Assessing the Motivation of MDs to use Computer-based Support at the Point-of-Care in the Emergency Department

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Abstract

A significant body of research investigates the acceptance of computer-based support (including devices and applications ranging from e-mail to specialized clinical systems, like PACS) among clinicians. Much of this research has focused on measuring the usability of systems using characteristics related to the clarity of interactions and ease of use. We propose that an important attribute of any clinical computer-based support tool is the intrinsic motivation of the end-user (i.e. a clinician) to use the system in practice. In this paper we present the results of a study that investigated factors motivating medical doctors (MDs) to use computer-based support. Our results demonstrate that MDs value computer-based support, find it useful and easy to use, however, uptake is hindered by perceived incompetence, and pressure and tension associated with using technology.

Introduction

There is a significant body of research on using computer-based support at the point-of-care and the conditions these systems need to satisfy in order to be useful in practice[1, 2, 3]. Typical evaluations of computer-based clinical support tend to focus on the usability of systems, where factors such as perceived usefulness and ease of use are used to determine the acceptability of the system in practice. For example, measures of usability widely quoted in the literature include use or non-use, heavy or light use, extent of use, features used, tasks supported, frequency of use, and duration. These measures are combined to estimate a user's intention to use a system[4].

Our research is focused on developing point-of-care technologies that support MDs in the Emergency Department (ED). To this end we have developed a suite of point-of-care support tools, the most recent of which is MET3-AE (Mobile Emergency Triage – Asthma Exacerbation), a clinical decision support system that predicts asthma exacerbation severity and offers support to MDs in managing and treating paediatric asthma patients[5]. The MET3-AE system was trialled between 2009 and 2010 at the ED of Children's Hospital of Eastern Ontario. The primary focus of the trial was to evaluate the diagnostic accuracy of the embedded asthma exacerbation decision model. After the trial we asked participating MDs to complete a two-part questionnaire where the first set of questions focused on examining their attitude towards computer-based support at the point of care (devices and commonly used clinical applications), and the second set of questions were concerned with the usefulness of the MET3-AE application. In this paper we discuss the responses we obtained for the first part of the questionnaire which was designed to elicit those factors that intrinsically motivate MDs to use computer-based support in general. Our premise is that MDs motivation to use technology is important and worthy of analysis, as while many healthcare organizations recognize the benefits of computer-based support, they often encounter difficulties in overcoming the resistance of clinicians who may not perceive the benefits of technology adoption as being important for their tasks[6, 7]. Indeed this resistance is often reported as a key barrier to widespread adoption of computer-based support[8].

Studies outside of the clinical domain have used motivation theory to explore the factors that influence technology acceptance. Much of the research has been concerned with extrinsic motivation, and explores what outcomes outside the activity itself influence the end-user's performance (e.g. goal and rewards systems) [9, 10, 11]. At the same time, intrinsic motivation, defined as an end-user's propensity to engage in activities of interest and the resultant promotion in learning and expansion of the individual's capacities[12], is less well reported. Specifically, intrinsic

motivation entails "positively valued experiences that individuals derive directly from a task", and "conditions specific to the task that produce motivation and satisfaction, where a task is defined as engagement in a set of activities for a purpose"[13].

Important facets of intrinsic motivation outlined in Deci and Ryan's Cognitive Evaluation Theory[14], include feelings of competence (self-efficacy) during the performance of an action and an end-user's autonomy. We posit that a better understanding of intrinsic motivation and its relationship with other important constructs such as extrinsic motivation and usability could add to better understanding of MDs attitudes towards use of computer-based support. Furthermore, an appreciation of the role played by intrinsic motivation could have practical implications for developers of computer-based support systems as well as for clinical managers considering the deployment of such systems.

To this end we describe the results of a study that examined MDs intrinsic motivation to use a point-of-care computer-based support in the ED. Motivation was assessed using the Intrinsic Motivation Inventory (IMI) tool[15], which is a multidimensional scale that measures an individual's personal experience in performing a target activity. The instrument assesses motivation in terms of participants' interest and enjoyment, perceived competence, effort, value and usefulness, felt pressure and tension, perceived choice and relatedness to others while performing the given activity. The IMI has been previously applied to assess users' intrinsic motivation to use information systems[16, 17]; however we are not aware of it being applied to measure MDs motivation to use clinical computer-based support. Our analysis shows that the tool can provide useful insights into motivating factors for using computer-based support at the point-of-care in the ED. We propose that the IMI tool be used to supplement usability analysis which measures acceptability, with an intrinsic motivation dimension which estimates the subjective factors that stimulate MDs to use computer-based support.

The rest of this paper is organized as follows. In the next section we review related research in information system analysis and evaluation from a user perspective. We then provide a detailed description of the IMI tool for measuring intrinsic motivation. We continue with a description of the trial of a computer-based support application and our methods for collecting data about MDs perceptions of point-of-care support technology in the ED. We describe how we applied the IMI tool to analyze these perceptions and present our experimental results. We conclude with a discussion.

Background

Studies on information technology continuously report that user attitudes are important factors affecting the successful implementation of information systems. The Theory of Reasoned Action (TRA) is a frequently used model from social psychology that posits that behaviour is predicted by the behavioural intention which subsequently is predicted by a person's attitude and subjective norms[18]. Davis[19] adapted the TRA in the development of the Technology Acceptance Model (TAM). According to TAM, perceived ease of use and perceived usefulness, are significant determinants of behavioural intention to use an information system. In other words, TAM suggests that users formulate a positive attitude towards the technology when they perceive this technology to be useful and easy to use. TAM's measurement scales have been validated across domains and different experiments, and have demonstrated internal consistency and high reliability. It has also been found that the model has predictive validity for intent to use, self-reported usage, and attitude towards use[20]. Thus TAM has gained widespread acceptance within the information systems research community[21, 22].

In 2000, TAM was updated to TAM2, which aimed to improve TAM's predictive ability by introducing moderators to qualify the effects of perceived ease of use and perceived usefulness of intentions. The moderators included demographic variables (e.g., gender, age), users' experience and an introduction of voluntary versus mandatory contexts of usage[23].

A key criticism of TAM and TMA2 has been the lack of a factor addressing user motivation. In order to address this shortcoming, Venkatesh et al.[24] formulated a unified model, the Integrated Model of Technology Acceptance, which integrates a motivational model of user acceptance with the TAM. Subsequent research showed that the Integrated Model of Technology Acceptance "emerged as a better predictor of user behaviour when compared to the existing models"[24]. However, the belief-intention-behaviour chain embedded in the Integrated Model of Technology Acceptance emphasizes notions of instrumentality, focusing on functional or extrinsic motivational drivers while ignoring an individual's subjective or intrinsic feelings of positive experience with information system usage[25]. At

the same time behavioural research suggests that extrinsic and intrinsic motivators jointly determine the adoption of new technologies[26]. Furthermore, motivation theorists argue that the reason individuals perform actions is not only because of external interests but for their intrinsic needs such as enjoyment and curiosity[27]; and others suggest that people spend more time and effort on a task and have increased exploratory behaviour and greater acceptance of information technology when tasks create a high level of intrinsic motivation[28, 29].

Efforts have been made to measure intrinsic motivation. For example, Webster and Martocchio[30] conceptualized intrinsic motivation as "computer playfulness". Their research introduced a game context to computer-based training to induce a state of playfulness among users and make the task more intrinsically motivating. Webster and Martocchio's scale has been used to examine the role of intrinsic motivation in decision support system use in various applications including online help desks, real estate and property management, and financial services[19, 31, 32]. For example, Davis et al.[19], found that extrinsic motivation (operationalized as perceived usefulness), and intrinsic motivation (operationalized as enjoyment), accounted for 62% of the variance in user intentions to use information systems in one study and 75% in another. Their findings suggest, "usefulness (extrinsic motivation) and enjoyment (intrinsic motivation) together represent a simple yet powerful explanation of what influences usage intentions". Venkatesh[31] found that the use of an intrinsic motivator during training could help create positive user perceptions of an information system, while Venkatesh and Speier[32] reported higher levels of intention and intrinsic motivation to use a new technology among participants who partook in game-based training.

Intrinsic Motivation Inventory

The Intrinsic Motivation Inventory (IMI) is a multidimensional measurement scale intended to assess a persons' subjective experience related to a target activity[15] such as using, for example, a computer-based support system. It is typically employed to determine intrinsic motivation and self-regulation. The IMI consists of a number of subscales, including - interest and enjoyment, perceived choice, perceived competence, pressure and tension, effort, value and usefulness, and relatedness.

The interest and enjoyment subscale is the self-reported measure of intrinsic motivation. The perceived choice and competence concepts are theorized to be positive predictors of both self-reported and behavioral measures of intrinsic motivation, and pressure and tension is theorized to be a negative predictor of intrinsic motivation. Effort is a separate predictor that is relevant to some motivation issues, for example, if a user perceives a task to be too difficult and requires too much effort they will not be motivated to complete it. The value and usefulness subscale is used in internalization studies, the idea being that people internalize and become self-regulating with respect to activities that they experience as useful or valuable for themselves. Finally, the relatedness subscale is used in studies having to do with interpersonal interactions, friendship formation, and so on. All subscales need not be used to measure intrinsic motivation for a given task – the evaluator selects the subset of subscales that are most relevant for the activity under investigation.

Each subscale has an associated series of generic statements that outline a set of possible beliefs about a particular subscale for an activity. Individual statements can be customized for the task-at-hand. For example, "I tried very hard to do well at this activity" associated with the effort subscale, can be tailored to "I tried very hard to use computer-based support in the ED", without effecting its reliability or validity. Respondents evaluate each statement using a Likert scale with values raging from 1-7 where a rating of 1 indicates that the statement is not true at all and a rating of 7 indicates that the statement is very true for the given user and activity.

The application of IMI involves a varied number of items from the subscales, all of which have been shown to be analytically correct and stable across a variety of tasks, conditions, and settings. Past studies using the IMI have examined internalization with an uninteresting computer task[16], text learning[17] and intrinsic motivation in sports[33].

Experimental Setting

A prospective study approved by the hospital's ethics review board was started in February 2009 in the ED of the Children's Hospital of Eastern Ontario (CHEO), and lasted for about 12 months[5]. The long duration of the study was due to unforeseen circumstances related to new measures for dealing with the H1N1 virus in the ED and a reorganization of the department due to the construction of a new facility. In the study, participating MDs used Motion Computing C5 tablet computers that communicated with a dedicated trial server using a wireless network available in the ED. At the time of the study, the Motion Computing C5 tablet had just been introduced as the supported mobile device at CHEO. A limited number of these devices were in use and preconfigured to interact with

other clinical systems in the ED. These systems included an EPIC ADT (admission-discharge-transfer) system and Sunrise ED Manager for patient tracking and managing clinical information. Both systems communicated via an eGate interface engine using HL7 messages.

In total 36 members of the ED medical staff – Pediatric Emergency Fellows, senior Medical Residents and ED physicians participated in the study. There were slightly more female than male participants (58% vs. 42%) and senior Medical Residents constituted the largest clinician's group (56%), followed by ED physicians (36%) and Pediatric Emergency Fellows (8%). Using generally accepted categorization of levels of clinical expertise, 36% of the participants (ED physicians) should be considered as clinical experts while 64% should be considered to be novice. All senior Medical Residents and Pediatric Emergency Fellows were younger than 40 years old while over 50% of the ED physicians were at least 40 years old. All participating clinicians were given short orientation sessions about the study and the Motion Computing C5 tablet. We recognize some limitations of the study, namely that it was conducted at one center with a relatively small number of participants. In addition 75% of participants were under 40 years old, therefore the age-related demographics of the group were younger than average for the general medical profession.

Experimental Design

All participants responded to the computer-based support questionnaire; firstly participants provided details about their experience with computer-based support and their use of it in clinical care, and secondly they rated the usability of specific features of the mobile Motion Computing C5 tablet.

In the section addressing experience of computer-based support in clinical care, MDs were asked to answer the following five questions:

> *Question 1: How would you rate your comfort level with technology and computer-based support, in general?*
>
> *Question 2: How would you rate your computer proficiency in relation to your peers?*
>
> *Question 3: For each of the following computer-based support applications, please tell us how often you have used it for work-related purposes in the past year, followed by how you would rate your level of expertise.*
>
> *(i) Browsing web-based medical sites (e-medicine, Up-to-date)*
> *(ii) Conducting searches of medical repositories (PubMed, etc.)*
> *(iii) Creating or modifying documents (word processing)*
> *(iv) Creating or modifying spreadsheets*
> *(v) Sending or receiving Email*
> *(vi) Viewing images on PACS*
> *(vi) Using clinical repositories (Sunrise, ED Manager) or EHR's*
> *(vii) Utilizing research databases or statistical software*
>
> *Question 4: Do you currently use a personal portable device (e.g. smart phone or PDA) for clinical care in your usual practice environment?*
>
> *Question 5: Had you used the Motion Computing C5 tablet before this trial?*

In the section addressing the use of mobile devices for computer-based support (using the Motion Computing C5 tablet as a mobile computing device), MDs were asked to answer the following question:

> *Please rate the usefulness of, and effort required to use the following features of the Motion Computing C5 tablet:*
> *(i) Digital pen*
> *(ii) Data entry*
> *(iii) Access to Sunrise ED Manager*
> *(iv) Use at the bedside*

We selected five of the seven IMI subscales as appropriate for analyzing computer-based support in clinical care - interest and enjoyment, perceived competence, pressure and tension, effort, and value and usefulness. The relatedness subscale is concerned with interpersonal interactions and thus was not used in the study. Participation in the study was voluntary therefore we did not assess the perceived choice subscale. All questions relating to general computer-based support were allied with one or more of the selected subscales. For example, Question 1, "*How would you rate your comfort level with technology and computer-based support, in general?"* was mapped to IMI subscales "Perceived Competence" and "Interest and Enjoyment". The complete mapping of questions to IMI subscales is shown in Table 1.

Table 1. Mapping questions to IMI subscales

Question		**IMI Subscale**
Please provide details about your experience with technology and your use of it in clinical care:	*Question 1*	*Perceived Competence* *Interest and Enjoyment*
	Question 2	*Perceived Competence*
	Question 3 *(i)-(vii)*	*Value and Usefulness* *Perceived Competence*
	Question 4	*Perceived Competence*
	Question 5	*Pressure and Tension*
Please rate the usefulness of and effort required to use the following features of the Motion Computing C5 Tablet:	*(i) – (iv)*	*Value and Usefulness* *Effort*

A number of statements associated with each subscale were then selected and tailored for the particular task. For example, some of the statements selected from the "Perceived Competence" subscale were, *"I think I am pretty good at using technology and computer-based support"*, *"I am satisfied with my performance when using technology and computer-based support"* and *"Using technology and computer-based support is an activity I cannot do very well"*. Some of the statements selected from the "Interest and Enjoyment" subscale *included "I enjoy using technology and computer-based support very much"*, *"I think using technology and computer-based support is quite enjoyable"*, and *"I think using technology and computer-based support is a boring activity"*. Users were then asked to rate these statements to indicate how true a particular statement was for them using a Likert scale.

Results

In this section we present the results of the IMI analysis. Figure 1 shows the mean scores across all questions for each IMI subscale used in the evaluation. The following subsections describe the findings for individual subscales.

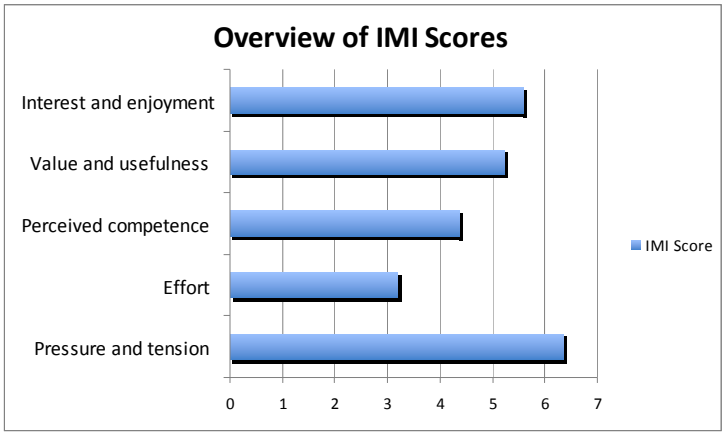

Figure 1. Mean Scores across IMI subscales

Interest and enjoyment
Enjoyment is considered the most integral factor of intrinsic motivation. If MDs are intrinsically motivated to use computer-based support, the enjoyment associated with this activity should be sufficient to make the MDs want to use computer-based support again in the future. The results of our analysis show a mean score of scores of 5.58 (where 7 is the maximum enjoyment), and a standard deviation of 1.13, for this subscale. Therefore, the fact that MDs find technology enjoyable and interesting to use is a positive predictor for the adoption and continued usage of computer-based support at the point-of-care in the ED.

Value and usefulness
MDs perception of the value and usefulness of computer-based support can act as a significant motivator for them to adopt and continue to use it. People internalise and self-regulate with activities that they perceive as being useful or of benefit for themselves. Figure 1 shows that the mean IMI score for value and usefulness was 5.22 out of 7 (where 7 is the maximum score) with a standard deviation of 1.34, indicating that MDs find computer-based support a valuable and useful activity.

By eliciting information from MDs about how often they use particular computer-based support applications, a sense can be gained of the value or usefulness of these individual applications in their clinical work environment. The breakdown for perceived value and usefulness for specific clinical applications is given in Table 2. MDs indicated that the most valuable or useful computer-based activities (in order from highest to lowest), are, sending and receiving email, using EHRs such as Sunrise ED Manager and viewing images on PACS. It would appear that these are also the tasks that MDs are most accustomed to using.

The perceived value and usefulness of mobile devices (in this instance the Motion Computing C5 tablet) was also assessed. These results are outlined in Table 3. Of interest is that the digital pen was deemed very useful, scoring 5.1. This is promising as it suggests MDs are willing to break from the pen and paper typical working model, and indeed that they find a digital alternative to be beneficial. Use at the bedside also scored relatively highly (4.94), suggesting that point-of-care applications may be perceived to be of value. If MDs consider functions of a mobile computing device to be useful, they are likely to be more motivated to use such technology at point-of-care.

Perceived competence
Perceived competence relates to an individual's perception of how capable they are at performing a certain action. In our study, this refers to an MD's perception of their competence in using computer-based support for various work-related activities. The mean perceived competence was 4.41 out of 7 (standard deviation of 1.23), which was the second lowest average IMI score recorded in our study. Table 2 provides a breakdown of perceived competence results across a number of applications commonly used by MDs. These figures suggest that MDs feel most competent at general computer-based activities such as sending email and creating or modifying documents than performing work-related computer supported tasks (such as using PACS or ED Manager). It is likely that MDs frequently use these top ranked applications outside of the clinical environment thereby increasing their confidence. MDs indicated that they believe they are less competent in performing specialized tasks (e.g. using research databases or statistics software). An important observation is that a correlation analysis shows a positive relationship between tasks which MDs perceive as being most valuable and useful, and how confident MDs feel about performing them - the correlation between IMI scores for value and usefulness and perceived competence across all applications tested and shown in Table 2 was 0.88.

Our study also assessed other measures of perceived competence. In Question 2 MDs were asked to assess their competence in using computer-based support in relation to their peers. MDs provided mean IMI scores of 4.5 for this question (standard deviation of 0.87), meaning that in principle they considered their peers to be more competent than they are. Question 4 asked MDs to provide information about their current use of computer-based support in their work environment. Prior use of a mobile device scored 3.83 indicating relatively low previous exposure to point-of-care computer-based support. We are surprised by this result considering the relatively young age of the study participants. This low score represents an important challenge that needs to be addressed. While our analysis indicates that MDs believe computer-based support to be valuable and useful, most do not feel highly competent or confident in using it due to a relative lack of experience. This is demonstrated by the fact that more than half of the MDs who participated in the study had not previously used any type of mobile device in a work environment and achieved a low overall IMI score for perceived competence (4.41). It is particularly important that

MDs are confident in their own ability to use technology as in an environment such as the ED where mistakes in using the device may have severe consequences. Our observation calls for increased MD training to use computer-based support to instill confidence in using technology.

Table 2. IMI scores for Value and Usefulness and Perceived Competence for work-related functions

Application	Value and Usefulness	Perceived Competence
Browsing web-based medical sites	5.97	4.86
Conducting searches of medical document repositories	4.22	4.44
Creating or modifying documents	5.69	4.92
Creating or modifying spreadsheets	4.1	4.28
Viewing images on PACS system	6.11	4.47
Using Sunrise, ED Manager, EHR	6.03	4.53
Using research databases or statistics software	2.69	3.1
Sending and receiving email	6.94	5.19

Effort

The effort subscale assesses a person's perception of how much effort they put into a task. If MDs are to be motivated to move away from their traditional way of working, the effort required to do this and to learn computer-based support must be low. In our study, effort refers to the amount of effort required by MDs to carry out various tasks on a mobile device (in this instance the Motion Computing C5 tablet). From Figure 1, the mean effort required in using the mobile device was 3.2 (standard deviation of 1.4). An ideal score on this scale is 1, thus implying that overall MDs found the device relatively easy to use.

A breakdown of the effort involved in using particular functions of the mobile device is given in Table 3. According to MDs, the easiest feature to use was the digital pen and the most difficult features were data entry and accessing ED Manager. These two functions are related – imputing data to ED Manager was performed via a remote desktop connection using a virtual keyboard which users found difficult to use. Features of the mobile device were also tested for their value and usefulness and we note a high correlation (0.99) between perceived value and ease of use (low effort). This reinforces our belief that computer-based support must be intuitive and easy to use in order to convince MDs of its value and usefulness.

Pressure and tension

The overall pressure and tension associated with using a mobile device for computer-based support was scored at 6.33 (standard deviation of 1.9). Given that pressure and tension is a negative predictor of intrinsic motivation, an ideal score on this scale is 1. This was the least satisfactory IMI score obtained in the study and implies that MDs feel significant pressure while using a mobile device at point-of-care. We believe the low scores can be attributed to three factors. Firstly, the study was conducted in the ED which is recognized as an inherently high-pressure environment where the introduction of any new process can increase levels of anxiety.

Secondly, it is likely that the poor scores for pressure and tension are strongly related to the low scores for perceived competence. If MDs do not feel confident in performing a computer-based support task it is likely they will experience anxiety when completing this task. Furthermore as our analysis shows, a lack of perceived competence is linked to a lack of prior experience in using technology. Therefore we conclude that a lack of experience in using computer-based support is tightly coupled with pressure and tension experienced while performing computer supported tasks.

Finally, a possible reason for perceived pressure and tension when using mobile computer-based support may be related to the actual mobile device itself. The Motion Computing C5 tablet is relatively heavy and slightly awkward to carry. Since our study was conducted, a number of other mobile devices have appeared on the market (i.e. iPad that is already being used at some hospitals), and it is possible that users would have had more positive attitudes towards these devices that are easier to carry and lightweight. In addition such devices are likely to be more familiar to MDs as they may already use them outside of the clinical environment. For example, we observed this tendency earlier in our analysis when we noted that MDs perceive themselves to be more competent at tasks such as sending and receiving email which they are more accustomed to.

Table 3. IMI scores for Value and Usefulness and Effort for Motion Computing C5 tablet functions

Function	Value and Usefulness	Effort
Digital pen	5.1	2.95
Data entry	4.7	3.3
Access to ED Manager	4.73	3.26
Use at bedside	4.94	3.06

Discussion

The results of applying the IMI tool provided a number of important insights into MDs motivation to use computer-based support at the point-of-care in the ED. The best results were recorded for the interest and enjoyment, value and usefulness, and effort subscales. These subscales are important predictors of user attitudes as they are self-reported measures of intrinsic motivation. Poorer scores were recorded on the perceived competence, and pressure and tension subscales. We conclude that these two subscales are tightly coupled – many MDs had low prior experience of using computer-based support at work and therefore did not feel competent in performing computer-based support tasks.

The study allows us to draw these general conclusions about the use of computer-based support at the point-of-care.

- MDs are motivated to use computer-based support at the point-of-care. They perceive computer-based support in clinical practice to be valuable and useful and they actually enjoy and are interested in using it as part of their clinical work;

- Digital features of mobile devices are not considered to be obstacles by MDs – they score high on value and usefulness subscale. Furthermore they are relatively easy to use – they score low on the effort subscale;

- One of the major obstacles to motivating MDs to use computer-based support is that they tend to have limited experience with using technology and mobile devices in general. This results in lower confidence in their competencies and translates into tension and anxiety when they are asked to use computer-based support for important clinical tasks. However we note that the particular mobile device and its specific features and usability may have impacted this result.

Our analysis reveals that while many MDs realize and appreciate the potential of computer-based support and moreover are willing and motivated to use it, a lack of experience causes them to feel tension when asked to use it to perform clinical tasks. Research into motivation that states that the pressure involved in learning a new way of working must be perceived to be worth the effort involved in learning it[10, 11]. Therefore computer-based support must be designed and implemented in such a manner that is easy to learn with minimal effort on the part of the end-user. Furthermore, MDs training should involve more instruction on using technology in general, not just specific devices or applications, to alleviate pressure and increase confidence in using technology in clinical care.

Conclusion

We have presented the results of a study to assess the intrinsic motivation of MDs to use computer-based support at the point-of-care in the ED. MDs were asked to complete a questionnaire outlining their experience and attitudes to computer-based support in clinical care and responses were analyzed using the IMI tool. Our conclusions are that MDs are in general motivated to use computer-based support as they perceive it to be valuable, useful, and does not require too much effort on their part. Furthermore our study suggests that MDs are interested in using computer-based support and also enjoy and are interested in using technology in clinical care. The major barrier to MDs motivation to use computer-based support is pressure and tension emanating from a relative lack of perceived competence due to limited experience of using technology in clinical care.

These finding have important implications for clinical managers who are deploying computer-supported solutions in clinical practice. Much research in this domain focuses on the usability of such solutions. For example, features commonly used and recommended in usability evaluations include the graphical user interfaces, ease of use, ease of navigation, and functionality such as data entry and information retrieval[8, 34, 35]. Others have examined and recommended characteristics of specific applications, e.g., clinical decision support systems. For example Bates et al[36] describe the Ten Commandments for effective clinical decision support which includes features such as speed,

anticipating clinician's needs, delivering information in real time and a tight fit with the clinical workflow. The lack of adoption of CDSS in clinical practice is often attributed to these and other usability shortcomings.

Our study suggests that there are other reasons for the limited adoption of computer–based support in practice and that these are related to clinician's motivation to use technology. In particular, MDs perceived lack of competence and feelings of pressure and tension, both of which stem from limited experience of using technology in the workplace, are significant barriers to technology adoption in clinical care. Clinical managers responsible for deploying computer-based support should pay attention to these findings and invest in familiarizing MDs and other healthcare practitioners with the general underlying technology of computer-based support. Such familiarization should increase levels of perceived competence, reduce levels of pressure and tension, and therefore increase user's motivation to use technology in the workplace. This will in turn boost users' motivation to use specific support applications, assuming that their design conforms to factors described by Bates et al[36].

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