

What factors influence emergency department staff attitudes towards using information technology?

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ABSTRACT

Objectives Information technology (IT) has an important role in the emergency department (ED) functioning, but staff attitudes can influence the way IT is used.

Qualitative research into the perceptions of the ED staff has identified a variety of individual, environmental and system factors that may influence attitudes towards using IT. The authors aimed to determine which factors predict attitudes towards using IT and which factors are the most influential.

Methods Findings from a previous qualitative study were used to develop a self-administered questionnaire measuring individual, environmental and system factors, along with staff attitudes towards using IT. The questionnaire was sent to 535 staff working in three English EDs. Simple linear regression was used to examine the relationship between each potential predictor and user attitude, and multiple regression was used to identify the most important predictors.

Results Completed questionnaires were returned by 362/535 participants (68%). The factors with the strongest positive association with staff attitudes towards using IT were the perceived individual impact of technology ($r^2=39\%$, $p<0.001$), perceived usefulness ($r^2=7\%$, $p<0.001$), perceived ease of use ($r^2=2\%$, $p=0.006$), perceived subjective norms ($r^2=1\%$, $p=0.013$) and computer experience ($r^2=1\%$, $p=0.034$).

Conclusion The perceived individual impact of technology is the most important factor in determining ED staff attitude towards using IT. The ED staff are more likely to view using IT systems positively if they can see direct individual benefits arising from their use.

INTRODUCTION

The emergency department (ED) is a complex environment where the speed and variety of work create challenges different to other healthcare settings. The ED can be regarded as a small-scale healthcare delivery system in terms of the process of care and the categories of required information.¹ The unpredictable nature of the workload within the ED makes the use of information technology (IT) and information systems more challenging, but also potentially more beneficial. An understanding of the factors that can influence the use of an information system by clinical and administrative staff can help improve acceptance, leading to more effective use of technology.²

Clinician resistance is a major barrier to the implementation of computerised information systems.³ This might be due to technical, organisational or individual factors.⁴ If a system fails to meet clinical needs or if the clinicians believe their

jobs will be worse if they use IT, they may resist or reject the new technology.⁵ The opposite of resistance is acceptance, and represents the willingness of users to use the technology.⁵ Despont-Gros *et al* 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.'⁶ The degree of acceptance and factors predicting acceptance can be measured and used to inform implementation.^{7 8}

Previous studies have suggested that clinicians may accept change and use a new information system if it has a positive impact on their work.⁴⁻⁶ System designers need to understand clinical requirements, workflow and problems with the existing systems.^{9 10} Similarly, clinicians need to be involved in the process of change,¹¹ and be informed about the purpose of a new information system, the potential benefits and impacts, and any anticipated changes in their workflow.⁹ These can help to improve acceptance of the new system¹² and facilitate the system design and implementation. Opinion leaders, such as senior staff,^{11 13} provision of IT training^{5 13} and the diversity of the environment in which a system operates^{9 14 15} can also influence acceptance. Clinicians' attitudes are also important to accept a new information system.^{10 16-19}

Although several studies have investigated factors influencing attitudes towards, and the use of, clinical information systems in different settings, few have investigated factors influencing attitudes towards information systems in the ED. Given the specific characteristics of the ED, research could be helpful to guide design and implementation of future systems. We previously undertook a qualitative study^{20 21} that identified potential factors influencing staff attitudes towards using IT in the ED (see figure 1). Qualitative studies are useful for developing hypotheses, but quantitative methods are required to test these hypotheses and determine whether findings are representative of the ED staff in general. The aim of this study was therefore to identify the most important factors influencing the attitudes of staff towards using IT in the ED.

METHODS

The study was approved by the Research Ethics Committee of the Information School at the University of Sheffield.

Questionnaire design

A questionnaire was developed using the relevant literature and main findings of our earlier

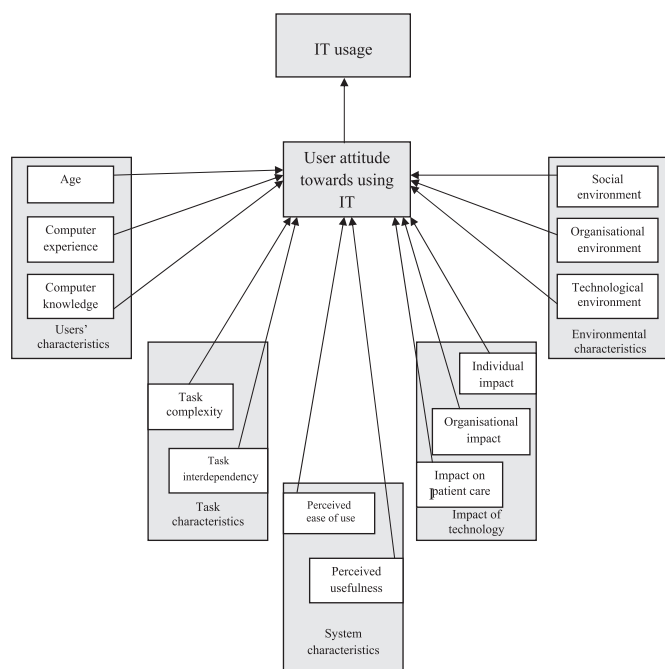


Figure 1 Potential factors influencing attitudes towards, and the use of, informational technology (IT) in the emergency department.

qualitative study.^{20 21} A 5-point Likert scale was used to elicit response categories ranging from strongly disagree (−2) to strongly agree (+2). In order to reduce potential bias in participants' responses, both positive and negative statements were used in the questionnaire. Scores for the negative statements were reversed, that is, strongly disagree (+2) to strongly agree (−2). The final questionnaire contained 41 questions in eight sections relating to the constructs in figure 1 (see appendix I). Minor changes were made following a pilot study.

Setting and recruitment

The study was undertaken between October 2008 and January 2009 in three regional EDs in England with different information systems, annual patient census and organisational characteristics. These EDs were located in the north and west Yorkshire and the east midlands of England. One of them was located in a district general hospital and the others were in teaching hospitals. The largest ED in the UK was one of these settings. In each ED, there was a local contact who could help to facilitate the survey. All three EDs used computer systems and users were able to use specific functions of the systems based on their access level. The use of the systems was mainly influenced by the ED staff roles, their needs and the functions of the systems to which they had access. Most of the EDs were using systems which had been implemented a few years ago. In one ED, the newest system was picture archiving and communication system which was used since 2007. In another ED, Agfa, a system similar to picture archiving and communication system had been upgraded to a new version in 2008. All staff who had access to the ED information systems were invited to participate. Having designed the self-administered questionnaire and following the pilot study, it was posted to the research facilitators (SYL, MD, FAK) in the three EDs and was administered by them in each hospital.

Validity and reliability

The content validity of the questionnaire was established through the qualitative study and from the relevant literature.

The face validity of the questionnaire was established through a pilot study and discussion within the research team. The internal reliability of the constructs (figure 1) was measured using Cronbach's α coefficient. This was >0.70 for four constructs: user attitude; task characteristics; system characteristics; and the impact of technology, and responses for these constructs were combined into scales. However, it was low for the environmental characteristics construct ($\alpha=0.39$), indicating that this construct had limited internal consistency. We therefore analysed the four internally consistent constructs as primary hypotheses, but analysed the individual question responses relating to the environmental characteristics as secondary hypotheses.

Data analysis

Data were analysed using SPSS for Windows V.15.0. The sum of the scores for the scales and subscales was calculated, such that individuals with higher scores were more positive about using IT. Simple and multiple linear regression were used to test the importance of each independent variable in relation to attitudes towards using IT in the ED (dependent variable) in the following way.

First, simple linear regression was used to examine the primary null hypotheses that there was no association between each of the following independent variables and the dependent variable (staff attitudes): staff characteristics (age, computer knowledge and experience), the task characteristics scale (perceived task complexity and perceived task interdependency), the system characteristics scale (perceived ease of use and perceived usefulness) and the impact of technology scale (perceived individual and organisational impact of technology, and perceived impact on patient care). The variables that were significantly associated with attitudes towards using IT in the ED were included in a multiple linear regression model (model 1) to identify the factors that predicted staff attitudes. A forward stepwise approach to variable selection was used, with entry into the model at the 5% level, and removal at the 10% level.

Second, simple linear regression was used to examine the secondary null hypotheses that there was no association between each of the social, organisational and technological environment variables (ie, the variables that had low internal consistency as a scale) and the dependent variable (staff attitudes). The variables that were significantly associated with attitudes towards using IT in the ED were included in a multiple linear regression model (model 2) to identify the factors associated with staff attitudes, using a forward stepwise approach, as above.

The significant variables from models 1 and 2 were then included in a final multiple regression model (model 3) to identify the most important factors associated with staff attitudes, using a forward stepwise approach, as above. Finally, the relationship between staff attitudes towards using IT in the ED and reported use of IT was tested using simple linear regression.

RESULTS

Sample characteristics

In this study, the whole eligible population of staff in three EDs ($n=535$) were invited to participate (94 (17%) in hospital A, 144 (27%) in hospital B and 297 (56%) in hospital C). Approaching the whole population helped to increase the number of responses and studying three EDs enhanced the generalisability of the findings, as the EDs were different in the size, work load, geographical location and organisational structure. The

questionnaire was completed in two waves. During the first wave of the survey, 286 questionnaires (79%) were completed and, after sending reminders a further 76 replies (21%) were received. The facilitators were responsible for distributing reminder letters, as well as reminding participants verbally to complete the questionnaires. The proportion of responders by the study sites were 53.1%, 69.4% and 71.3%. In this study, the non-respondents' data were not gathered. Completed questionnaires were returned by 362/535 (68%).

More than two-thirds of respondents were female subjects (73% (n=265)). The respondents' professions were as follows: doctors (n=107; 30%), nurses (n=177; 49.0%), administrative staff (n=50; 14%) and other clinical staff (n=27, 7%). Most of the respondents (n=252, 71%) were 40-years-old or younger and the mean age was 36-years-old (range: 20–66). Further details are reported elsewhere.²²

Reported IT use, computer knowledge and experience

The reported amount of IT use ranged from 0 to 40 h in a week. The results showed that the highest percentage of respondents (n=132, 38.7%) used information systems in their workplace for '0.1–5.0' h per week. The internet (n=340, 96%) and WORD (n=339, 96%) were the applications with the highest reported usage. PowerPoint (n=236, 67%), EXCEL (n=215, 61%) and ACCESS (n=84, 24%) were also used. Almost half the respondents (n=178, 49%) rated their computer knowledge as 'average', while 99 respondents (27%) perceived their computer knowledge as 'good' and 51 respondents (14%) reported their computer knowledge as 'poor' or 'very poor'.

Figure 2 shows the distribution of attitude scores in the EDs. Most of the participants agreed (n=204, 56%) or strongly agreed (n=133, 37%) that 'using computerised information systems in the ED is a good idea.' Similarly, most respondents agreed (n=162, 45%) or strongly agreed (n=125, 35%) that using computerised information systems in the ED is better than using manual methods. Most of the respondents also agreed (n=196, 54%) or strongly agreed (n=92, 26%) that using computerised information systems in the ED is more helpful than a hindrance. Finally, most of the respondents disagreed (n=162, 45%) or strongly disagreed (n=140, 39%) with the attitude statement 'If I had a choice, I would not use computerised information systems in the ED.'

In this study, the theoretical concept of the dependent variable (staff attitude) was assumed to be continuous and the

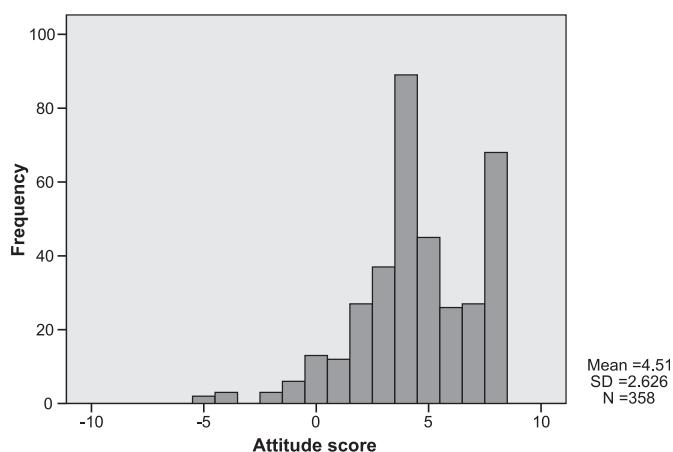


Figure 2 Frequency of scores for users' attitudes towards using information technology in the emergency department.

scores were calculated to be used in linear regression. Univariate analysis of user, system and task factors and the impact of technology showed significant associations between staff characteristics (age ($p<0.001$), computer knowledge ($p<0.001$) and experience ($p<0.001$), perceived task interdependency ($p=0.035$), perceived ease of use ($p<0.001$), perceived usefulness ($p<0.001$), perceived individual ($p<0.001$) and organisational ($p<0.001$) impact of technology, perceived impact on patient care ($p<0.001$) and staff attitudes towards using IT in the ED. When these variables were included in the multiple regression model, four variables (table 1) explained 0.496, or 50%, of the variance in the staff attitudes towards using IT in the ED. The contribution of each factor to the variance was as follows: perceived individual impact of technology (41%), perceived usefulness (6%), perceived ease of use (2%) and computer experience (1%).

The secondary hypotheses examined the associations between the environmental characteristics and staff attitudes towards using IT in the ED. There were significant associations between perceived subjective norms ($p<0.001$), helpfulness of the senior staff ($p<0.001$), perceived adequacy of training ($p=0.002$), perceived staff involvement in the process of developing information systems for the ED ($p=0.023$), use of bedside computer terminals in the ED ($p<0.001$), perceived appropriateness of the location of computer terminals ($p=0.027$) and use of portable computers ($p<0.001$) and staff attitudes towards using IT in the ED. Table 2 shows the results of multivariable analysis of these factors. Five variables remained in the model, accounting for 0.155, or about 16%, of the variance in staff attitudes towards using IT in the ED.

Table 3 shows the results of the third model, which included all the independent predictor variables from models 1 and 2. The influence of the perceived individual impact of technology accounted for 39% of the variation in staff attitudes. Perceived usefulness and perceived ease of use contributed to 7% and 2% of variation in staff attitudes, respectively. Finally, perceived subjective norms and computer experience each accounted for about 1% of the variation in staff attitudes.

Finally, there was a small, but significant ($p=0.016$), association between staff attitudes towards using IT in the ED and the reported IT use: this explained 2% of the variance in reported IT use.

DISCUSSION

Given the potential benefits of using IT in the ED, it is important to understand how staff attitudes towards using these systems are influenced by other factors. Our previous qualitative study^{20 21} suggested that the characteristics of staff, their tasks, systems and the environment, as well as the impact of technology, might influence staff attitudes and subsequent use of IT

Table 1 Predictors of attitudes towards IT: summary of stepwise multiple regression (model 1)*

Predictor variables	Standardised coefficient (β)	p Value	R ²	R ² Change
Perceived individual impact	0.345	<0.001	0.407	0.407
Perceived usefulness	0.297	<0.001	0.467	0.060
Perceived ease of use	0.160	0.001	0.490	0.023
User computer experience	0.087	0.036	0.496	0.006

*Variables excluded from the final model: age, computer knowledge, perceived task interdependency, perceived organisational impact and perceived impact on patient care. IT, information technology.

Table 2 Predictors of attitudes towards using IT: summary of stepwise multiple regression (model 2)*

Predictor variables	Standardised coefficient (β)	p Value	R ²	R ² change
Perceived subjective norms	0.221	<0.001	0.068	0.068
Views about using handheld devices in the ED	0.173	0.002	0.112	0.044
Views about appropriateness of the location of the computers	0.134	0.009	0.130	0.028
Views about using bedside computer in the ED	0.131	0.019	0.145	0.015
Adequacy of training in the use of information systems	0.100	0.049	0.155	0.010

*Variables excluded from the final model: perceived helpfulness of the senior staff in the use of information systems and the importance of user involvement in the process of developing information systems for the ED.

ED, emergency department; IT, information technology.

in the ED. The current study aimed to test the hypotheses that these characteristics predicted staff attitudes towards using IT.

Overall, the ED staff attitudes towards using IT in the ED were positive. The principal predictors of staff attitudes were 'perceived individual impact of technology', 'perceived usefulness', 'perceived ease of use', 'perceived subjective norms' and 'user computer experience', and the strongest predictor was the perceived individual impact of technology. This means that the ED staff had a more positive attitude towards using IT in the ED if they recognised that the technology had a positive impact on their individual ability to carry out their work, and if the systems were perceived to be useful. The perceived ease of use, perceived subjective norms and users' computer experience, although significant, appeared less important.

While the main aim of implementing information systems in clinical settings is to improve efficiency and effectiveness,¹⁹ the possibility that there is no improvement, or that there could be negative impacts, should not be underestimated. In some studies, direct value for patient care has been suggested as a basis for evaluating clinical information systems by healthcare professionals.²³ Other authors have reported their findings about the negative impact of IT. Ammenwerth *et al* found that an increase in the documentation time caused staff to show negative attitudes towards using a computer in nursing, possibly due to a lack of fit between the actual practices and the system functions.¹⁴ In another study, Moody *et al* found that while 64% of respondents perceived that the nursing workload had not been decreased by using EHR in the hospital, 75% of respondents thought it had improved documentation.²⁴

The perceived usefulness of an information system was a more powerful predictor of staff attitudes than the perceived ease of use (7% vs. 2%). This is consistent with findings of Davis, which showed that the influence of perceived usefulness was much stronger than the influence of perceived ease of use.¹⁹ Chismar and Wiley-Patton found that perceived usefulness had a significant influence on the use of the internet by doctors; however, perceived ease of use was not significant.²⁵ They suggested that users might be willing to use a beneficial system, even if it was not easy to use. Our results suggest that system

usefulness and ease of use were both important for the ED staff. A possible explanation for this might be the nature of the ED in which the speed of care and decision-making are of high importance. Therefore, systems have to be easy to use to save users' time, and useful to improve users' performance. Although system usefulness and ease of use both are important factors, these can be affected by the technical issues. For example, the shortage of computers can influence the use of the system, no matter how useful the system is perceived by users.²⁶

Limitations

In this study, a single questionnaire was designed and used for several occupational groups, that is, doctors, nurses, administrative staff and other clinical staff. While more profession-specific questionnaires may have provided more detailed information, our approach helped to draw more general conclusions regarding the factors that might influence staff attitudes and the subsequent use of IT in the ED. The survey was conducted in three EDs, and so a number of issues, such as the period of time that the staff were using the systems, their training, systems' maintenance strategies, the type of information systems and their design, and the organisational issues might have influenced perceptions in each setting. While these issues need to be taken into account when reporting the results for each setting, when taken as a whole, this diversity produced a representative sample of the wider population of the ED staff.

Moreover, the non-responders' data were not collected and the analysis does not reflect the attitudes of the non-responders towards using IT in the ED. There might be a possibility that the non-responders were less likely to use IT or less interested in the subject of the research. However, the workload in the ED might also be a reason for not completing the survey rather than their negative attitudes towards using IT.

CONCLUSION

The ED staff may have a more positive attitude towards using IT in the ED if they recognise that the technology will have a positive impact on their own work. This is the most influencing factor on their attitude and can be achieved by training

Table 3 Predictors of attitudes towards IT: summary of stepwise multiple regression (model 3)*

Predictor variables	Standardised coefficient (β)	p Value	R ²	R ² change
Perceived individual impact	0.334	<0.001	0.389	0.389
Perceived usefulness	0.294	<0.001	0.460	0.071
Perceived ease of use	0.136	0.006	0.478	0.018
Perceived subjective norms	0.100	0.013	0.487	0.009
User computer experience	0.089	0.034	0.494	0.007

*Variables excluded from the final model: views about using handheld devices in the ED, views about appropriateness of the location of the computers, views about using bedside computer in the ED and adequacy of training in the use of information systems.

ED, emergency department; IT, information technology.

the staff and improving their knowledge about using technology in the ED. Before introducing any new systems, it is necessary to demonstrate its positive impact and usefulness in practice and make the users ready to use it. Other factors, such as perceived ease of use, subjective norms and user computer experience that might influence users' attitudes towards using IT in the ED should also be taken into account. Further research could usefully compare the associations between the most important factors and attitudes towards using IT in the ED across the professional groups.

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Contributors This study was undertaken by HA as part of a PhD study under the supervision of PB and SG. HA developed the initial framework and conducted the survey with the support of, and advice from, SG and PB. SYL, MD and FAK facilitated conducting the survey in the settings of the study. HA was also responsible for data analysis which was critically reviewed by PB and SG. The first draft of the paper was prepared by HA and the other authors all had input in developing the final text.

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Competing interests None.

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