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Factors Influencing the Use of IT in the Emergency Department: a Qualitative Study

Haleh Ayatollahi^{1,2}, Peter A. Bath¹, Steve Goodacre³

¹Centre for Health Information Management Research (CHIMR) and Health Informatics Research Group, Department of Information Studies, University of Sheffield, Regent Court, 211 Portobello Street, Sheffield, UK, H.Ayatollahi@sheffield.ac.uk, p.a.bath@sheffield.ac.uk

²Iran University of Medical Sciences, Tehran, Iran

³Emergency Department, Northern General Hospital, Herries Road, Sheffield, UK
s.goodacre@sheffield.ac.uk

Investigating factors influencing the use of clinical information systems can help to develop a strategy to improve user acceptance of a given system or similar ones in the future. In this research, we investigated factors influencing the use of information technology in the Emergency Department (ED). We undertook a qualitative study in which data were collected using semi-structured interviews with the ED staff. In total, 34 interviews were conducted and data were analysed using framework analysis. The results showed that user characteristics and perception of task, technology, environment, and impact of technology could influence people's use of IT in the ED. Of these, the usefulness of the systems, the impact of technology, IT training, and the feasibility of using IT by all members of staff seemed to be the main concerns. Addressing these factors in designing and implementing a system could help to introduce the change successfully and improve the acceptance of information technology.

Keywords

Emergency Department, Information Systems, User Acceptance, User Perception

1. Introduction

A large number of information systems have been deployed in the healthcare environment to date; however, evidence shows that a number of these systems have not been implemented successfully [1-5]. In some cases, introducing a new system has negatively affected staff workflow [6], for example by increasing the time spent on data entry rather than on patient care [7]. In addition, some of these information systems have made routine tasks very difficult for users, while staff could do their job much easier using manual methods [8]. As a result, staff may resist using them and this resistance may lead to the failure of the systems [9].

To prevent system failure, factors influencing the acceptance and use of technology need to be investigated. Despont-Gros et al. [10, p.1,040] noted "acceptance concerns user perception of the system". For example, when users perceive an information system to be easy to use, such a perception can positively influence the acceptance of the system.

In the main theories and models of user acceptance [11], user perception and other factors have been addressed as the key determinants of using technology. For example, in the Theory of Reasoned Action (TRA), user perception influences user attitude, and user attitude, in turn, influences behavioural intention, and the actual behaviour (e.g., using IT). In the Technology Acceptance Model (TAM), perceived usefulness and perceived ease of use are two main criteria to predict the level of user acceptance by influencing user attitude. In the Theory of Planned Behaviour (TPB), perceived behavioural control was added to the main determinants of TRA model [11]. Similarly, in the Unified Theory of Acceptance and Use of Technology (UTAUT), performance expectancy and effort expectancy were similar concepts used for perceived usefulness and perceived ease of use,

respectively. These factors, along with social influence, facilitating conditions, and some user characteristics could influence behavioural intention and IT usage [12].

In relation to the clinical information systems, the TAM model has been used more than other theories and models; however, using this theory, user acceptance can be evaluated with respect to a few variables [13]. As this model focuses mainly on the characteristics of the system, such as perceived usefulness and perceived ease of use, in some studies, this model has been adapted to include other key determinants in the healthcare environment [14,15]. Recent studies have also shown that several factors, such as the characteristics of a system, user, the context of use, environment and the development process might influence the acceptance and use of a clinical information system [10, 16]. However, this information is mainly related to the settings other than the Emergency Department (ED), and few studies have explored these factors in relation to the ED Information Systems. Therefore, in this study, we were interested in investigating factors that might influence IT use in the ED, and examined the results in relation to existing models [11-16]. Given the characteristics of the EDs, mainly in terms of providing urgent treatment for patients with a range of critical conditions, conducting such a study could help to develop better systems in the future and implement better change strategies.

2. Methods

This research was a qualitative study conducted to investigate factors influencing the use of IT in the ED. In this research, data were collected through one-to-one, in-depth semi-structured interviews with the ED staff who had access to the information systems in this department. Participants were 11 senior and junior doctors, 13 senior and junior nurses, and 10 administrative staff including receptionists, patient flow champions, service manager, and secretaries.

Before conducting the research in the ED, a favourable opinion was sought and received from a Local Research Ethics Committee in England. An interview guide was developed using the literature, and based on the aim and objectives of the research. All interviews were conducted in March-April 2007 by HA and continued until data saturation was reached. The research setting was an ED located in a teaching hospital in northern England. This hospital is the largest in the city, with more than 1100 beds and over 5,500 staff, and the ED is responsible for caring for adult patients. In the ED, three computerised information systems are used, a Patient Focus Information System (PFIS), a patient tracking system, and E-film; however, these systems are not integrated. The PFIS is the main information system in the hospital and its ED module has been used in this department since 1998. This system is used by doctors, nurses, and receptionists. The doctors and nurses use the system for ordering blood tests and for viewing the result. The receptionists use the system for patient registration and for entering a summary of the patients' records. The patient tracking system has been used since 2006 to monitor the time from admission to discharge to reach the UK's NHS four-hour target for treatment, discharge, referral, and admission of patients in the ED [17]. The ED staff are required to enter relevant information for each patient into the system to show "what *time they have arrived, who they have been referred to, what time they have been referred, what they are waiting for, and where they are in the department*" (Nurse 7). The E-film system operates like a Picture Archiving and Communication System (PACS) to view x-ray results, and is only used for patients who have x-ray tests in the ED. This system was implemented in February 2007, and during the interviews the system was used by the trained users. It is worth noting that except for the patient tracking system which was used by all ED staff, the access level to other ED systems varies.

We used purposive sampling to recruit a range of participants from different backgrounds in terms of age, gender, work experience, profession, and qualification to obtain a broader picture of their views. The first five interviews formed the pilot study. Following this study, the interview schedule was adjusted to ask additional questions, such as participants' previous experiences of using computerised information systems. Asking such a question helped them to talk more about what they liked and disliked about the current systems.

Although all interviews were carried out in the ED, it was arranged outside interviewees' working time, or when the departmental workload was low, in order to minimise disruption to work. Interviews were transcribed verbatim and analysed using framework analysis [18], which is useful for applied qualitative research. In applied research, specific information needs have to be met, and the results

can be used in practice. In this type of research, objectives are clearly set and the results should answer the objectives of the study appropriately. The main steps of framework analysis are data familiarisation, identifying a thematic framework, indexing (coding), charting, mapping, and interpretation [18]. To check the validity of results, a summary of findings and an evaluation sheet were sent to the participants. Seventeen replies out of thirty-four were received, and these confirmed the results.

3. Results

In total, 34 ED staff were interviewed and the interviews took 20-70 minutes (mean= 43 minutes). The interviewees were doctors, nurses, and administrative staff from different grades. Nine participants were male and 25 were female. The age range was 25 to 57 years old. Their work experience in Emergency Medicine and the period of time that they worked in that particular ED ranged from less than one year to more than ten years. Twenty-five interviewees reported having attended computer-training courses in the hospital.

Following data analysis, six main themes were identified. These themes were: users' characteristics; task characteristics, information needs and related issues; ED Information Systems and related issues; training and information technology support; impact of information technology; and users' concerns and expectations. Each of these themes is discussed in the following sections.

3.1 Users' Characteristics

The results showed that demographic characteristics (e.g., age), user knowledge and experience of IT, and user attitude towards using information systems could influence the use of information systems in the ED. For example, a doctor noted:

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

As age did not seem to be an isolated factor influencing the use of an information system, its influence might be explained with respect to other factors, such as users' computer knowledge and users' experiences of IT. In this regard, a nurse noted:

"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).

The above comment showed that in the ED, the older staff members were thought to be less computer literate and less experienced in using IT; therefore, using a computer for daily tasks might not be easily accepted by them. Moreover, staff who had greater knowledge and experience of IT were more positive about, and "happy" with, change and using more advanced information systems, than staff who had no experience of using other computerised information systems. For the latter group, introducing the change and new systems could be even "frightening", as the following example illustrated.

"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).

This suggested that another factor was user attitude towards change and using computerised information systems. The results showed that the administrative staff were more concerned about using a new system in their work than the clinicians. Their main concern was related to the nature of their jobs, since they spent a significant amount of time using a computer, and implementing a new system could noticeably affect their jobs. Another concern was related to the process of patient care which might be affected due to staff being unfamiliar with the system. These perspectives suggested that users' attitudes towards change, e.g., using a new information system, could be affected by their perceptions and beliefs.

3.2 Task Characteristics, Information Needs, and Related Issues

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 nurse, psychiatric nurse, and cardiac nurse. Similarly, the administrative staff included receptionists, secretaries, and managers. Different types of information needs were mentioned by clinicians and non-clinicians. Generally, clinicians needed to have access to medical information, patient information, and occupation-specific information (e.g. psychological information). Non-clinicians mainly needed to have access to patient information, particularly patient demographic information, and job-related information.

To meet their information needs, the ED staff used different sources of information. These were verbal communication, paper-based records, and computer-based records. Verbal communication was the first, and appeared to be the most important, source of information for the ED staff. Apart from communication within the department, clinicians sometimes needed to contact people outside of the department, for example, to have access to patients' primary care records or their social care records. As a nurse noted, this information could help clinicians to give better care to patients:

"For example, if somebody comes and has fallen and broken her leg, yet her 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).

However, in some cases, their attempts might fail and their information needs could not be met. Most of the interviewees mentioned that communication, for example via the telephone, was often *"time-consuming and frustrating"*, especially when the phone was busy. In addition, forgetting messages, misunderstanding, and other types of human error could lead to communication being unsuccessful. A further source of information was paper-based records including ambulance sheets, ED records (ED cards), and patients' hospital medical records, and other types of records. Other sources of information in the ED were computer-based records. Different computer applications, such as the Internet and some databases were also used by the authorised ED staff. Databases included UK poison information service called "Toxbase", "the NHS Strategic Tracing Service (NSTS)", and the "Psychiatric database". The ED Information Systems were used by different staff members who had different access levels. These systems included Patient Focus Information System (PFIS), patient tracking system, and E-film, which are discussed in the next section.

The diversity of jobs and records showed how clinicians and non-clinicians contributed to care for patients. This is an example of team working and task interdependency in the healthcare environment. Moreover, these features, along with a variety of patients' illnesses, the necessity of immediate decision making, and unpredictable workload in the ED, altogether showed the complexity of tasks in the ED, which might not be found in other types of hospital wards.

3.3 Emergency Department Information Systems and Related Issues

In the ED, staff had role-based access to the ED information systems. For instance, one of the administrative staff said *"on the secretarial job, it [PFIS] is just for checking patients"* (Administrative staff 6).

The PFIS was the main information system in the hospital and its ED module was used in the department. Generally, interviewees noted that the PFIS was easy to use. Some of the interviewees mentioned that the system was *"understandable"* (Doctor 4) and *"straightforward"* (Doctor 6). From the clinicians' point of view, the PFIS was perceived to be 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 mentioned that ordering blood tests via a computer was quicker than writing. As mentioned by a nurse, the risk of error could be reduced using the system, since the information was not transferred verbally and the risk of misinterpretation was limited. For the administrative staff, the system was also 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 administrative staff indicated.

The technical problems of PFIS were related to the speed of the system, the system content, systems integration, interface design, navigation, and the system downtime. The main non-technical problem mentioned by the interviewees was related to the quality of information on the system.

The patient tracking system was used as a tool to fulfil the NHS four-hour waiting time target. The patient tracking system showed patient demographic information, the amount of time a patient had been in the ED, and their status. 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). However, in terms of the usefulness of the system, the interviewees had different views. Nurses and administrative staff thought that the system facilitated their work, and helped them in completing the clinical and managerial tasks. However, doctors perceived the system as “an administrative tool” in which data were only entered retrospectively (Doctor 8). In their opinion, the tracking system offered no clear clinical benefit, since it mostly dealt with recording the time. Therefore, despite being easy to use, the patient tracking system was not used by some ED staff. Some clinicians also thought that, in terms of the interface design, the patient tracking system was “confusing” and its screen was “busy” (Doctor 2). A lack of integration with the PFIS, a limited amount of information on the screen, and system downtime were other problems mentioned by the interviewees.

E-film was a new Radiology Information System that had been recently installed in the ED Radiology Department. As mentioned above, when the research was conducted, this system had been implemented in the ED for about “three weeks” (Nurse 4). Interestingly, when the interviewees were asked to talk about this system, many of them only knew that such a system existed in the ED Radiology Department, and some of them thought it was not yet in use. At that time, the printed x-ray films and the digital x-ray images were both available in the ED. Most of the clinicians said that they had not used the system yet, because either they were not qualified in interpreting x-ray images, they thought that the system was not yet operational, or they had not been trained in the use of the system. Interviewees who had used the system were generally satisfied, and thought that it was “easy to use and self-explanatory” (Nurse 11). Apart from the positive aspects of E-film, the technical issues of the system were related to a limited number of high-resolution screens being available in the ED, viewing x-ray images on a particular screen rather than on PCs, and the long start-up time of the system, as mentioned by one of the doctors:

“... it takes probably three minutes to turn the machine on and to get it warmed up, and to access the data, the right software, two to three minutes maybe, and that is frustrating” (Doctor 11).

The main non-technical issue was related to a limited use of the system. As some of the staff noted, inadequate training could be one reason for the apparently limited use of the system. In addition, it appeared that the system was not introduced properly, as some interviewees were not aware of it.

3.4 Training and Information Technology Support

The ED staff were asked to talk about their training in the use of the current ED information systems. According to the interviewees, attendance on the training courses for PFIS was mandatory for the staff who were authorised to use the system. There was no training for the patient tracking system and training in the use of E-film was provided by the senior radiographers only for those staff who were able to interpret x-ray images.

The content of the training courses was based on the functions that a user was authorised to use. Most, but not all, of the interviewees mentioned that the training courses were useful for them. Some clinicians thought that the computer training courses were not adequate for the ED staff. They indicated that there were ED staff who did not even know how to use a computer, and no training was offered to them. Some of the interviewees had difficulties attending training courses, as they had to leave their workplace and get someone else to do their job, or they worked in the afternoons or on the night shifts.

The staff were generally satisfied with the IT support services. In terms of the availability of the IT staff, some of the interviewees indicated that during working hours they were usually available, whereas out of working hours they were on call and it took time to get their help. Moreover, most of

the interviewees agreed that the current computers in the ED were not adequate and they required more computers. One of the nurses said:

"There needs to be more [PCs], more equipment rather than greater depth of information available. The information is there, it is readily available; people don't use it because they don't have the opportunity" (Nurse 2).

The results also indicated that training should not be limited to training users how to use a system, but they should be informed about the usefulness of information systems. For example, a doctor noted *"I can't think of what we are using a computer for"* (Doctor 1). In fact, during training courses, users needed to be informed about the benefits and impact of the systems on their work.

3.5 Impact of Information Technology

The impact of IT was categorised as individual impact, organisational impact, and impact on patient care. In terms of impact on the individual staff, some of the ED staff explained that if they were to use a new computerised information system, they might experience feelings such as fear, stress, and nervousness.

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

Such feelings might be due to a change in their work practice and its consequences. For example, entering data into the computer rather than writing it on a paper might be time consuming. However, the interviewees agreed that using computers could help them gain easier and quicker access to the information that they needed. This, in turn, helped to increase efficiency at a departmental and organisational level. The use of information systems in the ED had also improved staff communication. For example, staff could be informed about a patient's status by using the patient tracking system.

According to the interviewees, the use of information systems could have a positive impact on patient care, mainly by improving the speed of care and the accessibility of information, and saving time for the staff.

"Obviously accurate and quick blood results affect patient care, because nobody likes sitting or lying around for too long waiting" (Nurse 2).

However, a few interviewees asserted that using information technology had no effect on patient care. Some of them even thought that system characteristics could affect patient care negatively, if they had to spend too much time on a computer rather than on patient care, or if the quality of information was not satisfactory.

3.6 Users' Concerns and Expectations

A number of factors, such as implementing change in the ED, the feasibility of all members of staff using computer-based records, the incompleteness and inaccuracy of information on the computer, disruption in a patient-doctor interaction due to using a computer, system downtime and a system crashing made users worry about using computer-based records. The concern of a nurse was illustrated in the following example:

"No time to do all of that, it takes far too long, I don't know who would [use a computer], 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).

From the users' perspectives, the nature and characteristics of the ED in terms of the speed of work, patients' conditions, and the departmental workload could make using computerised systems difficult.

"In the adult A&E [Accident and Emergency Department], you have got drunk people or violent [patients], they may smash the computer screen, so they [the ED staff] are so worried about that, about the safety and the equipment" (Doctor 8).

People who preferred using paper-based records thought that using paper would be easier and quicker when they need to walk around the department. 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. The ED staff expected issues, such as user involvement, change management, and training to receive more attention, and the process of change to be supported by the senior staff. They also expected technical issues, such as systems integration, system speed, and the usability issues to be considered in the future developments.

4. Discussion

Clinical information systems are designed and implemented in various ways. This, undoubtedly, requires a large amount of money, time, and human resource to be invested. While these are all necessary, they are not sufficient [19]. Before designing a system, it is important to have an in-depth understanding of the setting, users' tasks, and users' requirements. Although there is substantial literature on the factors associated with the success or failure of information systems, identifying these factors before designing a system can contribute to a better design, which, in turn, can improve the potential success of the system [20].

The results of the present study showed that different factors, such as the characteristics of users, their task, the systems, and the context of use could influence IT utilisation in the ED, which is consistent with the findings of some earlier studies [4,5,7,10]. These factors are summarised in Table 1.

Table 1 Factors influencing the use of IT in the ED.

Factors	Attributes
User characteristics	User attitude towards using information systems, age, computer knowledge, computer experience
Task characteristics	Task complexity and task interdependency
System characteristics	Perceived usefulness, perceived ease of use
Environmental characteristics	Social environment (e.g. subjective norms), organisational (e.g. IT training and support), physical environment (e.g. location of the computers)
Impact of technology	Individual impact, organisational impact, and impact on patient care

As can be seen from Table 1, a combination of factors, which have been addressed in different theories and models of acceptance, were identified in the current study. For example, two predictors of the TAM model were addressed as system characteristics. The results support the definition of user acceptance as a multi-factorial construction, and this can be used as a framework to evaluate the acceptance of a clinical information system from different perspectives. The current study also showed that providing users with information technology and improving access to the computers are not the same as improving computer literacy and the systems being used [21]. For example, although three computerised information systems were in place in the ED, only the PFIS was used properly compared to other systems. Moreover, with respect to the characteristics of the ED, such as the speed of work and the unpredictable workload, some factors appeared to be more important to the ED staff. According to the results, the main concerns of the ED staff could be addressed by answering four basic questions.

'Why use a computerised system in the ED?'

The answer to this question refers to the usefulness of an information system. In the Technology Acceptance Model (TAM), perceived usefulness is a key construct to predict the level of user acceptance of an information system, and its influence on user attitude and IT use is stronger than the perceived ease of use [11, 22]. In the current study, for example, the results showed that the patient tracking system was regarded as an easy-to-use system; however, the low level of perceived usefulness among clinicians caused limited use of the system. This is in line with Henderson and Deane [23], who suggested that if a system fails to meet users' expectations, a poor perception of the system may lead to user resistance. The results also suggest that while system designers assume that improving ease of use is the most important factor in improving user acceptance of a system [22], an easy-to-use system might not necessarily be useful from the users' point of view. Moreover, it might be assumed that the advantages of using a computer are evident for everyone and training in this area is not necessary; however, the results of this study showed that the clinicians and non-clinicians expected to know more about the direct benefits of using a computer in a clinical setting, such as the ED. Such an expectation stems from a wide diversity in capabilities of the clinical information systems. Therefore, training courses should include information on why clinicians and non-clinicians need to use an information system in their workplace and what the benefits of using these systems are.

'What is the impact of using a computer in the ED?'

The impact of technology on the individual staff, organisation, and the patient care was another important issue mentioned by the ED staff [24]. While it is normally expected to see a positive impact of technology, the likelihood of a negative impact should not be underestimated. The negative impact of technology, such as an increased time for completing a task, or IT-related stress affects user attitude towards change and using an information system [13,20]. This might be why some of the ED staff were not positive about change. Moreover, the results showed that the ED staff needed a system that was able to meet their information needs, and fitted in with their work. Such a system could also improve efficiency and effectiveness in the department, and could contribute to improve patient care by improving the accessibility of information. Therefore, it is important to identify how using technology may help to improve a process rather than interrupting it.

'Who is the user of a computerised system in the ED?'

Although a number of computerised systems have been implemented in the EDs, the issue of not keying data by all members of staff has been a barrier to proper use of these systems. For example, in some studies, doctors and nurses argued that data entry is not their job [25,26]. While changing the policy and asking the administrative staff to undertake data entry can be a solution in a number of EDs, other approaches, such as the role of the clinical directors and the nurse supervisors in encouraging the clinical staff to use the systems should not be underestimated. Moreover, demonstrating the usefulness and direct benefits of the systems could encourage clinicians to use the systems.

'How to use a computerised system in the ED?'

The influence of training and IT support on the acceptance and use of a system has been discussed in several studies [23, 27, 28]. In this study, the results showed that more computer training was needed for the ED staff. It might be assumed that all clinicians and non-clinicians had adequate training during their education. This assumption may not be true, since they might have acquired their IT skills by being self-taught, through self-directed learning, the requirements of work, or other activities. Therefore, when introducing a new information system, users should be trained specifically in the use of that system [29]. With respect to the workload and the characteristics of the ED, different methods of training should be studied and the best suited one to the ED should be applied [21].

The above mentioned questions can contribute to developing better ED systems and better change management strategies in the future. In terms of developing new systems, the first three questions help to justify why, and for whom, a system should be developed. In terms of change management, all four questions can be regarded as the principles of a strategy for introducing change and new systems. In this strategy, users are involved and their main concerns are addressed.

Limitations

This was a qualitative study, in which we collected data from one ED where specific information systems were used. Qualitative studies do not aim to be representative, but this ED was located in a typical hospital, so we see no reason why the results should not be relevant, or transferable, to other EDs with similar types of information systems. Our sampling method was also affected by working patterns in the ED. Therefore, we were restricted to using convenience, rather than purposive sampling, although we did manage to interview a diverse range of staff, and we expected to reflect a full range of opinions.

In order to confirm the results from this study and to generalise the findings to other EDs, a larger-scale quantitative study using a representative sample of ED staff would be needed. Applying quantitative methods in a wider population could help to validate the study findings.

5. Conclusion

This paper presented an overview of factors that might influence the use of information systems in the ED. These factors were related to the characteristics of users, tasks, systems, environment, and the impact of technology. This information could help system designers to understand users' concerns and expectations. Furthermore, identifying these factors can help to introduce the change into a setting more effectively. The priority and importance of these factors might be different based on the context of use and the characteristics of each setting. Therefore, further research is needed to investigate their importance and their relationships with the use of computerised information systems in the ED.

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