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Evaluation of users' acceptance of a computer-based HIS at Benghazi diabetes centre

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Background and Purpose: This study investigated whether an electronic medical record implemented at a medical centre was successful and shed the light on some of the factors that may have contributed to such outcome. Important indicators of the system's success include its acceptance by the users, meaningful use, and likelihood of sustainability. The users' acceptance is a reflection of their satisfaction with the amount of effort required, the amount of benefits realized, and the kind of experience they've developed using the system.
Methods: based on user acceptance literature, a questionnaire was designed and administered to clinicians at the medical centre. 18 clinicians participated in this qualitative, descriptive, cross-sectional study to evaluate users' acceptance of the system.
Results: expressing general impression, 56% of the participants think that the system is easy to use and 61% judge the system as useful for supporting their work tasks. Regarding their use experience, third of the participants object that the system's performance was timely and more than 80% agree that the system facilitates data documentation and medication order.
Conclusions: despite the system's suboptimal performance, it is accepted by the users and it is well integrated into their routine work. The few participants who evaluate the system negatively may belong to 'late adopters' group who will eventually adopt. Users' self-efficacy, the mandatory policy of the centre and the leadership of the centre management are some of the factors that may have contributed to such outcome. Issues of system performance and some of the participants' requirements ought to be addressed to insure the system's sustainability.

Keywords: *user acceptance, electronic medical record, HIS implementation challenges.*

1 Introduction

The ultimate goal of HIS implementation projects is to deliver a successful system. System success has been presented as a dynamic multidimensional concept that has different meaning to different parties and evolves over time [1]. Successful systems are effective systems that are adopted and used meaningfully by their intended users. Thus, avoidance of system underutilization and emphasizing the long term use of the system are measures of system success [2, 3]. Kishore and Mclean [4] have suggested two dimensions for success of adoption of IT innovations, diffusion and infusion. They considered diffusion as a measure of the breadth of the adoption which points to the number of potential adapters that have adopted the innovation. And Infusion as a measure of the depth of the adoption which indicates the magnitude of the innovation functionalities that are in use and how well the system is integrated into the routine work of the users. Effective use of HIS has been the concern of governments such as the US, and has initiated programs of financial incentives to promote the adoption of EHR. Healthcare providers are entitled to incentives on the condition of fulfilling the requirements of 'Meaningful Use' of these systems [5].

User acceptance and adoption are important indicators of system success. User adoption is a process composed of several stages, through which users start with the initial awareness and knowledge of the innovation. During this process, users pass through stages of forming an attitude, to taking a decision, to starting to use the innovation, to finally confirm or reverse the decision of adoption if users were dissatisfied [6]. Actually, many studies have considered system success as surrogate to users' satisfaction [7]. User satisfaction is a subjective measure that refers to user self-reported feelings and attitudes of their experience

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using the system. Thus user satisfaction can be measured via scales that estimate users' feelings and intention towards the system. Various constructs can be evaluated for this purpose including: a system's perceived usefulness, perceived ease of use, and performance. It is posited that state-of-the-art information systems can be a poor solution if users appraise it so. This clearly points to the fact that HIS implementation is not merely a technical role out but rather a social process of adaptation and experimentation as well where the stakeholders of the system are at the centre [1, 8].

User acceptance has been explained and elaborated in many theories and frameworks and it reflects user's satisfaction. IS acceptance is an attitude of users towards an IS and it is based on the user's affective and cognitive evaluation of the interaction process with the system. At pre-implementation, users engage in a cognitive process, basically to develop beliefs about the system usefulness and ease of use to reach a decision about whether to adopt the system. This decision is also affected by other factors such as subjective norm and image, which constitute a form of social influence on the individual's decision of adoption [3]. Compliance has been suggested as one determinant of perceived usefulness, which represents the social influence exerted upon individuals during the adoption process. Compliance indicates a situation in which an individual perform certain behaviour in order to attain an award or avoid punishment.

Venkatesh and Bala [3] posit the determinants of ease of use which include computer efficacy, computer anxiety, and computer playfulness. They argue that these determinants form general beliefs about computers and their use, and not necessarily associated with the target system. Consequently, these determinants are responsible for individuals' initial judgment about the IT innovation. Furthermore, the effects of these determinants attenuate after users' gain of hands-on experience with the new system.

Some studies postulate that user acceptance also includes understanding whether the system fits the requirements of the users and the tasks supported. User satisfaction has been defined as the degree to which the system has met the users' expectations and reflects on their interaction with the system – from the user point of view. Thus, it is important to evaluate user satisfaction as a mean for understanding users' experience with the system. Acceptance and satisfaction address the quality of interaction between the system and the users [7]. Moreover, several factors have been identified for user satisfaction including: user involvement in IS development, perceived usefulness, user experience, organizational support, and user attitude towards the IS. Users form attitudes based on their experience with IS, level of competency, and amount of use.

The Delone and McLean model present user satisfaction as one dimension of success along with other dimensions such as system quality, information quality, service quality, system use, and net benefits [7]. Additionally, the model elaborates on the relationship among these dimensions and establishes the interdependency between user satisfaction and other dimensions in the model. One study indicates that system quality is the best determinant of user satisfaction [9]. System quality can be evaluated by assessing a number of indicators such as: response time and the design of its user interface (sequence of tasks on the system).

Task technology fit model assess system success by understanding users' evaluation of the level of fit between task requirements and support provided by the system [7]. The model views information systems as a means to accomplish goal-oriented tasks, and elaborates on the fit between the system, the user, and the task. Likewise, the task-technology fit model can identify whether the system assists or hampers the user. Disconfirmation is another concept mentioned with relation to information system evaluation and is concerned with assessing the gap between the users' expectation and perceived performance of the system. There can be three levels associated with this concept: confirmation (no gap), negative disconfirmation (performance<expectation), and positive disconfirmation (performance>expectation) [7]. Moreover, the users' expectations are determined by their experience which may lead to high or low satisfaction levels. Furthermore, one refinement of this model differentiated between expectations and desires and argued that expectations are based on the rational evaluation of the possibilities and the desires are just what the user expect in the ideal situation.[7]

User expectations are defined as a set of beliefs that targeted users hold of an information system associated with the eventual performance of the IS and their performance using the system [10]. Accordingly, users can have realistic or unrealistic expectations. It is contended that users with unrealistic expectations are more likely to be dissatisfied and may discontinue using the system. Consequently, to set the users' expectations at realistic levels, it is recommended to expose them to game-based training and encourage their participation in the system development process.

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Nine factors have been identified that affect user satisfaction (in order of significance): user involvement, perceived usefulness, user experience, organizational support, user attitude toward IS, perceived attitude of top management toward the project, user expectations, user skills, and ease of use. Hence, systems acceptance is dependent on users' perception that the system they use and the information provided are relevant and useful to their job performance. [10]

Another paper points out to the importance of considering the temporal dimension of the user adoption process and explains the effects of persuasion, training and direct-use experience on users' attitude and adoption and usage decisions [6]. Persuasion of users is undertaken by enthusiastic initiators (champions) who are considered to be part of the social influence [11]. Moreover, they theorize that adoption and use of information systems are ultimately dependent on users' attitude and belief toward the system. Additionally, explain that persuasion and training are responsible for setting users' own unique understanding and expectations of the innovation, and this understanding evolves and can change with increased direct-use experience with the IT innovation. Direct-use experience is a post-adoption phase at which users would have examined the system characteristics. Rogers [12] had defined innovation characteristics to include: relative advantage, compatibility, complexity, trialability, and observability.

One important criterion of IS success is user acceptance, which is a surrogate of user satisfaction. Results from studies in the field of HIS implementation indicate that users are satisfied with the system if it is perceived as useful. Perceived usefulness has many determinants including perceived ease of use, subjective norm, image, and result demonstrability [3]. Perceived ease of use is defined as the degree to which a person believes that using an IT system will be free of effort. Subjective norms point to the degree of perception about the effect of the opinion of important people in the individual's social network on his/her intention and behaviour toward the IT system. Result demonstrability refers to the degree of a person's perception of the results of using the system with regard to being tangible, observable, and communicable.

Perceived ease of use determinants include computer self-efficacy, perception of external controls, computer anxiety and objective usability [3]. Computer self-efficacy is defined as the self assessment by individuals of their own ability to perform job tasks using computers. Computer anxiety points to the degree of apprehension that an individual feels about the prospect of having to use computers. External controls refer to an individual's perception of existing organizational and technical resources at their disposal that could support their use of the computer. Furthermore, Venkatesh and Bala contend that as users start using the system (post implementation) the developed experience becomes a moderating factor for many of the aforementioned determinants of the main constructs of the user adoption process. They mention that experience affects determinants such as subjective norms and computer anxiety. Experience lessens the effect of subjective norm as users start forming their own opinion about the system, and this effect is particularly salient in a voluntary context. It has been suggested that voluntariness negatively affects the users' intention to adopt [11]. Experience also mitigates the effects of computer anxiety and increases the levels of computer efficacy.

This study attempts identifying whether the implemented system at Benghazi diabetes centre is a success and shed the light on some factors that may have contributed to such outcome. Benghazi diabetes centre provides healthcare services to diabetes patients and covers patients from the whole eastern region of Libya. It is essential for the centre to maintain an information system for managing records of their patients and to have a memory of their medical history. New patients are required to register at the reception, and then they are issued a card with a unique identification number that they need to keep for future visits. The centre belongs to the Libyan government and provides its services free of charge, including the medication.

The innovation used is proprietary software developed by a local IT company and enables medical documentation and supports physicians' orders for lab tests and diagnostic imaging. It manages the medication prescription process and coordinates the process of transfer of patients between physicians inside the centre. It presents menu lists of diagnostic and therapeutic terms which were developed locally and used for data entry. After authentication of the user, the visit screen pops up and consists of relevant components such as patient history, review of systems tab, assistance for writing prescription including medication name list and corresponding dose and route information. It also enables the generation of a number of predefined medical reports, such obesity report and number of medication dispensed report. It also has lab and pharmacy components used by the laboratory and the pharmacy at the centre to execute physicians' orders. The self initiated project to implement the system is championed by the centre director, who is a doctor himself. All funds necessary to set up the LAN and finance the system were donated by

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local businessmen who were approached by the centre director. The system was developed specifically for the centre and based on requirements identified by the management.

Important indicators of the system's success include its acceptance by the users, meaningful use, and likelihood of sustainability. Thus, the main question posed was: Is the system implemented at Benghazi diabetes centre accepted by the users? This entailed the following sub-questions:

- How many of the clinicians use the system and how frequent?
- Was the system easy to use? (general impression and elements)
- Was the system useful? (general impression and elements)
- What experience did the users have while using the system?
- What facilitating factors had contributed to the outcome?

The users' acceptance is a reflection of their satisfaction with the level of effort required to use the system, the amount of benefit that has been realized, and the kind of experience they've developed using the system. Furthermore, meaningful use reflects the system's level of integration into the users' routine work and breadth of functionality use.

2 Methods

This cross-sectional descriptive qualitative study aimed at understanding physicians' acceptance and experience with an electronic medical record implemented at Benghazi diabetes centre. As well as identify some of the sociotechnical factors that have played a role in this outcome.

The study took place during the summer of 2022. A questionnaire was distributed by the medical staff director to elicit information from physicians at the centre. A total of 18 physicians participated and filled out the questionnaire. The questionnaire consists of 41 items, both open and close questions. 33 of these items asked direct questions about the system, the rest covered demographic information, computer and IT literacy, and one open question for general comments.

The questionnaire was designed to elicit data about the following aspects: system use, ease of use, usefulness, user's experience and facilitating factors. In addition to demographic questions and open-ended questions to further explore participants' thoughts and opinions.

Ease of use was probed through questions about participants' general impression and specific elements that factor into this aspect of the system. These specific elements are evaluated through inferring users' interactions with the aspect's elements of the system. Specific element questions included, for instance, system intuitiveness and clear presentation of data. Similarly, usefulness was probed through questions about the participants' general impression and the usefulness aspect of specific elements, most of which are about the level of fit between the provided system support and work task requirements. Participants were asked to reflect on their experience with the system's support for routine tasks such as: communication, coordination, documentation, information search, and order management.

User Experience reflects users' trust and comfort with the system and assumes noting observable events that occurred while using the system, such as failures and work delays. User experience was probed by eliciting users' testimony on incidents or events that have happened regarding:

- Trusting data presented by the system and whether the participants have come across a situation where they questioned the data integrity and have no reason to doubt information presented.
- System failure and recovery: system failure rate and whether users can manage a plan of action once it happens,
- Security: they trust that the system keeps the patients' data securely.

Facilitating factors include questions probing existing and contextual factors that could have contributed to the system acceptance outcome, these included users' characteristics, training provided, technical support available, and participation in the system development process.

3 Results

The following tables represent data extracted from the returned questionnaires as absolute numbers and calculated percentages. Demographically, most of the participants' are female, aged between 31 1nd 40, and have on average 9 years of work experience as clinicians (Table 1)

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Table 1: Participants demographics

Characteristic	Number	Percentage
Age group		
25-30	1	6%
31-40	15	83%
41-50	2	11%
Gender		
Female	16	89%
Male	2	11%
Years of experience		
1-5	3	16%
6-10	13	72%
11-15	1	6%
16-20	1	6%

Facilitating factors existed in the context that could have influenced the system evaluation outcome include participants' level of computer competency, adequacy of the training provided, and belief in health information technology are tabulated (Table 2). Third of the participants agreed that the training course was adequate and another 22% agreed cautiously. 44% of the participants doubted the adequacy of the training course. Only 22% of the participants participated in the system development process.

Table 2: Facilitating factors

Characteristic	Number	Percentage (%)
Prior computer training		
Yes	4	22
No	14	78
Computing skills		
beginner	5	28
intermediate	13	72
advanced	0	0
Attended training course		
Yes	10	56
No	7	39
No answer	1	5
Training course was adequate		
strongly agree	2	11
agree	4	22
somewhat agree	4	22
do not agree	4	22
do not know	4	22
Technical support available		
strongly agree	3	17
agree	5	28
somewhat agree	8	44
do not agree	2	11
do not know	0	0
Participated in the development process		
yes	5	28
no	11	61
no answer	2	11
Believe in role of HIS		
yes	13	72
no	2	11
no answer	3	17
Prior knowledge of EHR		
yes	3	17
no	13	72
no answer	2	11

Data presenting participants' impression and feeling about general aspects of the system such as ease of use, being a burden, usefulness, contribution to patients' satisfaction and health care quality are

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demonstrated in (Table 3). 39% of the participants do not agree that the system was burden. Third of the participants agreed that the system contributed to patients satisfaction and two third agree that the system contributed to positively to the quality of healthcare provided.

Table 3: Clinicians impression n(%)

Item	TA	A	SWA	DA	DK	NA
The system is easy to use	7(39)	3(17)	7(39)	1(5)	0	
I trust patient information provided by the system	4(22)	4(22)	6(33)	3(17)	0	1(5)
The system is an extra burden	3(17)	4(22)	4(22)	7(39)	0	
The system was useful in supporting work tasks	2(11)	9(50)	5(28)	2(11)	0	
The system has contributed to patients satisfaction	2(11)	4(22)	6(33)	1(5)	5(28)	
The system is highly effective in supporting the daily tasks	4(22)	5(28)	4(22)	4(22)	0	1(5)
The system contributes to raising the level of health care quality in the centre and the city	4(22)	8(44)	2(11)	1(5)	2(11)	1(5)
note: Totally agree (TA), Agree (A), Somewhat agree(SWA), Do not agree (DA), Do not know (DK), No answer provided (NA)						

Table 4 demonstrates the participants' experience with using the system with respect to speed of response, intuitiveness, and supporting specific aspects of their routine work such as documentation and order management.

Table 4: Clinician experience with the system

Item	TA	A	SWA	DA	DK	NA
The system performance is timely	0	1(5)	11(61)	6(33)	0	0
Sequence of tasks on the system is logical and fits workflow	5(28)	2(11)	7(39)	3(17)	0	1(5)
The system helps with communicating with colleagues	4(22)	4(22)	1(5)	9(50)	0	0
The system supports keeping patient data safe	5(28)	8(44)	4(22)	1(5)	0	0
The system is important for coordinating tasks with colleagues	4(22)	7(39)	2(11)	5(28)	0	0
The system facilitates patient data documentation	5(28)	10(56)	2(11)	1(5)	0	0
The system finds patients medical history easily	6(33)	5(28)	6(33)	1(5)	0	0
The system facilitates order of lab tests	3(17)	7(39)	3(17)	2(11)	3(17)	0
The system facilitates following up lab test results	3(17)	10(56)	2(11)	1(5)	2(11)	0
The system facilitates ordering medication prescription	5(28)	11(61)	1(5)	1(5)	0	0
The system enables access to all information needed to make a decision about patient cases	3(17)	9(50)	3(17)	2(11)	1(5)	0
The system helps in preparing educational material for patients	1(5)	3(17)	2(11)	11(61)	1(5)	0
note: Totally agree (TA), Agree (A), Somewhat agree(SWA), Do not agree (DA), Do not know (DK), No answer provided (NA)						

Summary of the participants' responses to the open questions of the questionnaire:

- The most important features/advantages of the system to the participants are:

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The most acknowledged feature/advantage of the system is its basic ability as a tool for the efficient data saving and timely retrieval of patient data and medical history. The second most appreciated advantage by the physicians is the system's support for the management of healthcare process through better organization of patient visits and fair allocation of daily work load among working physicians. Other features appreciated by the physicians included the system support to their daily medical tasks such as following up lab test and medication management. As well as enabling better quality healthcare, as quoted by one participant "[it] ensures the dispensing of medication to all liable Libyan citizens".

- The challenges that faced the participants while using the system:

The most frequently challenge of the system reported by physicians is its slow performance and frequent failures which caused numerous delays on busy working days.

- Features or functionalities the participants think were unnecessary:

None, all are necessary

- Functionalities that need to be added to the system

Mainly requests for executing some tasks quicker such as retrieval of patient's past medication list, suggestions for improving some user interface items such as text boxes, expanding the medication and disease menu lists, altering some information sequence display, improving some task sequence and produce more data summary reports.

4 Discussion

Most of the participants had no computer training and self assessed their computer competency as intermediate. 56% of the participants attended the training course and only third of them either agree or strongly agree that it was adequate. The system has no user manual or documentation, which suggests that many physicians have used other means to learn about the system, which could be a support from their peers and self learning about the system. Furthermore, or used the technical support available, although only less than half of the participants agree that such support was sufficiently available. This suggests that this group of physicians can be assessed as having a high level of computer efficacy as individual characteristics.

All users indicated using the system on daily basis with all patient cases. Essentially, this may be attributed to the centre's policy that mandates the system use.

A considerable percentage of the participants believes in health information systems in general. However, only three participants stated they have prior knowledge about electronic health record systems.

In terms of the system ease of use, the majority have a positive general impression about this aspect of the system (more than half of the participants agree that the system was easy to use as well as 39% agreed with some reservation). In terms of usefulness, most of the participants have positive general impression with this aspect as around two-third of the participants think that the system is generally useful in supporting their work tasks, in addition to another 28% agreed with some reservations.

Participants' experience of using the system to perform work tasks differed from one element to another, the system slow speed was their worst experience. The system intuitiveness rate good as 39% of the participants agree or totally agree that the sequence of tasks on the system was logical and matched their workflow and another 39% agreed with reservation, which suggests that the system use was perceived as requiring minimal effort.

In terms of supporting their daily tasks: 50% of the participants do not find the system supportive to their communication with colleagues, although 44% of their participants have perceived the system as a useful communication channel. However, in terms of using the systems for coordinating tasks between colleagues, 61% agree or strongly agree that the system is important with this respect. Worth noting is that the system does not provide any form of electronic communication such as email or messaging services, but, provides a distinct function for managing patient transfer between doctors.

Most of the participants agree that the system is an effective means for documenting patient data. 75% trust the system with keeping patients' data safe. With regard to system ability to search and find patient medical history easily 61% agree or strongly agree in addition to another 33% agree with some reservations. With respect to the system function as order management tool for lab tests and medications, 56% agree that the system improved test ordering task, 73% agree that following up of test results is easier, and 89% agree that the system improved ordering medications from the pharmacy. Only 17% of the participants seem to

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be not using the function of lab test orders. However, none of the participants stated non-usage/unawareness of the medication ordering function of the system.

With regard to system ability to provide all information needed to make a decision about patient cases, the majority agrees that the system provides such access.

Participants demonstrated some division on answering a question regarding the system help in preparing educational material for patients, as 61% do not agree that such help is provided, correspondingly, 22% agree that such help is provided although no direct function for preparing and generating educational material is available on the system. This could signify that some physicians may have improvised a derived use of the system to support certain tasks, such producing educational material for patients. The same postulation may be valid to understand the perception of some participants of the system as communication channel that mentioned earlier. This further suggests that the system is well integrated into the users' workflow.

5 Conclusion

The results indicate that the system is accepted by the physicians at Benghazi diabetes centre. Physicians perceive the system as useful, and it is well integrated into their routine work. The users mostly appreciated the system support for core tasks such as secure documentation of patients' data, patient history search, coordination with colleagues, and order management. As well as, appreciate the system's transparency and role in creating a fair work environment where everyone has an equal share of the workload. Furthermore, they've noted a high degree of fitness between support provided by the system and many of their task requirements.

Although the physicians have rated the system ease of use favourably, they faced some technical challenges related to the systems' performance that need to be addressed quickly to maintain the users' acceptance. Participants reported experiencing system slow response, work delays, and difficulties handling large numbers of patients. There are also a few improvement requests by the users that ought to be considered and implemented to establish users' ownership of the system that further cement the infusion of the system.

The system context has also provided a number of factors that have contributed to the successful implementation of the system which include: the fact that the system use in the centre is mandatory, the standardized type of healthcare provided by the centre to a specific group of familiar patients (frequent diabetes patients with past medical records), and the full support of the centre management to the system. The users' self-efficacy might have had an effect as well, as despite the non-existence of a system manual and low attendance rate to the training course, the users were able to manage using the system effectively.

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