INTEGRATIVE JOURNAL OF MEDICAL SCIENCES
ISSN: 2658-8218
MBMJ

2022, Volume 9, ID 619
DOI: 10.15342/ijms.2022.619

RESEARCH ARTICLES

Using the Diffusion-of-Innovation Theory to Examine Factors Influencing the Implementation of an Electronic Medical Record in Obstetrics

Mamour Gueye, Mame Diarra Ndiaye, Abdoul Aziz Diouf, Moussa Diallo, Mouhamadou Wade, Aissatou Mbodji, Abdou Karim Diallo, Aliou Diouf, Ousmane Thiam, Omar Gassama, Magatte Mbaye
Gynecologic and Obstetric Clinic, Aristide Le Dantec Teaching Hospital,Cheikh Anta Diop University, Dakar, Senegal

ABSTRACT

Objectives: The objectives of the present study were to assess the perceptions of physicians and midwives towards an Obstetric Electronic Medical Record and apply the diffusion-of-innovation theory to the examination of factors that users perceive as influencing the implementation of Electronic Medical Records.

Patients and methods: Type of study: This is a mixed study after implementing an Electronic Medical Record (EMR).

Study location: Dakar, Senegal. Methodology: We designed an online questionnaire sent to all users of the software. The questionnaire included three parts: a section collecting the socio-demographic and professional characteristics of the participants, a section about the usage of the software, the impact on the organization, the advantages, and limits, and finally, the last section where the users reported their degree of satisfaction as well as the extent to which they would be willing to recommend the software-based upon their experience. The questionnaire was completely anonymized and accessible to physicians wishing to take the survey. Their consent was first requested.

Results: A total of 51 physicians (85%) agreed to participate in this study among the 60 who were approached. Of the respondents, 62.7% were women, and the average age and experience were 32.3 years and 22.1 months, respectively.

Overall, the software was perceived as simple, intuitive, and designed for an obstetrician. On the contrary, some physicians reported some drawbacks. Those were mainly the time needed to type in the information, especially when they were on duty with a heavy workflow, lack of sufficient computers, and some bugs. More than half of the participants agree that there is no need to be young to use the software optimally. However, an ideal user should be open-minded and cope with change. On a 0-10-scale, participants acknowledged that they were satisfied with the software, it positively impacted their department's organization, and they were willing to recommend the software, all medians above 8.

Conclusion: Identifying the determinants of the adoption of the electronic medical record is crucial for its successful implementation and dissemination. User responses will help adjust implementation strategies to promote better integration of this technology into medical practices beyond our facility.

KEYWORDS: Electronic Medical Records, Diffusion of innovation, Dakar, Obstetrics.

Correspondence: Pr Mamour Gueye, Address: Gynecologic and Obstetric Clinic, Aristide Le Dantec Teaching Hospital, PO Box 3001, Pasteur Avenue, Cheikh Anta Diop University, Dakar, Senegal. Email: mamourmb@gmail.com

INTRODUCTION

Medicine is the area where changes are taking place every day in the development of new diagnostic and therapeutic techniques and the organization of care. Therefore, any change that aims to improve diagnostic, therapeutic, or organizational procedures is an innovation. Any innovation is hence called upon to be disseminated among potential users. The notion of dissemination, whatever its object, is central to any social system or construction because it is at the base of the coherence of the behavior of individuals or their representations, therefore of the coordination of their actions. It is an important concern in the humanities and social sciences, whether one is looking at it from a behavioral or cognitive perspective. The basic idea behind diffusion is that interactions between individuals are the main driver of the evolution of their behaviors, beliefs, or representations. Rogers defines the notion of diffusion of innovation as the process by which an innovation is communicated through certain channels, over time, between members of a social system [2].

Innovation is an idea, practice, or object perceived as new by an individual or group likely to adopt it [2].

Nowadays, Information Technology (IT) is not only a great help for the medical profession; it is at the very heart of modern medicine, medicine which requires the sharing of information between the actors of the health system and the patient to improve their care, coordination and continuity of care. To keep these millions of pieces of information collected, processed, analyzed, and exchanged, we now need databases, which implies the computerization of the patient record. The advent of information and communication technologies combined with the limits of the "paper" file has led to this computerization of the patient's file.

While the computerization of medical records is growing in Western countries, it is slow to start in our regions; chronologically, several decades separate us. The delay that our health system is accumulating in the face of this new prospect offered by information and communication technologies has led us to set up data management software in Obstetrics.

Indeed, despite their advanced potential advantages, the literature notes that the adoption rate of these systems is still very low. There is no data currently available in Senegal on the conditions of implementation of electronic medical records, their operation, use, and their potential impacts on professional practice and the organization of care. To this background, we report our experience towards adopting this software in a low-resource setting.

MATERIALS AND METHODS

Type of study: This is a mixed-method design combining a qualitative approach with a questionnaire and quantitative approach, 36 months after implementing an Electronic Medical Record (EMR).

Study location: Dakar, Senegal.

The software was located in Dakar, Senegal, the Maternity of Philippe Maguilen Senghor Health Center (PMSHC). Senegal's health system consists of three main parts: a peripheral level, a regional, and a central level. The peripheral level (local community level) is known as "District Sanitaire," with one health center and several primary care units. The regional intermediate level addresses the health problems of a given region/area. The central and national level holds the minister's office, subdivisions, and related services.

Furthermore, facilities comprise three categories: national and regional hospitals, health centers, and health posts. PMSHC is a level 2 health center. It does not have a hospital's performance, but surgical procedures are performed there. In obstetrics, midwives, and nurses, teams of residents provide continuous Emergency Obstetric and Newborn Care (EmONC). On-call duties are carried out under the supervision of an obstetrician. The setting has 34 beds. In 2018, the number of deliveries encountered was 8,172, and the number of outpatients encountered was 16,945.

Thanks to the support of the Heath centerboard and from the end of the year 2016, patients' files were recorded both paper-based and electronically. Additionally, previous records were electronically registered.

Description of the software being assessed

E_Perinatal was designed using Filemaker Pro Advanced. FileMaker is database management software developed by an Apple subsidiary called FileMaker Inc. It works under Mac OS X and Windows, either in a peer-to-peer network or in Client-server mode with "FileMaker Server." The application put together several tables to collect all the administrative data of the patient but also all the information from diagnostic and therapeutic management: medical visits, antenatal care visits, hospital stay for gynecologic pathology or intercurrent pregnancy, childbirth, ectopic pregnancy, abortion, prescriptions, an agenda (appointment management), an infertility management module, a specific module for the management of sexual abuse, of patients followed for HIV/AIDS, a module for the writing of operating reports, an ultrasound module integrating the growth curves of the Intergrowth 21st study, colposcopy, and hysteroscopy module. The entire activity is accessible via queries producing reports according to a predefined period. The software also generates a medical unit summary on discharge from the hospital, including, in addition to administrative information, the reporting of diagnoses made as well as the treatments administered (medical, obstetric, surgical, etc.).

The software implemented requires complete customization. It makes it very easy to create data tables that can be linked together. The software allows you to create screens for entering and consulting data. It is possible to integrate control buttons to move from one screen to another or launch predefined actions via a simple scripting language.

The design of a personalized application does not require extensive knowledge of IT. An obstetrician designed the database presented here. Use of the software on iOs mobile devices is free. The use of the software requires the acquisition of user licenses for Windows and Mac interfaces.

Learning to use the software followed a two-part process. Each new team is trained upon involvement. Secondly, two secretaries trained since the start in 2016 in using the software were responsible for supporting users in their daily activity.

Figures 1 (a prescription model) and 2 (dashboard of deliveries – The year 2018) are two customized models from the software.


Région Médicale de DAKAR
District Sanitaire Ouest
Centre de Santé Philippe Maguilen SENGHOR

Dakar, le 04/04/2021

Mme Jane DOE, 40 ans

ORDONNANCE

Solupred 20 mg comprimés QSP
3 comprimés par jour le matin pour 6 semaines

Oméprazole 20 mg QSP
1 comprimé le soir pendant la durée du traitement (6 semaines)

Kaleorid comprimés QSP
1 comprimé à midi pendant la durée du traitement (6 semaines)

Albendazole comprimés 2 flacons
1 prise à renouveler au bout de 3 jours

Pr Mamour GUEYE

Figure 1: A prescription from the software

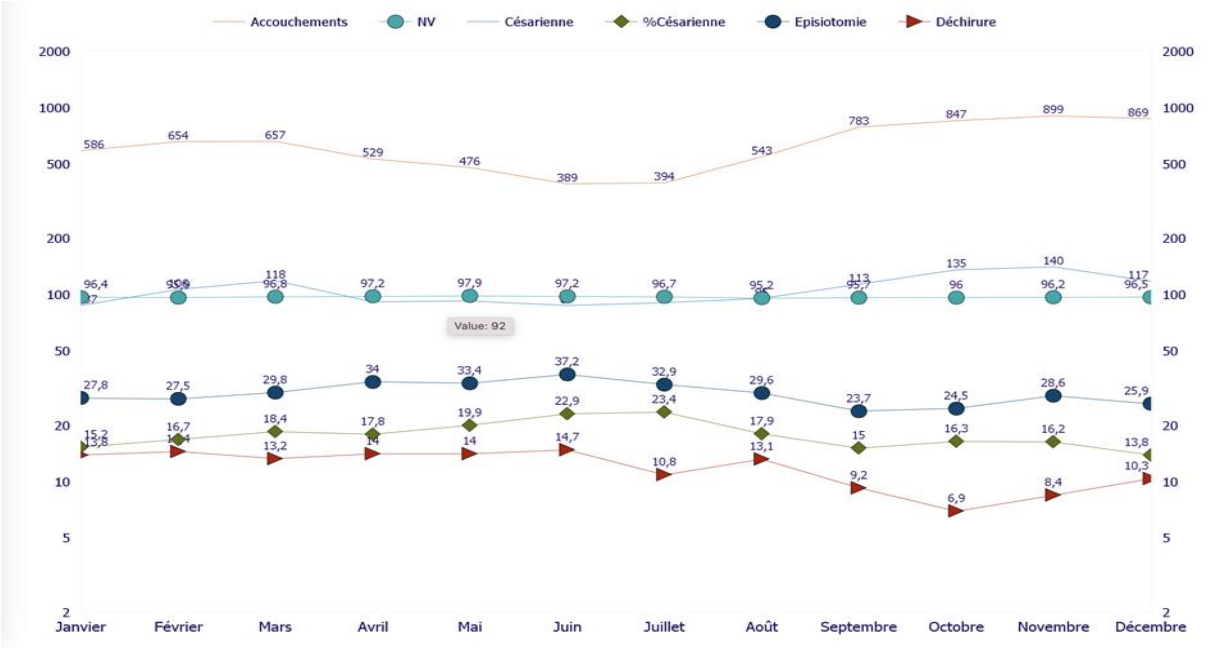

Figure 2: Deliveries dashboard from the software

The questionnaire

We designed an online questionnaire which link was sent to all users of the software.

The questionnaire included three parts: a section collecting the socio-demographic and professional characteristics of the participants, a section in relation to the use, the impact on the organization, the advantages, and limits, and finally the last section where the users reported their degree of satisfaction as well as the extent to which they would be willing to recommend the software-based upon their experience.

The questionnaire was completely anonymized and accessible to physicians wishing to take the survey. Their consent was first requested.

To avoid introducing bias, the principal investigator, who is also a medical developer and user of an electronic medical record, did not participate in the survey.

The questionnaire was offered to participants after they had used the software for at least three months.

Ethics approval was obtained from the hospital board (Reference number: CPMS/2020/MAT123).

Data analysis

Continuous variables were described by their means, medians, and standard deviations, while categorical variables were defined with frequencies.

When appropriate, frequencies variables were compared with the chi-squared test at a level of significance of 5%.

RESULTS

Participants' characteristics

A total of 51 physicians (85%) agreed to participate in this study among the 60 who were approached. Of the respondents, 62.7% were women. The average age and experience were 32.3 years and 22.1 months, respectively. 10 (19.6%) of these physicians were obstetricians in terms of professional profile. Almost one-third (31.4%) of participants had used an electronic medical record before our software.

Perceptions of users

Figure 3 shows the Likert-scale results of questions concerning the use of the software and the description of a typical user through a coordinated set of diverging stacked bar charts as suggested by Heiberger and Holland [3].

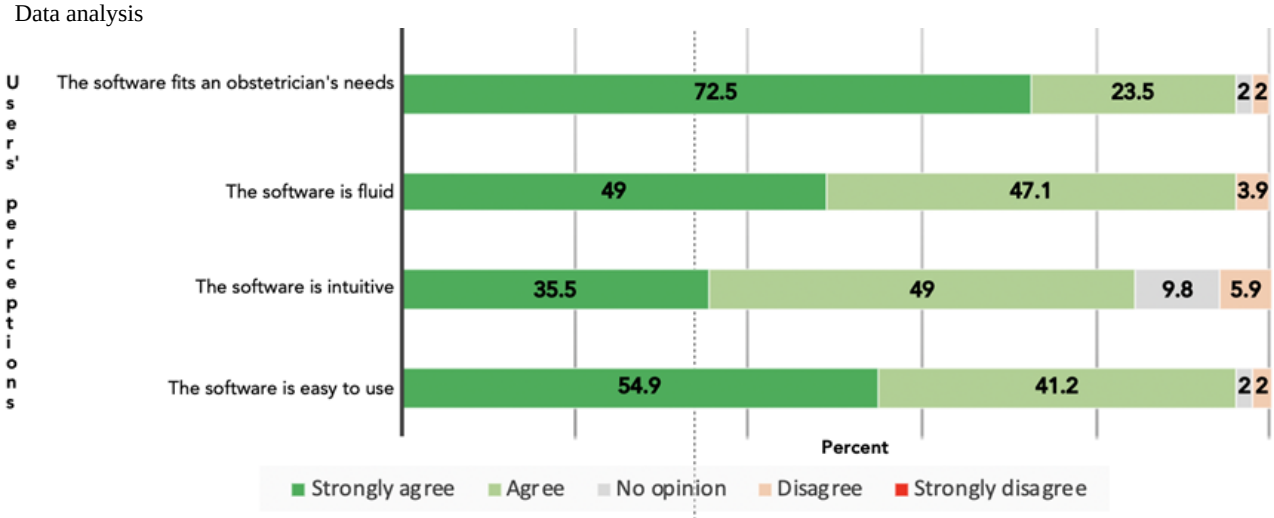

Figure 3: Diverging stacked bar graphs showing the perceptions of users

Overall, the software was perceived as simple, intuitive, and designed for an obstetrician, as stated by the following participant.

"The advantage is that this tool has been designed by a professional who knows the specifics of the profession. He thought of almost everything! If you want to change parameters, this is easy! Scalability is an important feature of this software!" [Participant 25]

Users were asked to state the advantages and drawbacks of the software. Advantages conveyed are mainly of three categories: improving organization, visibility, and research.

Improving organization: Saving time and space as well as accessing easily to information are described as key elements of the software. Besides better patient follow-up, the software enables sharing information with colleagues, pre-built prescriptions, certificates.

"I can only see advantages." *[Participant 9]*

Visibility: Users find the software very handy in building reports, allowing them to get insight from the activity and consider improvements.

"What is undeniable is that you cannot process the information by opening the paper files one by one. You will have to enter the information in an electronic file sooner or later to store it, sort it and merge it for reports. If we aspire to change, we must have reliable data to evaluate them to improve our practice. This tool allows you to do this in an early, regular, and efficient way." [Participant 7]

"I used to spend 15 days to finish my monthly report. Now I can produce it on the first day of the following month! The data are more consistent, and I can compare the trends by quarter, semester, or year! In addition to the indicators we usually collect, the software brings more specific ones. It changes your life!" [Participant 44 - Midwife]

Research: The software is also described as allowing to design of robust epidemiological studies with large sample sizes,, giving them much more power. Besides, students have reliable information to perform their thesis and dissertations.

"This tool is extraordinary! I don't know how much time I've lost! But hey, I enjoy it and enjoy it every day." [Participant 4]

"I cannot do without it! You get addicted to it, really" [Participant 4]

"I can't understand how people can still hesitate to get started." [Participant 4]

On the contrary, some physicians reported some drawbacks. Those were mainly the time needed to type in the information, especially when they were on duty with a heavy workflow, lack of sufficient computers, and some bugs. One user suggested getting more control over the software to be able to change or modify some features, and another described the software as not fluid difficult to use, and very time-consuming.

"*It takes too much time and is complicated.*" [Participant 50]

More than half of the participants agree that there is no need to be young to use the software optimally. However, an ideal user should be open-minded and be able to cope with change, as stated in the following quotes from verbatims:

"Some professionals believe that they are wasting time using the software. They should understand that there is a time to learn everything. Once you have mastered the tool, which is a matter of 5 attempts at most, you catch up exponentially with the time you spent losing, and you gain speed, reliability, and completeness of the information." [Participant 34

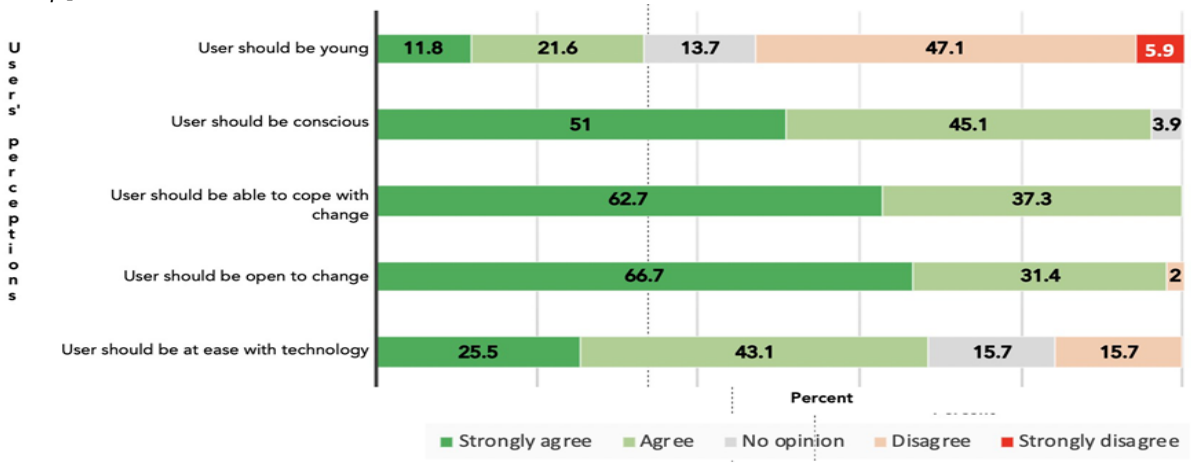

Figure 4: Diverging stacked bar graphs showing the perceptions of users with regard to the ideal software user

Finally, on a 0 to 10 scale, participants were asked the extent to which they were satisfied with the software, how it positively impacted their department's organization, and how they would recommend the software. Figure 5 shows their responses with a median of 9 and almost all answers above 8.

The three boxplots are comparatively short. This suggests that overall, participants have a high level of agreement regarding the positive impact of the software in their department's organization. Most of the answers ranged between 8 and 10. The same feature is remarked in their satisfaction with the software. Regarding recommending the software, 92.16% of participants rated 9 to 10 their willingness to recommend the software on a 0-10 scale.

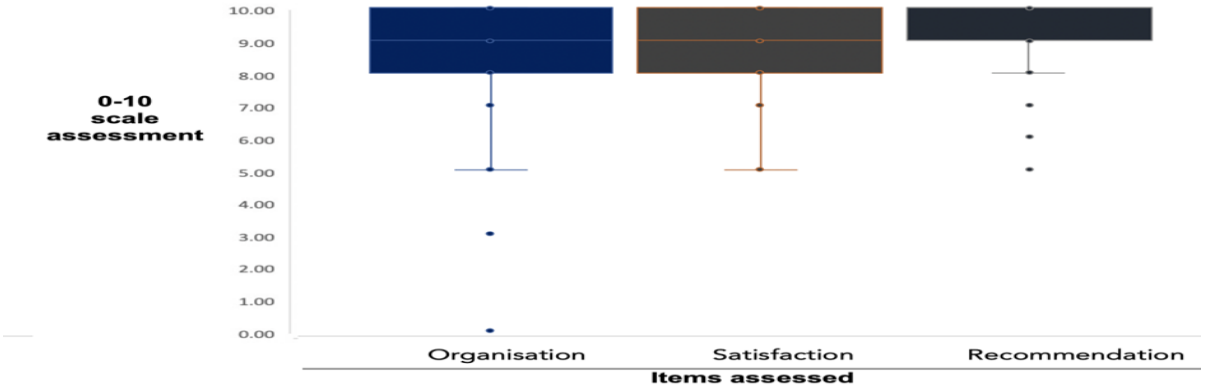

Figure 5: Boxplots showing participants answers on a 0-10 scale with regard to their organization improvement of the software, their satisfaction and willingness to recommend the software

"It is a great idea and a good approach to computerize medical records. And the archives are more compliant and allow better exploitation. It would be good if all health structures in the country could use the software at all levels of the pyramid." [Participant 42]

"Excellent working tool that facilitates medical consultation gives patients confidence who know that their follow-up history is kept somewhere reliable." [Participant 14]

Quantitative improvements

A quantitative study run using the software's data investigated the consistency of information in paper-based records when registered in parallel with an electronic medical record [4]. Information about some maternal and fetal/neonatal characteristics was assessed. A total of 48,270 unique patients' records were identified during the eight years. Among the study population, data for patients' age, address, and parity were available most of the time before and after 2017. However, phone numbers, maternal weight, maternal height, last menstrual period, and blood group were found to be missing up to 96% before 2017. From 2017, these rates experienced a sudden decrease at a significant level: from 82.4% to 27.8% for the phone number, from 96% to 56.3% for maternal weight, and from 60.1% to 21.3% for blood group. Regarding newborns' data, it was found that fetal height, head circumference, and chest circumference were missing up to just under 25% before 2017. After that date, their completeness improved and flattened under 5%. The authors concluded that structured and computerized files reduced missing data and urged the Ministry of health to provide hospitals and health care providers with guidelines that describe the standardized information that should be gathered and shared in health and care records.

Before computerization, the rate of major obstetrics complications leading to death was 13.3%. The rate decreased once the electronic registration began to 9.23% ($p < 0.001$), as shown in Table 1. The cesarean section rate also decreased from 28.66% to 18.5%.

Table 1: Rate of major obstetrical complications and C-section before and after computerization (N = 51,548)

Parameters	Before computerization	After computerization	p value
Major obstetrical complication	13.3%	9.23%	<0.001
C-section	28.6%	18.5%	<0.001

DISCUSSION

Main findings

The Electronic Medical Record we designed was perceived as being simple to use and intuitive. The software suits almost all users, be they obstetricians or midwives, young or old. However, an ideal software user should be resilient. Users were mostly satisfied with the software. It positively impacted their department's organization and they were willing to recommend the software. On the contrary, some physicians reported some drawbacks, mainly the time needed to type in the information, especially when they were on duty with a heavy workflow, lack of sufficient computers, and some bugs.

Interpretation of the results

The diffusion of innovation theory is made up of four parts: the innovation itself, the communication channels, time, and the social system in which the innovation is to be implemented [2].

Our software is an innovation as defined by Rogers. Rogers highlights that the real newness of the object does not matter. The perceived newness rather counts.

There are countless typologies of innovation in the literature. In what constitutes one of the first efforts to critically review this literature, Downs, and Mohr [5] distinguish two broad categories of typologies: typologies based on an aggregate of characteristics and those based on a single characteristic. The three most common typologies are dichotomies opposing "technological" or "technical" innovation to "managerial" innovation, "product" innovation to "process" innovation, and, finally, "radical" innovation to "incremental" innovation. The first two represent classifications according to the nature of the innovation. They are based on an aggregate of characteristics. The third is a classification according to the degree of novelty and is therefore based on a single characteristic. Moreover, they are not mutually exclusive: the same innovation can be technological, process, and radical at the same time.

As early as the 1960s, research such as that of Evan [6], Evan and Black [7], Downs and Morh [5], or Daft [8] focused on innovations that did not include a technological dimension. These authors introduce the terms "administrative innovations" or "organizational innovations" to qualify these innovations. They propose the following definition: "Administrative innovation is an innovative idea related to the recruitment of personnel, the allocation of resources, the definition of tasks, the management method or the development of personnel" [6]. In a slightly different conception, for Harrow and Willcocks [9] or Rogers [2], a managerial innovation is "an idea, a practice or an object perceived as new by individuals or organizations" [2]. This definition highlights the notion of the actor's perception of novelty.

In the 1990s, all of this research found an echo in France, under the leadership of authors such as David, Hatchuel, and Weil [10, 11]. These authors are particularly interested in the structure of managerial innovations [10]. David thus distinguishes three interacting elements. Knowledge-oriented innovations concern the knowledge produced. They correspond to what Hatchuel and Weil [11] call "managerial techniques"; relationship-oriented innovations concern relationships such as a new decentralized structure, the constitution of a project team, a network of trainers, etc.; mixed innovations are managerial innovations that relate simultaneously to the knowledge produced and the relationships between actors.

The speed with which an innovation is adopted varies widely. Some innovations spread quickly and reach a high adoption rate, while others spread slowly and are only adopted by a tiny fraction of the target groups. The rate of speed with which an innovation is adopted depends, among other things, on the characteristics of the innovation. Rogers [2] traditionally considers five characteristics: advantages, compatibility, complexity, ease of testing, and perceptibility. These characteristics are not the only factors affecting the adoption rate of innovations, but studies in this area indicate that they are the most important.

Assessing the perceptions of EMR users can highlight that perceived benefits are important determinants of EMR use. The so-called relative advantages of innovation are the extent to which this innovation is perceived as preferable to what it should replace. These advantages refer to the construct "perceived utility" of the Technology Acceptance Model proposed by Davis [12]. Perceived utility relates to the degree to which use of the system or technology improves user performance in the organization [13]. It also refers to the notion of perceived consequence proposed by Triandis [14] or to the relative advantage of Rogers [2].

For all of these theoretical models, the perceived utility positively affects the intention to use or recommend to use. Our study recognizes the advantages of implanted electronic medical records found in the literature [15-18]. This is mainly about its potential to facilitate professional access to relevant data and improve communication and the two-way exchange of information.

We also highlight some concerns that may limit EMR adoption discussed in the literature [19, 20]. Those are the quality of the data generated, the potential effect of the EMR on the workload, and the quality of the practice on the patient-professional relationship or in the generation of new types of errors and responsibilities. One of the main complaints from the health personnel in our settings is the workload of monthly reports. This task is mandatory and mainly under the responsibility of residents and midwives. While designing the software, this task was taken into account extensively. One of the main interests highlighted by users was the time saved by E-Perinatal, particularly in the ease of monthly reports. Before installing the software, this task was rather manual and consisted in consulting all the registers to gather the information then exploit it before products of the outputs in the form of curves or charts.

A similar study carried out in psychiatry shows that a large proportion of health professionals in psychiatric services used the computerized medical record and had a rather favorable opinion of it [21]. They recognized that this could improve the quality of care, the continuity of care, and the coordination of actors with, however, restrictions, more often associated with the nursing discourse, about the time spent filling out the case file, lack of equipment, or lack of computer experience and, consequently, reduced time spent on care.

A large study conducted by Eden [22] within the Australian hospital and healthcare service (HHS) showed a favorable perception of the use of the electronic medical record globally with differences according to the profession. The authors had quantitatively assessed the reported impacts of a comprehensive EMR used by all healthcare professionals, nurses, paramedics, administrative and executive staff in all HHS hospitals. This was a remarkably positive finding, given that the sample was taken during the disruptive period immediately after implementation.

Finally, the quality of the computer equipment plays a major role in filling out the file: speed of the computer network, sufficient equipment, movement to the patient's bed (tablets, text recognition software to facilitate time entry)

On the other hand, quite quickly, everyone involved in producing the reports noticed the unparalleled time savings offered to them against the daily effort of recording files. In fact, it is not the actual relative advantages of the novelty that count, but what potential users perceive. The greater the relative advantages perceived, the higher the adoption rate.

We found that fear of the unknown or resistance to change is key when considering EMR adoption. Indeed, respondents stressed that for a practitioner to use the EMR, they must be able to adapt and be open to change. It should be noted that resistance to change is a personality trait that influences the diffusion of NICTs. Indeed, individuals will react differently to the changes brought about by new technologies: either they will adapt easily or resist [23]. Venkatesh et al. [24] have even argued that resistance to change is one of the main reasons for the failure of the NICT establishment. Lapointe and Rivard [25] noted that physician resistance manifests itself during the different stages of technology implementation. Resistance behaviors are triggered or reinforced by perceived threats, such as loss of power or reorganization of work.

Compatibility is the degree of agreement of the innovation with potential users' values, past experiences, and needs. An innovation that does not match needs has very little chance of being adopted. For this reason, needs assessments are often necessary for this area, especially

when the offer does not correspond to an explicit request or when the request does not come from the potential users themselves. The more the innovation corresponds to real or perceived need, the more it will be accepted. Furthermore, an innovation that is not compatible with the values and norms of a social system will not be adopted as quickly as another innovation that would be compatible with these values. The larger the gap between the two, the more difficult the substitution will be. E-Perinatal has two advantages about compatibility. First, it was designed by an obstetrician. Second, it was designed following difficulties in designing reports, missing files, and increased workload, which was quite impossible to manage manually. From the answers, it can easily be seen that users highly agreed with the software utility in terms of fitting obstetricians' needs.

The complexity is associated with the degree of difficulty understanding and using an innovation perceived by potential users. In general, the easier an innovation is to understand and use, the faster its adoption. Among the factors constraining the use of Electronic Medical Records, users mentioned the difficult handling of the software in the context of daily duties. The workload is already very heavy. In the theory of acceptance model, perceived ease of use is a determinant of intent to use [12]. It refers to the degree to which the technology user finds the use of that technology devoid of the deployment of some effort [12]. This construct also refers to the complexity of innovation proposed by Rogers [2], which expresses the degree to which the innovation is perceived as difficult to understand or use. The perceived ease of use construct may encompass the perceived drawbacks of the EMR as well as organizational, technical, and individual barriers [23].

Implication for practice and research

Identifying the determinants of the adoption of the electronic medical record is crucial for its successful implementation and dissemination. The database serves as an information base for scientific questions, integrating all relevant medical and technical information into one system.

Healthcare facilities can benefit from implementing their research and development software. By consulting with local IT developers, hospitals that also perform research can create custom database software that allows them to store critical information and results and share this information with other physicians in the area. By doing so, healthcare providers can create a community at the forefront of research and innovation in their field and educate fellow doctors and nurses about the latest data available in the field. This can help foster an innovative organization committed to success. The detailed and regular analysis of care indicators, complications, and deaths improves practices and improves the quality of patient care. User responses will help adjust implementation strategies to promote better integration of this technology into medical practices beyond our facility. This study provides an initial basis for implementing electronic medical records in developing countries and future evaluation work that will need to include larger samples of organizations and users in different clinical settings involving varieties of systems. These studies will be needed to assess the best ways to use these systems and identify effective interventions for improving clinical and health outcomes for patients. Also, they can target the analysis of useful, appropriate and relevant limitations and barriers to technology maturity and the identification of specific means to facilitate compatibility and interoperability with existing electronic medical records.

Strengths and limitations of the study

This is a qualitative study that anonymously collected participants' views and feelings about using an electronic health record. It included users with different backgrounds, different user levels, and different user experiences. The answers obtained can be qualified as honest and reflect the content of the software being evaluated. In addition, data saturation was obtained.

The questionnaire was addressed to all users who wished to take the survey. However, this study has certain limitations. The study may contain a selection bias linked to the participation of respondents.

CONCLUSION

Identifying the determinants of the adoption of the electronic medical record is crucial for its successful implementation and dissemination. Through our study, we demonstrated the usefulness of the Obstetrics EMR, its simplicity, ease of use, and how it fits user expectations. User responses will help adjust implementation strategies to promote better integration of this technology into medical practices beyond our structure.

All structures should seriously consider setting up the computerization of their records to help them reduce the rate of obstetric and neonatal complications as well as the rate of cesarean section.

Summary points

E_Perinatal as an obstetric software was perceived as being simple to use, intuitive, and designed for an obstetrician.

Advantages conveyed are mainly of three categories: improving organization, visibility, and research. On the contrary, some physicians reported some drawbacks. Those were mainly the time needed to type in the information, especially when they were on duty with a heavy workflow, lack of sufficient computers, and some bugs. There is no need to be young to use the software optimally. However, an ideal user should be open-minded and be able to cope with change.

ACKNOWLEDGMENTS

We would like to thank Ms. Adja GUEYE LEYE, Ms. Ndeye Maguette SARRE and Ms. Nafissatou DIENE for their priceless help as well as the midwifes and obstetric residents of PMSHC and students who participated to populate this database.

AUTHORS' CONTRIBUTIONS

The participation of each author corresponds to the criteria of authorship and contributorship emphasized in the Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly work in Medical Journals of the International Committee of Medical Journal Editors. Indeed, all the authors have actively participated in the redaction, the revision of the manuscript, and provided approval for this final revised version.

COMPETING INTERESTS

The authors declare no competing interests with this case.

REFERENCES

[1] Badillo P-Y. Les théories de l'innovation revisitées : une lecture communicationnelle et interdisciplinaire de l'innovation ? Du modèle « Émetteur » au modèle communicationnel. Enjeux l'information commun. 2013; 14/1(1):19-34. [Accessed 2022 Feb 08]. Available from: https://archive-ouverte.unige.ch/unige:77640

[2] Rogers EM. Diffusion of innovations. 5th Ed. New York: Free Press; 2003.

[3] Heiberger RM, Holland B. Statistical Analysis and Data Display: An Intermediate Course with Examples in S-PLUS, R, and SAS. Springer-Verlag; 2004. DOI:10.1007/978-1-4939-2122-5

[4] Ndiaye MD, Mamour G, Ndour SB, Niang N, Fall NG, Fall k. Completeness of information in electronic compared with paper-based patients' records in a maternity setting in Dakar, Senegal. Intern J Reprod Contracp Obstetric Gynecology. 2020; 9(4):1429-33. [Accessed 2022 Feb 08]. Available From: https://go.gale.com/ps/i.do?p=AONE&u=anon~4a933df1&id=GALE|A624028020&v=2.1&it=r&sid=googleScholar&asid=81e6fc9c

[5] Downs GW, Mohr LB. Conceptual Issues in the Study of Innovation. Administrative Sci Quarterly. 1976; 21(4):700-14. DOI: 10.2307/2391725

[6] Evan WM. Organizational lag. Human Organization. 1966; 25(1):51-3. DOI:10.17730/humo.25.1.v7354t3822136580

[7] Evan WM, Black G. Innovation in business organizations: some factors associated with success or failure of staff proposals. J Business. 1967; 40(4):519-30. [Accessed 2022 Feb 08]. Available from: http://www.jstor.org/stable/2351633

[8] Daft RL. A dual core of organizational innovation. Academy Management J. 1978; 21(2):192-210. DOI:10.5465/255754

[9] Harrow J, Willcocks L. Public services management: activities, initiatives and limits to learning. J Management Studies. 1990;27(3):281-304. DOI:10.1111/j.1467-6486.1990.tb00248.x

[10] David A. Structure et dynamique des innovations managériales. Cinquième Conférence de l'Association Internationale de Management Stratégique. Lille ;1996.

[11] Hatchuel A, Weil B. L'expert et le système. Paris: Economica; 1990.

[12] Davis FD. Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. MIS Quarterly. 1989;13(3):319-40. DOI:10.2307/249008

[13] Dhagarra D, Goswami M, Kumar G. Impact of Trust and Privacy Concerns on Technology Acceptance in Healthcare: An Indian Perspective. Int J Med Inform. 2020;141:104164. DOI:10.1016/j.ijmedinf.2020.104164

[14] Triandis HC. Interpersonal Behavior. Monterey, CA: Brooks/Cole; 1977.

[15] Keplinger LE, Koopman RJ, Mehr DR, Kruse RL, Wakefield DS, Wakefield BJ, et al. Patient portal implementation: resident and attending physician attitudes. Fam Med. 2013 May; 45(5):335-40. [Accessed 2022 Feb 08]. Available from: https://fammedarchives.blob.core.windows.net/imagesandpdfs/fmhub/fm2013/May/Lynn335.pdf

[16] Urowitz S, Wiljer D, Dupak K, Kuehner Z, Leonard K, Lovrics E, et al. Improving diabetes management with a patient portal: a qualitative study of diabetes self-management portal. J Med Internet Res. 2012 Nov 30;14(6):e158. DOI: 10.2196/jmir.2265

[17] Yau GL, Williams AS, Brown JB. Family physicians' perspectives on personal health records: qualitative study. Can Fam Physician. 2011 May; 57(5):e178-84. [Accessed 2022 Feb 08]. Available from: https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1016.8387&rep=rep1&type=pdf

[18] Huba N, Zhang Y. Designing patient-centered personal health records (PHRs): health care professionals' perspective on patient-generated data. J Med Syst. 2012; 36(6):3893-905. DOI:10.1007/s10916-012-9861-z

[19] Witry MJ, Doucette WR, Daly JM, Levy BT, Chrischilles EA. Family physician perceptions of personal health records. Perspect Health Inf Manag. 2010 Jan 1;7:1d. [Accessed 2022 Feb 08]. Available from: https://bok.ahima.org/doc?oid=106698#.YgJB9urMLIU

[20] Lester M, Boateng S, Studeny J, Coustasse A. Personal Health Records: Beneficial or Burdensome for Patients and Healthcare Providers? Perspect Health Inf Manag. 2016 Apr 1;13:1h. [Accessed 2022 Feb 08]. Available from: http://perspectives.ahima.org/wp-content/uploads/2016/03/PHRsBeneficial.pdf

[21] Boyer L, Renaud MH, Limousin S, Henry JM, Caietta P, Fieschi M, et al. [Perception and use of an electronic medical record system by professionals of a public psychiatric hospital]. Encephale. 2009 Oct;35(5):454-60. DOI:10.1016/j.encep.2008.06.010

[22] Eden R, Burton-Jones A, Grant J, Collins R, Staib A, Sullivan C. Digitising an Australian university hospital: qualitative analysis of staff-reported impacts. Aust Health Rev. 2020; 44(5):677-89. DOI:10.1071/ah18218

[23] Mezni H, M-P G, Duplantie J. [Individual determinants of the Quebec electronic health record adoption]. Prat Organ Soins. 2009; 40(2):125-31. DOI:10.3917/pos.402.0125

[24] Venkatesh V, Morris MG, Davis GB, Davis FD. User Acceptance of Information Technology: Toward a Unified View. MIS Quarterly. 2003; 27(3):425-78. DOI:10.2307/30036540

[25] Lapointe L, Rivard S. A Multilevel Model of Resistance to Information Technology Implementation. MIS Quarterly. 2005; 29(3):461-91. DOI: 10.2307/25148692