design and implementation. The role of the opinion leaders is also important. Senior staff who are enthusiastic about an information system can support a project and encourage other staff to use a system (Ash et al., 2003; Lium et al., 2008).

Providing users with adequate IT training is another factor that can influence the acceptance of technology (Karsh, 2004). Handy et al. (2001) found that IT training costs can be a barrier to technology acceptance, for example, if there is no organisational support for training. Other aspects of training, such as the timing of training courses are also important. Ash et al. (2003) indicated that in successful projects, post-implementation training is more important than pre-implementation training to support the users with using a system.

Karsh (2004) suggested that the predictors of technology acceptance can be categorised into four groups: organisational factors, technological factors, job factors, and individual factors. The organisational factors include, for example, the degree to which the new technology can be integrated with the existing technologies and the environment. The technological factors are related to the response time, flexibility, down time or crashes, ease of use, usefulness, and usability of the technology. The job factors are related to the degree that one's work routines may change due to the use of the new technology. The individual factors include computer experience, computer knowledge, age, and gender (Karsh, 2004).

The diversity within the environment in which a system operates can be another factor influencing user acceptance. In healthcare settings, each ward and department in a hospital is quite unique (Ammenwerth et al., 2003b). This might be related to the socio-organisational aspects of each setting, for example, different tasks and workflow, different patient profiles, different management support, and different IT history, which can be led to different adoption processes for the same IT system (Ammenwerth et al., 2006). As mentioned in section 2.3.7.1, the diversity in the nature of tasks and the departmental

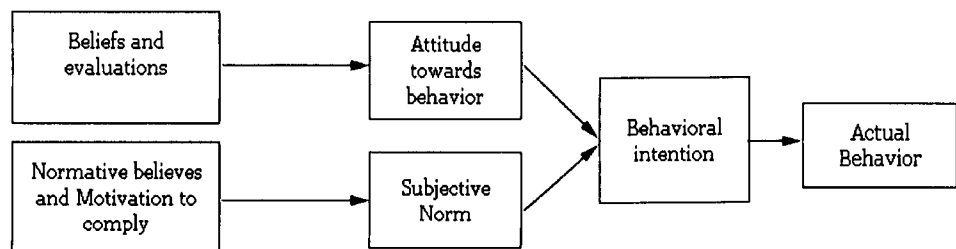
characteristics challenged the design and implementation of a single EHR within the NHS in England. Similarly, van der Meijden et al. (2003a) showed that users' reactions towards an Electronic Patient Records (EPR) system, which was introduced to both a neurology inpatient department and an outpatient clinic, were different. In the neurology inpatient department, users preferred paper-based records, although they assumed that the EPR was easy to use and easy to learn. Researchers explained that the diversity between the departmental characteristics was the main reason for the low level of acceptance. In the inpatient department, patients mostly suffered from stroke and their critical conditions were unpredictable, compared to the patients in the outpatient clinic who were in a relatively stable condition. As EDs have special characteristics (discussed in section 2.4.1), the factors that influence the use of an information system in the ED may be different from the factors influencing the use of the same system in other departments. Therefore, as Ammenwerth et al. (2003b) suggested, further investigation is needed to gain a complete picture of all factors that should be taken into account when planning and developing new information systems.

### **2.5.3. Theories and models of user acceptance**

In order to study the acceptance of technology, a number of theories and models have been suggested. Some of these have been used to understand the psychology of user acceptance and concentrate more on the process of human decision-making in the context of accepting or rejecting technology. The Theory of Reasoned Action (TRA), the Technology Acceptance Model (TAM), the Theory of Planned Behaviour (TPB), and the Unified Theory of Acceptance and Use of Technology (UTAUT) model are theories that have been proposed for this approach (Dillon and Morris, 1996). A further theoretical approach of user acceptance deals with the design of information technology. In this approach, the theory of socio-technical systems and the Human-Computer Interaction (HCI) model and usability engineering are the most important theories and models of user acceptance (Dillon and Morris, 1996). In this section, the theories and models mentioned above are described in detail.

### ***Theory of Reasoned Action (TRA)***

The theory of reasoned action defines relationships between beliefs, attitudes, subjective norm, behavioural intentions, and actual behaviour in the context of understanding the psychology of user acceptance (Fishbein and Ajzen, 1975). According to this theory, accepting or rejecting technology (behaviour) is based on one's intention and the intention is influenced by the individual's attitude and subjective norm (Dillon and Morris, 1996; Venkatesh et al., 2003). Figure 2.1 shows the Theory of Reasoned Action (TRA) and its variables.



**Figure 2.1- Theory of Reasoned Action (TRA) from Davis et al. (1989: 984)**

In the Theory of Reasoned Action (TRA), behavioural intention refers to “the intention to perform a particular response that is to be predicted” (Fishbein and Ajzen, 1975: 301). Attitude towards behaviour refers to “an individual’s positive or negative feelings about performing the target behaviour” (Fishbein and Ajzen, 1975: 216). The subjective norm deals with the influence of the social environment on behaviour and is defined as “a person’s perception that most people who are important to her/him think s/he should or should not perform a given behaviour” (Fishbein and Ajzen, 1975: 302). Subjective norm is determined by the perceived expectations of the group important to an individual and the individual’s motivation to comply with those expectations. Beliefs and evaluation refers to the person’s perceived consequences of performing a given behaviour and the person’s evaluation of those consequences (Fishbein and Ajzen, 1975).

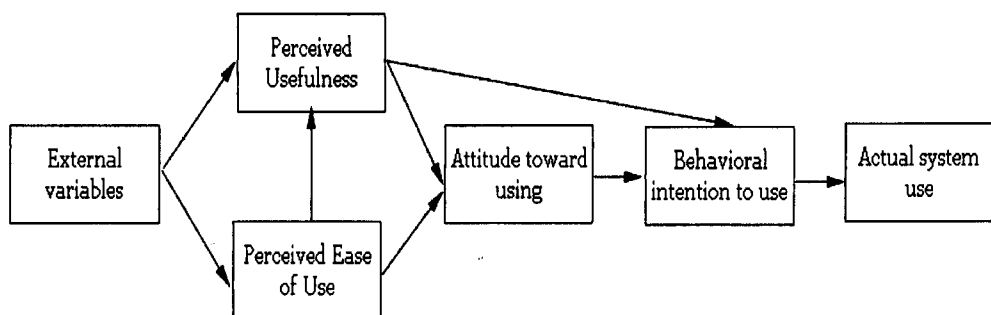
Although this model helps to explore relationships among some psychological factors that influence user acceptance, applying this model may not be adequate to evaluate the acceptance of clinical information systems. In the healthcare environment, there are a number of environmental and organisational factors that may influence the acceptance of technology. While this model has not been used in relation to the acceptance of clinical



information systems, its two main variables, which are user attitude towards using information systems and subjective norm, have been addressed in different studies in the healthcare environment (van der Meijden et al., 2001). The research on clinical information system acceptance has been heavily focused on user attitude towards the new system prior to its implementation or shortly after its initiation (Sicotte et al., 2009). In terms of subjective norm in the healthcare environment, the role of clinical directors has been identified as important in encouraging staff to use the technology and in improving user acceptance (Saathoff, 2005).

### ***Technology Acceptance Model (TAM)***

The Technology Acceptance Model (TAM) is another model that can be used to predict the acceptance of an information system while the system is under development. In this model, the perceived usefulness (the degree to which a user believes that using the system will enhance her/his performance) and the perceived ease of use (the degree to which a user believes that she/he can use the system free from effort) are two main criteria to predict the level of user acceptance (Davis et al., 1989; Dillon and Morris, 1996; Venkatesh et al., 2003). In this model, the external variables include the system features, training, and user support (Davis et al., 1989). In another study, Davis (1993) found that perceived usefulness and perceived ease of use had significant effects on attitude, but the effect of perceived usefulness was stronger, and perceived ease of use could directly influence perceived usefulness. Figure 2.2 shows the Technology Acceptance Model (TAM) and its variables.



**Figure 2.2- Technology Acceptance Model (TAM) from Davis et al. (1989: 985)**

Similar to the Theory of Reasoned Action (TRA), the Technology Acceptance Model (TAM) deals with a limited number of variables. In this model, other variables, such as individual, environmental, and organisational factors are not considered and user acceptance can be evaluated based on the system characteristics. However, Davis (1993) indicated that where users are required to use a system in a setting, the TAM model should be extended and other variables, such as user involvement, user experience and task characteristics should operate through user attitude or subjective norm. The TAM model was extended by Venkatesh and Davis (2000) and was introduced as TAM 2. In this model, the additional constructs included subjective norm, voluntariness, experience, image, job relevance, output quality, and result demonstrability. Voluntariness is defined as “the extent to which potential adopters perceive the adoption decision is non-mandatory” (Venkatesh and Davis, 2000: 188). Image is “the degree to which the use of an innovation is perceived to enhance one's status in one's social system” (Moore and Benbasat, 1991: 195). Job relevance is defined as “an individual's perception regarding the degree to which the target system is applicable to support his or her job” and “the perception of how well the system performs those tasks” refers to output quality (Venkatesh and Davis, 2000: 191). Finally, the result demonstrability refers to “the tangibility of the results of using the innovation” (Moore and Benbasat, 1991: 203). Figure 2.3 shows the extended Technology Acceptance Model 2 (TAM 2) and its determinants.

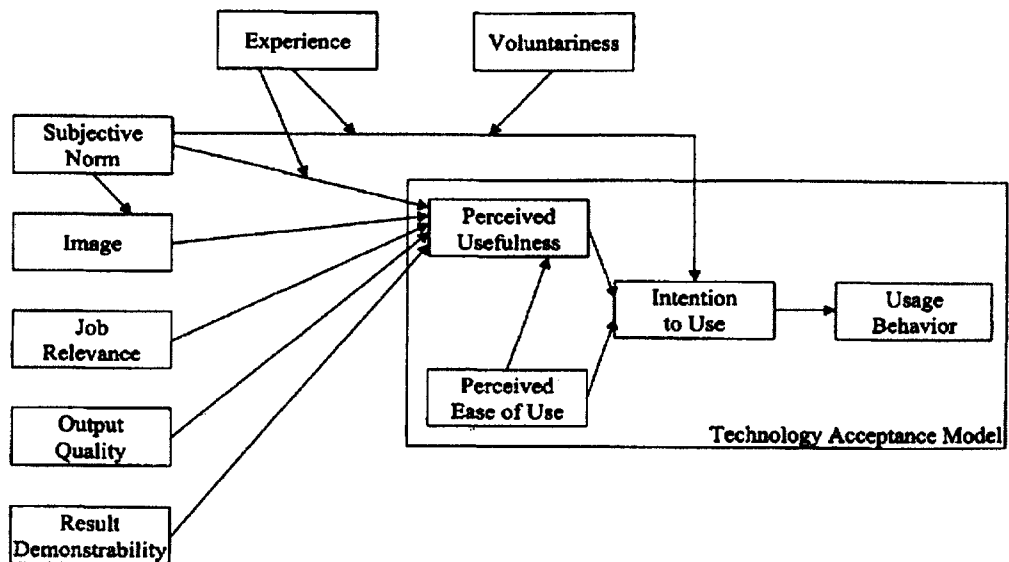
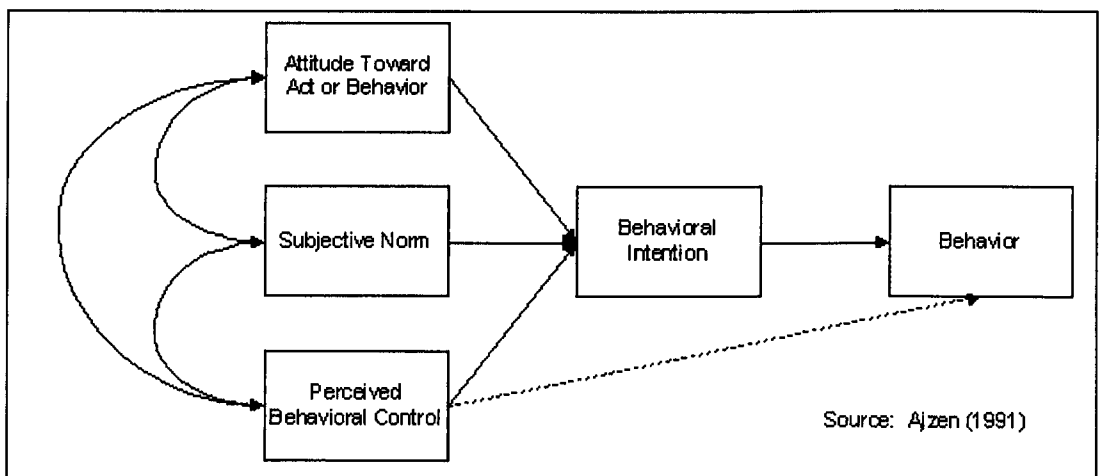


Figure 2.3- The extended Technology Acceptance Model (TAM 2) from Venkatesh and Davis (2000: 188)

In the healthcare environment, some studies have used TAM model to evaluate user acceptance with clinical information systems (Mazzoleni et al., 1997; Chang et al., 2003) and some studies adapted this model to include other variables, such as individual, environmental, and organisational factors (Handy et al., 2001). However, TAM 2 model has been used in a few studies (Chismar and Wiley-Patton, 2002). These studies are discussed in section 2.5.4.

### ***Theory of Planned Behaviour (TPB)***

In the Theory of Planned Behaviour (TPB), a third antecedent of intention, namely, perceived behavioural control has been added to other components of the TRA model discussed above. This factor refers to the external and internal constraints on behaviour, such as the availability of skills, resources, and the opportunities as well as the perceived importance of these in achieving the outcomes (Ajzen, 1991; Dillon and Morris, 1996; Venkatesh et al., 2003). Figure 2.4 shows the Theory of Planned Behaviour (TPB) and its variables.



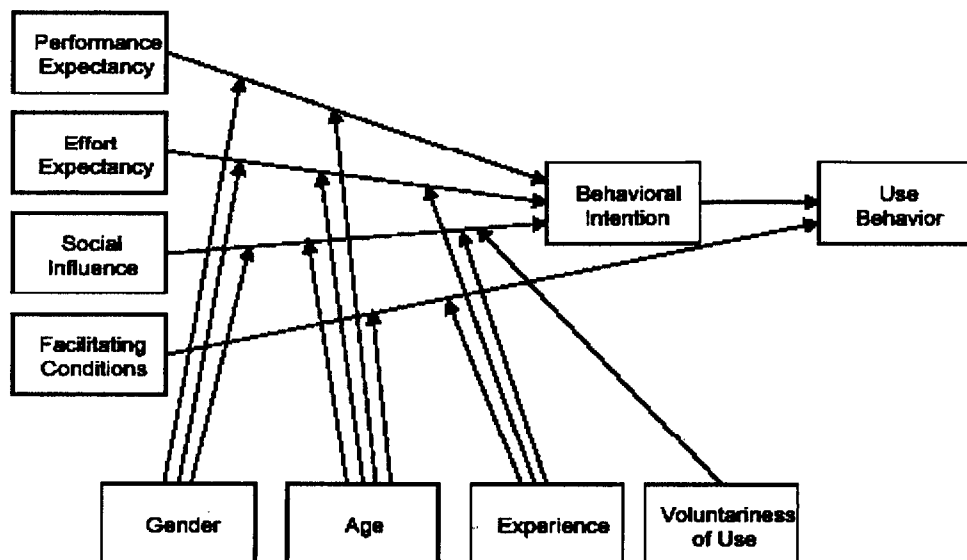
**Figure 2.4- Theory of Planned Behaviour (TPB) from Ajzen (1991: 182)**

It seems that no research has applied this model to evaluate user acceptance with clinical information systems, although the perceived behavioural control has been addressed in some studies in different ways. For example, the importance of training, IT skills, and IT support have been addressed in different studies (van der Meijden et al., 2001;

Despont-Gros et al. 2004) which can be regarded as the perceived behavioural control for accepting a new clinical information system.

### *Unified Theory of Acceptance and Use of Technology (UTAUT)*

Venkatesh et al. (2003) introduced the unified theory of acceptance and use of technology (UTAUT) which is shown in Figure 2.5. These researchers indicated that the new model integrated all constructs in the previous models and could explain variance in IT behavioural intention and use behaviour better than previous models. In this model, four constructs had a significant role as direct determinants of user acceptance and usage behaviour. These were performance expectancy, effort expectancy, social influence, and facilitating conditions. The key moderators of this model were gender, age, voluntariness of use, and experience. In this model, the performance expectancy and the effort expectancy were used as similar concepts for the perceived usefulness and the perceived ease of use, discussed in TAM. The social influence refers to the subjective norm in other models and facilitating conditions include aspects of the technological and organisational environment. Figure 2.5 shows the Unified Theory of Acceptance and Use of Technology (UTAUT) and its variables.



**Figure 2.5- Unified Theory of Acceptance and Use of Technology (UTAUT)**  
(Venkatesh et al., 2003: 447)

Venkatesh et al. (2003) suggested that the effect of performance expectancy is stronger for men and for younger users, and the effect of effort expectancy and social influence is stronger for women and older staff. The effect of age on the facilitating conditions was also stronger for the older workers. Social influence is not significant when the use of the system is voluntary, but it is important in settings where it is mandatory. In terms of the user experience, Venkatesh et al. (2003) indicated that the key constructs of the model are more important for less-experienced users than for experienced individuals. This model has been used in some studies related to healthcare information systems (Chang et al., 2007; Kijisanayotin et al., 2009), which are discussed in the next sections.

### *Socio- technical systems theory of acceptance*

As Dillon and Morris (1996) indicated the socio-technical systems theory of acceptance deals with analysing the organisational impact of technology. As the theory originates from models of human behaviour, the term 'socio-technical' is used for both aspects of acceptance, namely, the user and the technology. According to this theory, applying technology is dependent on the ability and willingness of users to employ it, and the technology impact should be analysed based on the organisational goals.

According to Kijisanayotin et al. (2009), an inadequate understanding of the socio-technical aspects of IT, for example, an inadequate understanding of how people and organisations adopt information technology, has been one of the major factors leading to the failure of healthcare information systems. Berg (1999) suggested that the socio-technical approach should be regarded as a priority in designing clinical information systems. In this approach, healthcare practices are perceived as a network of people, tools, organisational routines, documents, and so forth. In this network, two important characteristics are the cooperative work processes and patients' conditions, which might be unexpected or unstable, such as emergency situations. Such a situation may force healthcare staff to use informal pathways. It is, therefore, imperative to acquire a deeper insight into the healthcare workflow by involving end-users in the process of system design.

### ***Human-Computer Interaction (HCI) model and the usability engineering approach to acceptance***

This model deals with traditional human factors in workflow, and focuses on a user-centred design. Another important concept in this field is designing systems with better interface in order to make systems more usable for users (Dillon and Morris, 1996). As Preece et al. (1994) indicated, four main components of this model, which can influence user interaction with an information system, are people, work, technology, and environment. Despont-Gros et al. (2005) adapted the 'Human-Computer Interaction (HCI)' model to develop a framework for evaluating user interaction with clinical information systems. The suggested framework was composed of the information system characteristics, the user characteristics, the context of use and environmental characteristics, and development process characteristics. In this framework, the researchers added the fifth dimension; namely, the impact or outcome of computerisation on users and on the organisations. However, it was not clear whether the new framework could be applied to evaluate user interaction with different clinical information systems or not.

#### **2.5.4. Evaluation of user acceptance**

As mentioned earlier, in a number of studies the terms user satisfaction and user acceptance have been used interchangeably (Ammenwerth et al., 2003a). Therefore, separating these two areas of research can be difficult, especially where researchers have addressed both terms in one study. Nevertheless, studies with a more clear focus on the acceptance of clinical information systems are discussed in this section, and studies related to user satisfaction are presented in section 2.5.5. As little research has been conducted to evaluate user acceptance of ED systems, or to investigate factors that may influence the use of IT in the ED, this section first reviews the literature related to the acceptance of clinical information systems and then presents studies related to the acceptance of ED systems.

Henderson and Deane (1996) investigated the expectations and perceptions of two groups of healthcare professionals about using a patient management information system in a mental health setting in Australia. The first group included one hundred staff who were about to receive the new system (pre-user group) and the second group included sixty staff

who were using the system (user group). The response rate for the first and second groups was 72% (n=72) and 50% (n=30), respectively. The measurement instrument was the Computer Expectations Questionnaire (CEQ) and respondents were asked to rate items on a 5-point Likert scale from (1) strongly agree to (5) strongly disagree. The questionnaire was used in the original format for the pre-user group and was modified by using statements in the past tense for the user group. The results showed that while the pre-users expressed a cautiously positive attitude towards the new system implementation, the users were relatively dissatisfied with the training support, system accuracy, communication with patients, ease of retrieving data, speed of computers, and communication with other staff. In this study, a higher mean value indicated negative perceptions, and could be seen among user groups about most of the aspects of the system. For example, the mean value for the ease of retrieving data was 3.65 for the user group, while this value for the pre-user group was 1.75. According to the results, professional groups (psychologists and social workers) had more negative perceptions of the system than nurses and clerks (Henderson and Deane, 1996). In this study, the researchers indicated that the users' negative attitudes might be due to their perceptions of the system as a managerial tool, or their unmet expectations after using the system; however, it seemed that this issue needed further investigation, for example, using qualitative studies. Furthermore, the results of this study were limited to the setting and a specific system; therefore, the results could not be generalised to a wider population.

Mazzoleni et al. (1997) assessed the level of user acceptance of a Hospital Information System (HIS) in Italy. The participants of the study were physicians and nurses who worked in four different departments, namely, nephrology, dialysis, general medicine, and oncology. In this study, the influence of the user characteristics, the system characteristics, and the context on the acceptance of the HIS were measured on a seven-point Likert scale using two questionnaires. The results showed no correlation between the user characteristics and the perceived usefulness or the perceived ease of use. Assessing system characteristics from the users' perspectives showed that the system was acceptable, although clinicians' perspectives were different depending on the department in which they worked. The influence of the context was another factor that dealt with the previous experience of using information technology and its effect on the current perceptions of users. As users had an experience of using a low speed information system, they were

worried about losing time when using a new system with similar characteristics. Similar to other studies, the results of Mazzoleni et al.'s (1997) research could have been supported by qualitative data or open-ended questions to obtain more information about the users' perceptions.

Van der Meijden et al. (2001) conducted research in the Netherlands to measure users' attitudes towards the future Electronic Patient Records (EPR) in a neurology department. Data were collected using two different questionnaires and two sets of in-depth interviews at two different times before implementing the system. The participants of the study were nurses, residents, and specialists. The first questionnaire measured staff attitudes towards computerising paper-based records on a scale of (1) fully disagree to (5) fully agree. This questionnaire was sent to 63 future users and was completed by 65% of participants (n=41). The second questionnaire was sent to 65 potential users and measured their satisfaction with the paper-based records, their knowledge of computer, and their expectations of an EPR. The response rate for this questionnaire was 66% (n=42). The results showed that the attitude of experienced computer users was more positive (mean=3.6) than the inexperienced users (mean=3.0), but in general the difference was not significant and the experienced and inexperienced users appeared to be neither positive nor negative (van der Meijden et al., 2001).

In addition, although inexperienced users agreed that the quality of care could be improved by using the EPR, spending more time on data entry and learning how to use the system were their main concerns. The results of the first set of interviews revealed that users were not aware of the benefits of using electronic records. The second set of interviews focused on the impact of using EPR on the daily tasks and showed that in the users' opinions, better legibility, more concise reporting, and no more duplication could be some of the advantages of EPR. The analysis of the second questionnaire showed that although users were relatively satisfied with their paper-based records, their satisfaction was more about recording data rather than retrieving data from paper-based records. In addition, the inexperienced computer users were more satisfied with the paper-based records than the experienced users. Finally, both inexperienced and experienced users expected that the future EPR would have some characteristics, such as ease of use, increasing the availability and reliability of data, and high-speed data processing (van der



Meijden et al., 2001). This study was conducted before implementing the system, so there was a possibility that the results may have been different if users' attitudes had been measured after implementing the system. Apkon and Singhaviranon (2001) indicated that the level of user acceptance changes when an electronic system provides direct benefit to caregivers. Moreover, the results were limited to the setting of the study, since all of the participants worked in the neurology department. It is possible that clinicians in different departments had different attitudes towards, and expectations of, the EPR.

In another study, Handy et al. (2001) examined practitioners' views prior to the implementation of an Electronic Medical Records (EMR) system. In this study, which was carried out in New Zealand, the researchers modified the Technology Acceptance Model (TAM). Using the new model, the researchers evaluated the perceived system acceptability (the acceptability of the characteristics of the system), the individual's characteristics, organisational characteristics, the perceived usefulness, and the perceived ease of use of the system. Considering these elements, a questionnaire was developed and was sent to 167 doctors and midwives; however, the number of participants in each group was not clear. Fifty-one doctors (64%) and fifty-one midwives (59%) returned usable questionnaires. The results showed that the users were not confident about using the EMR, as they were concerned about the security of the system and the accuracy of data. In addition, the users indicated that ease of use (90%), usefulness (89%), the voluntariness of use (79%), and seeing the visible benefits of the system (30%) in their work were the main factors that could encourage them to use the system.

In Handy et al.'s (2001) study, a questionnaire was developed based on the TAM model; however, no information was available about the reliability and validity of the questionnaire for future studies. In addition, a comparison between doctors' perspectives with midwives' attitudes could have been helpful to discover similarities and differences in their opinions. Moreover, applying qualitative methods, such as interviews, could explore other aspects of users' perspectives that might have been overlooked using a questionnaire.

Chismar and Wiley-Patton (2002) investigated the adoption of the Internet and the Internet-based Health Applications (IHA) among paediatricians. These researchers modified the Technology Acceptance Model 2 (TAM 2) questionnaire to fit the population of the study. The questionnaire was sent to 205 paediatricians and 91 completed

questionnaires were received, of which 89 questionnaires were usable, and the response rate was 43%. In this research, regression analysis was used to identify the relative importance of the factors influencing their intention to use the technology. The results showed that perceived usefulness, perceived ease of use, and subjective norm contributed to 54% of variance in intention to use technology and perceived usefulness was the strongest determinant of intention to use. Moreover, while the younger respondents (aged 20-40) thought that the application was easy to use and easy to understand, the older respondents (51+) assumed that the application was difficult to use.

In Chismar and Wiley-Patton's (2002) study, the determinants of TAM 2 model were used to predict the acceptance of the technology among paediatricians. However, in order to gain a better understanding of factors influencing the use of the Internet and the Internet-based Health Applications (IHA), an exploratory/qualitative study might be useful. Such a study could provide a possibility to compare the results with the determinants of the TAM 2 model. Moreover, the results of this study were limited to the perspectives of paediatricians about a specific technology. The results might be different, if the perspectives of other healthcare professional were investigated.

Ammenwerth et al. (2003a) evaluated the user acceptance of an electronic report writing system in Austria. Three main user groups, namely, junior physicians, senior physicians, and clerical assistants were selected from three departments, neurology, internal medicine, and surgical transplantation. The study design was quantitative and a representative sample of users and departments was selected. In this study, a questionnaire including a few open-ended questions was used. The questionnaires were distributed to ninety users, and fifty-nine users completed and returned the questionnaire (response rate = 66%). The study findings revealed that the level of user satisfaction with the computer-based report writing system was medium to high; however, the exact figure of the mean value for satisfaction was not mentioned. The study results showed that the level of satisfaction was significantly different between user groups and departments that could be as a result of diversity in routine tasks. For example, in the neurology department, clerical assistants were much more satisfied with the new system than physicians. This was in contrast to the results in other departments. Further investigations revealed that another reason for user dissatisfaction was the condition of report writing before introducing the

system. For example, before introducing the new system to the department of internal medicine, report writing was a well-organised task. However, after implementing the new system, physicians were less satisfied with the new system, as they had to enter more data and to correct their reports (Ammenwerth et al., 2003a).

The above mentioned study (Ammenwerth et al., 2003a) is another example which explains the difficulties in implementing a single system in different departments, and for different user groups. The results of the study showed that users in each department had different expectations that should be considered in designing the system. From a methodological point of view, although developing different questionnaires for different groups of staff, such as physicians and clerks, could be time-consuming, it could have been useful to focus more on users' tasks in relation to using the system. In addition, using qualitative methods for data collection, such as interviews, could have helped to interpret the quantitative data and find more about users' expectations in different departments.

Ammenwerth et al. (2003b) investigated changes in user acceptance after introducing a computer-based nursing documentation system and analysed correlations between different influential factors. This study was carried out in one of the hospitals in Germany, and user acceptance was studied with respect to the basic computer acceptance, the acceptance of computers in nursing, and the acceptance of the nursing process among users. In order to support all three aspects, validated questionnaires from related studies were used. The participants of the study were sixty nurses who worked in four departments: paediatrics, dermatology, and two psychiatric wards (A and B). The study aimed to evaluate user acceptance at three different times (before, during, and after implementation) and nurses received the same questionnaires three times. The response rate for the first, second, and third phase was 82%, 86.5%, 90.2%, respectively. In addition, three to four nurses from each ward were interviewed in order to obtain deeper insights into user acceptance.

The results of Ammenwerth et al.'s (2003b) study showed that introducing computers in the nursing process did not significantly influence the general acceptance of the computer. The overall score of computer acceptance in nursing was medium to high before introducing the nursing information system and increased in all wards, except paediatrics, after its introduction. The general user acceptance of the computer-based

nursing documentation system was also medium to high. In addition, there was a positive correlation between users' experience of IT and the acceptance of computers in general ( $r=0.58$ ,  $p<0.05$ ) and the acceptance of computers in nursing ( $r=0.45$ ,  $p<0.05$ ). In the paediatric ward, patient turnover was high and completing a nursing care plan was time-consuming. In this ward, nurses who were older than other participants were not sufficiently prepared to use the computer in the nursing documentation process. Some factors, such as the computer knowledge, the previous method of documentation, the age of users, and the clinical directors, who could encourage staff to use the system, were identified as factors influencing the acceptance of the system (Ammenwerth et al., 2003b). However, the results were limited to the setting of the study and related to specific software. Therefore, the results may not be generalisable to other settings.

In order to introduce a framework for evaluating user acceptance in the healthcare settings, Despont-Gros et al. (2004) carried out a qualitative study and interviewed three groups of professionals, namely, healthcare providers (users), IT support group and trainers, and IT specialists and system developers in Switzerland. They found that the dimensions of user acceptance can be divided into five categories, the characteristics of users, the characteristics of the clinical information system, the perceived interaction with the system, the perceived environment, and the perceived consequences and impacts (Despont-Gros et al., 2004). However, the specialty of the healthcare providers and the number of interviewees was not clear. In addition, although this framework can be used to evaluate the user acceptance of clinical information systems, further research is needed to examine this framework in different settings, and compare the results with the original framework.

Chang et al. (2007) conducted a field study on the physicians' acceptance of a pharmacokinetics-based clinical decision support system (CDSS). This system was a web-based prototype embedded in a handheld computer, and was used in three Taiwanese hospitals. The participants of this study were 140 voluntary physicians from three hospitals. The revised Unified Theory of Acceptance and Use of Technology (UTAUT) model was used, in which the moderated variables of the original UTAUT model; namely, gender, age, experience, and voluntariness of use were excluded. In the revised model, the main constructs of the UTAUT model including performance expectancy, effort

expectancy, social influence, and facilitating conditions remained. A questionnaire was designed based on a five-point Likert scale, ranging from (1) strongly disagree to (5) strongly agree. The response rate was about 82% (n=115). The results showed that performance expectancy ( $p<0.05$ ) and effort expectancy ( $p<0.05$ ) had significant effects on physicians' intention to use the CDSS, and subsequent utilization of the system. The effect of performance expectancy was also stronger than the effort expectancy. The effect of social influence on intention to use ( $p<0.1$ ) and the effect of facilitating conditions on user behaviour ( $p<0.1$ ) were less significant, but these were supported by the data. Intention to use could also positively influence the use of the system ( $p<0.001$ ). In Chang et al.'s (2007) study, one of the limitations was related to the sample which only included the volunteer physicians. Therefore, the generalisability of the results might be limited. Moreover, physicians' use behaviour was measured using the self-reported items. However, the accuracy of self-reported usage might be limited.

Kijsanayotin et al. (2009) employed a modified version of Unified Theory of Acceptance and Use of Technology (UTAUT) model (discussed in section 2.5.3) to understand factors that might influence health IT adoption in the Community Health Centres (CHC) in Thailand. A national survey was conducted in which a random sample of 1607 CHCs was selected and an officer, who was responsible for the CHC's information management, or the CHC's administrative officer was asked to complete the survey. Data were collected using a self-administered questionnaire designed based on the Likert scale, and the response rate was 82% (n=1323). The results showed that the constructs of performance expectancy, effort expectancy, social influence, and the voluntariness of use could influence intention to use about 54%, and performance expectancy, as the strongest factor contributed to 29% of variation in intention to use. Intention to use, facilitating conditions, and the experience of IT accounted for 27% of variation in predicting IT use. Among these factors, the effect of the previous IT experience on IT use (13%) appeared to be stronger than the effect of facilitating conditions (10%) and intention to use (4%). User IT knowledge was added to the model which contributed to 2% of the variation in facilitating conditions. One of the limitations of this study was related to the responses received from the CHCs. As noted earlier, only one respondent in each CHC had completed the questionnaire. Therefore, other members of the CHC might have had different views. Moreover, the results of this study were related to the general use of IT in

healthcare; therefore, the results may vary where a specific technology is selected to be studied.

In relation to the ED systems, Chang et al. (2003) designed a comprehensive triage Personal Digital Assistant (PDA) for an ED in Taiwan and evaluated the level of user acceptance through using the Technology Acceptance Model (TAM). To evaluate user acceptance, a questionnaire was developed based on a seven-point Likert scale, and questions covered perceived ease of use, perceived usefulness, and user's willingness to use the system. The questionnaire was distributed among seventy-two nurses in the ED. While the response rate was 94%, only 63 questionnaires were used for data analysis, due to problems with data quality. The results showed that nurses agreed that the PDA system was easier to operate (mean value= 4.40) than the previous system (mean value= 4.28); however, they believed that the usefulness of both systems was relatively the same. In addition, the mean value for the nurses' willingness to accept the new system was (4.54), while this value for the old system was (5.10). Finally, because of the problems with the new interface, nurses preferred to use the old system. In fact, an inappropriate interface design resulted in nurses not accepting the new system, though it had been particularly developed to support the triage nurses and their work. Another reason for the users' resistance was familiarity with the traditional system; however, in order to use the new system nurses needed to be trained (Chang et al., 2003). It seems that investigating users' requirements and their perspectives about the old system before designing the new one could have helped to identify their expectations, and could have led to design a more acceptable system.

According to the studies reviewed above, it appears that the evaluation of user acceptance of clinical information systems has been undertaken mainly by using quantitative methods. However, using qualitative methods could help to identify factors that are important from users' perspectives and might not be addressed in quantitative studies. Moreover, in each study, specific software or a new system was studied. As a result, the findings were limited to the setting and the system under study, and might not be generalised to other settings. Furthermore, few studies have reported the acceptance of, or factors influencing the use of, ED information systems. With respect to the ED

characteristics, further research is needed to identify factors influencing the use of IT in the ED using qualitative and quantitative approaches.

### **2.5.5. User satisfaction**

User satisfaction is related to the experience of using a system. According to Chin and Lee (2000: 556), user satisfaction can be defined as the “overall affective evaluation an end-user has regarding his or her experience with the information system” (Chin and Lee, 2000: 556). System ‘use’ and ‘user satisfaction’ are interrelated, but ‘use’ precedes ‘user satisfaction’, and a positive experience with ‘use’ will lead to user satisfaction. As a result of use and user satisfaction, positive impact and benefits will be achieved (Delone and Mclean, 2003). A higher level of user satisfaction indicates that a system has been successful to meet users’ requirements. User satisfaction has been identified as an important indicator of system success; however, it can be affected by several factors. For example, system quality including response time, usability, availability, reliability; information quality including completeness and relevancy; service quality including the overall support delivered by the system provider; and the positive or negative impact of system usage can influence user satisfaction (Delone and McLean, 2003).

As Burkle et al. (2001) suggested, other factors influencing user satisfaction can be related to the system-dependent aspects, such as content satisfaction and interface satisfaction, and the system-independent aspects, such as an individual’s interest in using a computer are the main issues. Kim (1989) suggested that user attitude towards using an information system, user satisfaction in terms of data quality, and user satisfaction in terms of perceived effectiveness of an information system are three aspects which can be used in measuring user satisfaction. Heathfield et al. (1998) noted that satisfaction with an information system is related to users’ perceptions of system effects on their productivity, rather than the effects of the system on the quality of care. As the quality of care is dependent on different factors, such as the type of illness, the type of treatment, and many other factors, using information systems can indirectly influence the quality of care by providing the information that is needed, and the effects may not be visible. However, users are more interested in using a system with demonstrable benefits on their daily tasks,

and their perceptions about these benefits can affect the system usage (Handy et al., 2001). Other factors, such as perceived ease of use and perceived usefulness of information systems, as well as the organisational support have been identified as factors influencing user satisfaction (Palm et al., 2006).

The importance of user satisfaction with the clinical information systems has been highlighted in the literature, and several studies evaluated user satisfaction with these systems (Gardner and Lundsgaarde, 1994; Ohmann et al., 1997; Sittig et al., 1999). However, little research has been conducted to evaluate user satisfaction with ED information systems. Therefore, in this section, first some of the studies related to the evaluation of user satisfaction with different clinical information systems are reviewed and then studies related to the evaluation of user satisfaction with the ED systems are presented.

Gardner and Lundsgaarde (1994) evaluated physicians' and nurses' satisfaction with 'Health Evaluation through Logical Processing' (HELP), a clinical expert system implemented in a hospital in the United States. In this study, 360 attending staff physicians and 960 nursing staff participated. The response rate was 68% for physicians and 39% for nurses. Data were collected using a questionnaire, which asked physicians and nurses about their general computer experience, their opinions about the HELP system, the value of computerised access to various patients' data, present system features, desired features for the future, and ranking these features based on their importance. The results showed that the duration of using the system was correlated with user satisfaction, and physicians and nurses who used the system on a routine basis expressed greater satisfaction with the system than those who used it occasionally. In addition, on a scale of (1) unimportant to (5) very important, the mean value for physicians and nurses who agreed with improving healthcare delivery through using the HELP was (3.65) and (3.40), respectively. Physicians' and nurses' opinions and the level of their satisfaction with the capabilities of the system were different based on their work conditions (Gardner and Lundsgaarde, 1994). However, there was not enough information about the strengths and weaknesses of the system, and the results only presented users' general views about the system.

In another study, Ohmann et al. (1997) evaluated doctors' satisfaction with the documentation module of a Hospital Information System (HIS) in Germany. The research instruments were two standardised questionnaires, namely, the User Information



Satisfaction (UIS) and the Questionnaire of User Interaction Satisfaction (QUIS). In this study, 164 hospital physicians were selected randomly to receive both questionnaires, and the response rate was 58%. However, only 24% of the completed questionnaires could be used, as some of the participants had not used the system yet. The results of the UIS questionnaire showed that on a scale of (-3) to (+3), the mean value of the quality of information was (0.37), and the mean value for receiving support from data processing staff was (0.51). The involvement of users was rated as neutral with the mean value of (0.03). The total mean value of the UIS questionnaire was (0.34). The results of the QUIS questionnaire showed that on a scale of (1) to (9), users rated their satisfaction with the system (5.06).

Burkle et al. (2001) criticised some aspects of Ohmann et al.'s (1997) study. The researchers highlighted that although the use of standardised questionnaires would allow comparison of the findings with other studies, re-designing the questionnaires based on the variables related to the system under study would have been worth doing. Moreover, the study was purely quantitative. The results could have been supported by qualitative data to show greater details about the strengths and weaknesses of the system. Furthermore, the real users of the system could be identified before distributing the questionnaires to obtain more useful questionnaires. The results were also limited to the setting of the study and could not be generalised to a wider population.

Sittig et al. (1999) evaluated physicians' satisfaction with an Electronic Medical Records (EMR) system. The system had been in use for over ten years and 75 full-time and part-time primary care physicians were using it. The Questionnaire for User Interaction Satisfaction (QUIS) was used to collect data. The questionnaire was divided into five sections to assess the overall user reactions, the screen design and layout, the terminology and system messages, the learnability of the system, and the system capabilities. In their study, physicians' satisfaction with three main applications, namely, the clinical results review, the ambulatory medical records, and the list management were investigated. According to the rating scale of one (the lowest rating) to nine (the highest rating), the highest mean value (6.5) was calculated for the screen design and layout, and the lowest mean value (4.9) was reported for the system capabilities, such as the speed of the system. Overall, the results revealed that physicians were less satisfied with the capabilities of the

system and believed that their real needs had not been addressed in system design. The results of Sittig et al.'s (1999) study could be used to eliminate the weaknesses of the given system. Additionally, if qualitative methods had been used along with the questionnaire, more details about physicians' satisfaction could have been obtained.

Palm et al. (2006) investigated the determinants of overall user satisfaction with a clinical information system (CIS). This study was conducted in a hospital in France, and all of the departments of the hospital used the same clinical information system. The participants included 600 physicians, 1300 nurses, and 180 medical secretaries. The electronic survey consisted of 42 questions for nurses, 56 questions for physicians, and 54 questions for the medical secretaries. A seven-point Likert scale was also used where it was needed. The survey was designed to measure user characteristics, user satisfaction, use, system quality, perceived usefulness, and service quality. In total 324 replies were received, giving a response rate of less than 25%. The response rate was 16% (n=93) for physicians, 13% (n=174) for nurses, and 32% (n=57) for medical secretaries.

The results of Palm et al.'s (2006) study showed that users were overall satisfied with the CIS (mean=4.50). Secretaries (mean=4.86) were more satisfied with the CIS than the nurses (mean=4.69) and physicians (mean=3.93). Moreover, secretaries were the most frequent users of the system. From the users' point of view, the system was perceived as easy to use (mean=5.00) and useful (mean=4.88). The perceived service quality, including quality of support and training was less than other factors (mean=3.90). In a multivariate analysis, male sex ( $p=0.02$ ), the CIS quality including perceived ease of use and speed ( $p<0.001$ ), perceived usefulness ( $p<0.001$ ), and the service quality ( $p<0.001$ ) remained significant determinants of overall CIS satisfaction. In Palm et al.'s (2006) study, it was not clear how long after the system implementation the survey was conducted. This is important, as the level of user satisfaction with a system might change over time. Moreover, the questionnaire was adapted to the context of CIS use and reflected the functionalities of the system for each user group. Therefore, the current format of the questionnaire might not be suitable for other clinical settings with different systems. Another limitation of this study was related to the low response rate, and the responses might not be representative of the staff perspectives.

Likourezos et al. (2004) conducted a survey study in a large urban teaching hospital in the United States in order to evaluate emergency physicians' and nurses' satisfaction with an Electronic Medical Records (EMR) system. This survey was undertaken three months after implementing the EMR in the ED (Likourezos et al., 2004). The eligible participants of the study were 115 clinicians (37 physicians and 78 nurses). The questionnaire was completed by 23 physicians and 21 nurses giving an overall response rate of (38.3%). Data were collected using a questionnaire based on a four-point Likert scale (1) strongly agree to (4) strongly disagree. The questionnaire used to investigate the clinicians' demographic characteristics, the clinicians' computer experience, the clinicians' perceptions of using the EMR, and their concerns about its impact upon the quality of care.

In Likourezos et al.'s (2004) study, the results showed that 90.9% of physicians found the system easy to enter data, 82.6% of them believed that the system was easy to access information, and 78.3% of physicians explained that reading text on the screen was easy. Similarly, 95.2% of nurses found this system easy to enter data, 95.2% agreed that the system was easy to access information, and 81.0% indicated that reading text on the screen was easy. The results also revealed that nurses, in comparison with physicians, were more satisfied with the impact of the system on their work. For example, 61.9% of nurses agreed that with the EMR they were able to finish their work much faster than before; however, only 21.7% of physicians agreed with this. In addition, a majority of both groups, physicians and nurses, reported that the EMR would not improve the quality of care, reduce the costs of care, and decrease the waiting time or the number of ordered laboratory tests. Some of the concerns of the clinicians were related to the system downtime, being logged off when using the system, spending more time on the computer rather than on patient care, as well as the issues of the system security and data confidentiality. Similar to many other studies, Likourezos et al.'s (2004) study is about a particular information system and the results are limited to the setting of research. As the survey was conducted three months after implementing the EMR, the lack of communication with users about the benefits of the system could lead to users' dissatisfaction with some aspects, such as the impact of the system on the physicians' work or patient care.

Despont-Gros et al. (2007) evaluated the usability of, and user satisfaction with, a digital pen and paper (DP&P) technology in the ED. In this study, both qualitative and

quantitative methods were used. A voluntary user acceptance survey was conducted among 33 nurses who were involved in the triage process. The questions related to the user characteristics, the characteristics of technology, the perceived interaction, the perceived environment, and the perceived impact. The response rate was 67% (n=22). The overall user satisfaction with the new technology was examined on a ten-point Likert scale from (-5) not satisfied to (5) entirely satisfied, and the median was (3) indicating that the users were satisfied with the system. However, 44% of respondents perceived a burden was induced by the new technology. The additional burden was mainly related to the requested validation process when using the technology. The observation also confirmed users' difficulty with validation as well as managing the cap of the digital pen. The cap of the pen acted as a power switch and had to be used to shut down the pen. This study was undertaken at the time of implementation and the number of participants was limited. As the level of user satisfaction can change after gaining experience with the system, long term evaluation studies, with more participants, are needed.

Having reviewed the literature, it appears that similar to the evaluation of user acceptance, using a quantitative approach and standardised questionnaires has been common for evaluating user satisfaction. Although a standardised questionnaire may facilitate comparing the results (Burkle et al., 2001), using such a questionnaire may only help to investigate users' perspectives more generally rather than in-depth. Moreover, as the majority of clinical information systems have different characteristics, it is possible to develop new questionnaires or modify the available ones to be able to obtain more specific information about the systems. Furthermore, as working conditions and users are different across healthcare settings, applying qualitative methods along with quantitative approaches could be useful for obtaining in-depth insights into the strengths and weaknesses of the systems (Stoop and Berg, 2003).

### **2.5.6. Summary**

This section outlined factors that may influence the use of technology, particularly in the clinical settings, and highlighted the importance of evaluation of user satisfaction and user acceptance. The literature review showed that user acceptance has been distinguished

from user satisfaction, because of diversity in the theoretical approaches. However, both types of evaluation can help to investigate the strengths and weaknesses of an information system from the users' perspectives. Different factors that can influence user satisfaction and user acceptance include the individual's factors, the technical aspects of a system, and the organisational environment. The importance of these factors might be different in healthcare settings compared to other organisations, mainly due to the sensitivity of patients' conditions and the nature of team working. Few studies have investigated factors influencing the use of IT in the EDs. With respect to the special characteristics of this department in terms of the severity of patients' illnesses and the speed of work, it seems that identifying these factors can help to develop systems that are more acceptable to the ED staff.

## **2.6. Synthesis of the literature**

The NHS in England aims to create the most comprehensive Electronic Health Records (EHRs) infrastructure, in which multimedia records will be accessible at the point of care to the authorised users in all healthcare facilities, such as emergency care services. The use of information technology in the ED, for example, can improve the accessibility of information, clinical decision-making, and patient care. However, like other IT projects, the NHS National Programme for IT has encountered some technical and non-technical challenges, such as integrating information systems, designing an appropriate interface, inadequate communication with clinicians, and data confidentiality.

Apart from implementing information systems, the use of these systems in an effective way is quite important. The use of information technology in the clinical settings might be affected by several factors, such as user characteristics and system characteristics. The literature review showed that implementing new systems within the NHS has been the main focus of the National Programme for IT and less attention has been paid to the actual use and user acceptance of these systems.

To investigate the likely factors that may influence the use of a system, two main areas of research are evaluating user satisfaction and user acceptance. It is worth noting that although a number of studies have not clearly differentiated between user acceptance

and user satisfaction, there is little diversity between them in terms of theory and methodology.

Given the factors that may influence user acceptance, a number of theories and models, such as the Technology Acceptance Model (TAM) have been developed. These theories and models can help to predict factors that may influence the use of the systems at the later stage. However, none of these theories and models can cover all aspects of the use of IT in the clinical setting mainly due to the complexity of the healthcare environment. The literature review showed that in the healthcare settings, each ward and department in a hospital is quite unique with respect to the factors that can influence users' attitudes towards using an information system and the subsequent IT utilisation. For example, the factors that influence users' attitudes towards, and the use of, IT in the ED might be different from factors that influence users' attitudes towards, and the use of, the same system in other wards of a hospital. Such a difference might be, for example, due to the departmental characteristics (discussed in section 2.4.1).

Therefore, if the NHS aims to provide 24-hour access to information for all healthcare settings, such as EDs, further investigations are necessary to identify users' requirements and factors that may influence the use of these systems. Although a number of NHS projects were associated with implementing information systems in the ED, little information is available about the current ED systems and ED staff requirements and their perspectives about using IT in the ED. Investigating users' perceptions of the current information systems as well as identifying the strengths and weaknesses of these systems could be useful for developing systems which are more acceptable to the users.

## **2.7. Limitations of the existing research**

The literature review showed that although the use of computerised information systems in the healthcare environment has been identified as a key solution to support many aspects of healthcare delivery, system success is dependent on identifying and addressing factors that influence the use of these systems. While investigating these factors from users' perspectives can help to eliminate the weaknesses of the existing systems and improve user acceptance, it seems that this issue has not received adequate attention in the

NHS in England. For instance, little research has been published to highlight factors influencing the use of information systems from the NHS staff perspectives. It seems that paying more attention to the existing systems rather than solely focusing on the new ones can facilitate the process of system design and implementation and show how the new systems should be developed and implemented to be accepted by the users. Furthermore, the inadequacy of communication with the NHS staff and a lack of user involvement in the process of system design and implementation has been one of the major challenges for the NHS.

The literature also revealed that, despite the large volume of published material regarding the use of different clinical information systems in various clinical settings, few studies have investigated the use of IT and its influencing factors in the ED. Moreover, the use of a quantitative approach and standardised questionnaires has been a dominant approach in this area, and few studies have used qualitative approaches or triangulation methods. Furthermore, most of the studies have investigated factors influencing the use of new information systems rather than the existing information systems, and little research has addressed the application of the theories and models of user acceptance in relation to the use of these systems. Therefore, this research aims to investigate factors influencing the use of IT in the ED using both qualitative and quantitative approaches. The results are also examined in the context of theories and models of the acceptance of technology.

## **2.8. Conclusion**

In this chapter, the existing literature regarding the NHS approaches for developing and implementing information systems across the healthcare settings was reviewed. While the National Programme for IT aims to provide all healthcare professionals, such as emergency care staff, with required information at the point of care, there is limited information regarding users' perspectives about using IT in the ED. Not only within the NHS in England, but also in other countries, few studies have investigated the use of IT in the ED. Users' perspectives need to be investigated to develop and implement systems that are acceptable to users. To conclude, no in-depth study of the use of IT in the ED has been conducted to date; therefore, this area was identified as an area requiring further research.

Having used the literature to classify factors that may influence the use of technology, the current research aims to answer the following research questions:

1. What are the user, task, system, and environmental characteristics that might influence users' attitudes towards using IT in the ED?
2. What is the impact of technology on users' attitudes towards using IT in the ED?
3. What are the most important factors that might influence users' attitudes towards using IT in the ED?
4. What is the association between the users' attitudes and the use of IT in the ED?

Having identified the research questions for this study, the next chapter discusses the methodology of the research.



## CHAPTER 3: METHODOLOGY

### 3.1. Introduction

The term methodology refers to the activity of choosing, reflecting upon, evaluating, and justifying the methods used in research (Wellington and Szczerbinski, 2007). The methodology can cover the practical aspects of the research and includes the details of different stages of data collection and data analysis (Silverman, 2005). Every study has its own individual methodology. The differences in research methodologies are mainly due to the diversity in research questions, which might be answered through quantitative approaches, qualitative methods, or a combination of these. Having reviewed the literature and identified the need for conducting this research in Chapter 2, this chapter gives an overview of the methodological approaches used in this research. In section 3.2, the research paradigms for different types of study, particularly in relation to the evaluation of clinical information systems are presented. Sections 3.3 and 3.4, discuss the research approaches and the methods of data collection. Sampling methods and recruitment, the ethical issues, and the methods of data analysis are presented in sections 3.5 to 3.7. The reliability and validity issues are discussed in section 3.8 and the final section, section 3.9, provides a conclusion for this chapter.

### 3.2. Research paradigm

In order to conduct research, a research paradigm should be adopted to develop a strong research methodology (Myers, 1997). The research paradigm is a set of assumptions about the social world and appropriate techniques for inquiry. Each paradigm includes two philosophical concepts which are ontology and epistemology. While ontology refers to what exists in the world and the nature of reality, epistemology refers to the ways of enquiry to build knowledge (Punch, 1998; Mingers, 2001). In the literature, different paradigms, such as positivism, post positivism, constructivism, and critical theory have been discussed in detail (Punch, 1998; Denzin and Lincoln, 2000; Seale, 2000; May, 2001; Mason, 2002; Creswell, 2003). A positivist approach tends to see the reality objectively

and measure properties or test theories. This approach is used in quantitative research (Myers, 1997). A post positivist approach focuses on identifying and assessing the causes that influence outcomes, and on the discovery and verification of theories. In this paradigm multiple methods can be used to capture as much of reality as possible, and multiple perspectives of participants are considered (Denzin and Lincoln, 2000; Creswell, 2003).

An interpretive or a constructivist approach aims to find the reality through the social constructions and the meaning that people assign to phenomena. Finally, in the critical theory, the role of a critical researcher is to address the oppositions, conflicts, and contradictions in society (Myers, 1997). Among the above-noted paradigms, positivist, interpretive (or constructivist), and critical theory have been identified as an appropriate set of paradigms for conducting research in the field of information system (Myers, 1997).

In the field of medical informatics, objectivist and subjectivist assumptions are the two main perspectives that have been introduced for evaluating clinical information systems (Friedman and Wyatt, 2006). An objectivist assumption tends to lead to a quantitative study and proceeds by developing appropriate instruments for data collection. In contrast, the subjectivist assumption focuses on adopting a qualitative approach, and the hypotheses of the study will emerge from the progress of the research. These assumptions can be linked to the research paradigms discussed earlier. The objectivist assumption was derived from the positivist paradigm, and studies information systems using quantitative approaches and numerical measurements. In contrast, the subjectivist assumption was derived from the constructivist paradigm, and research methods such as interviews are used to show individuals' perspectives about the same condition (Friedman and Wyatt, 2006). Similarly, adopting a constructivist paradigm, a researcher tends to understand the real world based on the individuals' experiences. In this paradigm, the aim of the researcher is to gain participants' points of view about a particular situation by asking open-ended questions (Creswell, 2003).

According to the subjectivist assumption, people who are using information systems have different views about "what can be good", and they may have different opinions about the desirable outcomes of using a system in their workplace (Friedman and Wyatt, 2006: 250). Therefore, studies based on the subjectivist assumption tend to demonstrate this type of diversity rather than showing a consensus in one belief. In these studies, users' views

towards using a system are investigated to show that “perhaps there are many truths about an information resource, not just one”. In particular, disagreements need to be addressed for developing better systems in the future (Friedman and Wyatt, 2006: 250).

Having reviewed the literature in Chapter 2, the need for investigating factors that might influence the use of information systems in the ED was identified. As few studies have investigated these factors from the users’ perspectives, this research aims to examine the users’ perceptions of using information systems in the ED and to identify the most important factors influencing users’ attitudes towards using IT in this department. Therefore, a post positivist paradigm was considered for the whole study and triangulation method was used. The first phase of the research corresponded with the subjectivist assumption (constructivist paradigm) and the second phase was designed based on the objectivist assumption (positivist paradigm).

The subjectivist assumption was the most appropriate paradigm for the first phase, as the main aim of this phase was to gain a deeper understanding of the situation and users’ perceptions of using information systems in the ED rather than testing specific hypotheses. The objectivist assumption was selected for the second phase, as the findings and the hypotheses derived from the first phase needed to be tested in relation to a wider population, and the most important factors could be identified through quantitative research. The ontology of the first phase of the research was users’ perceptions of using IT in the ED, and the epistemology was using qualitative methods to understand users’ perceptions and experiences. The ontology of the second phase of the research was identifying associations between different factors and users’ attitudes towards using IT in the ED and the association between users’ attitudes and subsequent use of IT. The epistemology was using quantitative methods and statistical analysis to answer research questions. According to Mingers (2001), a diversity of research methods and paradigms can be a strength in a study, as this approach focuses on different aspects of reality and a richer understanding of a research topic can be obtained by combining several methods together in a single study. In the next section, research approaches are discussed.

### **3.3. Research approaches**

Choosing the right paradigm or assumption can guide the researcher to select the right approach for conducting the research. Research approaches can be qualitative, quantitative or mixed methods (quantitative and qualitative). Each of the research approaches is grounded in one of the research paradigms that were discussed in section 3.2. Quantitative approach, for example, is based on the positivist paradigm. However, a qualitative approach is based on the constructivist paradigm (Creswell, 2003). A combination of quantitative and qualitative approaches is called mixed methods, and can be used in the post positivist paradigm (Creswell, 2003). The main reasons for combining different approaches are to enhance the strengths of the study, and to compensate the weaknesses of each approach (Punch, 1998). One of the approaches derived from combining different methods is triangulation which is discussed in section 3.4.3. In the next sections, more details of qualitative and quantitative approaches, differences between these two, and the application of these approaches in the current study are presented.

#### **3.3.1. Qualitative approach**

The importance of conducting qualitative studies on the use of information systems was highlighted in Chapter 2. As Friedman and Wyatt (2006) indicated, qualitative studies are appropriate to be used in evaluating human interactions with information systems, investigating users' perceptions and the effects of information systems on patient care, and studying the political, organisational, and environmental aspects of the setting in which the system is used. A qualitative approach helps to address a major limitation of the quantitative approaches which is mainly related to not being able to answer questions that focus on 'how' and 'why' (Friedman and Wyatt, 2006). These sort of questions focus on the reasons for, and the explanation of, issues which are complex. Quantitative studies cannot provide in-depth information to answer these questions (Kaplan and Maxwell, 1994). Qualitative studies are also suitable to investigate the dynamic nature of a process. This type of study is useful to understand how people think and feel about something, such as using information systems, why they think in that way, and what the causes and effects of such perspectives are (Kaplan and Maxwell, 1994). In addition, qualitative methods help

to collect and analyse data for designing information systems, as tasks can be investigated in detail (Anderson and Aydin, 2005).

Generally, the five main uses for applying qualitative approaches in the field of information systems are: understanding users' perceptions, understanding the social and organisational factors, studying causal processes, doing formative evaluations and providing in-depth evaluation results for decision-makers (Kaplan and Maxwell, 1994).

### **3.3.2. Quantitative approach**

According to Punch (1998), a quantitative approach examines the reality in terms of measuring variables and their relationships. In quantitative studies, data are collected to be quantified, and are analysed using statistical analysis (Patten, 2007). Quantitative approaches are suitable for describing a situation in a systematic and comparable way and can facilitate qualitative research with a choice of subjects for further investigations. Quantitative studies are more suitable for generalising the results from the sample to the population, if the sample is representative of the population from which it is drawn. The choice of quantitative research depends on factors, such as the type of research question, the feasibility of research, the adequacy of resources, and the current approach in the field of study (Punch, 1998). In general, a quantitative approach is useful when something is known about a subject, and a qualitative approach is helpful either for exploratory studies or investigating a topic more in-depth, for example, at the early stages of the research (Begely, 1996).

### **3.3.3. Differences between qualitative and quantitative approach**

Differences between quantitative and qualitative studies have been addressed in the literature (Punch, 1998; Thomas, 2003; Patten, 2007). Punch (1998) compared quantitative and qualitative approaches and suggested that they lie on a continuum with the quantitative approach at one end of the continuum, since it has a predetermined structure, and the qualitative approach at the other end of this continuum, as it can be unstructured. In a quantitative approach, data can be collected based on a predetermined structure, such as

using a specific set of questions with defined response categories. However, in an unstructured or semi-structured in-depth interview, the structure of the data will emerge during the data analysis and coding process. Another distinction between qualitative and quantitative research is related to the format of the results. In the quantitative studies, the results are presented as quantities and numbers, whereas the results of the qualitative studies are presented as themes in textual format (Patten, 2007). Quantitative research is more concerned with the deductive testing of hypotheses, whereas qualitative research is concerned with the inductive approach to generating hypotheses (Punch, 1998). Quantitative researchers tend to select a large sample to be able to generalise their findings, whereas in qualitative research, a smaller sample is selected as generalising the findings is not the main purpose. Moreover, in quantitative studies, designing and administering a questionnaire to a large sample may take less time compared to conducting qualitative research, for example, through one-to-one interviews (Patten, 2007).

#### **3.3.4. Research approaches of the current study**

In this research, a qualitative approach was chosen for the first phase of the research, as this was the most appropriate approach to explore users' perceptions of using information systems in the ED, and to identify possible factors that might influence users' attitudes towards, and the use of, information systems in this department. This approach could help to provide initial findings on, and basic information about, the context and subject of the study and it allows the researcher to develop her understanding of the topic without having to impose her own preconceptions. This approach also focused on the important issues identified by the participants and could be used to form the research hypotheses at the later stage. As there has been little previous research on the use of IT in the ED, it seemed to be more appropriate to undertake qualitative research first to collect data and then develop further research hypotheses at the later stage. After obtaining in-depth information about the use of IT in the ED, the main aim was to identify the most important factors that might influence users' attitudes towards using IT and the subsequent IT use in this department, and to examine data from a wider population to see how the results could be generalised to the similar settings. Therefore, as discussed in section 3.3.2, a quantitative approach was chosen for the second phase of the research. At this stage, the

results of the qualitative study (Chapter 4), were used to generate hypotheses and to construct a scale (Punch, 1998) for the second phase.

### **3.4. Research Methods**

According to Silverman (2005), research methods are specific research techniques used for collecting data and include quantitative techniques, such as a survey study and qualitative techniques, such as observation and interviewing. In this research, qualitative methods, quantitative methods, and between-methods triangulation were used, and are discussed in the following sections.

#### **3.4.1. Qualitative methods**

When using a qualitative approach, different methods, such as observation and interviews can be used to collect data regarding a particular subject (Kaplan and Show, 2004; Friedman and Wyatt, 2006). Observation is a way of collecting data about a subject that needs to be observed to know what actually happens. This method does not rely on what people say or think (Denscombe, 2005). This method can be useful for recording events and information, and gives a holistic explanation of the relationships between different factors. However, the observer may be seen as intrusive and the reliability of the observation is low, as it depends on the observer and collected field notes (Creswell, 2003; Descombe, 2005). Another method of data collection in qualitative studies is interviewing. Different types of interviews are structured, semi-structured, and unstructured interviews (Descombe, 2005). As noted in section 3.3.3, the structured interview follows pre-determined questions and pre-coded responses; however, the unstructured interview is not pre-planned (Punch, 1998). A semi-structured interview is a list of issues and questions that an interviewer asks. However, the interview is flexible in terms of the order of topics and questions that will be discussed by the interviewer during the interview (Denscombe, 2005).

The advantages and limitations of interviews were addressed by Thomas (2003). Using this method, flexibility and personal interaction are important. Respondents can ask

the interviewer about any ambiguous question and make it clear, and responses can be more comprehensive compared to the use of a questionnaire or structured interviews. In addition, one-to-one interviews can usually encourage respondents to interact with the interviewer effectively. As a result, a relationship can be developed, which is not achievable by distributing questionnaires to the participants, and this is helpful to gain more information (Thomas, 2003). Another benefit of doing interviews is that data can reveal issues that the researcher may not otherwise think about them (Silverman, 2005). However, interviewing is time-consuming, requires skills, and needs to be arranged at a mutually convenient time and place. The ability to ask sensitive questions may be restricted, as the interviewee may be reluctant to answer truthfully or openly; however, this might depend on the nature of the research or questions (Thomas, 2003).

One-to-one interviews are the most common form of interviews. This method is popular, because it is easier to arrange and manage than, for example, focus group interviews. The one-to-one interview is easy to control, as the interviewer can listen to just one person and can gain the important points from one person rather than losing concentration by listening or talking to two or more individuals (Denscombe, 2005). The focus group is another interview technique which involves six to nine participants, and is managed by a moderator to explore their attitudes and feelings and ideas about a specific subject (Denscombe, 2005). This method is suitable to be used for the issues that are not sensitive, and can lead to insights that might not be achieved using one-to-one interviews, as it reflects the discussed ideas within a group. However, recording the discussion is difficult in focus group, as the participants may interrupt each other. Moreover, some of the participants may dominant the discussion and some may speak less, and the moderator has less control over the proceeding of a discussion compared to individual interviews (Denscombe, 2005; Bryman, 2004).

### **3.4.2. Quantitative methods**

One of the most common methods of data collection in the quantitative studies of information systems is a survey study (van Der Loo et al., 1995; Burkle et al., 2001). The purpose of a survey is to describe and compare the attitudes, beliefs, and behaviours of a



population (Fink, 1995; Patten, 2007). Moreover, a survey is used to show the strength of statistical association between variables (May, 2001). To conduct a survey study, a questionnaire is designed. Two types of questions are closed questions and open-ended questions. A closed question is one with a set of pre-defined choices to reply. In contrast, there is no choice of answers for the open-ended questions, and respondents need to write their responses. While completing a questionnaire with closed questions is usually easy and quick, filling in a questionnaire with open-ended questions can be time-consuming (Oppenheim, 1992). When conducting a survey, a questionnaire with closed questions provides the researcher with the information that is uniform in terms of length and can be quantified and compared (Denscombe, 2003); however, the information provided by the open-ended questions is not uniform.

According to Bourque and Fielder (1995: 31), the first task to design a questionnaire is to 'conduct a thorough search of the relevant or related literature'. This search can help to find how the current study would build on, or extend, existing work in the area. The use of standard questionnaires has also been suggested (Bourque and Fielder, 1995). One of the main advantages of using the standard questionnaires is that the possible answer categories have already been selected and tested. Additionally, using these questionnaires can help to compare data in various studies and populations. If designing a questionnaire is needed, the adoption or adaptation of questions from other studies is possible. A questionnaire can be adapted, for example, if it is too long to be used, or the population is different from the original population that was studied. The questionnaire may need to be translated into other languages, or the researchers may need to reorder or change the items according to the subject of the study (Bourque and Fielder, 1995).

Generally, the use of a questionnaire has some advantages, such as low cost and a wide geographical coverage (Oppenheim, 1992; Denscombe, 2003). The disadvantages of using a questionnaire are related to the possibility of the low response rate, receiving incomplete or poorly completed questionnaires, inappropriateness for respondents of poor literacy, and the truthfulness of the answers that cannot be checked. Moreover, respondents may not be able to express their opinions on a set of options, and as a result, an in-depth understanding of the situation might not be obtained (Oppenheim, 1992; Denscombe, 2003).

## **Attitude scales**

In order to assess the respondents' attitudes towards a given subject, instead of questions, attitude statements are used to form an attitude scale (May, 1997). According to Oppenheim (1992: 174), "an attitude statement is a single sentence that expresses a point of view, a belief, a preference, a judgment, an emotional feeling, a position for or against something". Attitude statements should be phrased in a way that respondents can agree or disagree with them. Attitudes can be reinforced by beliefs and can attract strong feelings that may lead to particular behaviour intentions (Oppenheim, 1992).

Different methods of attitude scaling are Thurstone, Guttman, and Likert scales (Oppenheim, 1992). In Thurstone scale, attitudes can be seen on a continuum ranging from positive to negative. It is also called an 'equal appearing interval scale' (Punch, 1998:94). In this method, a set of statements for the scale is selected and is given to a group of judges to evaluate each statement and sort them based on an instruction. The scale values are calculated later (McIver and Carmines, 1994). The construction of a Thurstone's scale is time-consuming and it is often difficult to obtain an adequate group of judges (Oppenheim, 1992).

The Guttman scale is used when the hierarchical structure of an attitude is studied. The statements include those that are easy to accept for most people to those that are not easy to accept. However, using this scale, it is difficult to achieve a uni-dimensional scale (Bowling, 2002).

The Likert scale is the most popular scale and its primary goal is to develop a uni-dimensional scale and make sure that all items measure the same thing. The items can also be clustered under several headings or sub-headings, each dealing with a different aspect of the topic under investigation (Oppenheim, 1992). The Likert scale contains a number of opinion statements about a subject and the respondents can indicate their agreement or disagreement on the scale, for example, by ticking 'strongly agree' or 'strongly disagree' (Bowling, 2002).

The advantages of the Likert scale is related to the ease of construction, providing precise information about the respondents' agreement or disagreement, and obtaining deeper understanding of the respondents' attitudes. The disadvantage of this scale is that

the same total score may be obtained in many different ways. Therefore, the pattern of responses to individual items is more interesting than the total score. Moreover, a respondent may try to fake or give similar responses to most of the questions (Oppenheim, 1992).

### **3.4.3. Triangulation**

The word triangulation is derived from navigation and refers to the use of two known and fixed points in order to locate the position of a third point (Nolan and Behi, 1995). However, when triangulation is used in research, it is a metaphor and should not be taken literally to mean that three, and only three, points can be used (Nolan and Behi, 1995). Triangulation is the use of multiple methods in the study of the same subject. Therefore, a combination of two or more data sources, investigators, methods, and theories can be used in the same study (Denzin, 1970; Denzin, 2006; Thurmond, 2001). When more than one type of triangulation is used, for example, using data triangulation and investigators triangulation in one study, the outcome is called multiple triangulations (Denzin, 1970; Thurmond, 2001).

Triangulation of data is based on the use of different data sources for the same phenomenon. Three types of data triangulation are person, time, and space. This means that data can be collected from different people at different times and in different places in one study (Nolan and Behi, 1995; Begley, 1996; Patten, 2007).

Investigators triangulation refers to the use of two or more skilled researchers to examine the data in the same project (Nolan and Behi, 1995). The purpose of using multiple investigators with different expertise is to decrease the potential of bias in gathering, reporting, coding, or analysing data (Denzin, 1970; Begley, 1996; Thurmond, 2001; Patten, 2007). This approach can help to enhance the validity of the study (Thurmond, 2001).

In methods triangulation, different methods are used to address the same phenomenon (Nolan and Behi, 1995). There are two types of methods triangulation, within-methods triangulation and between- or across-methods triangulation. The former is

related to the use of the same or different methods of data collection within the same research approach that might be qualitative or quantitative. For example, in a qualitative approach, observations can be combined with focus group interviews. The other method, which is between- or across-methods triangulation, refers to the use of both qualitative and quantitative data collection methods in the same study. In this method, for example, a combination of interviews and questionnaires can be used in the same study (Begley, 1996; Thurmond, 2001; Patten, 2007). In the case of using qualitative and quantitative methods at the same time, it is called simultaneous triangulation, and when using one method to plan for the use of next method, it is called sequential triangulation (Morse, 2006).

Theoretical triangulation is the use of multiple theories or hypotheses when examining a phenomenon (Denzin, 1970, Nolan and Behi, 1995). In this method, the perspectives or theories used in the study can be related to the findings or might have opposing viewpoints, depending on what the researcher hopes to accomplish (Denzin, 1970). Theory triangulation may be used to test various theories by analysing information from the same data set (Thurmond, 2001).

Two applications of triangulation are for confirmation and completeness. For confirmation, different methods or approaches can be used in the same study and the findings from one study can be checked against the findings derived from another study. For example, the results of a qualitative study can be checked against the findings of a quantitative study (Punch, 1998; Denscombe, 2003). Moreover, the findings of an exploratory study (e.g., a qualitative study) can be checked by undertaking a larger scale study (e.g., a quantitative study) in a wider population. This method can help to control bias and its influence on data interpretation, and enhances the validity of the findings. For example, an observer may make certain inferences from situations that can be examined during in-depth interviews to check whether these assumptions are correct or not. In completeness, different aspects of the same subject can be identified using different methods, and a more in-depth understanding of the subject of study can be obtained (Nolan and Behi, 1995; Begely, 1996; Thurmond, 2001). For example, the participants can be interviewed to find out more in-depth about their responses in a quantitative study. However, triangulation is time-consuming and expensive, does not guarantee internal and

external validity of a study, and cannot compensate the use of inappropriate methods (Begley, 1996; Thurmond, 2001).

#### **3.4.4. Research methods of the current study**

As there has been relatively little research investigating users' perceptions of using IT in the ED, it was decided to use between-methods triangulation, in which a small-scale exploratory qualitative study was undertaken to generate ideas and hypotheses for a larger scale quantitative study. In the first phase of this research, data were collected through one-to-one, in-depth semi-structured interviews with the ED staff to investigate users' perceptions of using computerised information systems in this department. This method is useful to investigate users' perceptions and experiences of using a particular system, as well as the factors that may influence using that system (Stoop and Berg, 2003). Thomas (2003) suggested that, in order to collect information about people's knowledge and opinions, interviewing is more efficient than direct observation. This method will help to gather more in-depth data. The setting for this study was an ED located in a large urban hospital, and staff were often busy providing a service. Therefore, conducting a focus group or interviewing two or more people would not have been practical, since several staff could not leave their jobs to participate in a focus group. Furthermore, using observational methods would not be appropriate, as they could not identify the ED staff perceptions, and the presence of the researcher might have altered the way staff used the systems. Therefore, face to face interviews were the most appropriate method to collect the richest data within the restrictions of the researcher's and the participants' time. The details of conducting the interviews in the ED including developing an interview guide, a pilot study, and the sampling method are provided in Chapter 4.

In the second phase of the research, a self-administered questionnaire was designed based on a five-point Likert scale and a survey was conducted to test the hypotheses derived from the interview study. A survey study was the most appropriate method for this phase of the research, as the results of the qualitative study needed to be examined in relation to a larger sample drawn from a wider population to be able to generalise the findings. Moreover, to identify the most influential factors on users' attitudes towards

using IT in the ED quantitative analysis was needed. The details of the settings of the study, the sampling method, and the reliability and validity of the questionnaire are presented in Chapter 5.

Finally, different types of triangulation including data, methods, and theories were applied and the findings of qualitative and quantitative studies were compared. These methods were useful to confirm and complete the results emerged from the qualitative study. More information about the use of triangulation in this research is presented in Chapter 6.

### **3.5. Sampling and recruitment**

According to Punch (1998) both qualitative and quantitative studies involve sampling, as it is not possible to study everyone and everything in a single study. Increasing the sample size can improve the precision of the study (Patten, 2007) and if the sample is representative of that population, the results can be generalised to a wider population (Punch, 1998). A representative sample reflects the characteristics of the population under study (Bryman, 2004). When deciding about the sample size, constraints such as time, cost, the need for precision, and the kind of analysis that will be undertaken after data collection should be taken into account (Bryman, 2004).

In quantitative studies, selecting a representative sample can be undertaken by using probability sampling methods, which are mainly based on a random selection (Punch, 1998). One of these methods is simple random sampling, in which each member of the population is given a number and has an equal chance to be chosen randomly using a table of random numbers (Patten, 2007). Another method is systematic sampling in which the participants will be selected from a list. This method starts with sampling fraction  $n/N$ , in which  $n$  is sample size and  $N$  is the number of population. Then, a random number between 1 and the result of sampling fraction is selected, and the result of sampling fraction forms sampling interval to select the next participants (Bryman, 2004). Stratified random sampling is considered a more precise method of sampling, in which population is divided into strata based on a criterion, for example gender, and a needed sample can be selected from each stratum using simple or systematic random sampling. Another method is cluster

sampling in which instead of individuals, groups of participants are selected randomly (Patten, 2007). This is multistage approach and further to the groups individuals are sampled (Bryman, 2004).

In non-probability sampling, different methods such as quota sampling and convenience sampling can be applied. In quota sampling, a sample that reflects a population in terms of the proportion of people in different categories, such as gender, age group, ethnicity is produced. However, the selection of individuals is not carried out randomly (Bryman, 2004). In convenience sampling, the participants who are simply available are invited to take part in the research. However, these participants might not be representative of a wider population and as a result generalisability of the findings is questionable (Bryman, 2004).

In qualitative studies, convenience sampling and other methods such as purposive sampling and snowball sampling can be used (Cresswell, 2003). In purposive sampling individuals who are good sources of information or meet the sampling criteria are selected to take part in the study (Patten, 2007). Snowball sampling can be used when finding participants for the research is difficult. In this method, the initial participant may help to establish contacts with others.

In the current study, purposive sampling was used for the first phase of the research, and the maximum variation strategy was applied to interview a wide range of doctors, nurses, and the administrative staff. In the quantitative study, three EDs were selected, and all staff who had access to the information systems in this department were invited to take part in the study. This method helped to avoid a low response rate. The details of sampling and recruitment in the qualitative and quantitative studies are presented in Chapter 4 and Chapter 5 respectively.

### **3.6. Ethical issues**

In the process of data collection and data analysis, ethical issues need to be considered and respected. Research ethics include respecting the rights and dignity of participants, ensuring that there is no harm to the participants from their involvement in the

research, and operating with honesty and integrity (Denscombe, 2005). Hence, before conducting research in which patients, care professionals, volunteers, or their organs, tissue or data are involved, independent review by an ethics committee is required to ensure it meets ethical standards (Department of Health, 2005). Moreover, the principles and requirements of the research governance framework have to be taken into account. The main aim of this framework is to address general principles of good practice. Other aims of this framework are improving the quality of research, continuing training and education in research, monitoring research, and reporting adverse events (Department of Health, 2005).

In order to conduct the qualitative and quantitative studies of this research, ethics approval was sought and obtained from the ethic committees of the NHS and the University of Sheffield respectively. For the qualitative study, research governance approval was obtained from the Research Department, Sheffield Teaching Hospitals NHS Foundation Trust, which approved the study. The participants' rights and well-being were considered in both qualitative and quantitative studies. Their rights included voluntary participation in the study, right to withdraw at any time, and right to understand the nature of the study, likely impact on them, the procedures of the study, and the benefits of the study (Creswell, 2003). Participants were provided with an information sheet, and were also fully informed about the confidentiality issues. Before conducting the interviews, participants were asked to sign an informed consent form. All participants' personal information was kept confidential and during data analysis, all data were analysed and used anonymously. The details of ethical considerations in each phase of the study are provided in Chapter 4 and Chapter 5.

### **3.7. Data analysis**

In this section, the methods of data analysis for both qualitative and quantitative studies are discussed.



### **3.7.1. Qualitative data analysis**

There are different methods for analysing qualitative data, and choosing each method depends on the purpose of the research (Punch, 1998). Two well-known methods are analytic induction or thematic analysis, and grounded theory. Analytic induction refers to the systematic examination of similarities between cases to develop concepts or ideas (Punch, 1998). Similarly, in thematic analysis, all unites of data (e.g., paragraphs or sentences) are examined in more detail to develop appropriate themes. Framework analysis, which is an approach to analyse qualitative data, is a type of thematic analysis (Lacey and Luff, 2001). This method has been developed to be used in applied qualitative research (Ritchie and Spencer, 1994). Applied research can be distinguished from other research, as it tends to meet specific information needs, and the results of the study can be used in practice. In applied research, objectives are clearly set and the results of the research should appropriately answer the objectives of the study. The method of data collection, in applied qualitative studies is mainly interviews, and sometimes observation (Ritchie and Spencer, 1994).

As Ritchie and Spencer (1994) noted, framework analysis consists of familiarisation, identifying a thematic framework, indexing, charting, mapping and interpretation. Familiarisation involves listening to the tapes, reading the transcripts, and studying observational notes. At the next stage, key issues or themes can be identified. These issues can be informed by the research aims or the interview guide. Indexing refers to the process of labelling data and applying a thematic framework or an index to the data. This process is called coding in other qualitative methods of data analysis. Charting is related to provide a whole picture of data by adopting a thematic approach (for each theme across respondents) or a case approach (for each respondent across all themes). Charting involves abstraction and synthesis of data, and respondents' views can be compared with each other. Mapping and interpretation refers to defining concept, finding associations, and providing explanations for the whole data (Ritchie and Spencer, 1994).

Grounded theory is a set of procedures for developing theory through data analysis (Punch, 1998). In this method, general research questions are initially used and the objective is to build an abstract theory grounded in data. Moreover, concepts and categories emerged from one stage of analysis are compared with concepts emerged from

the next stage. This is called the process of constant comparison until no new significant concept or category emerges (Lacey and Luff, 2001). Grounded theory has been criticised, as the process of analysis is complex and it does not follow a precise planning from the beginning. For example, the sample size and the nature of the sample are not clear at the beginning of research (Descombe, 2005).

One of the advantages of qualitative data analysis is that the data and the analysis are both grounded in reality. Other advantages are related to the richness of data, the possibility of showing ambiguity and contradictions, and the possibility of giving alternative explanations where it is possible (Denscombe, 2003). However, the qualitative data might be less representative of a wider population, interpretation is mainly completed by the researcher, and the researcher's background and beliefs may influence the interpretations (Denscombe, 2003). The main aim of the qualitative data analysis is developing meaningful answers to the research questions and explaining 'what is going on' (Kaplan and Maxwell, 1994:41).

### **3.7.2. Quantitative data analysis**

In order to analyse quantitative data, descriptive or inferential statistics can be used. Descriptive analysis summarises the data and describes the frequencies and distributions. Inferential statistics help the researcher to examine and test the research hypotheses and generalise the findings, if the sample is representative of a wider population (Denscombe, 2003; Patten, 2007).

In quantitative data analysis, the methods of data analysis are scientific, well-known, and transparent which enables reproducibility in the analysis (Punch, 1998). In addition, a large volume of data can be analysed relatively quickly, and findings are based on measured quantities. However, there is a risk of data overloading with too many variables and using too many statistical techniques (Denscombe, 2003). In order to identify the relationship between two variables simple correlation and simple linear regression can be used. In these tests, the relationship between one dependent and one independent variable can be examined. However, in multiple regression analysis, there are one dependent variable and more than one independent variable. Multiple regression analysis

can help to understand how much of the variance in the dependent variable is accounted for by the independent variables. The regression weights show how important each independent variable is in accounting for variance in the dependent variable (Punch, 1998).

### **3.7.3. Data analysis methods in this study**

In this study, framework analysis discussed in section 3.7.1 was used to analyse qualitative data. This method was chosen as the objectives of the study were clearly defined before conducting the interviews. Moreover, this method could give a clear picture of the steps taken during data analysis. The process of qualitative data analysis and the results are presented in Chapter 4. In order to analyse the quantitative data, both descriptive and inferential statistics, including simple linear regression and multiple regression analyses, were used and are presented in Chapter 5.

## **3.8. Reliability and validity**

When conducting qualitative or quantitative research, the reliability and validity of the study are important. In qualitative studies, concepts such as credibility, transferability, dependability, and confirmability are used to show the reliability and validity of the research. However, in quantitative studies, internal validity, external validity or generalisability, internal reliability, and external reliability are addressed (Seal, 2000). Different types of reliability and validity are discussed in the next sections.

### **3.8.1. Reliability**

Kaplan and Maxwell (2005) indicated that the subjective nature of qualitative research is in relationship with the fact that different researchers can collect different data using the same questions and they can interpret the same data differently. Therefore, reliability and generalisability do not play a key role in qualitative studies, as the sample is not representative of the population (Creswell, 2003). Instead of the reliability issues in a

qualitative study, confirmability and dependability of the study should be considered. Confirmability shows that bias has been controlled, and dependability, similar to internal reliability, deals with consistency and the correctness of the process of the research (Seal, 2000). In order to improve the confirmability and dependability of the qualitative study conducted in this research, several approaches were considered which are discussed in Chapter 4.

In quantitative studies, the concept of reliability includes the characteristics of the instrument and the condition of measurement, which should be consistent (Oppenheim, 1992). Reliability can be measured in different ways such as test-retest reliability, alternative form method, split-half method, or the internal consistency using Cronbach's alpha coefficient (Oppenheim, 1992; Litwin, 1995). When data are collected by one or more observers, intra- and inter-observer reliability also need to be addressed (Litwin, 1995).

The test-retest method refers to administering the same instrument, for example, a questionnaire, to the same sample at different times within a short period of time. If the correlation between scores is high, the measurement is reliable from this perspective (Fink, 1995). The disadvantage of this method is that the concept may change over time, the participants might be sensitive to the subject and demonstrate change at re-test, or their replies might be affected by their memories at re-test, as they may answer based on their memories of what they answered previously (Carmines and Zeller, 1994).

The alternative-form method refers to using alternative questions to measure the same concept at the same level of difficulty. For example, the same sample can be asked to answer two types of questions with the same concepts at the same level of difficulty at different times (Fink, 1995). Alternatively, the sample can be divided to two groups, if it is large enough, and each group can answer one set of tests (Litwin, 1995). However, constructing items in two forms while both are able to measure the same concept is the most difficult part of this test (Carmines and Zeller, 1994).

The split-half method is a test in which the total number of items is divided into halves and the correlation of scores for each part is calculated to obtain an estimate on reliability (Carmines and Zeller, 1994). Internal consistency is related to 'the extent to

which all items or questions assess the same characteristics or quality of the same concept' (Fink, 1995: 48). The internal consistency can be calculated using Cronbach's alpha coefficient (Fink, 1995; Bryman, 2004).

Inter-observer reliability refers to how well two or more observers agree in their assessment of a variable, and intra-observer reliability refers to correlation between two datasets collected by the same observer (Litwin, 1995). These types of reliability were not applicable to the current study, as only one researcher was involved in the process of data collection, and the methods of data collection were interviewing and a survey study.

In the second phase of this research, as noted in section 3.4.2, a questionnaire was designed using attitude statements and based on a Likert scale. According to Oppenheim (1992), the reliability of the attitude questions should be assessed by a set of questions or attitude scale, rather than a single question, to avoid bias in interpretation. When using a single question, the possibility of bias and unreliability might be increased, due to wording, question format, and the contextual bias. The reliability of the scale can be assessed by calculating internal consistency using Cronbach's alpha. Therefore, the reliability of the questionnaire was tested using Cronbach's alpha coefficient and the results are presented in Chapter 5.

### **3.8.2. Validity**

According to Kaplan and Maxwell (1994), the validity of qualitative studies is stronger than their reliability, since the researchers try to ask right questions and avoid overlooking or excluding important points. Similarly, Creswell (2003) noted that the validity of qualitative studies is one of the strength of this type of research.

In qualitative research, credibility shows the results of the study are acceptable and that the study has internal validity. Transferability shows to what extent the results can be applied in similar groups (Seal, 2000). In order to increase the validity of qualitative research, applying different strategies has been recommended (Kaplan and Maxwell, 1994; Creswell, 2003). These strategies include: collecting rich data; paying attention to ambiguous parts of an interview; clarifying biases; triangulation; member checking, which

is submitting a summary of research findings to the participants of the study to confirm the results (Bryman, 2004); reporting both positive and negative cases; and inviting an external auditor to review the entire project. To improve the validity of the qualitative study conducted in this research, a number of the above-mentioned strategies were considered and are discussed in Chapter 4.

The validity of a quantitative study can be investigated by checking content validity, face validity, criterion validity, and construct validity. Content validity refers to 'the extent to which a measure thoroughly and appropriately assesses the characteristics it is intended to measure' (Fink, 1995: 50). Therefore, to establish content validity, the literature needs to be consulted and the domains of the concept should be identified (Carmines and Zeller, 1994). Face validity refers to the appearance of an instrument. For example, in relation to a questionnaire, it deals with the language, format of questions, and the structure of the questionnaire (Fink, 1995).

Criterion validity compares responses with those obtained from other well-established surveys. There are two subgroups for criterion validity, namely, predictive and concurrent validity. The predictive validity forecasts future performances, for example, through using a test to select appropriate people for a specific type of job (Carmines and Zeller, 1994). The concurrent validity shows that 'two assessments agree, or a new measure is compared favourably with one that is already considered valid' (Fink, 1995: 51).

Construct validity refers to 'the extent to which a particular measure relates to other measures consistent with theoretically derived hypotheses concerning the concepts (or constructs) that are being measured' (Carmines and Zeller, 1994: 15). The three main steps of construct validity are defining the theoretical relationships between the concepts, examining the relationships in empirical research, and interpreting the evidence to show how it supports the construct validity of a specific measure (Carmines and Zeller, 1994). In the quantitative part of this research, content and face validity were considered and are discussed in detail in section 5.7.

### **3.9. Conclusion**

In this chapter, a number of research paradigms were reviewed and those relevant to this research, post-positivism, positivism, and constructivism were discussed in detail. Research approaches including qualitative, quantitative, and mixed methods were also presented and their differences were described. The methods of data collection and data analysis in qualitative and quantitative studies were other issues discussed in this chapter. Furthermore, this chapter presented the approaches and methods used for the current study. In this research, a qualitative approach was selected for the first phase to gain a deeper understanding of users' perceptions of using information systems in the ED, and a quantitative approach was chosen for the second phase to investigate the most important factors influencing users' attitudes towards using IT in the ED. The next step was using triangulation methods to confirm the results of the qualitative study and to gain a more complete picture of the study results. Data were collected using semi-structured interviews in the first phase and a self-administered questionnaire in the second phase. The following two chapters present the details of the qualitative study (Chapter 4) and the quantitative study (Chapter 5). Chapter 6 triangulates and discusses the results of the qualitative and quantitative studies.

## CHAPTER 4: QUALITATIVE STUDY

### 4.1. Introduction

The literature review presented in Chapter 2 revealed that several factors may influence the use of information systems in healthcare settings. These factors might be different from one setting to another as healthcare practices are complex and users' requirements and expectations can be different based on their professions. Understanding these factors can help to design better and more efficient systems for healthcare professionals.

The literature review also suggested that, although issues related to clinical information systems have been discussed in a number of studies, few studies have examined the use of information systems in the ED, or the factors that may influence the use of these systems. As noted in Chapter 3, applying a qualitative approach could help to gain an in-depth understanding of these factors. Therefore, this chapter reports a qualitative study conducted in an ED. In this study, data were collected using semi-structured interviews and analysed using framework analysis.

This chapter includes eight sections to present the process of research and the key findings. Following this introductory section, section 4.2 presents the research questions. In section 4.3, the study design, the research setting, sampling and recruitment are discussed. This section is followed by an explanation of the method of data collection, the pilot study, the process of data collection, the method of data analysis and checking the validity of results. Section 4.4 is devoted to the results of the qualitative study. Sections 4.5 to 4.7 include a discussion, the limitations of the research, and areas that need further research in the future. Section 4.8 provides a conclusion for the chapter, and identifies issues for the second phase of the research presented in Chapter 5.



## **4.2. Aim and research questions**

As mentioned in Chapter 1, the main aim of the research was to explore factors that might influence users' attitudes towards, and the use of, IT in the ED. The research questions of this study were as follows.

1. What are the user, task, system, and environmental characteristics that might influence users' attitudes towards using IT in the ED?
2. What is the impact of technology on users' attitudes towards using IT in the ED?

In this chapter, the results of the qualitative study are used to answer questions 1 and 2. To answer questions 3 and 4 (noted in Chapter 2), a quantitative study was conducted which is discussed in detail in Chapter 5.

## **4.3. Research Methods**

In this section, the details of the qualitative research, including the study design, the research setting, the method of recruitment and data collection are presented. This is followed by a discussion of the preparation needed for conducting interviews, a pilot study, the process of data collection, the method of data analysis and checking the validity and reliability of the results.

### **4.3.1. Study Design**

As noted earlier, the main aim of the study was to explore factors that might influence users' attitudes towards, and the use of, IT in the ED. These factors could be identified by investigating users' perceptions of using electronic information systems in the ED. Therefore, a qualitative approach was chosen for the first phase of the research, as this approach could help to provide an in-depth understanding of the context and the subject of

the study. This method is also in line with the constructivist paradigm discussed in Chapter 3, section 3.2.

#### **4.3.2. Research Setting**

The research setting was an ED located in a large urban teaching hospital in the north of England. The hospital has more than 1100 beds and over 5500 staff. The ED is particularly busy as it is the only major one in the city responsible for caring for adult patients suffering from a wide range of emergency conditions. Typically, the ED team treat more than 250-300 patients per day. In this department, paper-based records (e.g. medical records, patient notes, and ED cards) are used as the main source of information, although electronic systems are also used.

The ED has three main electronic information systems: a Patient Focus Information System (PFIS), a patient tracking system, and a Radiology Information System called E-film. These systems are not integrated with each other. The PFIS is the main information system in the hospital and its ED module is used in this department. This system is mainly used for ordering blood tests, viewing blood test results, and patient registration. The patient tracking system is used to track the location of patients in the ED and to monitor the time from admission to discharge for each patient, and helps to attain the four-hour target for treatment, discharge, referral, and admission of patients in the ED (Hughes, 2006). The E-film is used as a radiology information system, and works like a Picture Archiving and Communication System (PACS) (discussed in Chapter 2). The level of access to the information systems is different for the user groups. For example, qualified clinicians are able to use the PFIS for ordering blood tests and retrieving blood results, and the receptionists are allowed to register patients and book appointments using the system. Other administrative staff are mainly able to search information through the PFIS. The patient tracking system can be used by all of the clinicians and non-clinicians in the department, and E-film can be used only by staff qualified in interpreting X-ray images, such as qualified nurses.

### **4.3.3. Sampling and recruitment**

Before conducting the interviews, a scoping study was conducted to identify different user groups and their access level to the information systems. In this study, the researcher attended an informal meeting with the audit lead in the ED and different user groups were identified. In order to recruit the participants, a purposive sampling method was initially chosen. This method involves selecting participants on the basis of known characteristics (May, 2001). In order to gain an in-depth understanding of users' perceptions, a maximum variation strategy was adopted and different groups of ED staff in terms of age, gender, work experience, profession and level of qualification were invited for interview.

To achieve a higher response rate, one of the doctors, who had more than 10 years work experience in that department, facilitated the process of recruitment. This approach was chosen, as the facilitator knew the ED staff who could help with the research. In this process, the researcher attended the ED and was introduced to the staff, who had access to the systems, by the research facilitator. After introducing the research topic, the researcher invited the staff to participate in the interview then and there, if they were interested and time permitted.

### **4.3.4. Data collection**

In this study, a semi-structured interview was chosen as the most appropriate method for collecting data, as the researcher intended to investigate users' perceptions. Punch (1998) and Denscombe (2005) explained that interview is one of the main tools for collecting data to understand people's perceptions, emotions, experiences, feelings and their definitions of different situations. This approach would help to gather more in-depth data.

#### **4.3.5. Preparation for interviews**

An interview guide was developed based on the literature review to meet the objectives of the research, and was revised several times after discussions with the research supervisors. The questions covered the information needs and information flow in the ED, and the importance of immediate access to information in this department as well as the possible ways to get it. In addition, interviewees were asked about the role of computerised information systems in the ED and the positive and negative aspects of these systems. In order to collect demographic and background data about each participant, a brief questionnaire was also designed. Copies of the interview guide and a demographic and background questionnaire are included in Appendix III.

#### **4.3.6. Pilot study**

The first five interviews formed the pilot study. The pilot study revealed that the interview guide needed to be adjusted to ask additional questions, such as asking people about their past experiences of using computerised information systems. These questions helped the interviewees to recall what they liked and what they did not like about past and current systems. Moreover, after conducting the first five interviews, it was revealed that some of the ED staff were specialised in treating patients with specific conditions, such as the DVT nurses, who were responsible for treating patients with Deep Vein Thrombosis (DVT). Therefore, the researcher needed to obtain more information regarding their roles and responsibilities, and different types of information that they might need. Furthermore, as the interviews were undertaken in the actual workplace, the researcher had to be able to cope with any interruption. The pilot study aided the researcher to develop her interview skills and to adjust her interview guide.

#### **4.3.7. Process of data collection**

Before conducting the research in the ED, an NHS Research Ethics application form was submitted to one of the Local Research Ethics Committee and a favourable opinion was obtained in January 2007. Subsequently, Research Governance Approval was received

from the Research Department of the NHS Sheffield Teaching Hospitals in February 2007. Copies of these documents are provided in Appendices I and II. Other ethical principles, such as providing the participant with an information sheet and obtaining their informed consent before undertaking the interviews were considered during data collection, and are discussed in this section.

Before conducting the interviews, participants were asked to read the participant information sheet to be fully informed about the process of the interview and their rights. This could help them to decide whether to take part in the study or not. In addition, staff were asked to sign a consent form, which showed that they were fully informed about the process of the interview and that their voice could be recorded during the interviews. Copies of these documents are provided in Appendix III. All interviewees were assured about the confidentiality of the content of interviews, such as names and all sensitive issues related to their jobs.

All of the interviews were carried out in the ED. However, these were arranged outside of the interviewees' work time or when the departmental workload was low. The interviews were conducted in a convenient place for the participants to prevent any interruption. In addition, the research facilitator, or the colleagues of the interviewee, were informed about the place and time of the interview in order to contact them if they were required urgently. In this case, the interviewee could leave at any time that s/he was needed.

Data were collected using in-depth semi-structured interviews in which the researcher adopted a flexible approach to ask prompt questions based on the process of interview and the responses of the interviewee, and to clarify some questions based on the participant's request. At the end of each interview, the interviewees were asked to complete a background information questionnaire that included questions about gender, age, work experience in EDs, work experience in that particular ED, the period of time that the interviewee spent using a computer on a daily basis, and in the ED, and attendance at computer training courses in the hospital. Interviews were conducted and continued until data saturation was reached, and no new information was collected from the interviewees.

#### 4.3.8. Data analysis

All interviews were digitally recorded and transcribed verbatim for subsequent analysis. The demographic data collected for all interviewees were analysed to describe the characteristics of the sample. In order to analyse the interview data, the method of framework analysis was used. As noted in Chapter 3, section 3.7.1, framework analysis consists of six main steps which are: familiarisation; identifying a thematic framework; indexing; charting; mapping and interpretation (Ritchie and Spencer, 1994).

Initially, the interviews were listened and transcripts were read carefully by the researcher to become familiar with the data. The second step was developing a thematic framework. To do this, the first 10 interviews were read, and a list of the main concepts with related categories was developed based on the interview guide and familiarisation with the structure of data. The third step was indexing, or coding the data. At this stage, each of the transcripts was read and data were analysed paragraph by paragraph, and at times, line-by-line to see how the initial codes could be applied to them. The emergent issues were also identified as new categories, and the initial list of themes, categories, and subcategories was revised and refined several times during and after coding the data. The transcripts of all interviews were imported into QSR NVivo 7 and were coded using the software, which is specialised for qualitative data analysis. The software facilitated the process of coding data and grouping them under appropriate themes, sub themes, categories, and subcategories.

Once a transcript was reviewed, categories emerged and 'nodes' were created in the software and the text was coded on the respective node(s). As analysis progressed, memos were documented within the software. Later, using the software functionalities, related nodes were grouped under 'tree nodes' to show the sub themes and themes. For example, during data analysis the following statement "*a patient's name, date of birth, address, next of kin, religion, marital status, and occupation*" was coded as 'demographic information'. This code in conjunction with other codes 'clinical information' and 'social information' were coded as 'patient information'. This code was placed under the sub theme, 'information needs in the ED' and theme 'task characteristics, information needs and related issues in the ED'. The fourth step was charting, in which all themes, sub themes,

categories, subcategories, and quotations related to each code were transferred into the MS EXCEL program.

A thematic chart was developed for each theme across all the respondents and the same order for respondents was used in each chart. This helped to identify patterns, associations, concepts, and explanations in the data (Ritchie and Spencer, 1994). At this stage, each quotation was reviewed and the main concepts were extracted. Then, the researcher started mapping and interpreting the data in conjunction with giving examples of the interviewees' quotations. The results were also supported by the literature and the main findings were discussed in the discussion section.

#### **4.3.9. Reliability and validity**

As noted in Chapter 3, the criteria for assessing the reliability and validity of the qualitative studies are different from the criteria for the quantitative studies. In the current qualitative study, the credibility of the findings was established through member checking, in which a summary of the results and an evaluation sheet (Appendix IV) were sent to the participants to get feedback and to confirm that the findings were valid from their perspectives. Seventeen replies out of thirty-four were received. The interviewees indicated that the results presented in the summary were accurate representation of the discussion that they had in their interviews and included different aspects of it.

The qualitative data might be limited to the setting and the context of study rather than being representative of the population under study. Therefore, to show the transferability of the findings, the main aim was to gain rich data. As Kaplan and Maxwell (1994: 44) noted, "*rich data are detailed and varied enough*" to show a full picture of what is happening in a certain setting. The richness of data can help to provide a basis for making a judgement about the possible transferability of data to the similar settings (Bryman, 2004).

The dependability of the research was established by keeping a complete set of records about different stages of the research. These included the interview guide, participant information sheets, consent forms, interview transcripts, and the process of data

analysis. These documents can help to provide a full picture of the research that can be repeated by other researchers.

The confirmability of the research was associated with controlling the possibility of bias during interviews and data analysis. For example, the researcher attempted to control the effect of her background and understanding of the systems during the interviews. In addition, the interview guide was discussed with the research supervisors to increase the confirmability of the research, for example, by excluding potentially leading questions.

## **4.4. Results**

In this section, the characteristics of the sample and the findings of the study are presented.

### **4.4.1. Sample characteristics**

In this study, 34 ED staff were interviewed and the interviews took 20-70 minutes (mean= 43 minutes). The participants were 11 doctors at different levels, 12 nurses in different grades, two patient flow champions who were responsible for monitoring patient flow in the ED, one service manager, two secretaries, five receptionists and one doctors' support worker. Table 4.1 shows the sample characteristics.



**Table 4.1- Sample characteristics**

Question	Response	Frequency
Gender	Male	9
	Female	25
Age	≤ 25	1
	26-35	9
	36-45	17
	46-55	6
	≥56	1
Job title	Doctor	11
	Nurse	12
	Patient flow champion	2
	Doctors' support worker	1
	Service manager	1
	Secretary	2
	Receptionist	5
Work Experience in Emergency Medicine	less than 1 year	5
	1-3 years	4
	4-6 years	6
	7-9 years	4
	10 years or more	16
Work Experience in that particular ED	less than 1 year	6
	1-3 years	5
	4-6 years	6
	7-9 years	7
	10 years or more	10
Use of a computer in a day	less than 1 hour	8
	1-2 hours	8
	3-4 hours	10
	5-6 hours	5
	7 hours or more	3
Use of a computer in the ED during a day	less than 1 hour	10
	1-2 hours	9
	3-4 hours	7
	5-6 hours	5
	7 hours or more	3
Attendance at computer training courses	Yes	26
	No	8

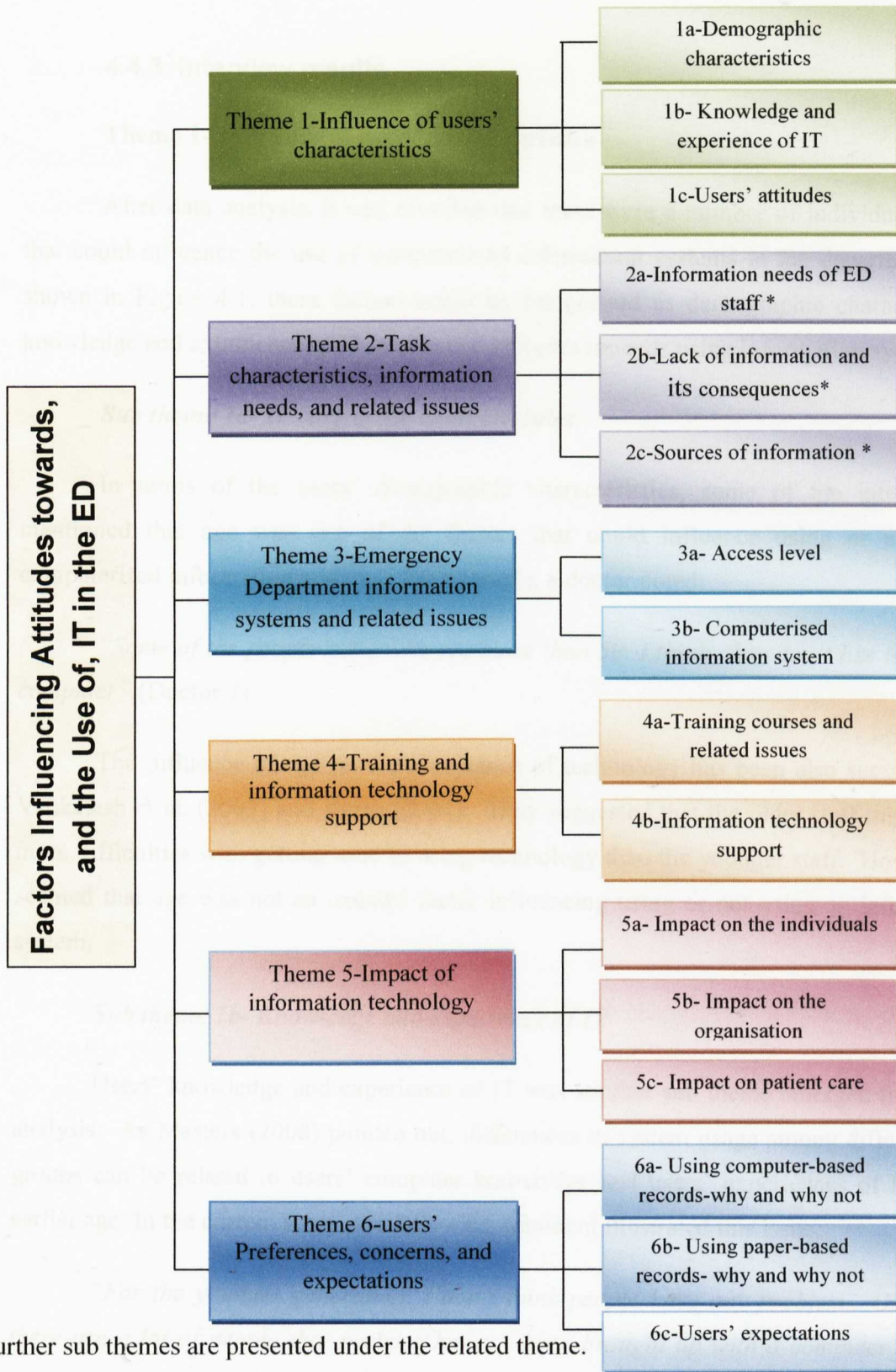
As table 4.1 shows, the interviewees were different in terms of gender, age, work experience and attendance at the computer training courses. Most of the interviewees were female (n=25) and about one third of them were nurses (n=12). Half of the interviewees aged between 36 and 45 years old (n=17). The highest frequency of the interviewees (n=16) had work experience of 10 years or more in the field of Emergency Medicine, and 10 interviewees had worked in that particular ED for 10 years or more. In terms of using a computer in a day, less than one third of the interviewees (n=10) indicated that they used a

computer 3-4 hours a day, and in terms of using a computer in the ED, less than one third of the interviewees (n=10) noted that they used computers in the ED less than one hour in a day. Most of the interviewees (n=26) indicated that they attended computer training courses.

In order to maintain the confidentiality of personal information, the identities of the participants were anonymised during data analysis and in reporting the findings, and they were described as being in one of three main groups; doctors, nurses, and administrative staff. A doctors' support worker was grouped with the nurses, and the rest of the interviewees, who were mainly office/clerical workers, were grouped as administrative staff. In order to trace quotations, each of the interviewees was given a number in their own group. In the results section, this number and the interviewee's group name are cited alongside each quotation.

#### **4.4.2. Overview of themes and sub themes**

Having analysed the data, the findings of the study included six main themes. These themes were the influence of users' characteristics; task characteristics, information needs and related issues in the ED; Emergency Department Information Systems and related issues; training and information technology support; the impact of information technology on the ED; and users' preferences, concerns, and expectations. Figure 4.1 illustrates these themes and the related-sub themes, and these are described and discussed in section 4.4.3.



**Figure 4.1- Themes and sub themes that emerged from the qualitative data**

### **4.4.3. Interview results**

#### **Theme 1- Influence of users' characteristics**

After data analysis, it was revealed that there were a number of individual factors that could influence the use of computerised information systems in the department. As shown in Figure 4.1, these factors could be categorised as demographic characteristics, knowledge and experience of IT, and users' attitudes towards using information systems.

##### ***Sub theme 1a- Demographic characteristics***

In terms of the users' demographic characteristics, some of the interviewees mentioned that age was one of the factors that could influence using or not using computerised information systems. For example, a doctor noted:

*"Some of the people here, who are more than 50, I think, they don't like to use the computer"* (Doctor 7).

The influence of age on the acceptance of technology has been also suggested by Venkatesh et al. (2003) and Karsh (2004). They suggested that the older staff might have more difficulties with getting used to using technology than the younger staff. However, it seemed that age was not an isolated factor influencing using or not using an information system.

##### ***Sub theme 1b- Knowledge and experience of IT***

Users' knowledge and experience of IT was another sub theme emerged from data analysis. As Masters (2008) pointed out, differences in system usage among different age groups can be related to users' computer knowledge and users' experiences of IT at an earlier age. In the current study, the following comment illustrated this issue.

*"For the younger generation, I don't think people have any problem. Obviously there are a lot of people that perhaps haven't been brought up with a computer in their generation, so for them there would probably be a problem"* (Nurse 3).

This comment suggested that, in the ED, the older staff in the department might not have received adequate formal computer training during their professional education, and

this might influence their attitudes towards using a computer. This is consistent with the results of Jones' (2003) study, in which junior doctors were more enthusiastic to use information systems, and it seemed to be associated with their prior experiences. Therefore, this might be a cohort effect rather than solely the age effect, i.e., due to their being born at a certain time, e.g., before the widespread use of PCs, rather than because of their age *per se*. Nevertheless, Laerum et al. (2001) indicated that familiarity with using a computer does not mean that users are able to use any computerised system properly. This implied that the importance of training on a particular clinical information system should not be underestimated.

According to the interviewees, their experiences of IT could be related to using different applications such as MS-WORD, EXCEL, ACCESS, the Internet, and clinical databases or other clinical information systems in the past. Users who had more experience of using other clinical information systems were more positive about change and about using more advanced information systems than the staff who had no experience of using other computerised information systems. For example, some of the interviewees stated:

*"I work at the [name of the hospital] hospital in the Emergency Department there, ..., they are ahead of the game from us certainly in that way, their electronic record system is better"*(Doctor 8).

*"I am from a trust where everything is computerised, and the whole system, from the patient arriving to be discharged, it was on the computer, ..., much quicker than having, as we have here with the notes, much quicker, because you don't have to look for anything"* (Nurse 9).

The results showed that some of the nurses and administrative staff were less experienced in using other clinical information systems as they had never worked in other hospitals.

*"I came straightaway to ED from qualified, so I didn't work on a ward to date"* (Nurse 6).

*"I have never been, or worked in a hospital until I worked in the ED"* (Administrative staff 8).

In terms of the influence of users' previous experiences of IT on the acceptance of new information systems there are different perspectives (Aydin and Rice, 1991). Some studies (van Der Meijden et al., 2001; Ammenwerth et al., 2003b) have shown that such experience results in greater acceptance of information systems. Aydin and Rice (1991), however, pointed out that too much experience may raise users' criteria for satisfaction and can reduce their acceptance of a new system.

### *Sub theme 1c- Users' attitudes*

Another factor, which might influence staff using or not using an information system, was related to users' attitudes towards change and using information systems. While some of the interviewees were "happy" with using more advanced computerised information systems in their workplace, some of the respondents were not interested to see any change in their work. For instance, one of the administrative staff said "*I am quite happy with what I have got*" (Administrative staff 6). Similarly, two interviewees suggested:

*"I like to do what I am doing, because I know what I am doing and I can't, I don't like to do new things, it frightens me"* (Administrative staff 2).

*"I get a bit, well, not frightened, but it worries me a bit, if something new comes in"* (Administrative staff 9).

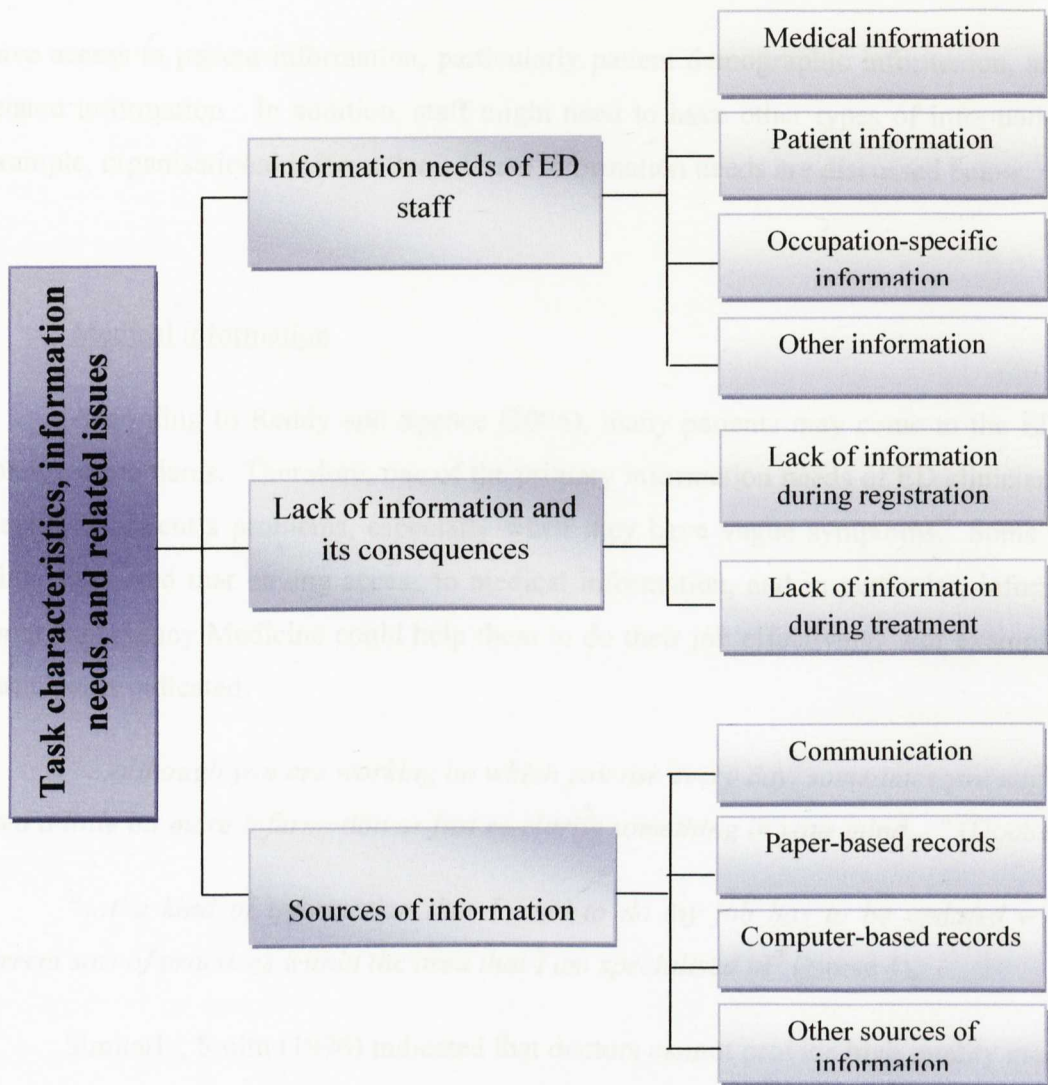
The influence of age on the users' attitudes towards using an information system has been addressed in other studies (Aydin and Rice, 1991; Laerum et al., 2001). According to Aydin and Rice (1991), people who are younger and less experienced at working in organisations seem to be more positive about using computers, and they show less resistance to change in their routine tasks. However, in their study, the researchers found that age was not associated with the users' attitudes. Similarly, the findings of a quantitative study conducted by Laerum et al. (2001) showed that there was no correlation between age, sex or work position and total computer use.

An individual's attitude towards different objects, such as an information system can be created and influenced through interaction with other members of a common social context (Aydin and Rice, 1991). In clinical settings, such as the ED, interaction between

different members of staff shapes this social context. In such a setting, senior staff could have a significant influence on users' attitudes towards using a system (Jones, 2003). Therefore, it is important to ensure that they have adequate knowledge and experience of IT, and are positive about change. In terms of users' attitudes towards change, the results showed that the administrative staff appeared to be more concerned about using a new system in their workplace than did clinicians. This might be related to the nature of their jobs in which they spend a significant amount of time using computers and implementing a new system could considerably affect their jobs. For example, a user needs an adequate amount of time to learn a system and get used to using it. This may have consequences, such as delays in work or stress for the users and other staff. Moreover, the process of patient care might be affected due to staff being unfamiliar with the system. These perspectives suggested that users' attitudes towards change, for example, using a new information system, could be affected by their perceptions and beliefs. Therefore, it is important to pay more attention to the requirements of staff who are worried about new technology.

## **Theme 2- Task characteristics, information needs, and related issues in the ED**

In order to design a successful clinical information system, task characteristics, the information needs of clinicians and non-clinicians, and the context in which they work there should be taken into account (Lappa, 2005). This can help to develop 'context-specific information resources' to meet the users' information needs (Currie et al., 2003:190). As discussed in Chapter 2, EDs have unique characteristics. However, few studies have been undertaken to examine the information needs of clinicians and non-clinicians in this department. In the current study, interviewees were asked about their information needs and information flow in the department to obtain a better understanding of the environment in which they worked, and to determine to what extent current information systems were able to meet their information needs. In this section, three main sub themes, namely information needs in the ED, a lack of information and its consequences, and the sources of information are discussed in detail. Figure 4.2 shows this theme and related sub themes.



**Figure 4.2- Task characteristics, information needs, and related issues in the ED**

***Sub theme 2a- Information needs in the ED***

The interviewees were asked about their task characteristics and the information that they needed in their job. The results showed that there was a wide diversity of jobs and specialities in the ED, particularly among nurses and the administrative staff. For example, nurses included triage nurses, psychiatric nurses, and cardiac nurses. Similarly, the administrative staff included receptionists, secretaries, and managers. In the ED, clinicians and non-clinicians needed different types of information. Generally, clinicians needed to have access to medical information (medical knowledge), patient information, and occupation-specific information (e.g. psychological information). Non-clinicians needed to



have access to patient information, particularly patient demographic information, and job-related information. In addition, staff might need to have other types of information, for example, organisational information. These information needs are discussed below.

### Medical information

According to Reddy and Spence (2006), many patients may come to the ED with unknown problems. Therefore, one of the primary information needs of ED clinicians is to identify a patient's problems, especially when they have vague symptoms. Some of the clinicians noted that having access to medical information, and in particular, information about Emergency Medicine could help them to do their job effectively. For example, two participants indicated:

*"...although you are working on which you use every day, sometimes you might still need a little bit more information or just re-clarify something in your mind..."* (Doctor 3).

*"...the kind of information that I need to do my job has to be updated with the current sort of practices within the area that I am specialised in"* (Nurse 4).

Similarly, Smith (1996) indicated that doctors cannot provide high quality medicine without constantly updating their medical knowledge. Moreover, as the ED was located in a teaching hospital, a number of junior doctors, house officers, and senior house officers had to work in the department for a short period of time. These people needed to be trained in *"what to do in the ED, and how to deal with the patients, how to deal with emergencies, like if there is a heart attack"* (Doctor 7). This information as well as information on *"where to refer people with specific problems, who refer them to, and who you are seeking advice from"* (Doctor 9) would be given through teaching sessions. This suggested that the information needs of clinicians might be affected by the organisational context of their workplace (Reddy and Spence, 2006). For example, in a teaching hospital, students might be looking for more support, guidance, and approval of what they are doing (Smith, 1996).

## Patient information

According to Reddy and Spence (2006), patient information is the most needed information in the ED, and this information is normally obtained by asking patients or their relatives (Smith, 1996). Similarly, the findings of a study conducted by Currie et al. (2003) showed that patient information was more demanding than information related to the staff specialities or the institution where they work.

In the current study, patient information could be categorised as demographic, clinical, and social information. In terms of demographic information, clinicians needed to know “*who they [patients] are, how old they are, whether they are male or female*” (Doctor 6). Information about the patient’s address in terms of whether they lived in their own homes or in a nursing home was also identified as useful information for clinicians in order to contact and get more information about the patient. However, the demographic information collected by receptionists was in greater detail, as they needed to know “*the patient’s address, GP, next of kin, religion, marital status, occupation,...*” (Administrative staff 2).

In terms of clinical information, clinicians needed to know about the current problems of a patient, the results of the clinical investigations, a patient’s medical history, and the type of patient referral to the ED. However, as one of the administrative staff stated “*if it is something like a traffic accident*”, other questions needed to be asked, such as “*where it did happen, how they have got to the hospital, who were they with?*” (Administrative staff 9). For the follow-up patients, although clinicians could have access to the patients’ notes and had some ideas of what had happened to the patient in his/her previous attendance, they still needed to know more about the current condition of the patient. In this situation, usually patients themselves were helpful.

The clinical information that clinicians needed to treat a patient would be completed by clinical investigations and their results. Some of these investigations, such as “*observations, [and checking] blood pressure, temperature, respiratory rate, pulse, ECG*” (Nurse 10) would be done prior to making a primary diagnosis and selecting appropriate tests. Then, in order to confirm the diagnosis, clinicians needed to do more investigations. The complexity of patient care in the ED can be compared to other wards of a hospital.

While ED clinicians have to make a diagnosis quickly and based on limited information, in other wards of a hospital, patients have been usually diagnosed before being hospitalised, and the focus is on their care plan (Reddy and Spence, 2006). In the ED, in order to have a full picture of a patient's medical problem, most of the clinicians thought that having access to the patient's medical history was important. However, the necessity and the amount of information could be different, depending on the patient's condition. A nurse indicated:

*"I think, if you are coming with a broken toe, you still need history to that, but what you need for that is obviously less in my view than what you would need for somebody with the heart condition, but there is still a certain amount, a certain level you need to obtain about every patient"* (Nurse 10).

According to a doctor, the majority of ED attendees could be treated without having access to their previous medical histories, since their problems were considered "*an isolated problem*", such as "*I fell over, I cut my leg*" (Doctor 8), or because their medical records were not available easily. However, for a minority of patients, having access to their previous medical histories was important from different aspects. For example, two participants indicated:

*"[If] I know this patient has been in [the hospital] three times with the same problem, I can use it as a continuation, as an unplanned return with the same ongoing problem rather than booking them in on the new card, and you would continue with the plan of care"* (Nurse 13).

*"It will help to have an integrated patient record, it would avoid duplication, so if the patient had a foot scan last week, you didn't need to repeat it this week maybe, there is a big cost saving at avoiding duplication"* (Doctor 8).

Some of the clinicians suggested that not only was having access to the patient's previous medical records produced in the ED or other hospitals important, but also having access to the patient's primary care records was useful. According to some of the respondents, sometimes having information about a patient's "*immunisation status*", such as "*Tetanus injection*" status for treating wounds, or patient's allergies from their primary care records could be crucial to treating them. In this respect, one of the nurses told a story of a patient who was allergic to antibiotics and thought that it was Penicillin. In order to

treat the patient, Erythromycin, which is another type of antibiotic, had been given to the patient. However, he was allergic to both of those. Obviously, having access to his primary care records could have helped the ED clinicians to be aware of his allergies and dispense antibiotics that were suitable for him. Moreover, due to the specific characteristics of the ED, in which clinicians need to make decisions as quickly as possible (discussed in Chapter 2), having access to such information can save patients' lives.

Apart from the demographic and clinical information, clinicians needed to know more about a patient's social circumstances to give better care to patients. As a nurse remarked:

*"For example, if they live alone, or if they have relatives there to support them, if they have dependent carers, for example, if somebody comes and falls and breaks her leg, yet their husband is very ill and need to care, ..., I would speak and liaise with district nurses, or social services to ensure that the patient is able to function in their own environment"* (Nurse 11).

Having access to social information was particularly important for elderly people. This information could help clinicians to make the right decision on whether to admit patients to the hospital or to send them home. According to a doctor, this information could help clinicians to know:

*"Whether patients are capable of living on their own, whether they live in a protected environment, and whether they have got social services who come in two, three, four times a day, to help them in their home"* (Doctor 8).

The above comments suggested that social information and healthcare information could complement one another and was needed to support patient care.

### Occupation-specific information

With respect to the characteristics of the ED, in which patients with a range of illnesses were treated, doctors had to have adequate knowledge of emergency medicine. Similarly, some of the nurses were specialised in their own field and needed to have access

to information related to their specialties. For example, having access to a patient's psychological information was of great importance for a psychiatric nurse. Similarly, other specialties needed different types of information. This is illustrated in the following example.

*"It is important for me to know what is happening in medical physics department, because that's a department that scans for patients, if we are considering that they might have DVT, Deep Vein Thrombosis"* (Nurse 2).

For the administrative staff, their job descriptions could specify the information that they needed. For example, receptionists were responsible for booking patients, making appointments, booking ambulances and transport for patients. Therefore, in order to do each part of their jobs, they needed to have a certain level of information. For instance, in order to book transport for a patient they needed to know *"where they are going to, if they are going to transfer to another hospital [what] the reason for transfer [is], what type of mobility they are, ..."* (Administrative staff 7).

The occupation-specific information could be different for the secretaries who were mainly responsible for *"keeping consultants' diaries, typing letters, filing, and doing general matters"* (Administrative staff 4).

### Other information

When working in an organisation, such as a hospital, staff are required to have adequate information regarding their jobs, and relevant rules, regulations, and organisational changes. According to a nurse, some of this information included:

*"Relevant government papers, anything like government-led initiatives or targets, particularly for the ED in terms of targets, any information about current practice"* (Nurse 6).

In the ED, staff also needed to have adequate information about the number of patients, their waiting time, and where they were in the department. As a nurse said *"it is important that anybody knows where the patient is"* (Nurse 2) to gain a full picture of the

departmental workload and to follow care plans. Similarly, Reddy and Spence (2006) noted that information about the coordination and the flow of patients is of high importance in the ED and allow the members of staff to work effectively and efficiently. This also suggested that ED information systems should be able to meet these types of information needs. The department included three main areas; minor unit, major unit, and a resuscitation unit, with a number of beds and cubicles in each of them; therefore, clinicians needed to know exactly where the patient was to go. This could help them to care for patients as quickly as possible, rather than looking for them in different areas. In addition, if patients were sent to the radiology department, or they were discharged, admitted, or transferred, the clinicians needed to be informed about this.

Generally, the results showed that the ED staff had a variety of information needs that needed to be met through using different sources of information. It is notable that the information needs of the ED staff discussed by the participants could be regarded as the most frequent ones. With respect to the context of the ED, staff might face with unexpected situations in which they might need other types of information. Therefore, as Rose et al. (2005) highlighted, when designing an electronic system, the details of users' tasks need to be considered. Systems which are designed without studying the information needs of users may fail to support routine practice (Smith, 1996).

### ***Sub theme 2b- Lack of information and its consequences***

As mentioned above, although having adequate information particularly about the patients was of high importance for the ED staff, there were times when either clinicians or non-clinicians faced a lack of information. This could happen during registration or treatment. A lack of information in the ED, particularly at the right time and right place has been addressed in different studies (Reddy and Spence, 2006; Hakimzada et al., 2008). According to a member of the administrative staff, some of the reasons for a lack of information at registration were as follows.

*“Sometimes, because of either language problems, or they [patients] are in pain, or the drink problems or the drugs, or they are just ill, the details [are] not quite the same as when they registered at the first time, [and] we may register them with some details that are slightly incorrect” (Administrative staff 2).*

For people, who were not able to give any information, such as unconscious patients, the following procedure was undertaken, as a participant explained.

*“... , if we can't get all details, they are classified as unknown, and we give a date of birth which makes 110 until the patient comes round and gets in touch with the relatives, that is when we update the system”* (Administrative staff 7).

In the case of having more than one unknown patient, patients' gender and their *“distinguishing marks, or probably clothing”* were the only ways to identify patients in the department, as an administrative staff said. In addition, as an ED number was produced for each patient in the department, this number was used to identify blood results and other documents for an unknown patient. It was expected that nurses who were looking after a patient would find more information about them. As a doctor noted, sometimes patients might introduce themselves as someone else, since they might have committed a criminal offence or they might be hiding from something. However, as the main aim was to treat the patient whoever s/he was, the ED staff trusted them. One of the nurses also stated:

*“Sometimes people have their driving licence or they have got a card or something on them, but we can't take that, because somebody else may put it in their pocket for whatever reason, we still have to treat them as an unknown until it is proved verbally”* (Nurse 8).

The lack of access to the patient's name and surname could result in not having access to the patient's medical records since a patient's name and surname were key pieces of data to search a patient's medical history. As a result, clinicians had to *“manage the patient without it”* (Doctor 2). Particularly, if the patient was not able to talk, a decision was made based on the information that the clinicians had. Some of the consequences of not having access to the patient's information were as follows:

*“... , either take a risk and send them home, or you admit them, [sometimes] an unnecessary admission, because you are worried about their social circumstances and you didn't have the information, so lack of the information makes you decide one way or the other [way]”* (Doctor 8).

*“... , maybe the patient doesn't get the optimum care, because we haven't got the right information, ...”* (Nurse 5).

*“... , we can't order any notes, there is no information about the person at all, ..., we can't trace the [ED] card, ...”* (Administrative staff 9).

The results are consistent with the findings of Hakimzada et al.'s (2008) study in which the reasons for incompleteness or inaccuracy of information at registration have been highlighted. According to Hakimzada et al. (2008), failure in registration in terms of obtaining complete and accurate identification information may cause failure in getting access to the patient's previous medical records. As a result, the chances of error will be increased and patient safety will be at risk. Hakimzada et al. (2008) introduced ED registration as a source of error since the registration staff work in a stressful environment and deal with a high volume of patients. In fact, a lack of information could cause making a decision based on the little information that the clinicians had, and for example, *“treat the signs, and plan based on more information later on”* (Doctor 5). In this case, more clinical investigations might be needed, more time would be spent and more resources would be used. Therefore, it is important to identify how clinical and non-clinical staff can increase efficiency and reduce error in their jobs.

### ***Sub theme 2c-Sources of information***

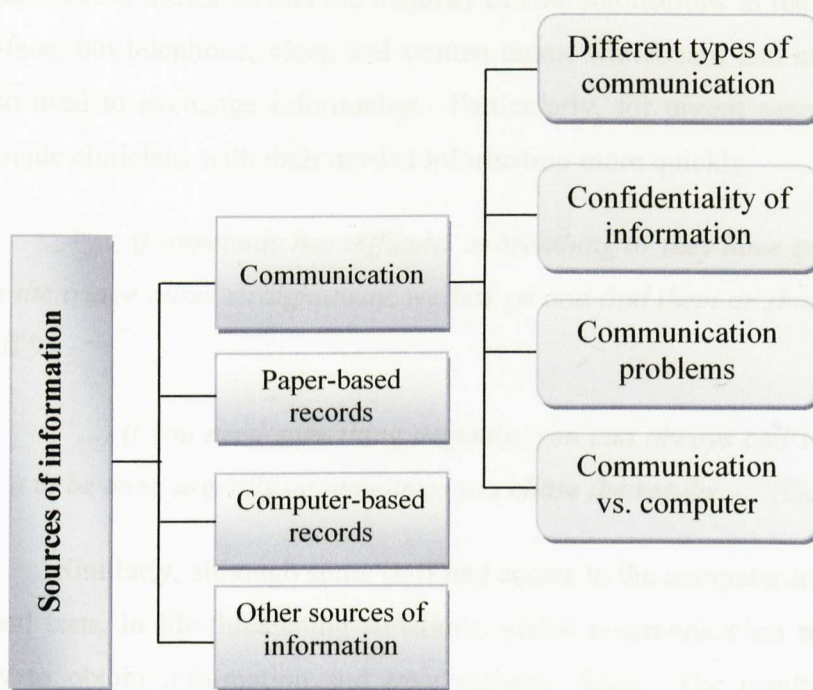
As noted above, the ED staff had various information needs, and they used different sources of information to meet their needs. After analysing the data, it was evident that the ED staff had access to information through three main sources of information including verbal communication, paper-based sources and computer-based sources. However, there were also other ways to exchange information, for example, using a whiteboard. In this section, the sources of information used by the ED staff are discussed in detail.

### **Communication**

According to Redfern et al. (2009), communication among ED staff is of high importance in exchanging information, mainly due to the time constraints, rapid turnover, and the complexity of the tasks in this department. Similarly, in the current study, analysis



revealed that verbal communication was an important source of information for the ED staff. Figure 4.3 shows related sub categories for this category. According to the results, verbal communication with ambulance crews, colleagues in the department or in the hospital, GPs, patients and their relatives, mental health services, and nursing homes was usual in the ED. Although verbal communication was important for the ED staff, in some situations their attempts might fail and their information needs could be left unmet. This encouraged some of the interviewees to compare the advantages and disadvantages of verbal communication with using a computer. This is discussed later in this section.



**Figure 4.3- Communication and related issues**

*Different types of communication*

According to most of the participants, in order to get information about the patients, who were brought in by an ambulance, particularly, “*if the patient was unconscious or confused, or not able to give a good history themselves*” (Doctor 5), ambulance crews were the main source of information to tell:

*“Time of things that happened, how they found the patient, why they would call, what the patient would be like when they got there, vital signs, blood pressure, and what treatment they have given to them in the ambulance” (Doctor 5).*

Communication with colleagues in the department was another way to exchange information. This also included consultations for making clinical decisions. Colleagues could communicate with one another either face-to-face or using the telephone. The results are consistent with the findings of Reddy and Spence’s (2006) study, in which ongoing verbal communication between team members was common in the ED. Similarly, Redfern et al., (2009) indicated that the majority of communications in the ED are verbal and face-to-face, but telephone, bleep and written notes, whiteboard and computerised systems are also used to exchange information. Particularly, for urgent cases, communication could provide clinicians with their needed information more quickly.

*“..., if somebody has difficulty in breathing or they have got chest pain, we have to see the triage nurse straightaway, we just go and find them or shout them” (Administrative staff 9).*

*“..., if you need something urgently, you can always call the labs directly and ask for it to be done urgently or sometimes you chase the results, ...” (Doctor 5).*

Similarly, although some staff had access to the computer to check the results of the blood tests, in life-threatening situations, verbal communication was chosen as a quicker way to obtain information and save patients’ lives. The results are supported by the findings of Reddy and Spence’s (2006) study, in which authors explained that face-to-face communication offered a convenient and fast way to gather information, without interrupting the workflow.

For some of the staff, verbal communication could constitute the main part of their job. For example, administrative staff were responsible for making phone calls, patient registration, and answering patients’, their relatives’, and other staff enquiries. As a member of administrative staff highlighted, their job involves *“talking to the clinicians and listening to others properly”* (Administrative staff 3). This is consistent with the findings of Reddy and Spence (2006), in which the important role of non-clinicians in addressing the information needs of other colleagues in the ED has been emphasised. Another type of

communication was related to communication with the patients' GPs. The ED staff usually phoned the GP to ask about patients' medical histories and medications that they were taking. The required information was mainly obtained verbally and sometimes it could be faxed to the department. In addition, GPs might phone the ED and ask for information regarding a patient's attendance and procedures performed in the ED.

According to most of the participants, in the ED, similar to other healthcare settings, communication with patients and their relatives was inevitable. In fact, from arrival to discharge clinicians communicated with patients or their relatives in order to gain the information that they needed and give the information that the patients needed. This type of communication was regarded as a first step in the process of caring for patients. Sometimes, communication with patients and their relatives could save time for clinicians as they might have a summary of their medical history. For example, as a doctor indicated:

*"Some patients have pre-prepared pieces of paper in their wallets, so at least they have the names of the medications they are taking,..."*(Doctor 8).

However, patients could be questioned about their condition several times by different members of clinicians, which could be due to a lack of reliable source of information. In case of using reliable electronic records, a number of questions might not be asked, as the information is already available. Communication with patients also included giving some information to the patients and their relatives. For example, some of the patients needed to be informed to follow a specific care plan, as a nurse explained:

*"I need to provide the patient with relevant [health] literature to explain to them [and] to take away with them, to explain to them what the problem is and what they can do to help themselves,..."*(Nurse 4).

Another type of communication was related to the mental health services for patients who suffered from mental health problems. Although a mental health team was established in the ED, it worked from Monday to Friday within office hours and they would be able to have access to the information that they needed. Beyond that, if the ED staff needed this type of information, they needed to contact mental health services.

*“You would have to request it via the telephone, and then somebody would give you a verbal account, for example, if this patient has been seen and treated by them in the past, ..., but we don’t have access to [the psychological database] directly”* (Nurse 11).

In the ED, clinicians sometimes needed to contact nursing homes. If the patient was confused or was accompanied by a person who did not know anything about the patient, then clinicians needed to contact the nursing home to know more about the patient.

*“You can often call the nursing care, and ask what is normal for that patient”* (Doctor 5).

Moreover, when patients were discharged and sent to their nursing home, the necessary information was communicated with the nursing home staff to continue the patient’s care plan.

#### *Confidentiality of information*

As some of the interviewees noted, confidentiality of information was an important issue, which needed to be maintained even in communication. One of the nurses indicated that the ED was responsible for caring for patients who might have been assaulted, or left on the doorstep while they had been stabbed. She added *“you always are very suspicious that somebody may have an intention of coming into the department to attack them again”* (Nurse 11). Therefore, it was important for the staff *“to limit the amount of information which was circulated about that patient”*, and they needed to be careful about where that information was displayed.

Similarly, administrative staff were not allowed to disclose details of a patient’s attendance. There was a limited amount of information that could be disclosed to the people outside of the department, and for further information departmental regulations including obtaining written consent from patients should be taken into account.

#### *Communication problems*

Although verbal communication was one the main ways of exchanging information in the ED, most of the interviewees were concerned about the problems that might occur during communication. Most of the interviewees noted that communication, for example

via the telephone, was often “*time-consuming and frustrating*”, especially when the line was busy. A doctor, who had experienced difficulties with getting access to the patients’ social information, said “*different agencies, e.g., social care services, don’t share information easily*” (Doctor 8).

Moreover, communication with patients and their relatives could fail, if they were confused or sick. As a doctor said:

*“When someone feels quite ill, they often want to give that information not more than once, because it is quite tiring...”* (Doctor 11).

According to some of the interviewees forgetting, misunderstanding, and other types of human error could lead to communication being unsuccessful. The following example illustrated this issue.

*“It is all based on what you hear over the phone, how you have interpreted that voice, what they have just told you, but you’re embarrassed to ask again what she said. So, this is the problem, ..., some people, they don’t ask about it - they panic”* (Nurse 13).

The results are consistent with the findings of Redfern et al. (2009) who found that the communication system in the ED was highly vulnerable to failure and could cause significant time delays and information loss.

#### *Communication vs. computer*

When interviewees were asked to explain how using a computer might affect their communication, some of them mentioned that using a computer could help them to reduce human errors. For example, a doctor highlighted:

*“Years ago we didn’t have the PFI system, so, you had to phone the lab, tell them you were sending a blood sample, they did the blood test, and then they phoned back with the results, so, there were a lot of human handling numbers, and the more people handled the data, the more mistakes have been built in and there was a delay...”* (Doctor 8).

Another interviewee indicated that using a computer could improve communication with other staff, as they did not need to have verbal contact, but they could leave a message.

Similarly, a nurse explained that using a computer could accelerate some procedures that were time-consuming using the telephone.

*“It [computer] is good, because the department is busy, you can’t always find who you need to talk to, in a certain amount of time they might be busy assessing [patients], ...”* (Nurse 8).

However, some of the staff indicated that it is not possible to replace communication with the computer, since *“a machine you can’t ask a question!”* (Nurse 4). Similarly, in terms of communication with colleagues some of the interviewees preferred to communicate with them verbally rather than using a computer. The following example illustrated this issue.

*“It is very much about an individual patient care, and I need to speak to an expert one to one, so the computer wouldn’t really help in that respect”* (Nurse 2).

The above comments showed that verbal communication could not be easily replaced with other sources of information such as computers. The results are consistent with the findings of Reddy and Spence’s (2006) study in which verbal communication was introduced as the first source of information, especially when the ED was busy and team members did not have time to search information in formal sources, such as computer and paper-based records. Similarly, Currie et al. (2003) showed that clinicians were more successful in meeting their information needs through verbal communication than using a computer. In their research, for example, it was revealed that human interaction was used to meet information needs more frequently than a computer resource.

The results of the current study also indicated that inter-departmental communication is an important factor that should be taken into account when designing an information system. However, as Aydin and Rice (1991) highlighted, the way that physicians communicate with one another and act according to their understanding of departmental tasks in one department can be different from other departments. Similarly, for nurses and administrative staff, the methods of communication can be different from one department to another. As a result, different patterns of communication can be identified within and between different groups of staff in a department.

### Paper-based records

As described above, the ED clinicians tried to meet their information needs mainly through verbal communication. After interviewing staff, it was apparent that the second most frequently used source of information was paper-based records. This was similar to the findings of a study conducted by Currie et al. (2003), in which non-computer resources including paper chart and books were considered the second most frequently used sources of information. In the ED, the main paper-based records included the ambulance sheet, ED records (ED cards), and patients' hospital medical records. Other types of paper-based records were appointment cards, blood forms, copies of guidelines and protocols, leaflets, letters, memos and notes, photocopies, printed materials, textbooks and X-ray cards. These are discussed in the following sections.

#### *Ambulance sheet*

As noted above, the ED staff needed to communicate with the ambulance crews to know more about the patients. Along with verbal communication, ambulance crews were responsible for completing an ambulance sheet. According to a nurse, ambulance crews were responsible for *“documenting all the patient's vital signs, the treatment they [patients] have been given, and the address where they were picked up, so if there is an unconscious man, it shows what street he was picked upon, ...”* (Nurse 9).

In terms of the quality of information in the ambulance sheets, the ED staff had different views. For example, two interviewees commented:

*“Sometimes they [ambulance crews] don't have a very good history, because if the patient has been found unconscious, they don't know why, ...”* (Doctor 5).

*“From the ambulance sheet, we do get a lot of various [information], the date of birth can be wrong, ..., misspellings, and some of the addresses are not spelt correctly”* (Administrative staff 10).

The above comment suggested that quality of information on the ambulance sheet depended on the information given by the patients themselves or their relatives and the patient condition.

### *ED records*

One of the main paper-based records used in the department was ED records, called ED cards. As a member of administrative staff noted, every patient had an ED card and clinicians could document all of the information on this card. When a patient was booked into the department an ED number was also produced. Having this number and the patient's name, clinicians and administrative staff could find a patient's previous ED card, if they had been admitted previously. According to most of the participants, the ED staff usually had quick access to the ED cards, if they were available. For instance, it might take about 5 to 10 minutes, as a doctor commented.

*"If they are in file, then you can get them pretty much straightaway. If they are in somebody's office, you have to probably wait longer"* (Doctor 6).

An ED card contained demographic and medical information. On front of the ED card, demographic information, such as the patient's details, age, address, and next of kin was printed. The ED clinicians were supposed to write medical information, such as a medical history, allergies, presenting complaint, clinical observations and examinations, nursing assessment, and medications on the card. At the back of the card, there was a list of investigations, procedures, and treatments with small boxes next to each of them, which should be ticked by doctors. With respect to the importance of the information recorded on an ED card, having access to this source of information was of great importance to the ED staff, particularly when a patient came with a recurring problem, or they were seriously ill, or the ED staff needed to answer queries regarding a patient's previous attendance. In this regard, two participants stated:

*"That [ED card] would be a great advantage particularly to the very seriously ill patients; obviously, you need to know information straightaway to give them treatment"* (Nurse 1).

*"If the notes are lost, again it is a long winded process, starting everything again, going over everything again, because there is a different doctor on a different day"* (Nurse 7).



Usually, administrative staff would be asked to find the previous ED cards and file them when patients were discharged. The ED cards were stored in a filing cabinet and kept for 18 months, as a member of administrative staff noted. Then, cards would be boxed and sent to be microfilmed. Although having access to the ED cards was of great importance to the ED clinicians, sometimes staff faced difficulty in using the cards. One of the doctors criticised the quality of information on the ED cards and said:

*“Usually a bit patchy, if somebody doesn’t write very much at all. It is not always clear why they have brought the patient back, mostly it is ok, and sometimes it is very difficult to read handwriting as well”* (Doctor 11).

Looking for missing cards or misfiled cards was another problem noted by a number of interviewees. It was a time-consuming process and could interrupt departmental workflow. For example, one of the nurses said:

*“I spend a lot of time looking for an ED card that goes missing and they go missing an awful lot, that can have a huge delay on the management of a patient, ..., that is extremely frustrating and it does happen when we are busy, ...”* (Nurse 11).

As noted earlier, the inaccessibility of ED records could cause duplication in terms of documentation and clinical investigations, and more time and resources would be needed to care for patients.

#### *Hospital medical records*

Hospital medical records were also regarded as an important source of information for clinicians and patients. If a patient had been previously admitted to a hospital, it was important to have access to her/his medical records. For instance, as a doctor said:

*“If the patient has been seen over the [name of the hospital], but they get brought here by an ambulance, you may have no idea whatsoever about their previous management, because the notes are over there, and that can be very frustrating”* (Doctor 11).

Usually, administrative staff would be asked to call the Medical Records Department to order the patient’s previous medical notes, according to the interviewees.

However, access to medical records would take longer than access to ED cards. As a doctor noted, out of normal working hours it took about one or two hours but during working hours they could get it within half an hour. Most of the interviewees complained about delays in getting medical records, particularly if they were requested from other hospitals in the city. In addition, the way of handling the notes between hospitals could increase the chance of error or delay. As a doctor said, notes could be handled by a number of people, such as the staff of the medical records department in another hospital, porters, a taxi driver, or the ED staff. This could cause delays in receiving the records on time.

#### *Other types of paper-based records*

In the ED, appointment cards were given to the patients who needed to return to the department for follow up. This card was given to the patient by the doctors or nurses, and then the administrative staff were responsible for making an appointment for the patient and completing the appointment card. The blood form was another type of paper-based record. Although ordering blood tests and viewing blood results would be mainly undertaken online, some other laboratories were not computerised. As a result, clinicians used a blood form to order blood tests. For example, a doctor highlighted:

*“..., haematology and biochemistry are online, but for example immunology is not and when you do any immunology test, you request it by a handwritten form and then you have to phone the lab to get the results, they don't post it online” (Doctor 8).*

To order X-rays, an X-ray card would be used by the clinicians. In fact, while in other departments clinicians were able to request an X-ray test using a computer, this facility was not available in the ED. The main reason for that was incompatibility between information systems in the ED radiology department and the hospital radiology department. Although the radiology department in the ED had been computerised recently, it was only able to support electronic results, but not electronic requests.

Clinical guidelines and protocols were other sources of information and would be available through the internet. However, printed copies of them were accessible in the ED. One of the doctors explained how using these guidelines and protocols could be helpful.

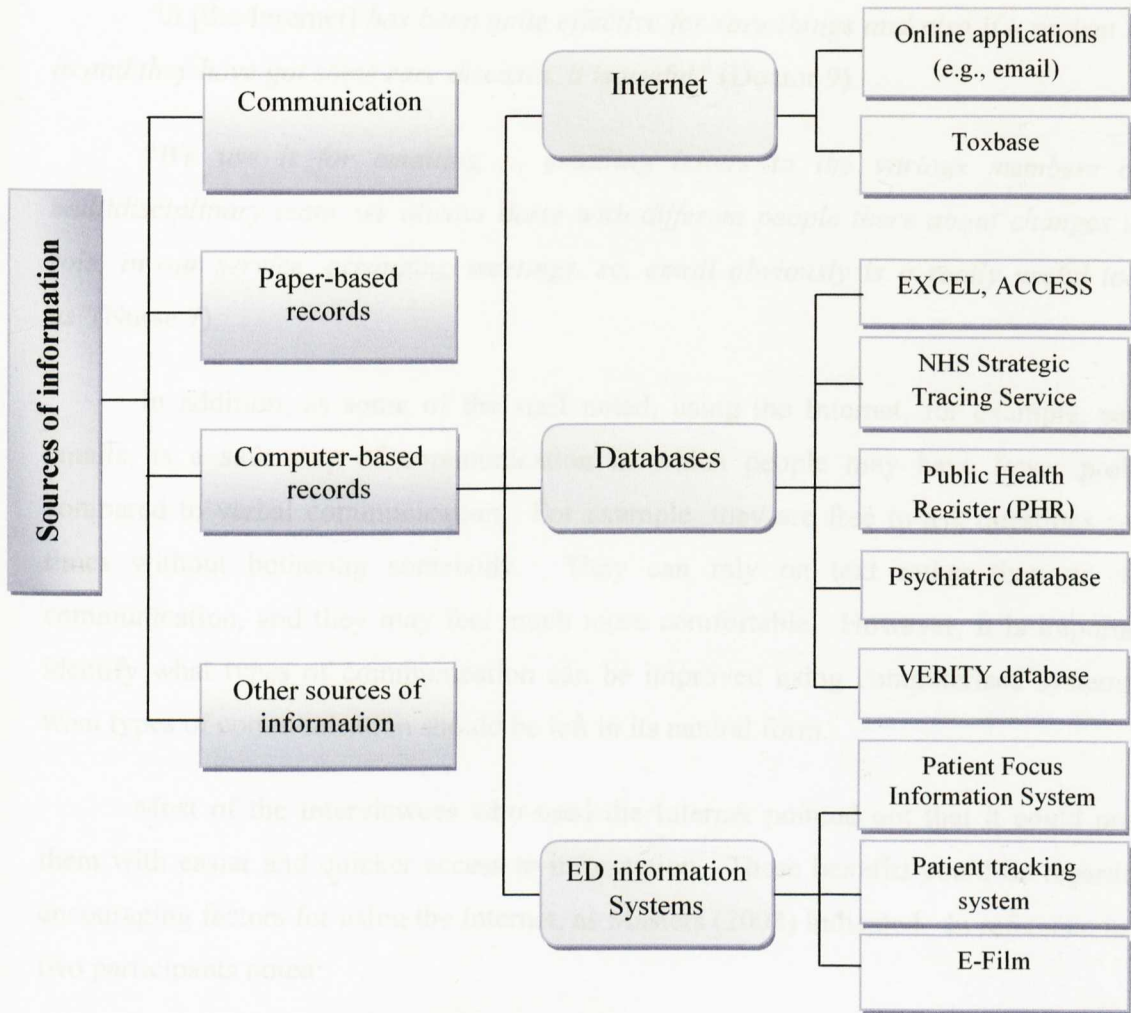
*“If there is a diabetic emergency, the prescription chart is on the back of the protocol, so you’re following the protocol and prescribing things on the same piece of paper, and that is the same for anything like DVTs, or Pulmonary Embolism” (Doctor 5).*

Other paper-based records were letters, such as a GP letter, a letter from a nursing home, and a complaint letter that would be received or sent by the ED. These showed that part of the ED correspondence was related to the outside of the department. It seems that understanding the nature of these work practices may help to design better systems with more functions for the ED. Other paper-based records included textbooks and handwritten notes.

As the results showed, paper-based records were used in a large number of activities by all members of the ED. However, apart from the variety of paper-based records, different types of information documented on these records can give a broader picture of the information needs and the complexity of tasks in the ED. These issues need to be considered, particularly, when designing a new information system to support departmental routine practices (van der Meijden et al., 2003a).

### Computer-based records

Other sources of information in the ED were computer-based records. The ED staff used different computer applications, such as the Internet and some databases, as well as the ED information systems, which were used based on the users’ access levels. Figure 4.4 shows these computer applications. In this section, computer-based records used by the ED staff are discussed in detail. However, the details related to the ED information systems are presented under theme 3.



**Figure 4.4- Computer applications in the ED**

*Internet*

The Internet users had open access to different types of information. For example, general information about new changes and new policies within the hospital were available through the hospital website. However, the main aim of using the Internet in the ED was to obtain medical information and to send emails to the colleagues. As a doctor indicated, access to medical information could help both clinicians and patients in the process of care. Sending messages via email was also regarded as a useful tool for communication, as the following example illustrated.

*“It [the Internet] has been quite effective for rare things and also if a patient comes in and they have got some rare diseases, it is useful” (Doctor 9).*

*“We use it for emailing,..., emailing letters to the various members of the multidisciplinary team, we always liaise with different people there about changes in our role, in our service, arranging meetings, so, email obviously is a really useful tool for us”(Nurse 7).*

In addition, as some of the staff noted, using the Internet, for example, sending emails, is a safe way of communication in which people may have fewer problems compared to verbal communication. For example, they are free to ask questions several times without bothering somebody. They can rely on text rather than on verbal communication, and they may feel much more comfortable. However, it is important to identify what types of communication can be improved using computerised systems and what types of communication should be left in its natural form.

Most of the interviewees who used the Internet pointed out that it could provide them with easier and quicker access to information. These benefits could be regarded as encouraging factors for using the Internet, as Masters (2008) indicated. In reference to this, two participants noted:

*“Sometimes it is a lot easier just to have a look on the internet and clarify something” (Doctor 3).*

*“It is a lot better, because I used to go to the library to do it, but now I can do it on my computer, which is a lot better, it saves a lot of time” (Administrative staff 6).*

However, there were some factors, such as time, workload, and patients’ conditions that might influence using the Internet. The following examples illustrate these issues.

*“Obviously, I don’t use it for every patient that comes into the door” (Doctor 5).*

*“It [the Internet] is not used when somebody is collapsing in front of you, but maybe when you are discussing the option for treatment once they are stable” (Doctor 10).*

Another factor that might influence using the Internet, especially in the ED, was related to difficulty in navigation. Most of the participants indicated that in order to obtain medical information they needed to search for it via search engines or different websites. This approach could be time-consuming. The ED staff preferred to follow specific links to have access to information that they needed rather than spending time on navigation, as the following examples show.

*“If we are looking for basic information, or quick information, we just normally Google it in sort of confined”* (Doctor 3).

*“I think everything is available, it is just knowing where to get the information or how to get it”* (Doctor 6).

According to Masters (2008), the Internet is considered a large and useful library for clinicians. However, it is important to make it easy to use, as accessing too much information can be confusing and time-consuming. The results implied that clinicians, particularly in the ED, should be provided with easier access to information on the Internet while there is no disruption in their daily tasks.

The ED staff also had access to a national poison information service called Toxbase. Using this website, clinicians could have more information about the poisonous substances. In order to use Toxbase, staff needed to have their own password. It appeared that people who did not have access to the Internet could not have access to Toxbase. As a result, other staff, who had a password would be asked to search the information for them or give their own passwords to them. In relation to this, a nurse noted:

*“It doesn’t matter if you get one of the nurses who has got the password to get onto that. Because not everyone has got access to it,...”* (Nurse 6).

As one of the nurses indicated, Toxbase information would be printed and filed in the patient’s notes to support medico-legal issues. This participant thought such a process caused more paperwork and was *“frustrating”*. Generally, the clinicians’ attitudes towards using Toxbase were positive and most of them indicated that they were satisfied with the website and it was useful. For example, a doctor stated:

*“You can’t possibly remember what the effects of every product are. So, we rely on it [Toxbase] quite a lot” (Doctor 4).*

Although there was a telephone number and a clinician could call them to get information, they usually chose Toxbase. One of the nurses believed that getting information via the telephone was *“very time consuming”* and *“there could be a misunderstanding with what information has been given verbally”* (Nurse 11).

When clinicians were asked about the difficulties that they might have experienced using Toxbase, most of them said that the website was fine and they were satisfied with it. However, a doctor noted that it was difficult to search when they had only half of the name of a substance.

### *Databases*

The ED staff were asked about other computer applications that they used. Some of the interviewees stated that they used applications, such as MS EXCEL and MS ACCESS to manage loads of information in a more organised format. For example, a member of the administrative staff stated:

*“I have got a database for locums, I enter all the shifts that we need covering for that particular month, you put the time that is the start of the shift, and the time that is the end of the shift, ...”* (Administrative staff 6).

Some of the ED staff had access to specific databases that were relevant to their jobs. For example, some of the receptionists had access to a database called the NHS Strategic Tracing Service (NSTS). This was a national database in which information about GPs in England and patients who were registered with them was provided. If a patient was registered with a GP and did not have the GP’s details, the patient’s details such as name, date of birth, and address would be used to find his/her GP through the NSTS.

Another database, which was used during patient registration, was the Public Health Register (PHR). If a patient had been registered with a GP, just by entering the patient’s demographic details in the PFIS, the main hospital information system, an option would appear to get the rest of the information about the patient from PHR, for example, about his/her GP. However, the information was limited to the GPs in the city and this was the

main difference between PHR and NSTS, which covered all GPs and their patients in England. Most of the receptionists agreed that using PHR made their jobs easier, as it could save time to find a patient's GP. In addition, they could use PHR to update the information about a patient, as it was linked to the GPs' system. In this regard, a member of administrative staff noted:

*"We can go to PHR and more often it is quite up-to-date. The patient might not attend in 3-4 years and might be divorced in the meantime, so you can go onto PHR, it is quite a good back up, ..."* (Administrative staff 10).

Another database used in the ED was a 'psychiatric database'. Access to this database was restricted and only authorised staff who dealt with psychiatric patients were able to use it. The database could be regarded as an electronic record system that contained information about the psychiatric clinics that a patient attended, the clinicians who had visited her/him, the copies of the clinical assessments, and the letters to doctors. After visiting a patient in the ED, information regarding the patient's attendance and treatment would be given to a secretary to be entered into the system.

The other database used by a limited number of nursing staff was a 'VERITY database'. It was a national database to register patients with DVT (Deep Vein Thrombosis). Part of the information was related to the patient's demographic information and part of that was related to their clinical information. Although using VERITY database was easy, and mainly relevant boxes needed to be ticked, sometimes users experienced some problems with the database. For example, one of the nurses said *"it does restrict you sometimes, you can't type something a bit unusual in"* (Nurse 2). Another nurse noted:

*"It [entering data] takes ages, ... if you put the [name of a] GP, and it doesn't know it, then you can't put the GP in. The other day I had a patient with a really big blood result and it wouldn't let me put it in, because it just wouldn't recognise the number"* (Nurse 7).

The above comments suggested that when designing a website, e.g., for clinical purposes, it is important to investigate users' views to improve it.



### *ED information systems*

As Figure 4.3 showed, in addition to the mentioned databases, ED staff used specific computerised information systems. These systems were Patient Focus Information System (PFIS), patient tracking system, and E-film, and are discussed in detail under theme 3.

### Other sources of information

Apart from different sources of information discussed above, some of the doctors used specific devices, such as a tape-recorder to record what they wanted to be typed by their secretaries. This method was usually used for preparing letters and statements. Another source of information, which was often used by clinicians, was a whiteboard in the main part of the ED. The whiteboard showed the map of the department and could help clinicians to find the exact location of a patient. The names of the patient and the person who was looking after the patient were written on a small magnetic strip stuck on the specific part of the whiteboard to show the patient's room. The white board was located opposite to the patient tracking system screen. The difference between information on the whiteboard and information on the patient tracking system was explained by a doctor:

*“The tracking system is only telling about the minors [unit], majors [unit], or resuscitation [unit], but we don't know where exactly in majors [unit], because it consisted of different cubicles, so nearly 20-24 cubicles are there. That white board; the nursing staff will write down the name of the patient on the small card and they will stick it there. If the patient is in room 14 of majors [unit], it will be stuck to 14, so that is mainly to find out where the patient is” (Doctor 7).*

The whiteboard was also compared with the patient tracking system in terms of its advantages and disadvantages. In relation to this, some participants commented:

*“It [whiteboard] is also useful, if the system [patient tracking system] goes down, we still have something there to see who in the department is, in that particular area, ..., so it actually facilitates communication amongst staff about patients” (Nurse 11).*

*“The patient tracking system can get information from allied today, whereas if you see the whiteboard, you just rub of it at the end of the shift. So, it is not a permanent record” (Doctor 4).*

The results showed that the ED staff used various sources of information to meet their information needs. Similarly, Reddy and Spence (2006) and Currie et al. (2003) found that different sources of information were used in the clinical settings, such as the ED. However, both studies focused on three main sources of information, computer, human, and paper. Among them communication was the first and the most frequently used source of information. Therefore, when designing an information system for the ED, not only the information needs of the staff, but also the current sources of information and the importance of each of them should be taken into account. Moreover, work practices should be assessed and complex processes should be revised to facilitate system design and implementation (Taylor, 2004).

### **Theme 3- Emergency Department Information Systems and related issues**

As mentioned in the previous section, as well as using the Internet and specific databases, the ED staff used particular information systems in the ED. Three information systems were patient focus information system (PFIS), a patient tracking system, and E-film. However, the access level was different for different user groups. In this section, users' access levels and the information systems that they used in the ED are discussed in detail.

#### ***Sub theme 3a-Access level***

When the interviewees were asked to talk about different information systems that they used in the ED, it was revealed that apart from the patient tracking system, access to the PFIS functions and E-film was role-based. For instance, one of the administrative staff said *“on the secretarial job, PFI is just for checking patients”* (Administrative staff 6). Similarly, two nurses noted:

*“The nurses can use the tracking; they are not trained on PFI. Because there is no reason for them to use the PFI...”* (Nurse 13).

*“..., everybody should be able to do it [PFIS] has a relevancy for it” (Nurse 4).*

As a doctor indicated, the ED clinicians had also a limited access to the patient information stored on the PFIS or different databases across the hospital. This participant, for example, indicated *“I don’t have the ability to look up on the wards” (Doctor 9).*

Another doctor stated:

*“..., the renal department for example, they have a standalone database that if you are not a renal department doctor, you can’t access, so if you want the results of their blood tests and other records for the renal patients, you have to get a renal doctor to log on with their passwords” (Doctor 8).*

In order to make better use of information and to save time, some interviewees wished to have access to other functions of the PFIS. One of the nurses stated:

*“..., just click on and do it instead of having to wait for the receptionist to be free to help you to find things, it just causes delay sometimes, if they are really really busy” (Nurse 7).*

The limited access to the system functions in ED caused people, who did not have access to the system functions, to ask other authorised staff to search for them and find the information that they needed. Usually, the administrative staff were responsible for finding the information that was requested. Not only the limited access to the system functions, but also forgetting a password could be a reason for asking other authorised staff to log in. This, in turn, could put the security of passwords at risk.

*“My only problem is I forget my log in, my password and everything, so I have to get somebody else to get me in there, because it is not something that I do very often” (Doctor 11).*

As a doctor indicated, forgetting the password might cause other problems for the user.

*“..., I forget and once you put the wrong password in twice, then it just log you out, and then you have to apply for a new one, ...” (Doctor 11).*

According to the participants, the PFIS password was different from other passwords that they had and it had to be changed monthly. However, users were not allowed to choose passwords that they had used before and always had to choose a new password. This could be one of the reasons for forgetting passwords. In addition, the ED staff who used computerised information systems had to memorise different passwords, for example, *“one for PFI, one for logging on the computer, and one for the email system as well”* (Doctor 9). It seemed that integrating information systems, so that the ED staff only required one password, could help to overcome some of the password-related issues.

According to some participants, the ED clinicians sometimes preferred to ask other staff to log into the system rather than to ask the IT staff to help them with their passwords. The inadequacy of computers in the ED and the departmental workload could be other reasons for asking other staff to search for information in the PFIS, or to enter data into the patient tracking system.

*“I don’t think it is because they [clinicians] don’t want to do it, I think it is because they can’t, it [computer] is not available for them to do. So, they ask us to do it, because we have a computer”* (Administrative staff 2).

*“It depends how busy they [clinicians] are, if they are very busy, I’ll just do it for them,…”* (Administrative staff 3).

Although the characteristics of the ED may necessitate information being accessible for treating patients, this, in turn, may raise new concerns about the confidentiality of data (Likourezos et al., 2004). The issue of confidentiality needs to be addressed using technical and non-technical approaches. For example, automatic log-outs and regular changes of passwords can help to prevent information from being viewed and abused by unauthorised people (Bourke and Wessely, 2008). However, sharing passwords can make tracing unauthorised access difficult (Foley, 2006). There is also a possibility that authorised users misuse their positions, which can create a serious threat to the confidentiality of information. Therefore, controlling access to the identifiable information has been suggested (Kelly, 1998).

### ***Sub theme 3b- Computerised information systems in the ED***

In this section, the information systems used in the ED are discussed in detail. As noted in section 4.2.2, these systems were patient focus information system (PFIS), a patient tracking system, and E-film.

#### **Patient Focus Information System (PFIS)**

In this section, different aspects of PFIS including functions, the ease of use and the usefulness of the system, problems, and suggestions for improving the system are discussed.

##### ***System functions***

As noted earlier, a main function of the system was patient registration. There was a facility on the system that helped the administrative staff to search patient information. This information was related to the previous patient attendances at the ED or the hospital and if a patient had attended previously, the system showed, for example, *“when it was, what was wrong with them, whether they have been discharged, whether they have been admitted, did they have X-rays”* (Nurse 7).

Another function of the system was producing a GP letter. When patient information was entered into the system, it could be automatically transferred to a standard format to be printed as a GP letter, as a member of administrative staff indicated. These letters would be sent by post to the GPs. The ED clinicians were able to order blood tests via the system. When the sample was received by the laboratory, the user of the system would receive a message indicating that the *“sample has been accepted”*, as a nurse said. In addition, there was a facility to re-order or cancel the blood tests. However, if the clinicians needed to give any further information regarding the sample, they had to contact the laboratory or handwrite it. For example, one of the nurses noted:

*“I did have one yesterday, ..., the amount of blood was really small that we had to put it in the paediatric little bottle, and so we had to handwrite on the bottle, because the sticker was too big...”* (Nurse 7).

Another function of the system was viewing the blood tests results. This was mainly related to the current and previous blood tests. In order to view blood results, a patient's hospital number or the patient's surname and forename were the key items. The system had no alert to inform the clinicians when the results were ready. Therefore, after about one hour they had to log on and keep checking to know whether the results were ready or not. The following example shows this issue.

*"..., it doesn't say the results are available, you have to get out and it is taking you 2-3 minutes each time to get to that point to say "ok, the results are online" while you are checking in every half an hour"* (Doctor 10).

This process could be time-consuming and could be regarded as an extra job for the clinicians. Before installing the new hospital radiology information system, the X-ray reports were also available on the PFIS. However, this facility was no longer available, as the new system was not compatible with the PFIS. As the results showed, the system functions were limited and before implementing new systems, the issue of compatibility with the current system needed to be taken into account.

#### *Perceived ease of use*

In general, the participants agreed that the PFIS was easy to use. Some of the interviewees mentioned that the system was *"understandable"* (Doctor 4) and *"straightforward"* (Doctor 6). The ED nurses had similar point of view. One of the nurses said *"I found it easy, so it is a lot better than writing"* (Nurse 13). Another interviewee stated:

*"I am not a very computer literate person, so there is a very simple procedure to type in and request blood results"* (Nurse 2).

Similarly, the administrative staff acknowledged the ease of use and user-friendliness of the system. For example, a member of administrative staff described the ease of use of the system in terms of the availability of the 'help button'. This button could be used to see a list of information that should be entered as a number or an abbreviation.

*“..., we deal a lot with numbers as well, if you are not quite sure what number is that you need to put in, you can go into your superb help screen and it will list you everything there and you just pick the number,...”* (Administrative staff 10).

As the system was easy to use, it facilitated users' tasks rather than interrupting their workflow.

#### *Perceived usefulness*

From the clinicians' points of view, the PFIS was a useful system, since they could order blood tests electronically and the system provided them with a brief summary about patients. Some of the clinicians suggested that ordering blood tests via a computer was quicker than writing. In reference to this, two doctors noted:

*“..., it will overcome our hassles like telephoning the people and getting all of the information from them. Then the other thing is the time management, because it is not taking much time,...”* (Doctor 7).

*“The fact it keeps the information that you put in about a particular attendance, so you don't have to keep typing the clinical information each time”* (Doctor 9).

According to a nurse, the chances of error could be reduced using the system, since information was not transferred verbally and the risk of misinterpretation was limited. For the administrative staff, the system was useful, as they did not need to type all of the information into the system. For example, some of the information appeared on the screen just by selecting a number, as a member of the administrative staff said.

*“..., for instance, if they [patients] are coming by themselves, when we are booking them on the system, we will just press number 1, so that will come up with itself,..., so it is a lot easier than writing it up”* (Administrative staff 7).

The perceived usefulness of a system is an encouraging factor that can improve the uptake of the system.

### *Technical issues*

In addition to the positive aspects of the PFIS, the participants talked about the technical issues of the system. These issues were related to the speed of the system, the system content, systems integration, interface design, navigation, and the system downtime. Some of the clinicians indicated that the system was “*slow*” and sometimes there was a delay between uploading the blood results by the laboratory and the availability of the results on the ED computer screens. As Rose et al. (2005) indicated, the speed of a system has been identified as a main determinant of user satisfaction with information systems in the healthcare environment. Therefore, a slow system might negatively affect user satisfaction with the system.

In terms of the system content, a number of clinicians indicated that it was limited. For example, they wished to have access to a patient’s previous medical records via a computer. Another issue mentioned by a number of interviewees was related to systems integration in the ED. They thought that systems integration could increase their efficiency and effectiveness. As a nurse noted:

*“They [computerised functions] need to be one on the same [system]; we need a single system. We log on to things that stand in isolation and don’t talk to each other”* (Nurse 4).

In terms of the interface design, while some participants thought that the system was easy to use, others described the PFIS as “*cumbersome*” (Doctor 11), “*complicated*” (Nurse 3), and “*confusing*” (Administrative staff 5). In fact, the PFIS was a “*DOS-based*” system and data should be entered into the system using a keyboard rather than using a mouse. As a nurse stated, a user should learn how to use different functional keys on the keyboard and different menus on the system. A doctor indicated that learning such a system for the junior doctors who used to use window-based systems seemed to be difficult and they needed to spend time to learn it. Moreover, some interviewees indicated that if they did not use some of the functions of the system for a while, it was difficult for them to use these functions again, as they could not remember which steps should be taken to complete a task. For example, a nurse remarked:



*“I still can’t remember now how to request or re-order stickers. If they are not printed off or you have lost them or something, you want to go back in, that is quite difficult, I can’t do it. I’ll ask someone else to come and show me” (Nurse 7).*

Some of the administrative staff described the booking function of the system as a “*time-consuming*” (Administrative staff 2) and “*very long winded*” (Administrative staff 4) process. This was mainly due to the interface design that required a user to use two to three screens to book a patient. In this regard, a member of the administrative staff stated:

*“..., we have a lot of screens that we don’t use and a lot of fields on there that we don’t use, we just have to skip by them, we just pass them,...” (Administrative staff 2).*

Moreover, sometimes the ED staff had difficulties with navigation through the PFIS. The system was usually able to recognise words based on its default information. However, the ED staff liked to have a system that could use different key words to navigate the right one. In relation to this, a nurse gave an example:

*“..., I was trying for all of the abbreviations for Lipid and something like, Li, Lip, and it was saying, no, it doesn’t know any of these, when it turned out, we found that we had to put “Chol” for Cholesterol” (Nurse 7).*

For the administrative staff, it could be helpful if the system could identify a patient’s address just by entering the postcode. As this facility had not been considered in the system, the receptionists had to type the patient’s address into the system. However, as a member of the administrative staff mentioned, the system was not able to match some of the addresses with related postcodes. For example, new accommodations in the city, especially student accommodations, would have some details, such as the room and block number which made the address longer than usual. In this case, the system was not able to recognise it or match it with a postcode. The process of putting a recognisable address into the system would take time and could keep some of the patients waiting for being booked in the ED. Similarly, in terms of entering a patient’s details, an interviewee noted:

*“..., if you have got spelling slightly wrong or the date of birth is slightly wrong, it wouldn’t bring the patient up,...” (Administrative staff 8).*

The system downtime was another problem of the system highlighted by most of the interviewees. Although the ED staff usually received prior notice about the time and duration of system downtime, their work could be still interrupted, as they did not have access to information that they needed. An interviewee indicated:

*“... , when the system goes down, obviously, we can't get access to old ED cards that all kept on the computer, we can't access the notes so quickly, and there is just no way to find that patient has been to us” (Nurse 13).*

Similarly, a member of the administrative staff indicated that when the system went down, they had to use the manual system and when the computer started working, they had to enter all of the information into the system. This was time-consuming and considered an extra job for the administrative staff. Another problem of the system was related to the use of the system by multiple users to update information about a particular patient at the same time. In this case, if somebody was using online patient's records from another area of the hospital, the ED staff could not get access to the patient's information. Therefore, in order to reduce waiting time, they had to phone different areas, such as admission, medical records department, ED reception, and the radiology department to know who was using the system. As one of the nurses stated, it was a time-consuming process and *“sometimes it could take 20 minutes”* (Nurse 13).

Overall, the results showed that although the PFIS had been recognised as an easy to use and useful system by a number of ED staff, it did not mean that all of the users were completely satisfied with the system. As noted above, there were a number of technical issues that should be taken into account for a better system design in the future.

#### *Non-technical issues*

The main non-technical issues discussed by the participants were related to the quality of information and the confidentiality of information on the PFIS. The quality of information, mainly in terms of the accuracy was highlighted by the interviewees. They said that the information on the PFIS was not always accurate. This might happen mainly due to human error or other reasons. From the clinicians' point of view, for example, human error could happen during ordering blood tests, as a doctor described:

*“... , the only time that I can see a problem with that [ordering a blood test] is if you label it wrong at the beginning, if you put the wrong number of a patient, then that blood results would be attributed to another patient” (Doctor 8).*

In addition, taking the blood from a wrong patient and failing to identify a patient correctly could be other types of human error which might cause producing inaccurate test results for a patient.

*“... , when you are rushing, you could quite easily request the blood for the wrong person, or check the results for the wrong person, if you are not constantly checking, wrong stickers can get pull off, if you mix them up or anything like that” (Nurse 7).*

Human error during patient registration was mainly related to booking a patient as a new patient while s/he had previously attended the ED or the hospital. This was called “*double-registration*”, and happened when patient information was entered incorrectly and as a result, the patient was registered as a new one (Administrative staff 4). This type of mistake could be identified by the PFIS technicians and one of the receptionists was responsible for checking the patients’ details and making corrections. In addition, sometimes a patient could be registered as another patient with the same name and surname, if the rest of her/his details were not checked on the system. Other reasons for human error could be the speed of work, language problems, drink or drug problems, or the patient might be too ill to give correct information. A member of administrative staff noted:

*“We are rushing, 80% of that time we are rushing to those patients booked in and that is where the mistakes are” (Administrative staff 2).*

Other reasons for the inaccuracy of information on the system could be related to the laboratory systems, which were used to analyse blood samples, or problems with a blood sample itself, such as being haemolysed, as a doctor explained.

*“Sometimes the blood sample we send might be haemolysed; in that case, we might get some abnormal results, like abnormal positive results” (Doctor 7).*

*“The machine [laboratory system], it was far too sensitive and just very positive results were coming out, and at the end we stopped using that machine, because we’re getting so many positive results” (Nurse 10).*

The confidentiality of information on the PFIS was also important for the users. One of the nurses was concerned about providing all of the clinicians with an open access to patients’ information. She suggested that the use of the system should be monitored. For example, the system should be able to identify the last person who looked at the patient’s details. In addition, the information should be available to those members of staff who were involved in caring for a particular patient rather than to all clinicians.

### *Improvement*

When the interviewees were asked how it was possible to improve the PFIS, some of them explained that they just used the system and they did not spend time thinking about it. This might be due to not being involved in the process of system implementation in the department or their limited experience of using similar systems. It seemed that the participants, who were more experienced in using similar systems in other EDs and other clinical information systems, were more positive about improving the PFIS. For example, a doctor suggested *“it might be nice to send GP letters straightaway from computers”* (Doctor 5).

Other suggestions made by the participants were related to the systems integration, designing a window-based interface, and adding a more complete summary of a patient’s medical records to the system content. One doctor wished to have a system that could inform the clinicians about the current status of the blood and X-ray tests automatically. For the administrative staff, improving the interface design was of great importance. For example, it would be better, if the system was able to search a patient’s address using their postcodes. Another participant wished to work with a simpler interface design. As she said, working with the current interface was time-consuming and they were looking for more facilities, such as ‘spell check’ on the interface.

### Patient tracking system

Another system installed in the ED was the patient tracking system. The main purpose of installing the patient tracking system was to monitor the time that patients spent in the ED. However, according to the NHS four-hour target (discussed in Chapter 2), this time should not be more than four hours from arrival to being discharged, transferred, or admitted. The target was set by the Department of Health to reduce waiting times and to give care to patients more quickly (Hughes, 2006).

However, patient care might sometimes take longer than four hours. This might happen for a clinical reason. If there was not a clinical reason, patient flow champions would investigate the reason for delay to *“get people through the system quickly and efficiently”* (Administrative staff 1). As one of the nurses explained, the patient flow champions were responsible for monitoring the four-hour target, making sure that patients did not breach the target, and beds were ready on the wards. In the next section, system content, perceived ease of use and perceived usefulness of the system as well as technical and non-technical issues are presented.

### *System content*

The information on the patient tracking system included the ED number, the hospital number, the time that a patient attended the ED, and the unit of the ED in which they were treated. This type of information would be entered into the tracking system by the administrative staff to inform the clinicians that there was a new patient in the department. The ED clinicians were then responsible for entering data, such as the time that they visited the patient, the time that they referred the patient to a specialist, and the time that the patient was discharged, transferred, or admitted. In addition, any comment regarding a patient, such as booking an ambulance, requesting medical notes or the reason for a delay in the process of care could be entered into the system as a free text. In reference to this, one of the nurses stated:

*“... if you put the cursor over the patient’s name, then it comes up with a different screen that allows you to enter free text in there, you know, any comments you want to put in”* (Nurse 2).

The programme was available on all PCs in the department, and to make tracking patients easier, all information was displayed on a big plasma screen in the main part of the department. This system could be updated by the clinical and administrative staff themselves rather than automatically. According to one of the participants, five different colours were used in the tracking system to show the latest status of a patient in the department. These colours were as follows.

*“..., white if they have just arrived, yellow if they have been in the department for 2 hours, green is 3 hours and then it goes red when they are about 15 minutes before they breach the target, and then pink when they breach the target basically” (Nurse 3).*

The use of different colours in the patient tracking system made it easy to use, as noted by the participants, and is discussed in the next section.

#### *Perceived ease of use*

Most of the interviewees agreed that the patient tracking system was easy to use, as they just needed to *“click on that with a mouse”* (Doctor 3) and *“it automatically pressed the time in”* (Doctor 4). One of the nurses indicated *“it is a good visual aid”* (Nurse 2), as information was available on a big plasma screen and waiting time could be tracked using different colours on the screen. Another nurse indicated:

*“..., it is really good, because you can see the colour changes as they get near up to the pink, which is the breach colour, so for example, light red, I think they have got something like, 10-15 minutes to breach” (Nurse 6).*

None of the interviewees had received training in the use of the patient tracking system, as the system was considered easy to use and *“self-explanatory”* (Nurse 7). Similarly, the administrative staff described the system as *“very user-friendly and very clear to read”* (Administrative staff 2) and *“interactive”* (Administrative staff 3).

#### *Perceived usefulness*

The interviewees talked about the usefulness of the patient tracking system in terms of facilitating their work, clinical implications, managerial implications, and using data in research. The results showed that nurses and administrative staff perceived that using the

patient tracking system could facilitate their jobs. For example, a nurse compared using the patient tracking system with the old method of tracking patients in the ED and said:

*“Ten years ago, we had a clipboard with lots of pieces of paper on it, for who was who, and where they were in the department, and it was a nightmare, you couldn’t track where patients were”* (Nurse 11).

The administrative staff were also advocates of the patient tracking system. They could use the patient tracking system as a backup for some information that they had on the PFIS. In addition, using this system could keep the ED staff up-to-date about the latest procedures carried out on a patient, as they could enter a note into the system and it was available to all members of staff. For example, a member of the administrative staff noted:

*“..., if the nurses have to change their shifts and if somebody says “can I have an ambulance for this person”, if you click on that person you can see that ambulance was booked at such a time, so everything goes on tracking”* (Administrative staff 9).

Some of the interviewees indicated that the system could be useful for both clinical and managerial tasks. In terms of clinical tasks, some interviewees indicated that the patient tracking system could help them to know *“which patient needs to be treated and where they are”* (Doctor 2). In addition, the ED clinicians could be aware of a patient’s status, for example, whether the patient had been visited by a doctor, or whether they had already been treated. This could be useful for patients, as none of them were left in the middle of the care.

*“It [the tracking system] raises the profile of who has been here for how long or you can get suspicious of what is happening and you go and question what is happening, so it is good that patients aren’t kept in the department for hours”* (Nurse 11).

Moreover, if a patient needed to be admitted, s/he could be identified on the system and *“they could get to a ward more quickly”*, as a nurse said. Some participants believed that the patient tracking system did not improve the quality of patient care, as the system had been installed to meet the four-hour target and the target focused on time. For example, one of the nurses indicated:

*"I don't think it improves the quality of care, because it does monitor how we input patients through the department. So, it tracks the patients, that is it"* (Nurse 4).

Although some of the interviewees mentioned that the patient tracking system was useful for clinical tasks, this system was mainly perceived as *"an administrative tool"* in which data were entered retrospectively (Doctor 8). According to the participants, the system could support the clinicians, for example, by providing them with the number of patients in different areas of the ED. This could help those who were responsible for managing the department to distribute the medical staff effectively. One of the doctors explained her opinions about the usefulness of the patient tracking system as follows.

*"I suppose it gives the management of the department help to organise overall of the department and find out where they are held up in the flow of patient,..."* (Doctor 5).

Similarly, other clinicians indicated that the patient tracking system could be useful for *"monitoring performance"* (Doctor 11), *"managing workload"* (Nurse 1), and *"monitoring the patient's journey throughout the department"* (Nurse 11).

As noted by one of the administrative staff, the information stored on the patient tracking system could be used for improving the departmental services in the future. However, in order to conduct an audit having access to the complete data was needed.

#### *Technical issues*

Although the patient tracking system was easy to use and useful, there were still technical issues to be taken into account. For example, in terms of the interface design, some clinicians perceived that it was *"confusing"* and the screen was *"busy"* (Doctor 2). According to a doctor:

*"It has just too many columns, too many bits of figures, it is very confusing. Too complicated, too much information,..."* (Doctor 1).

This is consistent with the results of a study conducted by Rose et al. (2005: 55). According to the results of their study, physicians complained that too much information on a screen would make it "too busy".



As noted earlier, the tracking system was not integrated to the PFIS. Therefore, patients' information and the time of arrival, discharge, transfer, or admission had to be entered onto both systems separately. This could cause duplication, as one of the nurses commented. Moreover, if the receptionists forgot to enter the patients' information into the patient tracking system, nobody knew that the patient was waiting to be treated. Therefore, the ED staff preferred to have a system that was able to track patients automatically. For instance, one of the doctors indicated:

*"It [the patient tracking system] is one of the systems that relies entirely on the data that is put into it. There is no automation over it at all, so, it purely relies on people to put the data in themselves, and it could be a real problem"* (Doctor 9).

According to Taylor (2004), a new system should not be designed to automate poorly designed manual processes. Taylor (2004: 255) indicated "an ED tracking system that requires staff to manually relocate patients on the system is an example for this design". This task probably is completed only when the ED workload is low, but not when the department is busy. Therefore, in a high workload department, such as an ED, the use of automated systems may operate better.

Some clinicians highlighted that the system content was limited and could not provide them with the information that they needed. For example, a doctor noted:

*"It is very much about the time and the location and the future location of the patient, but no other information really on that"* (Doctor 10).

Similarly, as a nurse remarked, if the patient was sent to the radiology department, the system had no option to show that, and still showed that the patient was cared in the previous area, such as the majors unit. Although the patient tracking system had been designed to monitor waiting time, it could be more efficient, if it was designed based on users' information needs and the departmental workflow. For example, as noted under theme 2, sub theme 2c, rather than using a whiteboard to find the exact location of a patient, another item, such as the room number, could be added to the interface of the tracking system.

System downtime was another problem that might be experienced by the users. This might happen suddenly and without notice. According to a nurse, *“once every ten days to two weeks”* the ED staff might have a problem with the system downtime. In this case, as a member of the administrative staff said, the ED staff had to use the whiteboard or track patients by keeping notes.

### *Non-technical issues*

From the users' point of view, the main non-technical problem with the system was related to *“the human aspects”* and the limited use of the system by the clinicians. As mentioned before, some ED staff perceived the tracking system as *“an administrative tool as opposed to a useful tool for the patient care”* (Doctor 8). In their opinion, the tracking system offered no clear clinical benefit, since it mostly dealt with recording the time of different phases of care process. This could be a reason for the limited use of the system by the clinicians, particularly when the department was busy, as a doctor highlighted.

*“..., if I am busy, I'm likely not to enter the details onto the patient tracking, because that is the least useful to the clinical care of the patient”* (Doctor 8).

Similarly, one of the nurses highlighted:

*“We are really on time pressure in the ED, they [clinicians] often have several patients that they are seeing at the same time, and some people don't see that [patient tracking system] as a part of a complete care package”* (Nurse 11).

Another reason for non-use or the limited use of the tracking system could be related to a shortage of PCs, according to most of the interviewees. One of the administrative staff mentioned that the ED computers were mostly used for viewing the blood results, ordering the blood tests, and other investigations. Therefore, the ED clinicians had to wait for their turn to update the tracking system. This is consistent with the results of the studies conducted by Laerum et al. (2001) and van der Meijden et al. (2003a). In these studies, the researchers found that a shortage of PCs, and insufficient powerful PCs were the important reasons for not using, or the low level use of, a system by clinicians. However, the limited and insufficient use of the system could cause an interruption in workflow, as a doctor commented:

*"..., the tracking system relies on people to remove them [patients] once you have finished seeing them and sent them out, if that doesn't happen, then often people are running around saying where is this patient. So, that can be a real problem"* (Doctor 9).

The location of the computers and the confidentiality of information were other issues discussed by the interviewees. Some of the participants wished to have access to more computers at better locations, for example, having one next to the place where they picked up a patient's case note. In terms of the confidentiality of information, as the information stored on the tracking system was displayed on a big plasma screen in the main part of the department, some interviewees expressed their concerns. Although the information on the system was restricted, patients' names were displayed on the screen. Therefore, as a nurse said, *"if a woman that has just been abused come in, or from her husband has been beaten up, you can see their names are in this team, you can easily find them"* (Nurse 13).

Similarly, another nurse mentioned *"it is very visual to people who are non-staff, so for example, visitors and relatives can quite easily see the information that is on the system"* (Nurse 11).

The ED staff expected more attention to be paid to the confidentiality of information on this system.

### *Improvement*

From the users' perspectives, not only the system itself should be improved, but also adequate attention should be paid to the use of the system. To improve the interface design, the use of symbols and abbreviations, instead of full text, was suggested by a doctor. Systems integration was another suggestion made by most of the interviewees, and they expected to see the patient tracking as part of a more sophisticated system, such as an Electronic Patient Record (EPR) system. In particular, users thought that integrating the PFIS and the patient tracking system could help to avoid duplication, mainly for the administrative staff. According to most of the clinicians, the patient tracking system could be more efficient if it could track all procedures, such as ordering blood tests and X-rays automatically. Similarly, they wished that the system could have informed them when the blood and X-ray results were ready. According to a nurse, the exact location of the patient

in the department should be shown by the system. If this was provided, the clinicians did not need to use the whiteboard in the ED.

In order to make sure that the system was used properly by the clinicians, a doctor commented "*they should encourage all of the doctors and nursing staff to use that tracking system*" (Doctor 7). Similarly, one of the nurses thought that continuous education on the use of the system, and informing users about the importance of entering data into the system could encourage the ED staff to use it. Providing the ED staff with more computers and using the collected data, for example for audit purposes, were other suggestions made by some interviewees.

Overall, the results showed that the use of the patient tracking system was limited in the ED, although users did not need a password and the system was easy to use. The clinicians were aware of the benefits of the system; however, the system was mainly regarded as an administrative system. It seems that a system which has no direct benefit for users or the users are not aware of its benefits is less acceptable than a system which provides the users with direct benefits. Moreover, training in the usefulness of the system and motivating staff to put data into the system are essential to improve the use of the system.

### E-film

E-film was a new radiology information system that had been recently installed in the ED radiology department. When this research was conducted, this system had been implemented in the ED for about "*three weeks*" (Nurse 4). E-film was similar to PACS (discussed in Chapter 2) whereby the X-ray images could be viewed digitally. However, this system was standalone, and it was not linked to the main hospital radiology information system. Therefore, only the X-ray images requested by the ED clinicians were available on the system. The main users of this system were the ED radiographers and the ED clinicians who were qualified in interpreting X-ray images.

When the interviewees were asked to talk about this system, a majority of the participants only knew that such a system existed in the ED radiology department, and

some of them thought it had not yet gone live. A number of interviewees, who had experience of using similar systems, called it 'PACS'. Although this system had been implemented for about three weeks and X-ray images were available digitally, the X-ray films were still being printed. According to a doctor, this was part of the implementation and ultimately, no X-ray film would be printed in the department. Most of the clinicians indicated that they had not yet used the system, as they were not qualified in interpreting X-ray images, they thought that the system was not live, or they had not been trained in the use of the system. For example, two interviewees stated:

*"I think some of the registrars haven't had the training... because it is a voluntary thing, I think lots of people haven't bothered"* (Doctor 11).

*"It is still not sorted out, still not people being trained for it. Till everybody is trained, they are not introducing it"* (Nurse 13).

However, as noted earlier, and one of the nurses indicated, the system was live.

*"Yesterday, I had a gentleman and he had a CT-scan done, as soon as he had that CT-scan done, I could view that through PACS, I could just put his hospital number in and I could view his scan on PACS"* (Nurse 4).

In terms of training in the use of the system, one of the doctors mentioned that the junior doctors' turnover was high in the department, as the hospital was a teaching hospital. She thought that although training might take only about 10 to 15 minutes, it seemed to be difficult to train all of the doctors. From her point of view, another problem was related to the accessibility of the X-ray films. This gave doctors a choice to choose either using E-film or viewing the X-ray films in a traditional way.

The training course was provided by *"a couple of senior radiographers"* in the main ED radiology department (Nurse 11). In fact, some of radiographers had their own training, and they had to train the qualified ED clinicians in the use of E-film. According to a nurse, some of the reasons for a delay in training might be related to the following factors.

*"...to receive the training, you have to be working on this side, a lot of the nurse practitioners work both here and in [the name of another hospital], also it is a matter of the*

*correct radiographer be in here and having the time to educate them in how it is used,...*" (Nurse 11).

The interviewees who had experience of using E-film were generally satisfied with the system. One of the nurses noted that the system was *"easy to use"* and *"self-exploratory"* (Nurse 11). In addition, the system could provide the clinicians with an archive of X-ray images. Therefore, they could compare related X-ray images taken at different times. In this regard, one of the nurses commented:

*"In the past, if you wanted old X-rays that had been done before, it could take an hour for them to go and retrieve them, whereas with this system you can just put the patient's name and ID number in, and it gives you the whole range of pictures that they have taken"* (Nurse 5).

Some clinicians talked about other positive aspects of E-film. For example, according to a nurse, the system helped the clinicians to magnify an area to look for an abnormality.

*"If you want to look for a foreign body, for example, you can change the light to dark and dark to light, switch the colours round, which is very useful"* (Nurse 5).

Another advantage of the system was related to the use of the system by multiple users at the same time. One of the nurses expected that in the future, doctors and nurses to be able to view the same X-ray image by using different screens around the department rather than on separate monitors. This could allow them to discuss the results via the telephone while they were in different areas of the department.

Apart from the positive aspects of E-film, those interviewees who had used the system talked about the technical issues of the system. One of the doctors indicated that in order to use the system, *"a high resolution screen"* was needed and it was expensive (Doctor 8). As a limited number of screens had been implemented in the ED, this might cause queuing sometimes. Another doctor expected to view X-ray images on the PCs around the department rather than on a particular screen. In addition, the long start-up time of the system was another problem noted by a doctor.

*“..., it takes probably 3 minutes to turn the machine on and to get it warmed up, and to access the data, the right software, 2-3 minutes maybe which is frustrating”* (Doctor 11).

As van der Meijden et al. (2003a) highlighted the workflow of the ED, particularly when the department is busy, does not allow, for example, waiting for logging on and starting up a system. This may cause non-use or a limited use of the system by staff and they may look for easier ways, such as using the telephone for communication or repeating clinical tests, because of the unavailability of information. One of the nurses indicated that some clinicians did not like the system, because it logged out too quickly and they needed to log in again to look at an X-ray. Another nurse noted that, similar to other information systems, system downtime was an important issue. She added:

*“..., if the system goes down, then you're stuck, so you still then have to have the results through the hard copy at the X-ray”* (Nurse 11).

Some of the interviewees suggested that, in order to make better use of the system, the process of logging in could be improved, more equipment could be provided around the department, and the system could be integrated with other systems in other hospitals.

The main non-technical issue was related to a limited use of the system. According to some participants, the inadequacy of training could be a reason for a limited use of the system. In addition, it seemed that the system was not introduced properly, as a number of interviewees were not aware that the system was in use. In this regard, one of the nurses stated *“If they are reliant upon the clinical staff to ask or go and seek help, they won't”* (Nurse 4).

The results showed that implementing E-film in the ED was an example of implementing a change in the department. The lessons learnt from this process could be used to have a successful system implementation in the future. Bowns et al. (1999) suggested that the process of change can start with awareness, introducing a simple and voluntary form of IT, and then the actual change. However, in this study, it seemed that these three steps were not taken properly. For instance, the ED clinicians were not all fully aware of the current stage of the change. In addition, the use of the system was optional and a limited number of staff liked to try it. It seemed that the change management was not

planned properly, and nobody was responsible for leading the change process. For example, training was provided for whoever was interested and qualified, rather than encouraging the qualified staff to go for training and to use the system.

#### **Theme 4- Training and information technology support**

In the literature, training and IT support have been addressed as organisational factors which may influence the use of information systems (Handy et al., 2001). In this section, training and related issues are discussed and the next section is devoted to the IT support.

##### ***Sub theme 4a- Training courses and related issues***

When the ED staff were asked about their training in the use of the current ED information systems, it was revealed that training provided by the IT staff was mainly related to the hospital-wide information systems, such as the PFIS. As discussed in the previous section, the senior radiographers provided training in the use of E-film for only a limited number of staff who were able to interpret X-ray images. It seemed that there was no training for the patient tracking system as it was considered an easy to use system and one that staff could learn it by themselves. According to the interviewees, most of them had attended PFIS training courses and those who had not had such an opportunity were not authorised to use the system. The content of training courses was based on the functions that a user was authorised to use. For example, a member of the administrative staff indicated:

*“Obviously, it is a specific course related to ED, so, receptionists have to know how to print, how to type all the relevant details, the doctors have got training on how to order bloods and blood investigations, and things like that. So, it is, I suppose it is job specific”* (Administrative staff 4).

Attendance on the training courses was mandatory for those staff who were authorised to use the PFIS. Otherwise, they were not given a password to use the system. As the ED was located in a teaching hospital, every 4 months a new group of doctors including house officers and senior house officers came to the department. This group of



doctors had to be trained to know how to use the system. In this respect, one of the interviewees highlighted:

*“...when new doctors come into the ED, the computer people will come here and ask the people whether anybody never attended the PFI training class. In that case, they will conduct a brief training class”* (Doctor 7).

Training courses usually would take a couple of hours. However, for the administrative staff, particularly receptionists, it would take longer than the training for the rest of the ED staff. It seemed that the receptionists needed to have more training, as they spent more time using a computer in their job, and they would then be able to do different tasks through using the software:

*“We had to go to PFI [when] we first started this job, you have to have a two-week course and know how to use the system”* (Administrative staff 7).

Training was usually offered once somebody started her/his job in the department. For example, one of the administrative staff said *“when I went on [a training course] it was 9 years ago”* (Administrative staff 7).

Most of the interviewees mentioned that training courses were simple and they could learn how to use the system. The method of training depended on the number of trainees and could be a one-to-one session or a group session. At the end of this session, a booklet about how to use the system was given to a trainee to use it when needed.

In terms of the usefulness of computer-training courses, most of the interviewees agreed that attending courses was necessary. Some clinicians and non-clinicians who were computer literate thought that these courses were *“straightforward”*, and they were concerned about people who were not computer literate. However, the ED staff, who felt they were not proficient computer users, found the training courses easy and useful. In relation to this, one of the nurses said:

*“... they are just aiming to allow us to operate our particular needs and, I think they addressed that very adequately”* (Nurse 2).

Among the interviewees, there were a few who thought that attendance at training courses was not useful for them:

*“They tried to train me about five years ago and at the end of our second hour they wouldn’t give me a code name [password], because I couldn’t use the machine”* (Doctor 1).

Some of the interviewees indicated that the training could be more effective, if they could learn how to use the system in their actual work place. For instance, two interviewees indicated:

*“... you need to use and know [the system], and then as long as you come away and use it straight away [it is fine], otherwise I think you very easily forget it in practice”* (Nurse 7).

*“It is always better when you go and do it yourself, you know, you have had your training and then you have got to go along and do it yourself and then you would find how to learn, even more”* (Administrative staff 6).

Although most of the interviewees were satisfied with the computer training courses, they also talked about their concerns and expectations. For example, some clinicians thought that the computer-training courses were not adequate for the ED staff. They were concerned about the staff who did not know how to use a computer, and no training was offered to them. As a doctor said *“they just assume that everyone can use computers”* (Doctor 1).

Some of the interviewees had difficulties attending training courses, as they would need to leave their workplace and get someone else to do their job. In addition, working afternoons or night shifts would make attendance at these courses more difficult as courses were usually held Monday to Friday during working hours. In relation to this, one of the nurses suggested that it would be better to have regular training sessions within the department.

*“..., you should have to do it in your own time, it should be something that you really want to do. If we have said we want all nurses to be PFI trained they are allocating someone and send them [to us] as part of the training”* (Nurse 11).

*“We are always short of staff, then busy, and then we never have time to go on them. Obviously, we just can’t go up, close the reception and go to the course”* (Administrative staff 2).

With respect to the workload in the ED, it seemed that providing the staff with different options of training, such as individual and group training could be useful for learning new systems. According to the participants, not only training in the use of a computer, but also training in the usefulness of the computerised systems was necessary. In their opinion, using this approach could encourage people to use the information systems. A member of the administrative staff suggested that the usefulness of a computer could be demonstrated, for example, by utilising data collected for the audit purposes. The results are consistent with the findings of Rose et al. (2005), who showed that during the training of a system, users should be aware of the impact of the system on their workflow, as well as the benefits of the system. Moreover, ongoing training sessions are suggested as, in a single session, users may have difficulty remembering all details that they have been told.

#### ***Sub theme 4b- Information Technology support***

The interviewees were asked to talk about the IT support that they received in the ED. According to the participants, IT support could be provided both by the IT staff and by colleagues in the department. The IT staff could be contacted if there was any technical problem with the systems, or if a system went down. In the ED, the nurses and the administrative staff were the main people who contacted the IT staff, if there was a problem with the systems, and they were generally satisfied with the IT staff services. The interviewees also indicated that system maintenance or system upgrade was usually undertaken with prior notice; therefore, they could be prepared.

*“We always know what time it is going down, the date, and they usually say it is going to take three hours, four hours. It might not go [down] all that time but it is usually on time as what they say”* (Administrative staff 7).

In terms of the availability of the IT staff, some of the interviewees indicated that, during working hours the IT staff were usually available, whereas out of working hours they were on call and it took time to get their help. One of the nurses described an instance that they had lost an icon on one of their computers in the evening and they could not

retrieve it. As a result, that computer could not be used to order blood tests. Although they contacted the IT staff, they did not receive any help from them.

*“..., we phoned IT. We left the message to call us back but we never had any contact back again from them” (Nurse 11).*

As the ED staff work in different shifts, arrangements are needed to support them with the IT services, particularly during out of hours. The availability of these services can be crucial, especially when there are difficulties with using the systems or retrieving information. As noted earlier, if the ED staff had any difficulty with using computerised systems in the department, they could also receive support from their colleagues who might know more about the systems. In relation to this, a member of the administrative staff commented:

*“I think you get more training from the girls here, because they know what they are doing, ... it is easy for someone to say yes, you use this button or you use that button, but when you are working here it is slightly different. You get your own ways to work...” (Administrative staff 8).*

According to the interviewees, a main concern of the ED staff was related to the availability of computers and workstations. Most of the participants agreed that the current computers in the ED were not adequate for the clinicians, and they had difficulties gaining access to the current systems. One of the nurses said *“we regularly queue for computers”* (Nurse 2). Similarly, a doctor stated:

*“You can’t possibly go paperless here with four terminals, it is just impossible. Twenty doctors on duty and four terminals and nurse practitioners, it is just nonsense- so you need a lot of IT” (Doctor 10).*

The inadequacy of computers could cause delays in workflow, and the ED staff could not use the computers since they were not available. As discussed earlier under theme 3, sub theme 3b, a shortage of computers in the ED was one of the reasons that users seemed to be reluctant to use the patient tracking system, even though the system was easy to use and easy to learn. Therefore, it seems that the availability of facilities and equipment can be as important as other factors. In reference to this, two interviewees indicated:

*“... we desperately look for a computer sometimes and can't find [one]. We have to wait until one [a computer] is free, it could be 10 or 15 minutes trying to find a computer, if they are available” (Nurse 7).*

*“... if we want to encourage staff to actually utilise the facilities we have to make the facility available to them, more facilities available” (Nurse 4).*

With respect to the nature of the ED, in which patient turnover was high and staff needed to move around the department, some participants preferred to have an access point in each cubicle and some others preferred to have handheld devices.

*“If there would be a point in each room, in each cubicle, then at the same time that you are seeing the patient, you could tap in the information, I think that is good” (Doctor 11).*

*“We need to have things that you can use when you are with the patient, not actually have to go away and do it as a separate thing” (Nurse 4).*

It seemed that although the information systems in the ED were relatively simple, the ED staff still required more training and support. Obviously, in order to provide the staff with more training and technical support, more financial resources should be allocated and more IT staff should be recruited. This may raise political and organisational issues. However, if a system is to be implemented successfully training and IT support should receive adequate attention. As Bowns et al. (1999: 142) pointed out, “successful industrial projects reported investing between 20% and 100% of hardware costs in training”.

### **Theme 5-Impact of Information Technology**

Another theme that emerged from data analysis was the impact of IT. Since the ED has special characteristics in terms of the variety of patients and the speed of work (Amouh et al., 2005), investigating users' perceptions of the impact of computerised information systems could help to identify factors that might influence the success or failure of the systems. According to Laerum et al. (2001), the impact of an information system is associated with the actual use of the system rather than its functions. The results of the

present study suggested that the impact of IT could be categorised as impact on the individuals, organisations, and patient care.

### ***Sub theme 5a- Impact on the individuals***

From the users' perspectives, the positive impacts were mainly associated with having easier and quicker access to the information that they needed. This could help the clinicians to provide patients with a better care plan in a timely manner. As two participants noted:

*"It is just easier access, it means that instead of phoning up or waiting for a piece of paper to come back you have got the blood results as soon as you need them"* (Doctor 3).

*"..., it would make the day run much more smoothly, so you go home without having to worry about you have tried to guess some"* (Doctor 8).

After data analysis, it was revealed that, if the ED staff were to use a new computerised information system, some of them might experience feelings such as fear, stress, and nervousness. Such feelings could mostly be experienced when a change happened in their work practice and in their day-to-day duties, for instance, when they had to enter data into the computer rather than writing it on a paper. In reference to this, two clinicians indicated:

*"I think people will get more frightened of these sorts of things at the beginning"* (Nurse 12).

*"I have never used a fully computerised system, so I am still a little bit nervous about that, but I think my nervousness from the bits that I have used has gone"* (Doctor 10).

Although most of the interviewees believed that the current ED systems were easy-to-use, some of them remembered that using these systems at the beginning also affected their work negatively.

*"The tracking system, when they first introduced it, you spent your time treating the tracking system and not treating patients"* (Doctor 10).

*“..., we didn't like it [the patient tracking system] when we first started it, because we thought it was an extra job we weren't supposed to, ...”* (Administrative staff 8).

In fact, a lack of fit between the staff work flow and the way that the system worked could be a reason for this negative impact. Some participants agreed that not only during the early stages of introducing a new system, but also after getting used to using it, any problem with the system, such as system downtime could make them “panic”. One of the administrative staff said: *“it is probably more stressful for the nurse in charge without the computer system”* (Administrative staff 1). The system downtime, for example, could cause the unavailability of information for the senior staff, who were responsible for managing patient flow and resources within the department. Some ED staff felt that they were “reliant” on the systems since they could be provided with the information that they needed:

*“If the system goes down, you are absolutely lost because you can't look for anything. You know, you are hopeless”* (Administrative staff 1).

According to a doctor, if the main hospital information system went down, such a feeling could also be experienced by the rest of the staff who were using that system in the hospital:

*“[When the system goes down] we have to phone the lab which obviously is very stressful for the lab, because everyone is phoning”* (Doctor 3).

Raitoharju (2005) suggested that IT-related stress can be divided into direct IT-stress and indirect IT-stress. The first type of stress is caused directly by using or being involved with IT. Indirect IT-stress may happen when a user is not afraid of using technology, but using a computer interrupts his/her job, for example, when a system is time-consuming. It is worth noting that the nature of work in a healthcare setting, particularly in the ED, may cause stress for the staff. Hence, it is important to understand how their IT-related stress can be reduced or eliminated rather than adding to their work stress. Otherwise, such feelings may have a negative effect on user performance, patient care, and user attitudes towards using technology.

### ***Sub theme 5b- Impact on the organisation***

As noted earlier under theme 3, sub theme 3b, some of the senior staff were responsible for managerial tasks in the department and using computerised information systems could facilitate their jobs. For example, the accessibility of information helped them to make better decisions at the departmental and organisational level. As a doctor noted:

*“It has completely changed how we work really. I have got so much more information about how well doctors are working. I can pick up doctors who are failing for various reasons, e.g., you can look at the doctors who X-ray every single patient that they see...”* (Doctor 10).

The accessibility of information had, in turn, helped to increase efficiency in the department. The use of information systems in the ED had also improved staff communication. For example, as noted in theme 3, sub theme 3b, the ED staff could use a patient tracking system to add notes regarding a patient’s status, and the rest of the ED staff could be informed about that by using the system. With reference to this, a nurse commented:

*“That computer [patient tracking system] helps us to communicate by putting information on that”* (Nurse 8).

However, most of the interviewees mentioned that system downtime had a significant negative impact on their work since they could not have access to the information that they needed. This situation was a ‘nightmare’ (Nurse 2) and caused ‘chaos’ (Nurse 6), as mentioned by several interviewees.

*“If the patient tracking system goes down, then we no longer have any real record of how long people have been within the department... and if you have got 50 people in the department it can be a quite time-consuming process to get aware of what time they have come in,... we don’t really know how many patients in the department start breaching again”* (Nurse 3).

In situations like this, staff needed to use a manual system to keep a record of what was going on. This was more difficult for the administrative staff as all of the information



recorded on paper had to be entered into the computerised system later. The results suggested that before designing and implementing information systems, current workflow should be investigated and re-designed if it is necessary. Otherwise, adding an information system to a dysfunctional organisation will not solve fundamental inadequacies (Taylor, 2004). As time and the speed of work are of great importance for the ED staff and patient care, it is also necessary to identify how using technology may help the process of care rather than interrupting it.

### ***Sub theme 5c- Impact on patient care***

This sub theme included positive, neutral, and negative impact of using information systems on patient care. Most of the interviewees agreed that the use of information systems had a positive impact on patient care, mainly in terms of the speed of care and saving time for the clinical tasks. In reference to this, the interviewees noted:

*“..., that is the way that information becomes absolutely key to that patient care, so if you have good information, accurate information, then the care would improve because your decision making is on a solid basis as opposed to on guesses,...”* (Doctor 8).

*“... speed at which blood results and other results can be accessed will probably make a huge difference to a patient”* (Nurse 2).

*“It is a lot quicker, a lot quicker. You can straightaway find out that a patient who was here last week with chest pain, and then they had an ECG, and you can get that much quicker [than] says years ago, when everything was written down, [it] took a lot longer, a lot longer”* (Administrative staff 2).

Other positive impacts in the use of information systems on patient care could be related to reducing clinical errors and increasing effectiveness.

*“If the information about patients is readily available that can be beneficial...for instance, you can know within minutes what the patient is allergic to then it obviously reduces the risk of harming him and giving him something he is allergic to”* (Doctor 6).

*“... , you would reduce the risk of things like one patient’s X-ray being put in another patient’s packet. So, it would reduce the risk of any incident and possibly it would reduce the negligence cases” (Nurse 5).*

While most of the interviewees stated that using information systems had a positive impact on patient care and could improve it, a few of the interviewees asserted that using information technology had no effect on patient care.

*“It usually speeds things up for beds and provides the methods of doing order, research and something, because you have got data available. But, it doesn’t affect the individual patient care very much, I don’t think” (Doctor 4).*

*“Computers won’t affect the nursing care that you give somebody, you know, the doctor’s care” (Nurse 2).*

The above comments are supported by the findings of Likourezos et al.’s (2004) study, in which a majority of clinicians reported that the ED Electronic Medical Records (EMR) would not improve the quality of patient care. Moreover, some of the interviewees were concerned about the negative impacts of information systems on patient care. From their point of view, system characteristics might cause them to spend too much time on a computer rather than on patient care, or low quality information on the systems could adversely affect patient care.

*“... if the data we’re putting into the system is not very good, then in actual fact, not having the information available is better than having it available, because you might interpret something incorrectly” (Doctor 9).*

*“If it [a computerised information system] is too time-consuming to put in the information, then that may be detrimental to the patient care, because the nurse might be using the time to input data, instead of giving direct patient care” (Nurse 5).*

Previous studies have also revealed that the impact of computerisation have been categorised in different ways. For example, van der Meijden et al. (2003a) focused on the individual and organisational impact of computerisation. From their perspectives, the individual impact attributes include changed clinical work patterns, changed documentation habits, information use, efficiency and effectiveness of work and job satisfaction. The

organisational impact attributes include communication and collaboration, impact on patient care, and cost. Despont-Gros et al. (2005: 251) concentrated on the impact of computerisation from a user's point of view. The authors indicated that the impacts of computerisation can be categorised either as "real impacts", such as a change in communication patterns or workflow or as "perceived impacts" such as a feeling of being controlled or too stressed to work in a standardised way. As noted earlier, IT-related stress was discussed by Raitoharju (2005) as one of the individual impacts of computerisation. The results of the current study suggest that, in order to investigate the impact of clinical information systems, a combination of the above mentioned areas should be taken into account. As introducing a system to a work environment may have a negative impact at the beginning, ongoing training in the use of the system and more communication with users should be considered to improve their understanding of the system (Campbell et al., 2006).

#### **Theme 6- Users' preferences, concerns, and expectations**

As mentioned above, the ED staff used both paper-based records and computer-based records in their workplace. The interviewees discussed these two and explained why they preferred each of those to be used in the ED. In this section, users' opinions about using paper-based records and computer-based records; encouraging and discouraging factors which might influence the use of paper or computer, and users' expectations for the future system development are discussed.

##### ***Sub theme 6a- Using computer-based records – reasons why and why not?***

After data analysis, it was revealed that some of the clinicians preferred using computer-based records and some preferred using paper-based records. However, most of the administrative staff preferred using a computer in their job. It seemed that staff who had experience of using a computer in their jobs were more interested in using computer-based records. Among the interviewees, some people preferred a combination of paper and computer, and some explained that they were not able to compare these two, as they had never used fully computer-based records.

From the interviewees' perspectives, the main reasons for using computer-based records were the advantages of a computer. Perceived benefits of using computer-based records included avoiding duplication, increasing the speed of processes, facilitating work, improving access to patients' notes, improving clinical decision-making, improving the legibility of writing, reducing clinical error, and providing accurate data as well as the possibility of sharing information with other healthcare professionals by using computer-based records. In reference to this, a doctor noted:

*"You'll get more accurate data, so you do not have to guess, or take risks on minimum information. So you have much more comprehensive information, it is up-to-date, your communication with other agencies is current, you can communicate well with others, and it makes the patient care pathway much more safer probably"* (Doctor 8).

Improving the accessibility of information was mentioned as another advantage of using computer-based records. Some of the interviewees mentioned that using computer-based records could save time and could make their jobs easier through improving the accessibility of information. This could be critical in an ED, in which patients' lives can be dependent on high-quality care being given immediately.

*"The great thing about [the] computerised system is I don't have to send somebody to find out the old records and everything is there and I can look up their blood results and whatever, so it is all there and I don't have to plan and get it"* (Doctor 10).

*"It is quicker with the computer system, it takes a lot less time to just click on the screen which obviously means we would have more time with the patient"* (Nurse 3).

*"The computer-based one is much more accessible, they [patients' records] don't go missing"* (Administrative staff 5).

The above comments suggested that the overall effect of improving patient care, in terms of making it safer and freeing up time, was an important aspect of using computers. Some of the ED staff mentioned that using computer-based records could also improve communication in the department. For example, a nurse suggested:

*"It [the patient tracking system] is good, because when the department is busy you can't always find who you need to talk to in a certain amount of time. They might be busy"*

*assessing or whatever they might be doing, so I mean having that system to put information on does help” (Nurse 8).*

A system’s features, in terms of ease of use and usefulness, were other factors which might influence the use of the system by the ED staff, for example two interviewees noted:

*“If it is not too time-consuming and it has got the value, value for time, if it is going to positively contribute to the patient care, if it is easier, much easier than to actually write in the classical fashion on notes then I prefer it to the notes” (Doctor 6).*

*“If we could have a system where you could log on and fill in your details and out very quickly, then I think that is good but otherwise it becomes inefficient” (Nurse 10).*

In the study conducted by Likourezos et al.’s (2004), ED staff reported that using the computerised system was time-consuming and they spent more time in front of the computer than with the patients. Although these interviewees indicated a preference for using computers, it was also clear that the preference was provisional on the potential benefits being realised, or on the potential benefits being greater than possible problems. Despite the advantages of computer-based records, some of the ED staff thought that even if they were not interested in using such a system personally, they should respect the organisational rules and policies:

*“If a computerised system is working, then you can’t do anything, there is not something to encourage me, if you have to use it, you have to use it” (Doctor 4).*

Interviewees also expressed their concerns about using computer-based records. For example, implementing a change in the ED would be a major concern for the ED staff, as some interviewees suggested.

*“I think, initially, when you’re introducing the change, it is quite hard for people to get used to it” (Doctor 4).*

*“It is just the human nature. I think a lot of people don’t like change, do they? It means you have to engage your brain a little bit more than you normally do and I just think*

*people find that quite hard really, when they have got lots of things going on at the same time” (Doctor 11).*

From the users’ perspectives, not only implementing a system, but also users’ work habits and computer skills should be taken into account, as noted by the following interviewees:

*“I can’t use a computer, I was trained on paper” (Doctor 1).*

*“A lot of staff do not have even basic knowledge of computer particularly, and they don’t use them in their everyday work” (Nurse 1).*

Some ED staff were concerned about the feasibility of all members of staff using computer-based records. In their opinion, entering data into a computer and searching for patients’ data were clerical work, for which the administrative staff were responsible, not the clinicians. Even the administrative staff believed that using a computer at work was their job and clinicians should not be expected to use it very much, especially in the ED, as they were busy treating a large number of patients. In relation to this, one of the nurses noted:

*“Everyone just assumes that we’ll just get the receptionists to do it. I don’t think it would be feasible for all members of staff to be trained and use that, I mean obviously that is the different job, that is their jobs and we have to know the reason for these all to be able to do what they do” (Nurse 7).*

The results are supported by Aydin and Rice’s (1991: 133) study. These researchers indicated “the question of who is to enter data into the system” can be an important issue, particularly among clinicians, and may influence their attitudes towards computerisation in healthcare settings. While clinicians’ entering the clinical data can improve accuracy, it may be considered “a clerical task” and conflicts with their professional roles. Similarly, as Bowns et al. (1999) highlighted, entering data offline by the clerical staff rather than online by the operational staff shows a failure in the system design and implementation. Therefore, in order to increase a system’s success organisational aspects should be taken into account, since working in new ways and performing tasks normally done by other staff may result in resistance from users. Moreover, if staff were asked to do extra duties, they

should have adequate incentives, for example, through a reward system (Laerum, et al, 2001).

Some interviewees, who had experience of using computer-based records in other hospitals, were concerned about using paper-based and computer-based records at the same time with the same information. In reference to this, one interviewee noted:

*“You have to do all of them on the computer and on the paper which is very frustrating, because then you are just doing everything twice. So, I found that quite annoying”* (Doctor 4).

Other concerns of the staff were mainly related to the completeness and accuracy of data, and intrusion on the doctor-patient interaction due to using a computer.

*“I do feel that would be highly inappropriate, instead of talking to the patient, looking at the computer”* (Doctor 6).

The interviewees were also concerned about the technical problems of a computer, such as system downtime and a system crashing, which were both discussed earlier under theme 5, sub theme 5b, the impact of technology on the organisation. The participants believed that such a system should be supported with a strong back-up system. The following example illustrated this issue.

*“You can’t just trust the computer, can you? If it is crashing and then you have lost everything at least we have got the paper work to back up as well”* (Administrative staff 9).

Typing information into a computer and the typing speed could be other issues that influenced users’ attitudes towards using computer-based records in the ED. These issues have been addressed in Jones’ study (2003). While some of the clinicians, particularly the doctors, indicated that typing information into a computer could be similar to writing on paper and the speed of typing could be increased by practice and training, a lack of adequate equipment and PCs could be a barrier to the effective use of computers in the ED.

*“..., there is a slight problem in terms of handwriting clinical notes; you are quicker probably than typing it. But, I think that is just a learning curve because we have always done it by hand”* (Doctor 8).

*“There needs to be more PCs, more equipment rather than greater depth of information. I suppose the thing that is a problem is the lack of adequate facilities to be able to do [it] in a timely fashion” (Nurse 4).*

The results showed that most of the ED staff were aware of the benefits of using computer-based records in their workplace. This is of great importance, because if users realise that using a new system can be useful for them they may be encouraged to use it. According to the results, while the interviewees agreed with the benefits of using computer-based records, they were concerned about how these benefits can be realised in practice, and this, in turn, could influence their attitudes towards using information systems in the ED. Therefore, it is important to identify practical solutions and address their concerns to improve their attitudes.

#### ED characteristics and the use of computers

When interviewees were asked about using computer-based records in the ED, some of them focused on the nature and characteristics of the ED. In their opinion, the speed of work, patients' conditions and the departmental workload were some of the factors that might influence using computer-based records. As noted in the previous section, some interviewees noted that entering data into the computer as well as writing the notes on paper could be time-consuming. This was important because the ED was a high workload department. In reference to this, some of the interviewees noted:

*“In the ED, especially it needs to do something a bit quick and if you have everything on the computer as well as writing the notes, then it is getting worse and the worst thing is it is going to use extra time” (Doctor 5).*

*“No time to do all of that, it takes far too long, I don't know who would [do], there are far too many patients in the department, many notes too, we certainly wouldn't be doing [them] ourselves, because there wouldn't be any time” (Nurse 7).*

A patient's condition was also important, as the ED clinicians were responsible for treating patients who might be in a critical condition. An interviewee suggested:



*“I think in a lot of ways it is the computer system that gets forgotten. If the patient is quite ill, they get the priority. Some of staff will look after the patient and the computer is the secondary thing”* (Administrative staff 3).

Another issue noted by some of the interviewees was related to the environment of the ED and safety. They thought that computers could be damaged by violent patients and their relatives who may attend the ED. In this case, using computerised systems in the department could be risky and costly.

*“I don’t think you could physically have one in each cubicle... they get vandalised with patients and things, if they get really in a temper or they get annoyed, they do... You get drunk people and they can be very unpleased or you can get people that they have been involved in accidents, they have got head injuries and that can make them violent”* (Administrative staff 4).

These comments highlighted the importance of the work environment and its possible influences on the use of IT in the ED. The results are consistent with the findings of Jones’ (2003) study. In Jones’ (2003) study, it was revealed that clinicians who worked in low workload departments were more positive about using an information system than clinicians who worked in high workload departments. In fact, the second group of clinicians were concerned about the time that they should spend on using a computer rather than on completing clinical practice.

On the other hand, in the setting of this study, clinicians used information systems mainly for ordering blood tests, viewing results, and tracking patients. In fact, for some of the staff, the limited use of a computer in the department along with no experience of using computer-based records in other hospitals or EDs could influence their attitudes towards the feasibility of using computer-based records in the ED. Their concerns could be addressed by informing users about the use of information systems in the similar clinical settings, and developing training courses to improve their IT skills.

### ***Sub theme 6b- Using paper-based records – reasons why and why not?***

The interviewees also explained why they preferred using paper-based records. In their opinion, a large amount of information could be available in a paper-based format. Some interviewee stated:

*“You can pull a picture out of written records that you may not get out of a simple computerised records”* (Doctor 1).

*“I will go for the one that can give me more information, which at the moment is the paper record”* (Nurse 2).

*“The paper information gives you more depth. It gives you a greater feeling and it will give you little personalised comments that somebody might have made about the patient and details on medical histories that we don’t have online in this hospital”* (Administrative staff 1).

In the setting of this study, apart from ordering blood tests, viewing results and tracking patients, the ED staff had access to limited information about a patient via a computer. Some other staff, such as receptionists were authorised to have access to a summary of a patient’s previous attendance at the ED. Apart from these, other types of information were hand-written on the ED cards. Some of the ED staff thought that using paper-based records would be easier and quicker. In addition, as the number of computers was limited in the ED they preferred using paper-based records rather than wasting time finding a free PC.

*“Just fill the card in and walk with them round would be quicker... it can sometimes be quicker and easier than finding a spare computer and inputting information”* (Nurse 7).

*“In the ED, I know where I am when I have my sheet of paper, and I go round the patient rather than thinking I have got to go back to the computer”* (Nurse 6).

The results are consistent with Laerum et al. (2001) study, in which the use of paper-based records was identified as being more convenient in some cases, such as writing a short prescription or carrying them round. Although using paper-based records had some advantages for the ED staff, some of them complained about the disadvantages of paper-

based records. For example, while some interviewees appreciated the amount of information in paper-based records, others thought that searching for information in paper-based records was time-consuming, mainly because of the volume of information.

*“Patients have lots and lots of medical notes, then you spend hours touring throughout some basics, some information that you might not need”* (Doctor 5).

Moreover, the legibility of handwriting was another problem noted by most of the participants. In reference to this, two interviewees commented:

*“My handwriting can deteriorate. If I am writing very fast, my words can just merge into a line..., some people might not interpret that”* (Doctor 9).

*“Everybody’s handwriting is completely different, we often have a problem because we can’t read what the doctors have written, read again, finally again, we prescribe things as we scan”* (Nurse 3).

As a nurse explained, a lot of information could be repeated in paper-based records, leading to a large volume of paper that was difficult to manage and store.

*“We probably do reproduce a lot of stuff by asking, doing the same paper work over and over again. We are going to see a patient and ask a lot of questions, then somebody else or one of the doctors come along and do that more in-depth, but a lot of questions are very similar...”* (Nurse 3).

*“Papers are good, but it is time and kind of space-consuming and not particularly environmentally-friendly”* (Doctor 5).

The inaccessibility of paper-based records was another issue mentioned by most of the interviewees. For example, a member of the administrative staff suggested *“nine times out of ten we spend a lot of time looking for missing records”* (Administrative staff 2). Another interviewee commented:

*“The ED cards get lost all the time, we spend hours looking for those. We just hope that it returns one day and use a new card and just write on it”* (Nurse 7).

As previously noted about paper-based records in theme 2, sub theme 2c, looking for missing cards could be time-consuming, and if it was not urgent, staff did not spend time looking for them. In fact, using paper in the department could be a “*challenge*”, as mentioned by a member of the administrative staff.

With respect to the advantages and disadvantages of both paper-based records and computer-based records, coupled with a tendency to move forward and computerise healthcare settings, it is important for system designers to understand how it is possible to combine the advantages of these in one source of information. This can be helpful for the clinicians, particularly the ED staff, as information can be stored on one source of information and gaining access to this information is easier and quicker than searching in disparate systems.

### ***Sub theme 6c- Users’ expectations***

As discussed in Chapter 2, before introducing a new information system, it is important to understand user requirements and expectations (Henderson and Deane, 1996). This can help to address their requirements in the process of design and implementation and can lead to improve user acceptance of, and satisfaction with, the system. In this study, the ED staff discussed their non-technical and technical expectations.

#### **Non-technical issues**

Among the non-technical expectations, organisational issues, such as user involvement, change management, and training were of great importance and mentioned by most of the participants. Other non-technical expectations were related to the information sharing, the confidentiality of information, and system use.

#### ***User involvement***

One of the expectations of the interviewees was to obtain a better understanding of the change and the systems that might be implemented in the future, for example, by the

NPfIT (discussed in Chapter 2). Some of the interviewees were unaware of the existing NHS IT projects towards computerising patients' records. However, people who were aware of the NHS IT projects and the NPfIT expressed their concerns, as they had not been fully informed about the process of change and new information systems. For example, one of the interviewees noted:

*"... at the moment in the clinical setting, there isn't enough information or the staff aren't actually adequately being prepared for what the future is going to bring..., says NPfIT - most of the staff in the department, they may know nothing about it. We need to be prepared, we are not"* (Nurse 4).

*"We don't have a choice, we would just get the system, so we're going to have to deal with what would be given and there are concerns around that"* (Administrative staff 5).

Van der Meijden et al. (2003a) suggested that if the process of change is accompanied by user involvement in designing and implementing an information system, user resistance to system usage can be reduced. This can help to design a system that meets user requirements, and influences user attitude towards the information system positively. Similarly, Taylor (2004) indicated that user involvement is essential, if a system is to be accepted by its users. In relation to the role of communication with system developers during the design and implementation process, one of the doctors suggested:

*"You need to work with people who are doing your program to tailor it to you, you can't just buy a ready-made programme (a) they are expensive and b) they cannot even fit all, and every place has its uniqueness,... and they all do things slightly differently, so you need to be able to tailor them"* (Doctor 10).

This is consistent with the results of a study by van der Meijden et al. (2003a), who suggested that poor communication between system developers and end-users, in terms of the benefits of the systems, may cause misunderstanding about the system and its objectives. Similarly, Jones (2003) indicated that more focus on demonstrating clinical benefits and involving users in the process of design and implementation is necessary.

## *Change Management*

According to Heeks (2006), although it is important to fit an information system to the environment of work, it does not mean that the system may not bring any change to the environment. In fact, when implementing a clinical information system, it is expected that work efficiency and patient care will be improved, but this may not happen unless by a change in the organisation. In this study, although most of the interviewees were positive about the application of IT in the ED, their main concern was transition from where they were at, to where they needed to be, as a nurse noted. In terms of the initial stage of introducing the change, the interviewees had different opinions. Some of them agreed with introducing the change bit by bit. In their opinion, this way of introducing the change allowed users to become familiar with the system gradually, *“whereas a whole big system sometimes is a step too far from people”*, as a doctor commented. Another doctor suggested:

*“If you’re introduced slowly, [there are] tremendous advantages on the whole”*  
(Doctor 10).

However, some of the staff preferred to become familiar with different aspects of a new system all at once, rather than to experience a series of changes that were central to their working practices. In explaining why, an interviewee said:

*“Every time you change something, change itself is a new thing, and during the process of change, there is a lot of pain”* (Doctor 8).

As Jones (2003) highlighted, it might be difficult to say whether a one-phase implementation is better than implementing a system piecemeal. Therefore, it is necessary to understand different aspects of the process and find the best solution. After implementing a change, the interviewees expected to have adequate time to learn the system and get used to using it. Some of the participants indicated that it was also important if somebody, for example, the senior staff, could take responsibility and lead the process of change in the actual workplace.

*“..., I think you would need to try and get everyone on the board to prevent sabotage that might happen with the introduction of the system, because if they are trying*

*to introduce it without our support, then people are going to feel very negative about it and won't use it effectively" (Nurse 5).*

As discussed earlier in Chapter 2, change management was a challenge ahead of implementing NHS information systems and many projects were affected by insufficient investment in implementing the change. According to Lorenzi (2004), the process of change begins before the implementation of information systems. The main five stages of this process are pre-contemplation (not yet acknowledging that a change needs to occur), contemplation (acknowledging that there is a problem but not yet ready to make a change), preparation (getting ready to make a change), action (making the change) and maintenance (maintaining the change). The results of this study showed that the ED staff acknowledged that their systems should be updated and they needed to move forward; however, they needed to be prepared to follow the process of change, e.g., in relation to NPfIT (discussed in Chapter 2). The results are supported by Lorenzi (2004: 1147) who suggested more attention should be paid to the last three stages of the process of change, namely "preparation, action, and maintenance".

### *Training*

As discussed in theme 4, sub theme 4a, training was another important issue noted by most of the interviewees. They thought that training should be adequately funded for all of the staff in the department. As a nurse highlighted, the more training that people had for using a system, the more confidence they felt about using it. However, some interviewees explained that in order to have adequate training, adequate financial resources needed to be allocated.

*"If they send you to a training course, somebody needs to be there to do their job so the cost implication is huge and it is not something that has been adequately resourced; there is no central fund for training" (Nurse 4).*

Providing users with more training and support in their actual workplace was another expectation noted by a number of interviewees. Such support could help to develop users' IT skills and improve their attitudes towards using computerised systems in the department.

### *Information sharing and the issues over confidentiality*

With respect to the difficulties in having access to the information at the point of care, some interviewees agreed on systems integration and information sharing between organisations.

*“There are more pluses than minuses in sharing the information within the health system. Between the primary care, secondary care and in that way you have less of this, chasing up and guessing that goes so...”* (Doctor 8).

However, other staff thought that information sharing could put confidentiality at risk. This might be due to the low level of awareness of, and knowledge about, the strategies applied to maintain the confidentiality of information on the computerised systems. People who were aware of the NHS IT projects and the National Programme for IT expressed their concerns about using ‘the Spine’ (discussed in Chapter 2) for information sharing by referring to the failure of the system. However, it seemed that their opinions were mainly affected by the complaints made by their colleagues about the Spine. For example, one of the doctors noted:

*“... , I am not the fan of Spine, I think I’ll be opting out with that if they allow me to [do that], because I think data safety is a major issue, because there are really a lot of people who complain about it [the Spine]”* (Doctor 9).

The issue of the confidentiality of information was also important for other members of ED staff. For example, one of the nurses stated:

*“What I expect from [the future IT systems], is some confidentiality, so, there is nobody [that] can be accessing [information], there must be a way of protecting patient confidentiality really”* (Nurse 10).

This is supported by the findings of Likourezos et al.’s (2004) study, in which participants were concerned about the security, privacy, and confidentiality issues. It is worth noting that implementing an information system should be supported by giving adequate information to the healthcare providers and involving them in the process of change, as noted earlier. The users of information systems should be informed about the capabilities of the systems to improve the confidentiality of information. They should also



be trained to respect the confidentiality of information and should be aware of the consequences of breaching this confidentiality.

### *System use*

A number of interviewees indicated that not only implementing a new information system, but also monitoring its usage was of great importance. In their opinion, the benefits of a system would not be realised unless it was used properly. One of the nurses noted: *“it [the computer] is only as good as the information put into it”* (Nurse 9).

As noted in theme 3, sub theme 3b, one of the reasons for the limited use of the ED radiology information system could be the optional use of the system. In order to gain better use of a system, one of the doctors suggested that a mandatory plan for using the systems would be more beneficial. This doctor added:

*“If you make it mandatory, you have to use the electronic records, that way you will have a better harvest of information and you integrate your day to day work... but if you leave it as an optional extra, the optional extra is not done when it [the ED] is busy. So, you don't get any complete data”* (Doctor 8).

One of the administrative staff expected that people given access to a system should use it by themselves, rather than asking other staff and interrupting their jobs. In addition, human error and the quality of information on the system needed to be taken into account.

### Technical issues

When interviewees were asked to talk about their expectations of future ED information systems, they also highlighted a number of technical issues. These issues were related to systems integration, the ease of use, the usefulness, and the content of a system. Paying attention to the speed, a strong infrastructure and backup system, and the usability of a system were other expectations of the interviewees. These issues are discussed in the following sections.

### *Systems integration*

As noted earlier, in the ED, the information systems were not integrated, and could provide the ED staff with limited functions, such as ordering the blood tests. Moreover, having access to the patient medical information, particularly through other hospitals, was usually time-consuming and the ED staff needed to contact them and request for the medical notes. Therefore, most of the interviewees expected to have an integrated system in their hospital that was also linked to other information systems at a local level. In relation to this, a nurse stated:

*“It would be really good if we had one computer system that linked up the whole of the hospital and primary care, ...”* (Nurse 5).

As Taylor (2004) indicated, integrating ED information systems with other related systems in a hospital can help to have a more efficient and effective system. In addition, the interviewees expected to have “just one password” for such an integrated system. Obviously, memorising one password would be much easier than memorising different passwords for different systems.

### *System ease of use*

With respect to the characteristics of the ED, such as the speed of work, the ED staff expected to have an easy to use system in future. In relation to this, a doctor said:

*“Easy to use, for instance in the ED we do need a lot of drawings and if that is available, that is good, if you have to spend half an hour extra on computers, just typing information in the computer then it is not good”* (Doctor 6).

Most of the interviewees expected to have a system that was “user-friendly” (Administrative staff 3) and “as simple as possible” (Doctor 11). Another doctor suggested:

*“They [the systems] need to be clear, and as few boxes as possible, just simplified really”* (Doctor 2).

Some of the interviewees indicated that using a flexible system was of great importance in the ED. In fact, the clinicians expected to have a system that could be customised to their needs. This system should be able to provide them with structured data, such as tick boxes, as well as free text. Moreover, spending less time on the computer and doing fewer clicks would be an advantage for the system.

Some of the interviewees expected to have access to the patient information just by entering "*the patient's NHS number*" (Doctor 7). One of the interviewees suggested that separate forms should be designed for entering clinical data by doctors and nurses, and a doctor commented:

*"That is very useful to tabulate all of the results. Also, you would have problems with diagrams. You have to put what you really use, it is one of those, little sketchy pads. So, you could draw diagrams and add them to the notes"* (Doctor 9).

The results are consistent with the findings of Likourezos et al.'s (2004) study, in which the ED clinicians wished to have a user-friendly system, with free text as well as tick boxes.

#### *System usefulness*

The interviewees had different perceptions of usefulness. For example, some of the interviewees indicated that the capability of a system to monitor staff performance and providing access to the patient information could demonstrate the usefulness of a system. For some other interviewees, a system would be useful if it was '*at least as good as the current system*' (Doctor 6), which was paper-based records. Another interviewee stated:

*"I expect it [a computerised system] to support my practice, not to be in addition to it. It needs to be something that helps me to do my job, not hinders me in providing the care really"* (Nurse 4).

As the above comments show, the ED staff expected to use a system that could improve their performance in the department. Although the main aim of implementing information systems in the ED is to increase efficiency and effectiveness, staff need to see some of the actual benefits of a system to be encouraged to use it (van der Meijden et al., 2003a). Similarly, Taylor (2004: 251) indicated that, "gaining early efficiencies is crucial

to EDIS acceptance”. This can be achieved, for example, through using an automated tracking system in the ED.

### *System content*

As mentioned earlier, the ED staff liked to have an integrated system to have better access to information that they needed. Such a system should be able to meet their information needs. As some of the doctors said, the information that they needed would be as follows:

*“It would be useful to have some if not all of the patients’ records available electronically or a summary of the essentials, past medical history, drug history, allergy history and any current specific needs that the patient has,...”* (Doctor 8).

One of the nurses wished that they had access to patient information in other hospitals or general practices through using a computer. Similarly, having access to the ED cards through using a computer was noted by a member of the administrative staff.

*“It would be nice if it could bring a patient’s file up, a previous ED card... instead of having to file them all and get them all out”* (Administrative staff 9).

Additionally, according to a doctor, the system could include websites and links to help clinicians to find medical information quickly via the Internet.

### *Infrastructure and backup system*

An integrated system should be able to store a large volume of information. Therefore, as the interviewees indicated, such a system needs a high quality infrastructure. For example, all data should be stored in a standard format to be exchanged between healthcare settings. A good infrastructure can support the system speed. According to a nurse, it was important for the ED staff to have a high-speed system, as they could not spend too much time using a computer.

*“I think if we could do have a system where the speed was high, you could log on and fill in your details and out very quickly, then I think that is good, but otherwise it becomes inefficient”* (Nurse 10).

A major problem with using computerised systems was system downtime or a system crash. Therefore, users expected to have a “robust” system supported by a good backup.

*“Because you are reliant on the computerised system, you have to make sure that you have some backup and that is worth, if the electricity goes down, then you have to be able to, still have to, treat the patients...”* (Doctor 8).

Most of the participants wished to have a system that never went down and wished information technology could support them in this particular respect. Overall, it seemed that staff, who were more experienced in using information systems, were more willing to use advanced technology and less concerned about the problems with the technology than staff who were less experienced. Nevertheless, communication with both groups was necessary to explain the objectives of the future systems and to create a balance between their concerns and expectations.

## **4.5. Discussion**

Clinical information systems are designed and implemented for different purposes and in various types. This, undoubtedly, requires investment of a large amount of money, time, and human resources. While these are all necessary, they are not sufficient (Jones, 2003). It is important to understand to what extent implementing a new information system in a setting is necessary and how such a system can help to improve organisational functions (Heeks, 2006).

As discussed in Chapter 2, there is substantial literature on the factors associated with the success or failure of information systems; however, identifying these factors before designing and implementing a system can contribute to have a better design and to improve the potential success of the system (Aydin and Rice, 1991). As a system should be accepted and used by users, investigating users’ views prior to implementation can also help to design a system that meets their requirements (Handy, et al. 2001).

This study investigated factors influencing the use of ED information systems. The results showed that factors such as, age, knowledge and experience of IT, and users' attitudes towards using information systems should be taken into account.

In order to explain users' attitudes towards using an information system, their professional and departmental context are important. Aydin and Rice (1991) showed that users' attitudes towards using an information system were different from one department to another. In the current study, the ED characteristics, a variety of tasks in the department, the diversity of clinicians' and non-clinicians' information needs, the multiple sources of information used to meet their needs, and the challenges they might experience, all in all suggested the complexity and interdependency of tasks which might influence users' attitudes towards using a computer. For example, the ED is one of the high workload departments in which patient turnover is high, and the staff work under time pressure. These features may restrict using computers in the ED, if they are time-consuming.

In this study, a number of system features were discussed by the interviewees. The findings revealed that features, such as systems integration, system content, and system functions were all important for the users. Apart from these, interviewees highlighted two other factors, ease of use and usefulness. As discussed in Chapter 2, these two factors have been used in the theories and models of acceptance, such as the Technology Acceptance Model (TAM) to predict the level of user acceptance of an information system (Davis, 1993). With respect to the speed of work in the ED and patients' conditions, it seemed that these two factors had to receive particular attention. An easy to use system with a good interface design could save the ED staff time and help them to complete their tasks easier. Similarly, a useful system with adequate functions and content that could meet users' information needs could improve users' performance and the process of patient care. However, the results suggested that an easy to use system might not be necessarily useful and *vice versa*. For example, the patient tracking system was perceived as an administrative tool rather than a clinical system. This perception could negatively influence the use of the system, even though it was easy to use.

The results also implied that with respect to the diversity of user groups, their information needs, and their tasks, the actual benefits expected by the clinicians and non-clinicians could be different. For example, while the doctors expected to have access to

clinical information, the administrative staff hoped to manage their clerical tasks in an easier way. As Rose et al. (2005) indicated, in order to design a system for different user groups, it is crucial to consider the diversity of users' requirements and expectations.

Another finding of the study was related to the role of training and information technology support in using an information system. The results showed that some of the nurses and administrative staff were less experienced in using other clinical information systems, as they had never worked in other hospitals. Therefore, more attention should be paid to developing users' IT skills. In particular, in an environment in which the use of the computer is limited, and users are relatively inexperienced, more investment in training is required. Moreover, it was revealed that the use of information technology should be supported by providing the users' with adequate equipment. Otherwise, the information systems would not be used properly. The need for becoming involved in, or being informed about, the future IT systems for the department was also discussed by the interviewees. According to Aydin and Rice (1991), user involvement can contribute to improve user understanding of a system that, in turn, can improve users' attitudes towards the system. The above-mentioned factors could shape the organisational environment around the use of IT in the ED, which, in turn can influence users' attitudes towards using the systems.

The impact of technology on the individual staff, organisation, and the patient care were other important issues discussed by the ED staff. As noted earlier, using a system, which is able to meet users' needs and have some benefits for users, can influence attitudes positively. In contrast, IT-related stress (Raitoharju, 2005) and using an information system that is time-consuming and is regarded as an extra job for users, may influence users' attitudes negatively (Aydin and Rice, 1991). It seems that a system that is able to meet users' needs, for example their information needs, can contribute to improve patient care by improving the accessibility of information. Overall, the findings of this study revealed that the ED staff were positive about using information systems in their department. However, their attitudes were mainly associated with the current systems that they used. Their attitudes may change, for example, by introducing a new system. Therefore, it is important to investigate their attitudes at different stages in order to identify the strengths and weaknesses of the information system. This can help to design better