A Pre-Assessment Questionnaire to Identify Healthcare Professionals' Perception on Information Technology Implementation

Y. Atilgan Şengül

Abstract—Health information technologies promise higher quality, safer care and much more for both patients and professionals. Despite their promise, they are costly to develop and difficult to implement. On the other hand, user acceptance and usage determine the success of implemented information technology in healthcare. This study provides a model to understand health professionals' perception and expectation of health information technology. Extensive literature review has been conducted to determine the main factors to be measured. A questionnaire has been designed as a measurement model and submitted to the personnel of an *in vitro* fertilization clinic. The respondents' degree of agreement according to five-point Likert scale was 72% for convenient access to data and 69.4% for the importance of data security. There was a significant difference in acceptance of electronic data storage for female respondents. Also, other significant differences between professions were obtained.

Keywords—Healthcare, health informatics, medical record system, questionnaire.

I. INTRODUCTION

AS a result of rapid development of information technology (IT), today hundreds of them are used in healthcare organizations to serve physicians and other professionals working with patients in their daily routine [1]. It is accepted that healthcare IT provide great potential for improving the quality of services, efficiency and effectiveness of professionals [2], and its effective utilization enhance and improve medical services and patient care [3]. Implemented software and hardware may vary extremely, but whatever the technology is, they are vastly used by human beings [4], and unfortunately lack of use or inefficient use of IT continues to be a barrier in practice [5].

Using information and communication technologies allow keeping all the health data of a person in a single electronic document and provide access and usage of authorized individuals and third parties when required [6].

Used technology in healthcare institutions has various names in literature such as 'health record system (HRS)', 'electronic health record (EHR)', 'electronic patient record (EPR)', 'health information system', 'electronic medical record (EMR)' and so on. The generally called health information system (HIS) is known as the healthcare planning system or hospital information system; its development can be

Y. A. S. is with the Computer Programming Program, Advanced Vocational Studies, Doğuş University, Istanbul, Turkey (e-mail: yatilgan@dogus.edu.tr).

dated back to 1960, when its basic functions were to perform administrative management only [7]. HIS are developing every day as IT develops. These advancements in technology and used systems in healthcare institutions or hospital raise another problem called adoption. These systems are said to be technologies that helps physicians in performing their daily tasks while improving quality, efficiency, effectiveness and decreasing costs. On the other hand, it is not enough just to have technology for a successful system, it also needs users. The users are the key that takes this new IT to a success. So, while considering designing and implementing new IT, the users' perceptions should also be considered. A qualitative study shows that quality improvement heavily depends on physicians' use of the EMR and not paper for the daily tasks [8]. To increase physicians' usage, the system should be fully accepted by users. One of the major barriers that delay the adoption and successful implementation of such systems is the great resistance of physicians and other healthcare professionals to accept and use these systems [9]. The development of such a system should start before the design phase with a proper pre-assessment model for measuring health professionals' perceptions and expectations. Understanding their level of technology knowledge and usage, the factors influencing their acceptance not only helps HIS designers but also enables more efficient implementation and evaluation processes.

In the literature, it can be clearly seen that there is a big effort for assessing end user reaction to already implemented IT [10]. Also, it is possible to find surveys using the technology acceptance model (TAM) for determining the users' intention to use a healthcare system [7], testing TAM's usefulness for providing a reasonable depiction of physicians' intention to use telemedicine technology [11] or extended versions of TAM for measuring HIS acceptance of hospital personnel [12]. Even though TAM is defined as a fitting theory for the health care context, it is not a model developed specifically for assessing acceptance in the healthcare context [13]. However, the study carried out by Zéphir et al. has conducted reports that HIS and other components to be integrated to current HIS has been developed after user requirements analysis [14]. They state that users are more and more involved in the development phase but there is a crucial need for them in the assessment phase as well.

There are also other studies using different models or taking TAM as a basis with some revisions for exploring user acceptance using social networks [15], for measuring IT

acceptance and utilization by occupational therapists [16], for describing pharmacy workers' perceptions and acceptance for bar-coded medication technology [17]. Some researches contributed to usability research and user-oriented development of healthcare technologies by conducting a web questionnaire [1], and a national study carried out in United States that reported that only 4% of 2758 physicians, with 62% response rate, use a fully-functional electronic-record system and 13% using a basic system [18].

All these studies are developed for measuring users' intention to use the technology or their acceptance for already adopted technologies. Adopting the technology is a time consuming and costly process. A study carried out by Kijsanayotin et al. shows that 40% of IT developments in different sectors including the health sector have failed or could not be completed, and a major factor leading to this failure is explained as the inadequate understanding of the socio-technical aspects of IT, particularly the understanding of how people and organizations adopt IT [19]. So, it is important to clarify users' needs, their perception about the planned system and its possible outcomes, before the technology is implemented. It is also possible to find studies carried out to understand the barriers of EHR implementation from the physicians' point of view [20]. The study identifies the factors that are stated as the direct determinants of physicians' acceptance of technology. The usability of a system is important, because poor usability delays system adoption by physicians and also hinders potential improvements to the efficiency and safety of care [21].

According to a report prepared for the Agency for Healthcare Research and Quality (AHRQ), the efficiency, cost effectiveness, quality, and safety of medical care delivery can be improved by using health information technology (HIT), by providing best practice guidelines and evidence databases immediately available to clinicians, and by making computerized patient records available throughout a health care network [22].

As stated by Berg, "whether an information system is 'successful' or not is decided on the work floor" [23]. It seems that no empirical research has addressed the users' intention to use and their perceptions about HER, or more generally, HIS before the adoption phase.

This study aims to focus on user side rather than the technology itself. It is planned to analyze users' intention to use the new technology and try to understand their perceptions' about the benefits and possible outcomes of the new technology. The study has been carried out in an *in vitro* fertilization (IVF) clinic, where currently, there is an extensive effort to collect and analyze data regarding treatments [24].

The rest of this article is organized as follows. Section II describes the general structure, process and the problems in the IVF clinic. Section III presents the factors to be measured in the questionnaire and the details of the questionnaire design. Section IV presents the analysis of data; the demographics of the respondents and the details and results of each factor. Section V gives the discussions and conclusion.

II. BACKGROUND

A. Processes in IVF Clinic

IVF is a common infertility treatment method since 1978 [25], during which female germ cells (oocytes) are inseminated by sperm under laboratory conditions. Fertilized oocytes are cultured between 2-6 days in special medical equipment and embryonic growth is observed and recorded by embryologists. Finally, selected embryo(s) are transferred into the woman's womb [26].

The amount of data generated in IVF can be very large and data analysis can be complicated. This makes IVF clinics ideal for using computerized IT for data storage and analysis [27].

Before the preparation of the questionnaire, the processes carried out in an IVF clinic have been determined to understand the information and communication needs for the design of the IT framework.

Generalized processes in the clinic are as follows:
- Examination phase
- Preparation phase
- Treatment phase

The examination phase starts with a patient coming to the front desk, filling out the necessary information and being examined by the doctor. In a paper based system, the information gathered in this phase is kept in a special form. The front desk secretary and the doctor fill in this document in paper form. After the examination phase, if the patient decides to go ahead with the treatment, the preparation phase starts. In this phase, the patient gets medication and is followed up by blood tests. Finally in treatment phase, the patient is monitored periodically at the clinic to determine the best time that she is ready for the implantation. When the patient is ready the selected embryo(s) (among fertilized embryos under laboratory conditions) are implanted. After the implantation of the embryo(s), a positive (pregnancy) or negative (non-pregnancy) outcome of the embryo transfer is observed at approximately the 12th week.

B. Current System and Problems in the IVF Clinic

Finally, as a background study, the current system in place at the selected IVF clinic and the problems faced by professionals in using it were investigated. This was done by unstructured interviews and field observations.

In the current system, the data collected about the patients are kept in paper format. All the forms filled out by physicians, nurses and patients, during the processes in the clinic are kept in a file for every patient. And all files are kept in a room assigned for hard copy files of every patient. The doctors note the next appointment of the patient in the file. When a patient comes for an appointment, a nurse finds the patient's file and delivers it to the doctor before the patient's examination. The physical transfer of files causes problems including lost files, and inefficient use of personnel time etc., thus causing an increase in costs and a decrease in the service quality.

When the processes and how they are handled is monitored, it is observed that the main problem is the 'physical storage'

of patient records. It is already accepted that the paper record can no longer meet the demands of modern healthcare [28]. EPR, on the other hand, brings enhanced storage and retrieval functionality, provides smart search functions, instantaneous and multi-location access, and the virtual integration of data elements stored in geographically disperse databases [29].

Other problems caused by physical storage can be listed as:
- There is no access hierarchy set;
- Read, write and update permissions cannot be set and controlled;
- Reaching patients' data needs physical access to patients' files;
- It is not possible to give instantaneous answers to patients;
- It is not possible to make research studies with the current storage system;
- It is not possible to make statistical analysis;
- It is difficult to generate reports; and,
- It is not possible to analyze success rates.

All these problems are the results of not using proper IT. It is believed that adopting an IT system in IVF clinic will provide easy data access and sharing, also increase the communication within and outside the clinic.

III. METHODS

A. Factors to Be Measured

Before the questionnaire survey a preliminary work has been conducted to understand the general structure of the selected IVF clinic. The structure, the processes and the problems are summarized in the previous section.

After this preliminary work, a questionnaire has been designed to determine the perception of professionals' about the foreseen outcomes of the planned IT structure. The questionnaire was distributed to employees including gynecologists, nurses, secretariats, embryologists, and other professions like anesthetists, psychologist, computer technician and etc., working in the selected IVF clinic. The perceptions of respondents relating to five factors were investigated. The factors and their explanations are given in Table I.

Keeping records in digital form means all professionals included in the system should use computers. This brings another issue into consideration; that of the computer usage of people in the system. This is a critical issue that should be determined before adoption, and the staff members who do not have enough computer knowledge should be trained. All these training issues add new and extra work loads for staff, which causes some resistance to the new system. So, these factors should be measured in parallel with the computer usage level of the personnel.

The questionnaire was divided into six parts with a total of 35 questions. Of the 112 questionnaires distributed, both by e-mail and by hand, 100 respondents replied.

B. Designing the Questionnaire

As mentioned in the previous section, the questionnaire consists of six parts with 35 questions. The first part of the questionnaire included the simple demographics of the respondents like age, gender and profession and also the computer usage level and e-mail usage of the respondents. The rest of the questionnaire is designed to understand the professionals' views about the factors given in Table I.

TABLE I
FACTORS TO BE MEASURED

Factor	Explanation
Storing patients' records electronically	For the adaptation of new technology, the records will be stored electronically
Access patients' data	New IT will make data access convenient and timely
Importance of sharing patients' data	New IT will provide easy data sharing
Patients' data security	New IT will cause new security issues to emerge
Impact on managerial functions	New IT will change the way managerial functions are performed

The first part of the questionnaire is designed to measure the new IT necessity perception and about the basic benefits of planned EHR system. Implementations of an EHR system are widespread and have been recognized as costly investments [30]. So, before implementation, it is important to determine professionals' needs and expectations.

The next part in the survey consists of questions to determine the information sharing necessity of the respondents. This section aims to understand the IVF health professionals' perception about data sharing within the organization and also, sharing information with other clinics. It is aimed to determine the perceptions about data integration between different departments and data sharing within and outside the organization. On the other hand, respondents' thoughts about the effects of data sharing in the service quality, diagnosis and treatment phases are measured. Espinosa [31] states that information is a strategic asset and the efficient and effective management manipulation and use of information is essential in healthcare providing services. In healthcare there are different actors such as patients and their families, physician, surgeons, epidemiologist, nurses, medical students, laboratory technologists and etc., and the healthcare professionals' specialized unique knowledge has to be shared by the different actors to improve patient care [32]. Also, the collection and sharing of clinical information can be said to be essential for providing high quality service for patients, as well as providing decision support to physicians. Also, the findings of [33] show that IT may be highly effective in supporting tacit knowledge sharing, and they suggest that health organizations should consider greater adoption of IT for sharing tacit knowledge. On the other hand, there is a big effort to collect and analyze data for IVF treatments [24].

The fourth part is to measure the data access necessities of the respondents. There are six questions in this section to identify professionals' need for instantaneous data access conveniently. The aim of this section is to understand respondents' views about the benefits of an IT structure on data access and also how much they believe that new IT will provide them instant data access. The results of this section will also provide knowledge about their needs on accessing

data whenever they need and wherever they are.

The next part is to investigate the perceptions' of respondents about managerial function. There are five questions to understand professionals view about the foreseen benefits of the new IT on managerial functions.

The last part is about the security issues. During the informal interviews with management and other staff before preparing the questions, it was observed that there is a huge security problem in the clinic. As mentioned before, patient files are kept in a room which almost everyone can reach. So, this section has been prepared to determine users' perception about how the new system can provide security, determine if staff thinks this system will help solving these security issues, and finally, if they think there is a need to determine access hierarchy for patient data.

IV. RESULTS

All the questionnaire answers were entered in SPSS for analysis. Before the results are analyzed, reliability analyses were applied and the reliability index Cronbach's Alpha was 0.957 for all questions. All scores were satisfactory.

A. Respondent Demographics and IT Skills

In total, 100 professionals completed the questionnaire. Respondent demographics showed that 60% of the respondents were women and 40% were men. Almost half of respondents' ages were between 26 years and 35 years. The details of the demographics and the profession distributions of the respondents are given in Table II.

TABLE II
GENDER, AGE AND PROFESSION DISTRIBUTION

Gender	%	Profession	%
Female	60	Gynecologist	21
Men	40	Nurse	22
Age	%	Embryologist	17
18 - 25	17	Secretary	16
26 - 35	53	Other	23
36 - 45	19		
46 - 55	9		
> 56	2		

B. Professionals' Perception about New IT Adoption and Its Foreseen Outcomes

The questionnaire results are reported in Table III according to the mentioned parts.

Part 1 demonstrates the results for electronic storage and its foreseen outcomes. The results show that for respondents, the most important issue is accessing patients' data conveniently, followed then, by the security of the patients' data. As explained in previous sections, these were some of the problems faced by professionals in the clinic, and the questionnaire shows respondents' needs for convenient access to data and that they think that security issues are important.

Part 2 demonstrates the perception of professionals' about the necessity for information sharing. In this part, the results show that they believe storing data in electronic forms will strengthen data sharing, but it can be clearly seen that they are

not positive about data sharing with other clinics. Briefly, the results show that the surveyed professionals believe that storing data in electronic form and in a communication network will ease and strengthen data sharing.

Part 3 aims to measure respondents' opinions about data access. The results show that they believe accessing data conveniently will increase the service quality they are providing at the IVF clinic. As mentioned earlier, accessing patients' data conveniently is the most important factor for the respondents. They believe that if the data are stored in electronic form, this will allow faster access.

Part 4 is to measure the effect of a communication network on managerial functions. The results show that respondents mostly believe that a communication network will increase the coordination of employees within clinic. Then, they believe it will increase efficiency. The degrees of agreement of the respondents are low when compared with other parts.

Part 5 demonstrates the results for data security. The respondents strongly believe that it is necessary to determine patients' data access rights for ethical issues. On the other hand, the degree of agreement for "storing patients' data in electronic forms will increase data security", and "this will provide access restrictions" is low when compared with other questions. As a result, it can be said that the respondents are not well enough informed or aware about the capabilities of an information system with a proper database management system. It may be possible to improve their awareness with well-designed informative meetings and training.

C. Differences between Responses According to Demographics

1. Differences According to Gender

First of all, differences between genders are analyzed. As a result of the Mann-Whitney test, the questions with $p < 0.05$ are determined. In a total of 13 questions, difference is observed between female and male respondents. Female respondents' degree of agreement is higher than male respondents. Especially, this difference is seen in all questions about managerial functions. The other significant difference is observed in questions about data sharing. Again, the female respondents' degree of agreement is higher. They also believe that accessing data conveniently will increase the quality of service and that it will also provide more reliable, consistent and accurate data for research studies.

2. Differences According to Profession

The next analysis is carried out to determine the significant difference between professions. As a result of the Kruskal-Wallis test, seven questions are determined with $p < 0.05$. One of the questions with a significant difference is the storing of patient data in electronic form.

Embryologists are the respondents with highest degree of agreement, while gynecologists showed the lowest degree of agreement. The interviews show that the reason is the doctors do not like to spend their time entering data using computers. On the other hand, embryologists are the ones making critical decisions like which embryo to transfer or which day to

transfer; thus, making the patient data more critical and important for them. Other significant differences are seen in data sharing and managerial functions. Secretarial staff has the highest degree of agreement about data sharing and

gynecologists have the lowest. About managerial functions, nurses show the highest degree of agreement about managerial functions and embryologists show the lowest.

TABLE III
QUESTIONNAIRE RESULTS

Item no.	Statements	Strongly agree %	Agree %	Neutral opinion %	Disagree %	Strongly disagree %
	Part 1: Electronic storage and its foreseen outcomes					
1	Keeping patient records in electronic forms in all departments is necessary.	62	26	8	4	0
2	Accessing patients' information conveniently is important.	72	24	3	1	0
3	Sharing patients' information with other colleagues is important.	51	24	17	7	1
4	The security of patients' data is important.	69.4	24.5	6.1	0	0
5	IT systems are necessary for performing managerial functions.	43	35	18	3	1
	Part 2: It support for data sharing					
6	Communication between data stored in different departments is necessary.	53	39	5	3	0
7	A communication network within the clinic will provide for an increase in data sharing.	67.6	25.3	5.1	2	0
8	Storing data in electronic form will strengthen data sharing with my colleagues in the clinic.	71	24	5	0	0
9	Sharing data with my colleagues at the clinic will increase service quality.	55.6	27.3	14.1	3	0
10	Data sharing within the clinic will effect diagnosis and treatment processes positively.	44	33	13	9	1
11	Integration of IVF data with other clinics is necessary.	59	30	10	1	0
12	Integration of IVF data with other clinics will affect IVF treatment processes positively.	38	22	23	12	5
13	Conducting research with data integrated from other clinics will provide more reliable results.	42	29	16	9	4
14	Conducting research with data integrated from other clinics will provide more consistent results.	41	31	17	8	3
15	Conducting research with data integrated from other clinics will provide more accurate results.	43	29	15.8	8.2	4
	Part 3: IT support for data access					
16	A communication network within a clinic will provide time saving for accessing data.	53	39	5	3	0
17	If data is stored in electronic form I can access data faster.	67.7	25.2	5.1	2	0
18	Accessing data conveniently will increase the service quality.	71	24	5	0	0
19	Making comparison and inquiry about patient data instantly will be beneficial.	55.6	27.3	14.1	3	0
20	Remote access to data will provide improvement for my research work	44	33	13	9	1
21	Storing data in electronic forms will ease data access for research studies	59	30	10	1	0
	Part 4: IT support for managerial functions					
22	Having a communication network within the clinic will provide better management in the clinic.	30	33	28	9	0
23	Having a communication network within the clinic will increase participation in the decision making process.	34	32	24	9	1
24	Having a communication network within the clinic will increase efficiency.	38	34	19	9	0
25	Having a communication network within the clinic will increase coordination between employees.	45	33	18	4	0
26	Storing data in electronic form will ease patient follow ups.	44	33	15	8	0
	Part 5: IT support for data security					
27	Storing data in electronic form will increase the security of the data.	38	31	23	6	2
28	Determining access hierarchy for patients' data is necessary for ethical issues.	51.5	38.4	9.1	1	0
29	Storing data in electronic form will ensure restricted access to patients' data.	30.3	35.4	27.2	5.1	2
30	Determining the access hierarchy will be beneficial for ethically protecting patients' data.	46	37	17	0	0

V. CONCLUSION

There are many studies and research papers about the assessment of information and/or communication technologies adopted in healthcare institutions or other sectors. All these studies investigate the users' acceptance, perception or usage levels about already implemented technology. Since implementing new technology is a costly and time consuming process, conducting an assessment after implementation is neither suitable nor enough.

This study proposes a technology acceptance measurement model to be used in healthcare institutions before the design phase. The model aims to measure the users' point of view about the IT. This study focuses on users rather than the technology before the implementation. Primarily, the critical factors to determine the technology acceptance of the users are investigated. After the investigation of major factors, the questions – to analyze these factors in more detail – are determined for each factor.

This study will help HIS providers for designing and implementing more effective and efficient systems in

healthcare institutions. This questionnaire will provide a better understanding about the users' perceptions and also determine the barriers for technology acceptance. The questionnaire has been design not for only physicians but all professionals in the healthcare institution.

The results of the questionnaire can also be used to make comparisons with assessment results after the implementation. Comparison results can provide answers to questions like; 'What hinders better technology adoption?', 'What can be done for smoother transition from paper forms to digital forms?', and 'What can be done to satisfy professionals' expectations from new implemented IT?' On the other hand, results of the questionnaire enlighten users' perceived knowledge about IT and provide insight into at what point the professionals will need training. Repeating the survey for more valid and accurate results in other clinics is essential.

REFERENCES

[1] J. Viitanen, H. Hyppönen, T. Lääveri, J. Vänskä, J. Reponen and I. Winblad "National questionnaire study on clinical ICT systems proofs: Physicians suffer from poor usability", Int J of Medical Informatics, vol. 80, no. 10, pp. 708-725, Oct. 2011.

[2] V. P. Aggelidis and P. D. Chatzoglou, "Using a modified technology acceptance model in hospitals", Int J of Medical Informatics, vol. 78, no. 2, pp. 115-126, Feb. 2009.

[3] A. Albarrak, N. Zakaria, "Editorial on Emerging Trends and Technologies in Healthcare in conjunction to the 1st International Saudi Health Informatics Conference held in Riyadh", Journal of Infection and Public Health, vol. 9, no. 6, pp. 689—690, Nov. Dec. 2016.

[4] R. Ward, "The application of technology acceptance and diffusion of innovation models in healthcare informatics", Health Policy and Technology, vol. 2, no. 4, pp. 222-228, Dec. 2013.

[5] L. B. Maruping, H. Bala, V. Venkatesh and S. A. Brown, "Going beyond intention: Integrating behavioral expectation into the unified theory of acceptance and use of technology", Journal of the Association for Information Science and Technology, vol. 68, no.3, pp. 623-637, 2017.

[6] G. Comandé, L. Nocco and V. Peigné, "An empirical study of healthcare providers and patients' perceptions of electronic health records", Computers in Biology and Medicine, vol. 59, pp. 194-201, April 2015.

[7] F. Y. Pai, K. I. Huang, "Applying the Technology Acceptance Model to the introduction of healthcare information systems", Technological Forecasting and Social Change, vol. 78, no. 4, pp. 650-660, May 2011.

[8] R. H. Miller, I. Sim, "Physicians' Use of Electronic Medical Records: Barriers and Solutions", Health Affairs, vol. 23, no. 2, pp. 116-126, Marc 2004.

[9] M. Khalifa, "Barriers to Health Information Systems and Electronic Medical Records Implementation A Field Study of Saudi Arabian Hospitals", Procedia Computer Science, vol. 21, pp. 335-342, 2013.

[10] F. D. Davis, "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology", MIS Quarterly, vol. 13, no. 3, pp. 319-340, Sep 1989.

[11] P. J. Hu, P. Y. K. Cha, O. R. Liu Sheng and K. Y. Tam, "Examining the Technology Acceptance Model Using Physician Acceptance of Telemedicine Technology", Journal of Management Information Systems, vol. 16, no. 2, pp. 91-112, Fall 1999.

[12] V. P. Aggelidis, P. D. Chatzoglou, "Using a modified technology acceptance model in hospitals", International Journal of Medical Informatics, vol. 78, no. 2, pp.115-126, Feb 2009.

[13] R. J. Holden, B. T. Karsh, "The Technology Acceptance Model: Its past and its future in health care", Journal of Biomedical Informatics, vol. 43, no. 1, pp.159-172, Feb 2010.

[14] M. C. Beuscart-Zéphir, J. Brender, R. Beuscart, I. Ménager-Depriester,

[15] "Cognitive evaluation: How to assess the usability of information technology in healthcare", Computer Methods and Programs in Biomedicine, vol. 54, pp. 19-28, 1997.

[15] L. Hossain and A. de Silva, "Exploring user acceptance of technology using social networks", Journal of High Technology Management Research, vol. 20, pp. 1-18, March 2009.

[16] L. K. Schaper and G. P. Pervan, "ICT and OTs: A model of information and communication technology acceptance and utilisation by occupational therapists", International Journal of Medical Informatics, vol. 76, pp. 212-221, June 2007.

[17] R. J. Holden, R. L. Brown, M. C. Scanlon and B. T. Karsh, "Pharmacy workers' perceptions and acceptance of bar-coded medication technology in a pediatric hospital", Research in Social and Administrative Pharmacy, vol. 8, no. 6, pp. 509-522, Nov. Dec. 2012.

[18] C. M. DesRoches, E. G. Campbell, S. R. Rao, K. Donelan, T. G. Ferris, A. Jha, et al, "Electronic health records in ambulatory care: a national survey of physicians", The New England Journal of Medicine, pp. 50-60, July 2008.

[19] B. Kijsanayotin, S. Pannarunothai and S. M. Speedie, "Factors influencing health information technology adoption in Thailand's community health centers: Applying the UTAUT model", International Journal of Medical Informatics, vol. 78, no. 6, pp. 404-416, June 2009.

[20] M. Beglaryana, V. Petrosyana and E. Bunker, "Development of a tripolar model of technology acceptance: Hospital-based physicians' perspective on EHR", International Journal of Medical Informatics, vol. 102, pp. 50-61, June 2017.

[21] J. Horsky, K. McColgan, J. E. Pang, A. J. Melnikas, J. A. Linder, J. L. Schnipper, et al., "Complementary methods of system usability evaluation: Surveys and observations during software design and development cycles", Journal of Biomedical Informatics, vol. 43, pp.782-790, May 2010.

[22] Agency for Healthcare Research and Quality, Costs and Benefits of Health Information Technology, Evidence Report/Technology Assessment Number 132, Publication No: 06-E006, 2006.

[23] M. Berg, "Implementing information systems in health care organizations: myths and challenges", International Journal of Medical Informatics, vol. 64, pp. 143-156, Dec 2011.

[24] J. K. Belcher, M. K. Corcoran, R. J. Han, H. M. Shageer, B. A. Welsh, L. M. Pastore, et al., "An Approach to the Modular Design of Medical Research Systems". IEEE Systems and Information Engineering Design Symposium, Charlottesville VA, USA, pp. 174-179, 2006.

[25] P. C. Steptoe and R. G. Edwards, "Birth after re-implantation of a human embryo", The Lancet, vol. 312, no. 8085, pp.366, 1978.

[26] A. Uyar, A. Bener, H. N. Ciray and M. Bahceci, "A Frequency Based Encoding Technique for Transformation of Categorical Variables in Mixed IVF Dataset", Engineering in Medicine and Biology Society, EMBC 2009. Annual International Conference of the IEEE, Minneapolis, Minnesota, USA, 2009, pp. 6214-6217.

[27] G. Tomkin and J. Cohen, "Data management and interpretation - computerized database for an ART clinic: hardware and software requirements and solutions", Textbook of Assisted Reproductive Techniques, Laboratory and Clinical Perspectives, Martin Dunitz, London, 2001, pp. 367-380.

[28] A. M. van Ginneken, "The computerized patient record: balancing effort and benefits", International Journal of Medical Informatics, vol. 65, no. 2, pp. 97-119, June 2002.

[29] M. Berg, P. Toussaint, "The mantra of modeling and the forgotten powers of paper: a sociotechnical view on the development of process-oriented ICT in health care", International Journal of Medical Informatics, vol. 69, pp. 223-234, March 2003.

[30] L. Nguyen, E. Bellucci, L. Thuy Nguyen, "Electronic health records implementation: An evaluation of information system impact and contingency factors", International Journal of Medical Informatics, vol. 83, no. 11, pp. 779-796 June 2014.

[31] A. L. Espinosa, "Availability of health data: requirements and solutions", International Journal of Medical Informatics, vol. 49, no. 1, pp. 97-104, March 1998.

[32] G. Mansingh, K. M. Osei-Bryson and H. Reichgelt, "Issues in knowledge access, retrieval and sharing – Case studies in a Caribbean health sector", Expert Systems with Applications, vol. 36, pp. 2853-2863, March 2009.

[33] N. Ali, D. Whiddett, A. Tretiakov and I. Hunter, "The use of information technologies for knowledge sharing by secondary healthcare organisations in New Zealand", International Journal of Medical Informatics, vol. 81, no. 7, pp. 500-506, July 2012.