FACTORS INFLUENCING THE ADOPTION OF ELECTRONIC HEALTH RECORDS IN THE AUSTRALIAN ENVIRONMENT

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ABSTRACT:

With the widespread use of medical records and the subsequent rise in the use of electronic health records (EHRs), the success of their adoption has become an important consideration for health agencies. In the current digital environment, the adoption of EHR has become significant because it limits the use of paper trails, and the care may be more effective because it is based on the electronic transfer of patient information. However, an improvement in the quality of the healthcare service is dependent upon how well EHRs are managed in healthcare as many stakeholders will contribute to them. While the advantages of EHRs are significant and cannot be disputed, a number of concerns have been raised regarding their success, as well as the ways in which they are adopted. The diversity of factors that affect the adoption of EHRs in various contexts requires a comprehensive investigation in order to establish a precise knowledge of their adoption in various healthcare settings. Such identification will help to mitigate many issues in their organisation at policy, workflow efficiency adoption and management levels. In this study, various factors that affect the adoption of EHRs in Australia will be identified and explored so as to arrive at a conceptual model that can be empirically tested later. Considering the vast amount of resources being dedicated to the adoption of EHRs in Australia, identifying barriers to their adoption, especially on an organisational level is essential for its success. Many studies have been conducted to understand barriers to the adoption of EHRs in Australia; however, there have been few studies concentrating on an organisational level in order to explore the challenges and obstacles that face specific organisations.

Keywords: Adoption, Healthcare, Electronic health record.

INTRODUCTION:

Rapid advances in Information and Communication Technology (ICT) have facilitated the development of applications like E-health (Electronic health), E-commerce (Electronic commerce), E-government (Electronic government) and E-learning (Electronic learning) (Al Nagi, 2009; Buckley, 2003). Health systems around the world are facing many challenges, including increasing population size, budgetary constraints and demographic changes and as a result, the complexity of health systems has increased, so that many health-care professionals have become involved in different systems (Mort & Smith, 2009). This has led to a great international interest in the development of health information systems (Mort et al., 2009) . Records are the best way to communicate, to reference sources or even to improve accountability in all sections of business including healthcare. In the past, health records were only written as notes on patient history, including illness and allergies. As a result of the development in the collection and utilisation of medical information, as well as the significant development of the Internet, a paper-based health record has become a computer-based health record (Van Fleet, 2010). At the start of the research into Health Information Technology (HIT), information systems were utilised for medical transactions. Following this early research, more attention was paid to the Hospital Information System (HIS) which is utilised to administer differ kinds of information in the hospital. The next development was the Electronic Medical Record (EMR) which represents a medical record within a single annex, such as a doctor's office; it was a basic model of electronic health records (EHRs). The first appearance and deployment of EHRs were in the early 1970s (Goldschmidt, 2005) and they were a record containing types of data such as personal information, laboratory tests, medical history, allergies, results, history of used medication and immunisation status (Häyrinen et al., 2008). In the literature, there are several diverse definitions of EHRs ranging from storing and managing patients' records in a single healthcare setting to more complicated system that is able to store, manage and share data among multiple health care settings (Black et al. 2011; Handler et al. 2003; Häyrinen et al. 2008). The aim of this study is to identify various factors that influence the adoption of EHRs in Australia by complementing and confirming the preceding studies, and then delivering a conceptual model that could help in the adoption process and avoid obstacles in the Australian context.

INDIVIDUAL AND ORGANISATIONAL LEVEL OF ADOPTION

The technology adoption project is an extensively investigated subject in information systems research, where the investigation is at three levels: the individual level (Venkatesh et al., 2003), the organisational level (Fichman & Kemerer, 1997)), and the group (Agarwal et al., 2000). Adoption refers to the decision by an individual or organisation to take advantage of innovation, while diffusion refers to the users' accumulated level of an innovation. (Rogers, 1995). Within the framework of research into technology adoption in the field of information and communications technology systems, at both the organisational and individual levels, several theories are used to provide an explanation of technology adoption. (Baysari et al., 2016; Faber et al., 2017).

One of these theories is the Technological-Organizational-Environmental Model (TOE) (Tornatsky & Fleischer, 1990), that has been widely used, including in the healthcare sector, independently or in combination with other theories (Oliveira & Martins, (2010); Zhu et al., 2002). It has also been used effectively to aid in the understanding of main contextual items that specify IT innovation adoption, involving Health Information Systems (Baysari et al., 2016; Chau & Hu, 2001; Faber et al., 2017). The second theory is the Diffusion of Innovation Theory (DOI) (Rogers, 1995) which is one of the oldest social science theories and it characteristics contributed to the interpretation of the innovation adoption rate (Greenhalgh et al., 2008; Sharma & Mishra, 2014; Zhu et al., 2006).It has been applied in many environmental studies to explore new motivations, besides financial benefits (Céspedes-Lorente et al., 2003; Hoffman, 2000), and also to study the adoption of new healthcare information technologies (Greenhalgh et al., 2008; Helitzer et al., 2003). The third theory is Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003) which incorporates eight models of human behaviour: Model of PC Utilization (MPCU)(Thompson et al., 1991), Technology Acceptance Model (TAM)(Davis, 1989), Motivational Model (MM)(Davis et al., 1992), Theory of Planned Behavior (TPB)(Ajzen, 1991), Theory of Reasoned Action (TRA)(Fishbein & Ajzen, 1975), Combined TAM-TPB (C-TAM-TPB)(Taylor & Todd, 1995), Innovation Diffusion Theory (IDT)(Rogers, 1995) and Social Cognitive Theory (SCT)(Bandura, 1986). Several works in the healthcare framework have used and adapted UTAUT to study IT adoption and concluded that the model of UTAUT and all models derived from it are applicable in illustrating the adoption of healthcare IT (Chang et al., 2007; Han et al., 2004; Schaper & Pervan, 2007).Therefore TOE, DOI and UTAUT have been selected as conceptual frameworks for guiding the development of the targeted adoption framework of EHRs for Australia.

METHODOLOGY.

A research review is the method applied for this study. EHR, Australia, Adoption, barriers and facilitators of EHR were used as keywords in ScienceDirect, Google scholar and Pubmed databases. A number of criteria were used

for searching the studies: 1) investigating issues related to EHR adoption, 2) addressing driving and/or impeding ICT adoption, 3) having been published between 2008 and 2019, and 4) having been reported in English. The studies excluded from this review were: 1) Not related to the research question, 2) focusing on laboratory, radiology and diagnosis-specific requirements. The following algorithm was used to gathering all relevant studies from the mentioned Databases:

A = 'Electronic Patient Record' OR 'Electronic Health Record' OR 'Electronic Medical Record'
B= Australia, **C** = Implement* OR Adopt*. **D** = Facilitators OR Barriers OR Driving OR Impeding OR Factor
E = **A** AND **B** AND **C** AND **D**.

All resulted studies were inspected using mutable steps as appear in (Table 1) below. The searching results showed that 91 studies were derived from the ScienceDirect library, 69 from Google scholar and 115 from Pubmed library. Finally, 35 articles were included in this review which represents 12.7% of the total studies obtained from the initial research.

Table 1 Process of inclusion

No	procedure	Result	% of included studies
1.	Initial search	275	
2.	Remove duplicates	165	60%
3.	Titles and abstracts screening	73	26.5%
4.	Apply Inclusion / Exclusion Criteria	35	12.7%

Data related to derived factors from included studies were abstracted, and four main classifications of factors were designed in table format (Table 2, Table 3, Table 4, Table 5) that contain main factors, sub-factors, the number of sub-factors and rate of covering. Rate of covering = (Number of Primary Studies addressed the factor/ Total Number of included studies [35]) x 100.

DISCUSSION
TECHNOLOGICAL FACTORS
Technological factors (Table 2) have been shown in the primary studies in preference to organisational, environmental and individual factors, because technological factors illustrate the attributes of innovation which in this instance is EHRs. In this review, a new set of factors linked to TOE and DOI theories has emerged from the literature. Secondary factors have been determined in the models. These are: compatibility, trialability, relative advantage, innovation characteristics, and complexity. Other sub-factors have emerged from the literature. These are: privacy, cost, reliability and security. The cost factor appeared as the most repeated technological factor with a rate of coverage of 62%, although Xu et al. (2013) listed cost factor in the third level, whereas Black et al. (2011) stated that there is a lack of solid research on the risks of adopting these technologies and their cost-effectiveness. Privacy and security followed the cost factor with 48% of repetition times and 40% respectively. Complexity and compatibility were equal in the rate of covering by 37%. Finally, reliability was 34% followed by trialability with 11% which is considered as the lowest covering rate among all other sub-factors in the technological factors.

Table 2 Technological Factors

Main-factor	Sub-factors	No of Studies addressed the factors	Rate of covering
Compatibility	Compatibility of the Technologies, Functional Suitability, Appropriateness of Task-Technology.	13	37%
Complexity	Complexity, Suitability, Complexity of the Technical, Facilitating the Use. Simplicity.	13	37%
Security	The Threat of Security Breaches, The Worry About Data, Apprehension of Data Loss, Security Risk.	14	40%
Cost	Workflow Alteration, Effectiveness of Cost, Savings of Costs, Cost of Maintenance, Cost of Training, Cost of Implementation, Costs of Delivering, Cost of Infrastructure	22	62%
Trialability	Trialability, Testing trialability	4	11%
Reliability	Reliability	12	34%
Privacy	Individual's Privacy, Privacy of institutions, Data Privacy.	17	48%

ORGANISATIONAL FACTORS

Within this review of the literature there were 60 single sub-factors in addition to seven main factors retrieved as shown in (Table 3) in the context of organisational factors. The most repeated organisational factor was culture with rate of cover that reached 68 %. The culture factor contained 11 sub-factors, which reflects the significance of the culture factor in the adoption of EHRs. Technology readiness, which had the second position in the number of repetitions and 51% of rate of covering has been categorised under the organisational factor because the technological factor is centred around the technology's characteristics itself. The employee's knowledge was covered by 17 studies and 10 sub-factors listed under this factor which represented 48% of rate of coverage. This result shows that employee's knowledge plays a less important role than organisational culture in affecting the adoption of EHRs, while an organisation's strategies, size and management support, are the areas where it has the lowest number of repetitions in the organisational context.

Table 3 Organisational Factors

Main-factor	Sub-factors	No of Studies addressed the factors	Rate of covering
Management Support	Management techniques, Support of IT Manager, Attitude of Executive, Interpretability, Support of Executive, Participation of Top Management Team, Intention of Top Management to the Innovation, Support of Major Managers.	9	25%
Size	Organisational Size, Firm Scope, organisational Structure, Managerial Structure, centralisation.	9	25%
Culture	Training, Acceptance of Change, Adaptation with Change, Collaboration and Sharing, Attitude Towards, Technology, Mobility of Employee, Awareness, Flexibility and Agility, Innovativeness, Capacity Absorptive.	24	68%
Technology Readiness	Expectation of Efforts, IT Resource of Organisation, IT Infrastructure, Readiness of Organisation, Technology Competence, Appropriate Resource, Organisational Systems, Facilitating Conditions, Availability of Technologies, Budget of IT Department.	18	51%
Employee's Knowledge	IT Expertise, Process of Organisation, Experience, Capacity of Innovation, Previous Experiment, Perceived Technical Competence, Employees' Competence, Internal Expertise, Voluntariness of utilize, Individual Skills.	17	48%
Organisation Strategies	Focus on Core Competencies, Insufficient Service Quality Guarantee, Quality of Service, Intensity of Information, Service Quality, Requirements of Business, Effective strategy, Satisfaction of End-User, Concentrate on Main Competencies, Critical Commercial Operations, Strategies of an Organisation.	10	28%

ENVIRONMENTAL FACTORS

Environmental factors (table 4) are vital in the adoption of EHRs, where 36 sub-factors were derived from primary studies which were categorised under seven main factors: trading and competitive, regulations and legislation, trust, external expertise, national infrastructure, physical location and industry properties. Nineteen studies have addressed regulations and legislation factors which represent 54% of total included studies in this review, followed by trust which received 48% of rate of coverage. The high rate of regulations, legislation and trust reflects the importance of these three organisational factors and show that there are concerns regarding these matters from those who are interested in the adoption of EHRs. External expertise is the third of the influenced sub-factors with 34% which represents 12 of the included primary studies, followed by national infrastructure that received 28% of the rate's coverage. Several sub-factors listed under national infrastructure are: connectivity of networks, broadband infrastructure, reliability of internet, infrastructure of country, telecom services. This shows the need to pay more attention regarding this factor. Physical location, industry properties and trading and competitive factors have the minimum significance on the adoption of EHRs with 14%,11%, and 11% respectively and this

shows that these main factors in the environmental context should get less attention than those which received a high rate in the adoption priority.

Table 4 Environmental factors

Main-factor	Sub-factors	No of Studies addressed the factors	Rate of covering
Trading and Competitive	External Pressure, Pressure of Competitiveness, Influence of Social Aspects, Pressure of Perceived Industry, Intensity of Competitiveness, Social Norm, Pressure of Trading Partner.	5	14%
Regulations and Legislation	Regulations and Legislation, Administration Policy, Regulatory Environment, Enhance Legal Structure, Enhance Regulatory Framework, Compliance of Regulations.	19	54%
Trust	Agreement, privacy policy issues, Second Usage, The Relation between Service, Providers and Users.	17	48%
External Expertise	Provider Efforts, External Support, Support of Service Provider, Availability of Supplier, Ability of Service Provider.	12	34%
National Infrastructure	Connectivity of Network, Broadband Infrastructure, Reliability of Internet, Infrastructure of Country, Telecom Services.	10	28%
Physical Location	Location of data, Uncertainty and Restriction of location.	4	11%
Industry Properties	Divide Between the Government and Vendors, Scope of Market, Characteristics of Industry, Structure of Market.	4	11%

INDIVIDUAL FACTORS

The results of this study illustrate individual factors (table 5) as a smaller number of factors were adopted by EHRs, where 6 sub-factors were derived from primary studies. These were categorised under two main factors: the technological knowledge of decision makers and individual decisions within the organisation. Three studies have addressed the technological knowledge of decision makers and same number of studies for the decisions of individual organisations. They represent 8% of the total included studies for both of them in this review. This shows that an individual factor seems to play a less important role than organisational, technological and environmental factors in affecting the adoption of EHRs.

Table 5 Individual factors

Main-factor	Sub-factors	No of Studies addressed the factors	Rate of covering
Technology knowledge of Decision Makers.	EHR Knowledge of Decision Makers, Understanding healthcare system, complexities by Decision Makers, IT Knowledge of Decision Maker.	3	8%
individual and organisation decision	Innovativeness of decision makers and CIO, Conflict between organisation's decision and decision makers.	3	8%

THECONCEPTUAL FRAMEWORK

The Figure 1 below showing the proposed initial conceptual framework that identifying the factors influencing the adoption of EHR in the Australian context. These factors that related to the technology, organisation, environment and individual contexts are represent a significance for EHR adoption from an organisational perspective. The proposed framework summarising the most important views of issues in EHR adoption, and it followed a multidimensional approach, offering a practical framework to be used for further investigation in the health sector organisations.
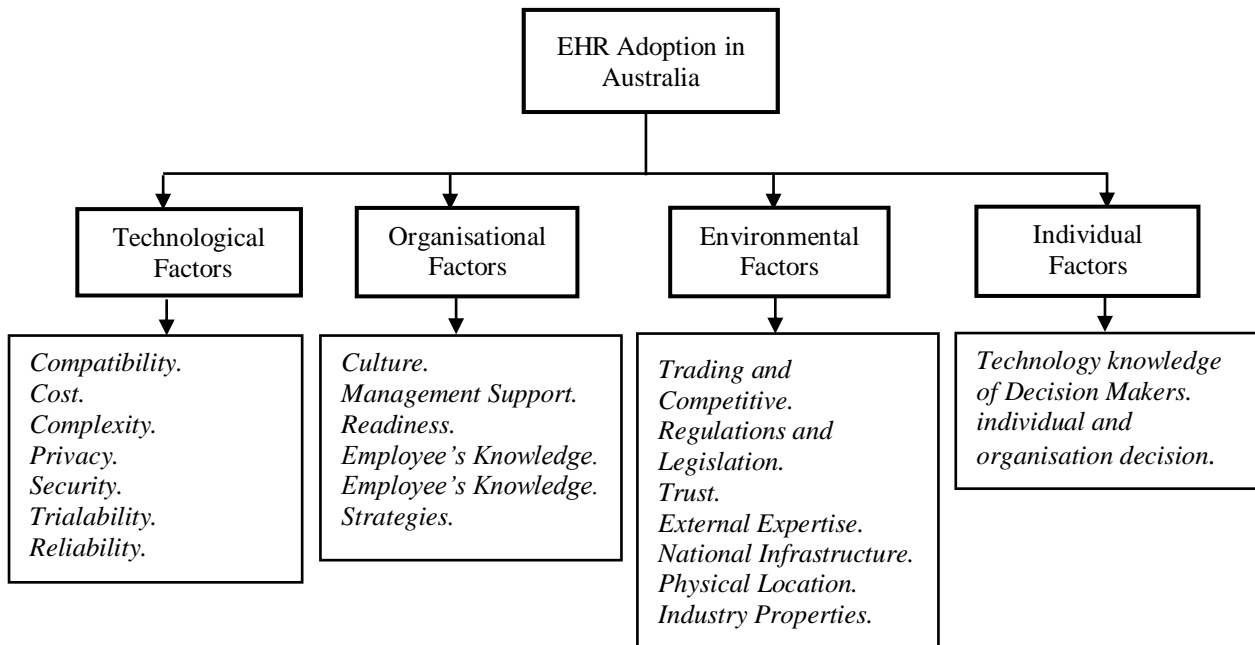

Figure 1 The conceptual framework

CONCLUSION

The aims of this study were to identify the factors which influence the adoption of EHRs in Australia, and then to develop a conceptual adoption framework (figure 1) which would be a guide for organisations seeking to implement EHRs. To do so, the relevant literature was reviewed in order to investigate models of technology adoption. This review led to the development of an initial model from 35 primary studies that were included in this review. This research identified 136 sub-factors resulting from these studies; they were classified and listed under 22 main factors which in turn were categorised into four categories: technological, organisational, environmental and individual. The findings of this research through the literature review indicate that technological factors are the most important adoption factors. Secondary factors are second level factors found from literature; they encapsulate the tertiary factors which are the similarly themed factors explained by a specific secondary factor. Furthermore, this research paper also identified 36 sub-factors for Technological Factors (TF), 70 sub-factors for Organisational Factors (OF), 36 sub-factors for Environmental Factors (EF), and 6 sub-factors for Individual Factors (IF). However, it was also noticed that organizational factors were the most significant main factors when adopting EHRs. Furthermore, culture, technology readiness and employee's knowledge received a high rate of coverage with ratios of 68%, 51% and 48% respectively, which indicates that they are the most important adoption factors. Finally, a conceptual model was developed in this research paper for future research to confirm or further modify this conceptual framework.

LIMITATION

Due to time constraints, this paper cannot provide a comprehensive review which includes large number of academic databases and search engines, beside the language restriction for many articles where they are written in English.

FUTURE RESEARCH

This review of the literature supports the findings of previous reviews. More reviews remain necessary to evaluate the adoption factors of EHRs in healthcare providers in the future.

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