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User acceptance factors of hospital information systems and related technologies: Systematic review

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ABSTRACT

This study reviews the literature on the most important acceptance factors associated with Hospital Information Systems (HIS) and related technologies based on user groups' perspectives (medical staff, hospital management, administrative personnel, patient, medical student, and IT staff), which can assist researchers and hospital management to develop suitable acceptance models to improve the quality of HIS. We conducted searches in online databases with large repositories of academic studies, written in English and fully accessible by the authors. The articles being reviewed are related to health information technology (HIT), clinical information systems (CIS), HIS, electronic medical records (EMR), telemedicine or telehealth, picture archiving and communication systems (PACS), radio frequency identification (RFID), and computerized physician order entry (CPOE), where the use of most of those applications and technologies is highly integrated. A predefined string was used to extract 1,005 articles, and the results were reviewed and checked. The results of this study found 15 user acceptance factors related to HIS and related technologies that were frequently identified by a minimum of five previous studies. These factors were related to individual, technological, and organizational factors. In addition, HIS and related technologies' user acceptance factors in each user group describe different results.

KEYWORDS

Acceptance factor; clinical information system; electronic medical record; health information technology; hospital; hospital information system; systematic review

Introduction

In order to support the e-health program launched by the World Health Organization (WHO), all health facilities—namely hospitals, clinics, and outpatient care centers—should be supported by Information Technology (IT) to provide optimal health care. Because hospitals are complex and unique entities, they require Hospital Information System (HIS) implementation in order to increase their service quality (1). Many people use the terms HIS and HMS (Hospital Management System) interchangeably, as managing has become inseparable from information; therefore, hospitals do not have separate information systems (IS) for managers and other staff members (2). According to Lee et al. (3) and Lakbala and Dindarloo (4), HISs help to reduce medical errors, increase efficiency and cost effectiveness, and increase patient involvement in healthcare decision making. WHO, along with the U.S. Institute of Medicine (IOM), strongly advocates for the use of IS to reduce the incidence of Adverse Drug Events (ADEs) or errors in administering drugs (5). Thus, HIS and related technologies—namely electronic medical records (EMR)/electronic health records (EHR) and computerized

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P.W.H, A.N.H., and I.B. are responsible for literature reviews of previous research related to the most importance acceptance factors and models associated with hospital information system (HIS) and its related technologies. All the authors designed the research methodology and undertook the literature review, analysis, and interpretation. All the authors made critical revisions of the manuscript for important intellectual content. All authors approved the final version.

physician order entry (CPOE)—are considered prerequisites for the efficient delivery of high quality care and are instrumental to the decrease in medical errors in healthcare delivery for the purpose of enhancing patient safety (4, 6). EMR refers to the management of patient medical records electronically from a variety of sources dealing with patient treatment, diagnosis, laboratory tests, imaging, history, prescriptions, and allergies. CPOE is an automated clinical decision support intervention that enables healthcare organizations to improve patient safety, clinician workflow processes, and resource utilization (7).

Other health technologies that are important in supporting HIS and should be highly integrated with HIS are as follows: telemedicine/telehealth, picture archiving and communication system (PACS), and radio frequency identification (RFID). Telemedicine is the use of telecommunications for patient care and can involve a number of electronic delivery mechanisms (8). PACS, an integral part of comprehensive EMRs, has been recognized as a strategic IT tool for improving a hospital's competitive advantage (9). In addition, RFID can help hospitals and clinics improve their inventory management, patient identification, and the maintenance of patient records and treatments (10).

According to Kelkar (2), HIS is a must for all hospitals, whether large or small, government or non-government owned, local or global, etc. Thus, it is essential that an HIS be built and deployed in such a way that it is well-accepted by all those affected by it. An HIS is a comprehensive, integrated information system designed to manage the administrative, financial, and clinical aspects of a hospital (11). The group of HIS users consists of internal users including medical (doctors), nursing, and administrative personnel as well as external users such as patients, suppliers, and insurance companies. To achieve optimal health services, internal users should provide the related medical information to the external users through the HIS and vice versa. To date, however, most hospitals still focus on the needs of the internal users, which can be categorized into hospital management, medical (doctor, nurse, medical students), and non-medical staff (administrative personnel such as cashiers or medical record personnel, and hospital IT staff. It has been shown that one of the most important factors in the successful implementation of HIS and related technologies is the involvement of all users—including the external users—at the development and implementation phases, thereby increasing user acceptance of HIS and related technologies (2, 12–16). Patients who are encouraged to access their medical data should also be involved in the development and implementation of HIS. Furthermore, suppliers should also be connected into HIS in order to accelerate supply chain flow of medical devices or medicine. Additionally, it is important that insurance companies are connected to HIS in order to accelerate the patients' claim processes. Hence, this review will analyze user acceptance factors from the perspectives of the key users of HIS, including hospital management, medical staff (doctors and nurses), administrative personnel, medical students, IT staff, and patients.

According to the Oxford dictionary, "acceptance" means the action of consenting to receive or undertake something offered. Esmaeilzadeh et al. (12) discussed users' acceptance as their willingness to use IT, which is designed to support tasks, especially focusing on the acceptance of medical staff. Moreover, user acceptance can be defined as demonstrable willingness within a user group to employ IT for the tasks it is designed to support (15). It is important to consider the viewpoints of all key adopter groups, because resistance in any of these groups could delay the overall adoption rate. HIS and communication technologies must be designed to meet the purposes of user groups through an understanding of human behavior and values (16). Furthermore, according to Brown et al. (17), when individuals perform certain behaviors, "the importance of their beliefs and attitudes as antecedents to the performance of those behaviors is likely to be minimized." Therefore, researchers need to look beyond acceptance models such as the technology acceptance model (TAM), the unified theory of acceptance and use of technology (UTAUT), and the DeLone and McLean IS success model, which could explain end-users' acceptance in the HIS context.

Additionally, discovering what motivates people to use new systems and understanding the source of resistance toward using new systems is important to hospital management, system designers, and developers (12) as it can help to increase the success of projects. The success of

HIT depends a great deal on the individual-level responses of clinician end users; these responses include acceptance/rejection of IT and how (or even whether) clinicians use IT (4, 6, 18, 19). Unfortunately, factors affecting healthcare users' adoption behavior regarding health applications are not completely clear (12); they vary over time in each health application implementation project stage (20) and can also vary amongst countries. According to King and He (21), there has been an increasing interest in the identification of factors that cause potential users to accept and take advantage of systems developed and implemented by others. However, to date, there are few studies on technology acceptance in the healthcare context, especially in developing countries. According to Hu (22) and Zakaria and Yusof (19), technology acceptance has three dimensions: characteristics of the individual, characteristics of the technology, and characteristics of the organizational context. A lower level of acceptance in individual users could increase the likelihood of failure (4). In addition, determining users' acceptance of a system is a difficult but important part of the research and application regarding human factors (15).

Until 2014, there were only three studies (13, 23, 19) carrying out systematic reviews of the acceptance factors of health applications in developed and developing countries. A systematic review attempts to collate all empirical evidence that fits pre-specified eligibility criteria to answer a specific research question (24). There are several limitations to the previous studies in this regard: 1) They do not provide clear explanations of the relationships among groups of users, users' acceptance factors, and related health applications, thus making it difficult to understand the requirement of non-technical aspects from each group of users; and 2) they more focused on IT adoption by healthcare professionals (i.e., doctors and nurses).

Thus, the aim of this study is to systematically review previous studies on user acceptance factors of HIS and related technologies in order to better understand the factors influencing the adoption of technologies as planned by users who have some degree of choice. Furthermore, this study intends to update previous systematic reviews. This systematic review followed the preferred reporting items for systematic reviews and meta-analyses (PRISMA) reporting guidance defined by Liberati et al. (24), due to its transparent and complete reporting of systematic reviews. In addition, this study is part of the research on developing users' acceptance models, whose factors will be identified by this study and will be adapted to the characteristics in developing countries. Therefore, we are particularly interested in the following research question:

RQ: What are the user groups' perspectives of acceptance factors regarding HIS and related technologies that need to be identified?

The target audience for this review is threefold. First, we aim at researchers who would like to get a systematic overview of the acceptance factors and models of HIS research. Second, we aim at hospital management who would like to determine related factors that can influence the process of design and implementation in a manner that will minimize the risk of resistance or rejection by users. Third, we aim at HIS vendors or developers who would like to understand the sociotechnical factors that need to be well planned before HIS implementation.

This paper is organized into six sections. Section 1 describes the research background, and Section 2 explains the literature review of HIS and related technologies, while the research methodology is discussed in Section 3. Then, the results and discussions of this study are subsequently elaborated in Section 4 and Section 5. The final section discusses the conclusions of this study and suggestions for future work.

His and related technologies

HIT is an area that combines IS, computer science (CS), and health care (25). According to Ahlan and Ahmad (25), there are several HIT systems available for patient monitoring that can be used in a clinical setting (supported with clinical information systems (CIS)) or remotely (usually from home),

such as telemedicine/telehealth or m-health. Furthermore, HIT should be supported with adequate, reliable medical, and related IT devices (i.e., hardware). CIS is defined as computer-supported applications with a relatively large, long-term database containing clinical data that are used to assist in the management of patient care (26). According to Blum (26), most HISs are considered CIS by this definition, in which some modules are not included, such as a hospital billing system (no clinical data). CIS could be implemented in all health facilities including hospitals which later been renamed as HIS. An HIS can have two or more components—including CPOE, EMR, financial information systems (FIS), laboratory information systems (LIS), nursing information systems (NIS), pharmacy information systems (PIS), PACS, RFID, and radiology information systems (RIS)—and these components can be linked to one another. Furthermore, in order to communicate between those applications or health technologies, hospitals should specify communication standards such as Health Level (HL) 7, Digital Imaging and Communications in Medicine (DICOM), and Clinical Context Object Workgroup (CCOW). Figure 1 shows the relationship between health applications and technologies.

An HIS is an integrated information system that improves patient care by increasing users' knowledge and reducing uncertainty, allowing rational decisions to be made from the information provided (27). Thus, there are two keys to this definition: 1) It is integrated among other applications and technologies; and 2) it delivers the required information to the professional in a usable format to allow him/her to make life-saving decisions accurately and promptly. In addition, timely and accurate information must be delivered in a cost-effective manner. Pride of ownership is one guarantee of a successful system (27). Furthermore, an HIS is defined as an integrated electronic system that collects, stores, retrieves, and displays overall patient data and information, such as history of the patient's information, results of laboratory tests, diagnoses, billing, and others related hospital procedures that are used by several departments within hospitals (28). In order to offer a higher level of care to patients, HIS could also be accessed via browser, touch screen, or pen tablet technology and can be used to store patients' information quickly and easily. Figure 2 describes the HIS architecture, where hospitals are required to implement HIS core modules that consist of at least registration, order communication system (OCS), medical record, billing, as well as emergency, inpatient, and outpatient unit module (29). Order communication system (OCS) modules assists medical staff in performing medical procedures that need to be performed according to the disease suffered by the patient. This module involves the medical record module and other supporting modules, such as laboratory and radiology. In addition, Figure 2 shows that these HIS core modules will be integrated with back office and support services modules.

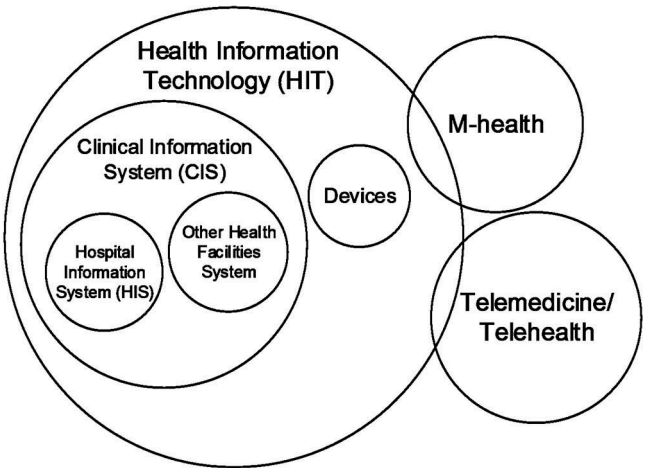

Figure 1. Relationship among health applications and technologies.

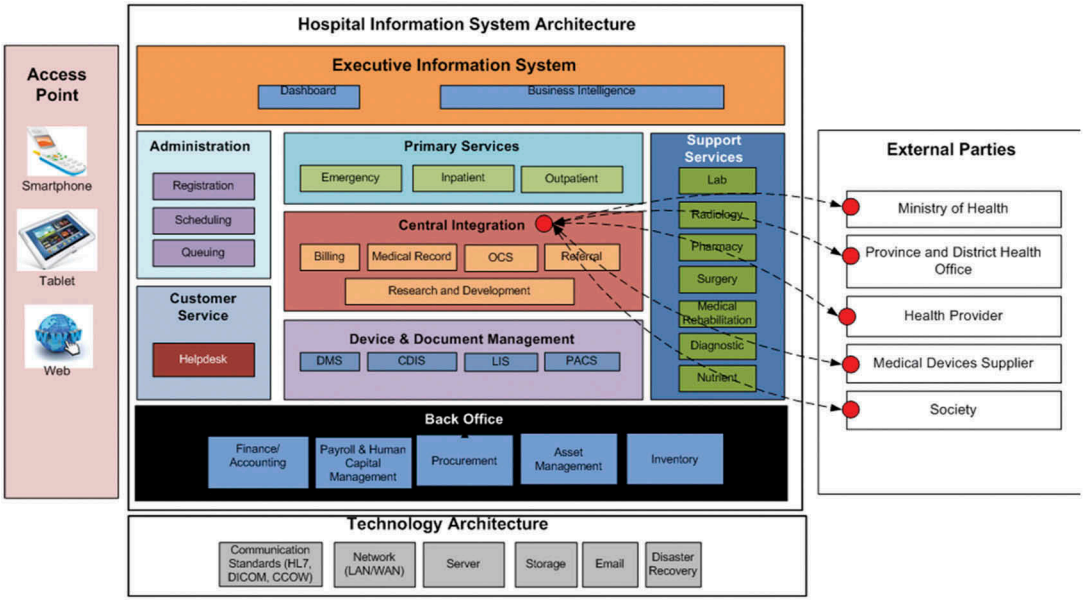

Figure 2. Hospital information system architecture (34).

By integrating HIS and PACS, a comprehensive EMR with a patient-centered data model can be constructed to provide effective and timely medical care (10). PACS is a medical image management information system that processes medical images and integrates different equipment through a network and that has the main function of capturing, transmitting, storing, retrieving, displaying, and analyzing medical images from CT, MRI, X-ray, and ultrasound imaging devices (30). In order to increase patient safety and prevent errors (e.g., giving patients the wrong medication, having insufficient and inaccurate pharmaceutical inventory control and operations, lacking patient identification, lacking the ability to accurately track patients' locations, and lacking the ability to track and manage equipment such as beds, wheelchairs, and surgical equipment), RFID can help healthcare industries to transmit and automatically identify objects and people based on radio waves (10).

Methodology

This systematic review was conducted from November 2014 to April 2015 using PRISMA reporting guidelines. According to these guidelines, there are several steps in this study: 1) defining eligibility criteria; 2) defining information sources; 3) study selection; 4) data collection process; and 5) data item selection (24). Figure 3 explains the steps of our work in conducting systematic review.

Eligibility criteria

The following inclusion criteria (IC) were defined for the review guidelines:

IC1: Original and peer-reviewed research written in English; and

IC2: Research aimed at investigating factors that influence the user's intention to use or the user's actual use of health applications, specifically in the hospital.

Only articles written in English (IC1) were selected, since English is a common language used by researchers in the scientific community. IC2 was included to answer the research questions.

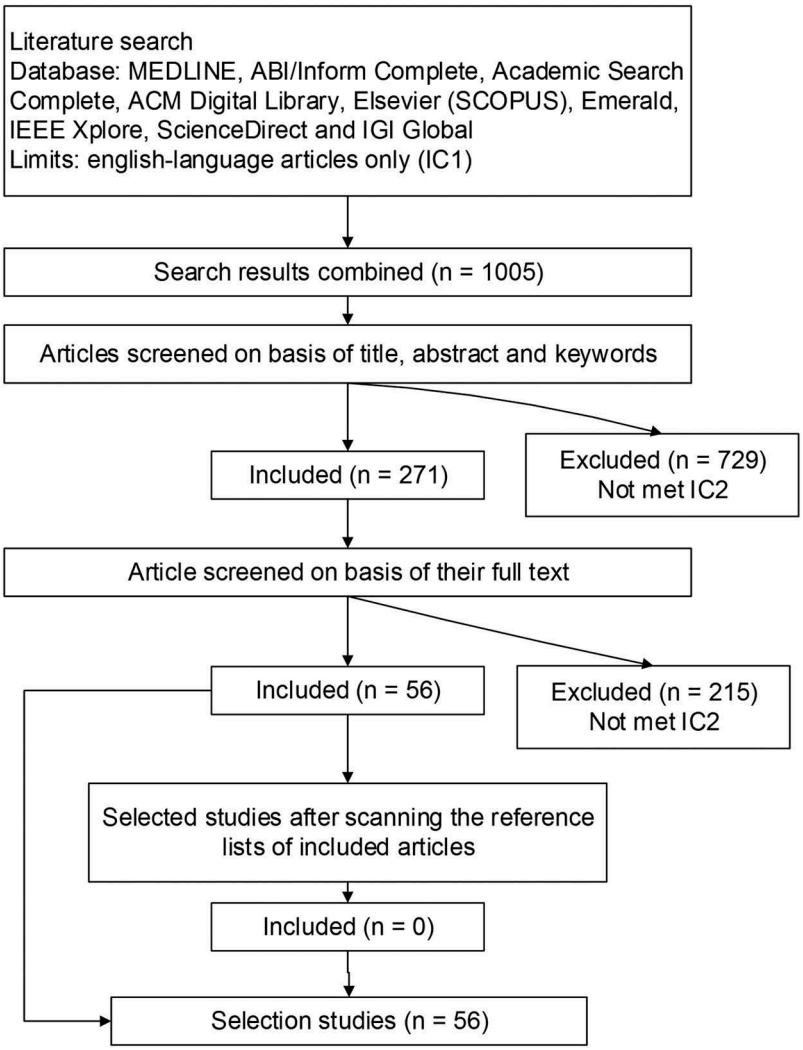

Figure 3. PRISMA flow diagram.

Our interests were not limited only to health applications (i.e., HIS, CIS, HIT, telemedicine, telehealth, EMR, PACS, RFID, and CPOE) in developing countries; they also extended to health applications in developed countries. In addition, we were also interested in papers analyzing the user acceptance factors involving hospital management, medical, and non-medical staff. The selected papers were thoroughly screened, first by looking at the inclusion criteria. Finally, these papers were classified according to health applications, user groups, and factor categories. Health applications groups consist of 1) HIT; 2) CIS; 3) HIS; 4) telemedicine/telehealth; 5) EMR/HER; 6) PACS; 7) RFID; and 8) CPOE. User groups consist of 1) hospital management; 2) medical staff (i.e., doctors and nurses); 3) administrative personnel; 4) patients; and 5) medical students. Factor categories consist of 1) information and communication technology (ICT) factors; 2) individual factors or healthcare professional characteristics; 3) human environment; and 4) organizational environment.

Information sources

We conducted searches of online databases with large repositories of academic studies, including MEDLINE, ABI/Inform Complete, Academic Search Complete, ACM Digital Library, Elsevier (SCOPUS), Emerald, IEEE Xplore, ScienceDirect, and IGI Global. We eliminated articles that could not be fully accessed by the authors. In addition, we scanned the reference lists included in the articles to find related studies.

Study selection

The study selection was conducted in the following four phases:

(1) The keyword search, or search string, was chosen according to our research interest in reviewing related adoption factors in HIS implementation; thus, it was related to a combination of health and computer science research topics. The search string was related to "factors and adoption" (including terms such as "factors," "adoption," "challenge," "barrier," "acceptance," "assurance," "lesson learned," "motivation") and information technology related to health care (including terms such as "hospital information system," "clinical information system," "e-health," "telemedicine," "telehealth," "electronic medical record," "electronic health record," "health electronic record," "order communication system," "picture archiving communication system," "health informatics," "computerized provider order entry," and "RFID"). Those exact search strings were searched one by one in each online database mentioned in section 3.2.
(2) Exploration and selection of title, abstract, and keywords of identified articles were conducted based on eligibility criteria.
(3) A complete or partial reading of the articles not eliminated in the previous phases was conducted to determine whether they should be included in the review, in accordance with the eligibility criteria.
(4) The reference lists of the articles were scanned to find related studies and start this phase from Phase 2.

These phases were carried out collaboratively by the three authors in an iterative process of the authors' assessments. Thus, any discrepancies were discussed by the three authors until a unanimous agreement was reached.

Data collection process

Data collection was carried out manually using a data extraction form consisting of the following contents: article type, name of journal or conference, year, topic, title, health technology, participant, keyword, country, research methodology, and user acceptance factors. Potentially relevant articles were assessed by each author. The assessment consisted of reading the full text and the extracted data. Any discrepancies were resolved through a discussion between the three authors.

Data items

Information extracted from each article was comprised of:

(1) Demography of selected articles with the following information:
    (i) Distribution of health applications study
    (ii) Countries involved in health application study
    (iii) Sources of health data study

(iv) Distribution of methods of study
(2) Users' acceptance factors related to HIS and related technologies.

The purpose of explaining data item number 1 was to provide the information to researchers, hospital management, and vendors in which health applications are widely implemented by the hospital as well as countries that have implemented those applications. Data item number 2 was then used to provide an explanation about related user acceptance factors for each aspect of health applications mentioned in the results of data item number 1 in order to understand the cause of success or failure of health application implementation.

Results

Study selection

The search results in the selected databases provided a total of 1,005 studies written in English from 1998 to 2015, matched with the keywords that needed to be analyzed. Next, those articles were screened on the basis of title, abstract, and keywords; the remaining 271 articles were then reviewed on the basis of their full text. A total of 729 articles were discarded due to IC2 (most of those articles discussed HIS application and its implementation). In addition, we eliminated five articles that could not be fully accessed by the authors. Finally, a total of 56 articles were selected in the review without additional articles resulting from the scanning of the reference lists.

Study characteristics

This section describes the data items of the demography of 56 selected articles. The results of this study show that 56 studies identified the user acceptance factors related to HIT (11 studies), CIS (4 studies), HIS (18 studies), EMR (12 studies), telemedicine or telehealth (4 studies), PACS (4 studies), RFID (3 studies), and CPOE (1 study). Moreover, 15 user acceptance factors related to HIS and related technologies were frequently identified by a minimum of five previous studies. These factors were related to individual, technological, and organizational factors. The detailed demography of relevant papers is described in Figure 4, Tables 1, 2, 3, and 4.

Demography of selected studies

Figure 4 shows that starting in 2000, most studies have focused on HIT. Beginning in 2010, studies of CIS and HIS grew rapidly, and there was a significant increase in HIS and EMR research in 2012; however, overall, the research trend in this area is in decline. These conditions were caused by

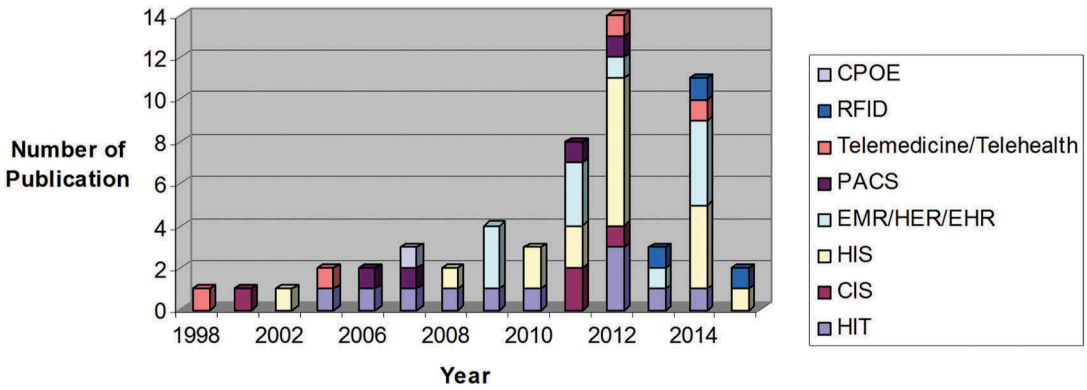

Figure 4. Distribution of health applications study.

Table 1. Countries involved in health study.

Category	Country	Number of publications
Developed country	USA	16
	Canada	7
	Taiwan	5
	United Kingdom	3
	Australia	2
	Austria	2
	Greece	2
	Spain	2
	Belgium	1
	France	1
	Korea	1
	Netherland	1
	Norway	1
Developing country	Malaysia	6
	Iran	2
	Thailand	2
	Ghana	1
	Turkey	1

Table 2. Participants of health data study.

Participants	Number of publications
Medical staff (physician and nurse)	46
Hospital management	15
Administrative personnel	9
IT staff	2
Medical student	2
Patient	1

Table 3. Distribution of methods of study.

Method	Type of study	Number of publications
Qualitative	Case study	2
	Interview	6
	Observation	1
	Focus group discussion	1
Quantitative	Questionnaire survey	30
Qualitative and quantitative		7
Literature review		11
Conceptual paper		3

implementation of information system to solve the year 2000 problems (31) and low adoption of HIS in the healthcare industry prior to 2010. There are few investigations into the user acceptance of PACS, telemedicine, and RFID, which may be due to the large financial investments involved in these technologies.

Research on HIS and related technologies has mostly been conducted in developed countries such as the United States and Canada, rather than in developing countries (Table 1). According to Mohr (32), the total number of medical persons is 39,470,000 and health management and support workers are 19,750,000, where both of their support are highly required by the health facilities to provide optimal health services. However, according to Table 2, most HIS studies have only assessed the acceptance factors that need attention from medical staff rather than other users. Therefore, it is important to involve other groups of users such as medical students, and administrative personnel to obtain thorough requirements of HIS. It has been noted that medical students may not vary too much as compared to other users of HIS (33). In addition, administrative personnel play an important role in the utilization of HIS because most hospitals implement HIS starting with billing

Table 4. Sources of selected studies.

Article type	Publisher title	Number of articles	Total number of articles
Journal	International Journal of Medical Informatics	12	43
	Journal of Biomedical Informatics	5	
	Decision Support Systems	3	
	BMC Medical Informatics and Decision Making	3	
	Journal of Medical System	2	
	Journal of Healthcare Information Systems and Informatics	2	
	Canadian Nursing Informatics	1	
	Information System Frontiers	1	
	Health Care Manage Science	1	
	Health Informatics Journal	1	
	Methods of Information in Medicine	2	
	SpringerPlus Bioinformatics	1	
	Journal of Academic Research in Business and Social Sciences	1	
	Technological Forecasting & Social Change	1	
	Health Policy and Technology	1	
	Malaysian Journal of Public Health Medicine	1	
	Research in Social and Administrative Pharmacy	1	
	Journal of Nursing Studies	1	
	Spanish Accounting Review	1	
	Journal Production Economics	1	
	Journal of Information Management	1	
	Journal of Information System	1	
Proceedings	Procedia - Social and Behavioral Sciences	2	9
	Procedia Technology	2	
	IEEE Proceedings of Technology Management in the Energy Smart World (PICMET)	1	
	Proceedings of the 36th Hawaii International Conference on System Sciences (HICSS'03)	1	
	Proceedings of the second KES international symposium Intelligent Decision Technologies (IDT)	1	
	Proceedings of the Annual Hawaii International Conference on System Sciences	1	
	Proceedings of the Pacific Asia Conference on Information Systems	1	
Book/book chapter	Clinical Technologies: concepts, Methodologies, Tools and Applications	2	4
	Int. J. of Healthcare Information Systems and Informatics	1	
	U- and E-service, Science and Technology	1	

or medical record modules. Gagnon et al. (13) also noted the importance of administrative and clinical leaders in implementing and promoting the use of new clinical IT. A small number of studies involved patients as respondents because only a few patients had been using HIS (13). Furthermore, according to Gagnon et al. (13), patients' attitudes regarding ICT were also cited in a small number of studies as positive or negative factors.

Table 3 shows that healthcare researchers use several methods to conduct their research: qualitative, quantitative, systematic review, conceptual paper, and so on. According to Sipil et al. (8), the qualitative method is used to gain a rich understanding of the healthcare IT context. A qualitative study may be conducted in a number of ways (e.g., case studies, interviews, observations, or focus groups). A case study examines a phenomenon of interest in its natural setting, employing multiple methods of data collection to gather information from one or a few entities (34). Most of the researchers used the qualitative method through interviews as a stand-alone method or as part of a case study by analyzing and coding keywords and phrases into themes and categories.

In the quantitative method, surveys or questionnaire research was by far the most prevalent methods used for collecting data in healthcare IT studies (8). A conceptual paper provides an in-depth discussion of topics on which authors take a position and points out issues that may often be overlooked in research efforts and in practice. The most frequent statistical analyses that are conducted by previous studies are regression, partial least square (PLS), basic statistics, and structural equation modeling (SEM). Finally, according to Table 4, a study of HIS and related technologies' acceptance

factors are published in most international journals. This study included 25 journals, 5 proceedings, and 3 books/book chapters.

User's acceptance factors related to HIS and related technologies

Prior to HIS implementation, hospitals should be able to identify and understand individual user acceptance of HIS. Yarborough and Smith (23) indicate, indicates that personal characteristics, technology, and organizational issues are significant barriers to physicians' technology acceptance. Therefore, it is important to better understand these factors. We classified user acceptance factors into four categories: 1) factors related to ICT; 2) individual factors or healthcare professional characteristics; 3) human environment; and 4) organizational environment. If users do not perceive and understand the benefits of HIS, they will immediately reject that technology. Thus, it is important for hospital management to conduct better planning and implementation of HIS in order to increase user acceptance. Furthermore, individual attitude is the most influential factor on individual acceptance of ICT. Human environment factors are associated with patients and peers' attitudes toward ICT for health care. The organizational environment consists of 1) work structure; 2) skills and staff; 3) facilitating condition; 4) risk; and 5) institutional trust. Institutional trust is the physicians' belief that favorable conditions are in place that are conducive to situational success (45). Other organizational factors that could lead users to accept or resist HIS implementation are lack of organizational or inadequate training, the presence or absence of a champion, management motivation, participation of end-users in the design, and communication of HIS implementation.

Based on the study, 79 of 92 factors influence medical staff. Fewer than 25 factors influence other users aside from medical staff, thus impacting hospital management to better understand the acceptance factors, especially for medical staff. Medical and IT staff are concerned with all factors that are related to ICT, individuals, human environment, and organizational factors. Since hospital management is largely responsible for the smooth hospital operations, these staff members are more influenced by factors related to ICT and organizational environment. Similar results were also perceived by the patients due to their lack of IT knowledge. Furthermore, because administrative personnel are the ones who often use the HIS and related technologies, they are significantly affected by factors related to ICT. In order to support their studies and work, medical students are more influenced by factors related to ICT and organization.

In addition, those 92 user acceptance factors are also correlated with health applications. Based on the study, it can be concluded that there are 53 factors that could affect user acceptance of HIS, 48 factors affecting user acceptance of EMR, 21 factors affecting user acceptance of PACS, 19 factors affecting user acceptance of telemedicine/telehealth and HIT, 12 factors affecting user acceptance of RFID, 6 factors affecting user acceptance of CPOE, and 5 factors affecting user acceptance of CIS. The user acceptance of HIS, telemedicine/telehealth, and EMR consists of all factors that are related to ICT, individual, human environment, and organizational factors. The use of CIS is influenced more by ICT, individual, and organizational factors. This result is slightly different than user acceptance factors regarding CPOE, where human factors are more influenced than individual factors. The user acceptance of HIS-related technologies—namely HIT, PACS, and RFID—includes ICT and organizational factors. Those results show that implementing HIS is more complex that other related health applications and technologies.

Finally, there are 15 factors that are frequently accepted by most users in a minimum of five from the previous studies. Each of these factors are characterized into groups. Factors are arranged sequentially based on the number of studies mentioning the importance of each factor. These factors are required mostly by medical staff, such as doctors and nurses, as well as hospital management in implementing HIS, EMR, and PACS as most hospitals still implement only these technologies, and a lot of research has focused entirely on these technologies.

Discussion

Since HIS is categorized as an enterprise system, the first two factors—perceived usefulness and ease of use—are the most frequently mentioned as user acceptance factors related to HIS due to the fact that most hospital staff does not have sufficient knowledge and experience related to HIS and its technologies. According to Walter and Lopez (36), perceived usefulness is not just a matter of functionality. For physician users, a sophisticated system would not be adopted if the system did not follow the natural flow of a physician's work, or if it could be perceived by the physician user as threatening to his/her professional autonomy. In general, users often resist change because new ways of doing things are unfamiliar and somewhat threatening. Additionally, technological change needs to address user satisfaction (4) and motivation to use the technological system; thus, what motivates people to use technology also differs depending on their values, needs, and expectations (16). Hospital management should therefore provide adequate training in order to build awareness and proper understanding among users of the importance of HIS with its positive outcomes, as well as introducing and using HIS. Further, according to Zakaria and Yusof (16), in order to motivate users, training must include clarification of language, jargon, or commands used to avoid further frustration and anxiety as new technological language has mystifying and alienating potential. It has been found that having a background of knowledge or training regarding computers fosters a feeling of comfort in the nursing staff (37). According to Zakaria and Yusof (16), with appropriate user training, communication, information, documentation, and user support, the process of managing technology will result in success. Furthermore, user experience and training will impact acceptance levels, as well as the manner in which the technology is implemented, to contribute to organizational goals and working practices (15). Therefore, according to Chen and Hsiao (38), planners and hospital managers should ensure that HIS introduced into hospitals is useful and easy to use.

DeLone and McLean (39) believe that system and information quality simultaneously affect use, user satisfaction, and individual performance and further influence organizational performance. Lee et al. (3) stated that the more uncomfortable people feel about the technology itself, the more unwilling they are to adopt it. Esmaeilzadeh et al. (14) also stated that a high quality HIS could eliminate perceived threats to professional autonomy, which are mainly intensified through an increased level of knowledge codification by means of HIS. The knowledge codification required in HIS causes medical and non-medical staff to have access to greater amounts of knowledge in organizations besides the load of medical staff activities (40). Moreover, doctors generally fear loss of privacy, additional workload and costs, increased medical liability, and poor usability specifically for the medical record system (41). According to Zakaria and Yusof (16), elements like motivation, anxiety, user knowledge, prior experience, and user skill in using technology all fall under user characteristics. Meanwhile, user curiosity, growing interest, disorientation, and discomfort along the process of integrating new technology into daily routines are factors that affect user perception. Hence, hospital management requires IT plans and roadmaps to ensure that the implementation of integrated HIS is running according to plan. This IT plan and roadmap must be communicated to all involved users in order to convey the notion that the positive benefits of HIS can be achieved. In addition, an evaluation of project planning and outcomes should be conducted periodically so that HIS implementation can be run in accordance with plans and organizational and technological developments. Finally, the involvement of users in every phase of the HIS development cycle is also important to deliver a high quality HIS.

A successful HIS implementation should be strongly supported by top management by providing adequate policies regarding HIS, infrastructure (facilitating conditions), and thorough project management. Chen and Hsiao (38) stated that in implementing HIS, effort should be placed on providing sufficient top management support, selecting qualified project team members, and delivering higher system quality in addressing physician's clinical needs. In fact, our study has shown that most hospitals appear not to receive support from top management when implementing HIS, which caused the appearance of the seven factors

—system quality, subjective norms, facilitating condition, self-efficacy, information quality, compatibility, and individual attitude—that are required by users to accept HIS implementation.

In addition, nine factors—perceived usefulness, ease of use, system quality, subjective norms, facilitating conditions, self-efficacy, information quality, compatibility, and individual attitude—are defined in the TAM, UTAUT, and DeLone and McLean's IS success model. Those acceptance models were a powerful approach to explain the intention to use and actual use of health technologies. However, these models with their related factors should also be adapted to the characteristics of the organization and the development of technology. According to Sezgina and Yildirim (19), there was a particular increase in degree of variance to explain intention in recent studies due to positive changes in people's lifestyles (involving more technology in their lives than before), mindsets, and attitudes toward new technologies. Finally, the limitations of this study include the following factors: 1) The search process was conducted manually by the authors, so the search string may not have included words relevant to our study; and 2) the authors only included articles written in English during the search date period.

Conclusion and future works

Replace first sentence with 'HIS have been implemented to improve the quality of patient care in many facilities around the world. However, most hospitals still face a great deal of non-technical problems in implementing those applications. This study reviewed previous research on user acceptance of HIS and related technologies based on PRISMA reporting guidelines. This study comprised 11 HIT studies, 4 CIS studies, 18 HIS studies, 12 EMR studies, 4 telemedicine or telehealth studies, 4 PACS studies, 3 RFID studies, and 1 CPOE study. Over the last 15 years, there has been a significant increase in HIS and related technologies research. HIS research was limited to developing countries as opposed to the United States and Canada. Most HIS research only assessed the acceptance factors that needed attention from medical staff rather than other users such as hospital management, administrative personnel, and patients.

The results of this study showed that there were 15 factors based on the number of studies and were related to individual, technological, and organizational factors. In addition, the HIS user acceptance factors in each user group (i.e., medical staff, hospital management, administrative personnel, patients, medical students, and IT staff) describe different results. Therefore, more work should be conducted for hospital management and researchers to focus on these factors before implementing HIS and related technologies to increase the chance of successful HIS implementation.

Future works in this study are planned to have a better understanding on the individual, technological, and organizational as user acceptance factors that could impact HIS implementation in developing countries, to identify acceptance factors that fit in with the characteristics of developing countries to provide a comprehensive review of the acceptance of HIS and related technologies. In addition, future works for gathering the required factors from external stakeholders, such as patients and medical students, are also important since these users are involved in healthcare process and could affect the success of HIS implementation.

Declaration of interest

The authors declare that they have no potential conflicts of interest.

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Appendix 1. User acceptance factors related to ICT based on user groups' perspectives

User acceptance factors	Perspectives						References
	Medical staff (doctor & nurse)	Management	Administrative personnel	Patient	Medical student	IT staff	
1.1. Design and technical concern/technical motivations	x	x					(13, 42, 43)
1.2. Characteristics of the innovation	x	x					(13, 42)
1.2.1. Perceived usefulness (or relative advantage or benefits)/performance expectancy	x	x	x	x	x	x	(3, 4, 6, 8–10, 12, 13, 19, 20, 25, 28, 33, 35, 38, 41, 44–70)
1.2.2. Compatibility (with work process)/job relevance	x	x					(9, 13, 19, 35, 38, 49, 50, 56, 62–64, 69, 71)
1.2.3. Perceived ease of use/complexity/effort expectancy	x	x	x	x	x	x	(4, 6, 10, 13, 19, 20, 25, 28, 33, 35, 36, 38, 42, 45, 46, 49, 54, 56, 57, 59, 60, 62–64, 67–74)
1.2.4. Triability	x	x					(13, 65)
1.2.5. Observability	x	x					(13)
1.3. System reliability	x						(13, 74)
1.4. Interoperability	x						(13, 74)
1.5. Legal issues							(13, 42)
1.5.1. Confidentiality—Privacy concern (information security expectancy)	x			x	x		(13, 33, 45, 73, 75)
1.5.2. Other legal issues—Security-related concerns	x						(13, 42)
1.6. Validity of the resources/output quality/information quality	x		x	x	x		(9, 13, 28, 33, 38, 45, 50, 60, 64, 76–81)
1.6.1. Scientific quality of the information resources	x						(9, 13, 28, 33, 38, 45, 50, 60, 64, 76, 78–81)
1.6.2. Content available (completeness)	x						(13, 50, 72, 78)
1.6.3. Appropriate for users (relevance)	x						(13, 50, 64, 78)
1.6.4. Format	x						(64)
1.6.5. Timeliness	x						(64)
1.7. Cost issues	x	x					(13, 42, 64, 78)
1.8. System quality	x	x	x	x	x		(4, 8, 9, 13, 16, 18, 19, 28, 33, 38, 44, 45, 47–49, 56, 60, 62, 73–76, 78–82)

Appendix 2. User acceptance factors related to individual or human characteristics based on user groups' perspectives

	Perspectives						
User acceptance Factors	Medical staff (doctor & nurse)	Management	Administrative personnel	Patient	Medical student	IT staff	References
2.1. Knowledge	x						(13, 41, 59, 73)
2.1.1. Awareness of the existence and/or objectives of the ICT	x						(13, 37, 41)
2.1.2. Familiarity with ICT	x						(13, 28, 37, 41)
2.2. Attitude	x			x			(3, 6, 13, 35, 45, 59, 68, 73)
2.2.1. Agreement with the particular ICT (general attitude)	x						(13, 49, 83)
2.2.2. Agreement with ICTs in general (welcoming/ resistant) Voluntariness/ anxiety	x					x	(8, 10, 13, 46, 63, 68, 83)
2.2.3. Applicability to the clinical situation (including practical)	x						(13, 70)
2.2.4. Confidence in the ICT developer	x						(13)
2.2.5. Challenge to autonomy	x						(12, 13, 36)
2.2.6. Impact on clinical uncertainty	x						(13)
2.2.7. Time saving/time consuming or increased workload	x						(13)
2.2.8. Motivation to use the ICT (readiness)/resistance to change	x						(10, 13, 66)
2.2.9. Self-efficacy (believes in one's competence to use the ICT)	x	x				x	(3, 6, 13,18, 19, 35, 46, 49, 51, 59, 64, 66, 68, 70, 73, 82, 84)
2.2.10. Impact on professional security	x						(13)
2.2.11. Demonstrability of the results	x						(70)
2.2.12. Personal identity	x						(70)
2.3. Sociodemographic characteristics (age, gender, experience, other)	x						(10, 13, 66)

Appendix 3. User acceptance factors related to human environment based on user groups' perspectives

	Perspectives						
User acceptance factors	Medical staff (doctor & nurse)	Management	Administrative personnel	Patient	Medical student	IT staff	References
3.1. Factors associated with patients				x			(13)
3.1.1. Patients' attitudes and preferences regarding ICT				x			(13)
3.1.2. Patient/health professional interaction				x		x	15
3.1.3. Applicability to patients' characteristics				x			(13)
3.2. Factors associated with peers (subjective norms/social influence	x	x			x	x	(3, 10, 13, 19, 20, 33, 35, 41, 44, 46, 49, 51, 52, 57, 66, 68, 70, 84–94)
3.2.1. Attitude of colleagues towards ICT	x					x	(13)
3.2.2. Support and/or promotion of ICT by colleagues	x					x	(13)
3.2.3. Relations between colleagues	x					x	(13)

Appendix 4. User acceptance factors related to organizational environment based on user groups' perspectives

	Perspectives						
User acceptance factors	Medical staff (doctor & nurse)	Management	Administrative personnel	Patient	Medical student	IT staff	References
4.1. Factors associated with work	x	x					(13)
4.1.1. Work structure (setting of care, salary status)	x						(8, 13, 83, 95)
4.1.2. Time constraints and workload	x	x					(13, 62, 66, 75)
4.1.3. Work flexibility	x	x					(13, 62, 75)
4.1.4. Relationship between professional groups (role boundaries, changes in tasks)	x					x	(13)
4.1.5. Professional culture	x	x			x	x	(6, 13, 56, 57, 70)
4.2. Skills and staff	x						(13, 45, 62)
4.2.1. Leadership (management support)	x						(13, 35, 38, 45, 62, 66, 83)
4.2.2. Staff issues (stability, shortage)	x	x					(13, 62, 75)
4.3. Resource availability/ Facilitating Condition/ Service quality	x	x			x	x	(3, 8–10, 13, 16, 33, 35, 45, 51, 56, 57,60, 62, 64, 68, 73, 76, 78, 96)
4.3.1. Resources available (additional)	x					x	(13)

(*Continued*)

(Continued).

User acceptance factors	Perspectives: Medical staff (doctor & nurse)	Management	Administrative personnel	Patient	Medical student	IT staff	References
4.3.2. Material resources (access to ICT)	x					x	(13)
4.3.3. Human resources (IT support)	x						(\9, 13, 54, 62)
4.4. Risk	x	x				x	(49, 62, 63, 69)
4.5. Institutional Trust	x						(19, 35)
4.5.1. Situational normality	x						(35)
4.5.2. Structural assurance	x						(35)

Appendix 5. User acceptance factors related to other organizational factors based on user groups' perspectives

User acceptance factors	Perspectives: Medical staff (doctor & nurse)	Management	Administrative personnel	Patient	Medical student	IT staff	References
5.1. Training/lack of or inadequate training	x	x				x	(13, 37, 45, 54, 69, 73, 82)
5.2. Presence and use of champions/ absence of champion	x						(13, 62)
5.3. Management (strategic plan)/ managerial or clinical strategic or operational motivation	x					x	(13, 43, 54)
5.4. Participation of end-users in the design/Lack of participation	x					x	(12, 13, 44, 45, 54, 72)
5.5. Participation of end-users in the implementation strategy	x					x	(12, 13, 44, 45, 54, 72)
5.6. Communication (included promotional activities)	x					x	(13, 45, 62, 72, 75)
5.7. Relationship between administration and health professionals	x					x	(13, 54)
5.8. Ongoing administrative or organizational support	x					x	(13)
5.9. Incentive structures	x						(13)
5.10. Readiness	x					x	(13, 19)
5.11. Other organizational or cultural aspects	x						(13, 45)
5.11.1. Organizational size		x				x	(55)
5.11.2. Tax status		x				x	(55)
5.11.3. System affiliation		x				x	(55)
5.12. Service needs	x						(49)
5.13. Strategic pressure and the context	x						(45)
5.14. ROI (Return on Investment)	x					x	(45, 53)
5.15. Perceived cost-effectiveness						x	(25)
5.16. Project team competency	x					x	(38)
5.17. Degree of Centralization	x						(9)
5.18. Degree of formalization	x						(9)
5.19. External environment							
5.19.1. Financing of ICT/financial support	x					x	(13, 19, 45, 53, 62)
5.19.2. Interorganizational relations	x						(8, 13)
5.19.3. Governmental influence (i.e., policy)	x						(8, 9, 35, 62)
5.19.4. Competition	x						(9, 62)
5.20. Clinical factors							(95)
5.20.1. Accessibility of medical records	x						(95)
5.20.2. Accessibility of patients	x						(95)

Appendix 6. User acceptance factors related to ICT group by health applications

User acceptance factors	Applications								References
	HIT	CIS	HIS	Telemedicine/ telehealth	EMR/ HER	PACS	RFID	CPOE	
1.1. Design and technical concern/technical motivations			x	x	x				(13, 42, 43)
1.2. Characteristics of the innovation				x	x				(13, 42)
1.2.1. Perceived usefulness (or relative advantage or benefits)/performance expectancy	x	x	x	x	x	x	x	x	(3, 4, 6, 8–10, 12, 13, 19, 20, 25, 28, 33, 35, 38, 41, 44–70)
1.2.2. Compatibility (with work process)/job relevance	x		x		x	x			(9, 13, 19, 35, 38, 49, 50, 56, 62–64, 69, 71)
1.2.3. Perceived ease of use/ complexity/effort expectancy	x	x	x	x	x	x	x		(4, 6, 10, 13, 19, 20, 25, 28, 33, 35, 36, 38, 42, 45, 46, 49, 54, 56, 57, 59, 60, 62–64, 67–74)
1.2.4. Triability									(13, 65)
1.2.5. Observability					x				(13)
1.3. System reliability			x		x				(13, 74)
1.4. Interoperability			x		x				(13, 74)
1.5. Legal issues									(13, 42)
1.5.1. Confidentiality— Privacy concern (information security expectancy)	x		x		x				(13, 33, 45, 73, 75)
1.5.2. Other legal issues— Security-related concerns			x		x				(13, 42)
1.6. Validity of the resources/ output quality/information quality	x		x		x				9,13,28,33,38,45,50,60,64,76–81
1.6.1. Scientific quality of the information resources	x		x						(9, 13, 28, 33, 38, 45, 50, 60, 64, 76, 78–81)
1.6.2. Content available (completeness)	x		x						(13, 50, 72, 78)
1.6.3. Appropriate for users (relevance)	x		x						(13, 50, 64, 78)
1.6.4. Format			x						(64)
1.6.5. Timeliness			x						(64)
1.7. Cost issues			x			x	x		(13, 42, 64, 78)
1.8. System quality	x		x		x	x	x		(4, 8, 9, 13, 16, 18, 19, 29, 33, 38, 44, 45, 47–49, 56, 60, 62, 73–76, 78–82)

Appendix 7. User acceptance factors related to individual or human characteristics group by health applications

User acceptance factors	Applications								References
	HIT	CIS	HIS	Telemedicine/ Telehealth	EMR/ HER	PACS	RFID	CPOE	
2.1. Knowledge			x		x				(13, 41, 59, 73)
2.1.1. Awareness of the e1istence and/or objectives of the ICT					x				(13, 37, 41)
2.1.2. Familiarity with ICT			x		x				(13, 28, 37, 41)
2.2. Attitude			x	x	x				(3, 6, 13, 35, 45, 59, 68, 73)
2.2.1. Agreement with the particular ICT (general attitude)									(13, 49, 83)
2.2.2. Agreement with ICTs in general (welcoming/resistant) Voluntariness/an1iety	x		x	x	x		x		(8, 10, 13, 46, 63, 68, 83)
2.2.3. Applicability to the clinical situation (including practical)					x				(13, 70)
2.2.4. Confidence in the ICT developer			x						(13)
2.2.5. Challenge to autonomy		x	x						(12, 13, 36)
2.2.6. Impact on clinical uncertainty			x						(13)
2.2.7. Time saving/time consuming or increased workload			x						(13)
2.2.8. Motivation to use the ICT (readiness)/resistance to change			x				x		(10, 13, 66)
2.2.9. Self-efficacy (believes in one's competence to use the ICT)	x		x	x	x		x		(3, 6, 13, 18, 19, 35, 46, 49, 51, 59, 64, 66, 68, 70, 73, 82, 84)
2.2.10. Impact on professional security			x						(13)
2.2.11. Demonstrability of the results					x				(70)
2.2.12. Personal identity					x				(70)
2.3. Sociodemographic characteristics (age, gender, e1perience, other)			x				x		(10, 13, 66)

Appendix 8. User acceptance factors related to human environment group by health applications

User acceptance factors	Applications								References
	HIT	CIS	HIS	Telemedicine/ Telehealth	EMR/ HER	PACS	RFID	CPOE	
3.1. Factors associated with patients				x					(13)
3.1.1. Patients' attitudes and preferences regarding ICT				x					(13)
3.1.2. Patient/health professional interaction			x						(13)
3.1.3. Applicability to patients' characteristic				x					(13)
3.2. Factors associated with peers (subjective norms/social influence	x		x	x	x		x		(3, 10, 10, 19, 20, 33, 35, 41, 44, 46, 49, 51, 52, 57, 66, 68, 70, 84–94)
3.2.1. Attitude of colleagues towards ICT			x					x	(13)
3.2.2. Support and/or promotion of ICT by colleagues			x						(13)
3.2.3. Relations between colleagues			x		x				(13)

Appendix 9. User acceptance factors related to organizational environment group by health applications

User acceptance factors	Applications								References
	HIT	CIS	HIS	Telemedicine/ Telehealth	EMR/ HER	PACS	RFID	CPOE	
4.1. Factors associated with work				x	x	x			(13)
4.1.1. Work structure (setting of care, salary status)				x					(8, 13, 83, 95)
4.1.2. Time constraints and workload					x	x	x		(13, 62, 66, 75)
4.1.3. Work flexibility					x	x			(13, 62, 75)
4.1.4. Relationship between professional groups (role boundaries, changes in tasks)			x						(13)
4.1.5. Professional culture			x		x				(6, 13, 56, 57, 70)
4.2. Skills and staff					x	x			(13, 45, 62)
4.2.1. Leadership (management support)	x				x	x		x	(13, 33, 38, 45, 62, 66, 83)
4.2.2. Staff issues (stability, shortage)					x	x			(13, 62, 75)
4.3. Resource availability/ Facilitating Condition/Service quality	x		x	x	x	x	x		(3, 8–10, 13, 16, 33, 35, 45, 51, 56, 56, 60, 62, 64, 68, 73, 76, 78, 96)
4.3.1. Resources available (additional)			x		x				(13)
4.3.2. Material resources (access to ICT)			x	x	x				(13)
4.3.3. Human resources (IT support)						x			(9, 13, 54, 62)
4.4. Risk			x			x			(49, 62, 63, 69)
4.5. Institutional Trust					x				(19, 35)
4.5.1. Situational normality					x				(35)
4.5.2. Structural assurance					x				(35)

Appendix 10. User acceptance factors related to organizational environment group by health applications

User acceptance factors	Applications								References
	HIT	CIS	HIS	Telemedicine/ Telehealth	EMR/ HER	PACS	RFID	CPOE	
5.1. Training/lack of or inadequate training			x		x		x		(13, 37, 45, 54, 69, 73, 82)
5.2. Presence and use of champions/absence of champion					x	x		x	(13, 62)
5.3. Management (strategic plan)/managerial or clinical strategic or operational motivation			x		x				(13, 43, 54)
5.4. Participation of end-users in the design/Lack of participation	x	x	x		x			x	(12, 13, 44, 45, 54, 72)
5.5. Participation of end-users in the implementation strategy	x	x	x		x			x	(12, 13, 44, 45, 54, 72)
5.6. Communication (included promotional activities)			x		x	x			(13, 31, 45, 62, 72, 75)
5.7. Relationship between administration and health professionals			x					x	(13, 54)
5.8. Ongoing administrative or organizational support			x						(13)
5.9. Incentive structures			x						(13)

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User acceptance factors	Applications								References
	HIT	CIS	HIS	Telemedicine/ Telehealth	EMR/ HER	PACS	RFID	CPOE	
5.10. Readiness			x						(13, 19)
5.11. Other organizational or cultural aspects					x				(13, 45)
5.11.1. Organizational size	x		x						(55)
5.11.2. Tax status	x		x						(55)
5.11.3. System affiliation	x		x						(55)
5.12. Service needs				x					(49)
5.13. Strategic pressure and the context					x	x			(45)
5.14. ROI			x		x				(45, 53)
5.15. Perceived cost-effectiveness			x						(25)
5.16. Project team competency			x						(38)
5.17. Degree of Centralization						x			(9)
5.18. Degree of formalization						x			(9)
5.19. External environment									
5.19.1. Financing of ICT/financial support			x		x				(13, 19, 45, 53, 62)
5.19.2. Interorganizational relations				x	x				(8, 13)
5.19.3. Governmental influence (i.e., policy)					x	x			(8, 9, 35, 62)
5.19.4. Competition						x			(9, 62)
5.20. Clinical factors									(95)
5.20.1. Accessibility of medical records				x					(95)
5.20.2. Accessibility of patients				x					(95)

Appendix 11. Summary of frequent user acceptance factors

No	User acceptance factors	Definition	References
1	Perceived usefulness or performance expectancy	The degree to which a person believes that using a particular system would enhance his or her job Performance	(3, 4, 6, 8–10, 12, 13, 19, 20, 22, 25, 28, 33, 35, 38, 41, 44–48, 50–70)
2	Perceived ease of use or effort expectancy	The degree to which a person believes that using a particular system would be free of effort/the degree of ease associated with the use of the system	(4, 6, 10, 13, 19, 20, 22, 25, 28, 33, 35, 36, 38, 42, 45, 46, 55, 56, 57, 64, 65, 67–69, 67–74)
3	System quality	The degree of excellence of the software	(4, 8, 9, 10, 14, 18, 16, 18, 24, 28, 33, 44, 45, 47, 48, 56, 60, 62, 73–76, 78–82)
4	Subjective norms or social influence	The person's perception that most people who are important to him/her think he/she should or should not perform the behavior in question	(3, 10, 13, 19, 20, 22, 33, 35, 41, 44, 46, 51, 52, 57, 66, 68, 70, 84–94)
5	5. Facilitating condition	Objective factors in the environment that observers agree make an act easy to perform, including the Provision of computer support	(3, 8–10, 13, 16, 33, 35, 45, 51, 56, 57, 60, 62, 64, 68, 73, 76, 78, 96)
6	Self-efficacy	The degree to which a person believes that the better their understanding and knowledge regarding computers, the more likely a person would feel (as a result of their confidence level) comfortable using computer	(3, 6, 13, 18, 19, 22, 35, 46, 51, 59, 64, 66, 68, 70, 73, 82, 84)
7	Information quality	The degree of excellence of the information produced by the software	(9, 13, 28, 33, 38, 45, 50, 60, 64, 76–81)
8	Compatibility with work process or job relevance	the degree to which an innovation is perceived as being consistent with the existing values, needs, and experiences of potential adopters	(9, 13, 19, 22, 35, 38, 50, 56, 62–64, 69, 71)
9	Individual attitude toward using technology	An individual's positive or negative feelings about performing the target behavior (individual's Evaluation of the behavior of interest)	(8, 10, 13, 46, 63, 68, 83)
10	Management leadership	Management provides/needs to provide a supportive working environment and encouragement to innovate and improve working practice	(13, 33, 38, 45, 62, 66, 83)

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No	User acceptance factors	Definition	References
11	Training	Providing adequate training—for example, involving end-users through onsite training by colleagues or individual follow-up, reinforces the perception of future benefits and allows for fewer degrees of resistance	(13, 37, 45, 54, 69, 73, 82)
12	Participation of end-users in the design process	Favoring active involvement of users during all implementation phases can help them develop feelings of ownership Toward the clinical system	(12, 13, 44, 45, 54, 72)
13	Participation of end-users in the implementation process	Favoring the active involvement of users during all implementation phases can help them develop feelings of ownership toward the clinical system	(12, 13, 44, 45, 54, 72)
14	Information security expectancy	The degree to which a person believes that their sensitive information will not be viewed, stored, or manipulated by unauthorized persons. Data confidentiality is preserved and the right levels of authorization to access data are given	(13, 33, 45, 73, 75)
15	Participation of end-users in the communication process	Favoring the active involvement of users during all implementation phases can help them develop feelings of ownership toward the clinical system	(13, 45, 62, 72, 75)