

The Implications of Technological, Organizational and Environmental Barriers on the adoption of Electronic Health Record (EHR) systems through Knowledge Stocks and Learning Flows

Peter A. Murray
Professor of Management
School of Business
University of Southern Queensland
Toowoomba. QLD. Australia.
Email: Peter.A.Murray@unisq.edu.au

Salem Ouheda
Adjunct Lecturer
School of Business
University of Southern Queensland
Toowoomba. QLD. Australia.
Email: ouheda@gmail.com

Anup Shrestha
Senior Lecturer Information Systems,
University of Southern Queensland.
Toowoomba. QLD. Australia.
Email: anup.shrestha@unisq.edu.au

Omar Ali
Associate Professor in Information Systems,
Abdullah Al Salem University.
Kuwait.
Email: omar.ali@aasu.edu.kw

Hanan Alsharah
Research Associate
University of Essex, UK
Email: h.alsharah@essex.ac.uk

**The Technological, Organizational and Environmental Barriers
of Electronic Health Record (EHR) Systems Adoption
through Knowledge Stocks and Learning Flows**

Abstract

The purpose of this research is to explore the technological, organizational and environmental (TOE) barriers to the effective adoption of Electronic Health Record (EHR) systems through knowledge stocks and learning flows. To achieve this, the study adopts an exploratory qualitative research approach by surveying the experiences and views of the top management team. Using a cross-theory framework integrating the TOE model with various stages of innovation, the study found that managers were not well equipped to identify the relationships between knowledge stocks and learning flows which impeded the adoption process. While the study design was restricted to a private hospital, study findings could be generalised to other users across health settings suggesting that the implications of a cross-theory approach is both important and timely. Moreover, our findings broaden the existing literature related to EHR system adoption by developing a framework that could be replicable in other health settings.

Keywords -Electronic health records (EHRs); Technology Adoption; Technology-Organization-Environment; Innovation capability; Knowledge Management

The Technological, Organizational and Environmental Barriers of Electronic Health Record (EHR) Systems Adoption through Knowledge Stocks and Learning Flows

1. Introduction

The aim of this study is to identify the stages of innovation capabilities for mitigating the barriers of Electronic Health Record (EHR) systems adoption. This study investigates the different dimensions of technology, organization, and environment (TOE) contexts (Tornatzky and Fleischer, 1990) that act as barriers to EHR systems adoption within an Australian healthcare organization. By investigating these barriers, this study breaks new ground between how the eight stages of innovation (Rogers, 1995) can be applied when considered with the density of knowledge stocks (KSs) (Prieto and Revilla, 2006) and the intensity of learning flows (LFs) (Crossan *et al.*, 1999). The outcomes of this research also offer new implications for health policy settings. Prior studies of IT adoption in the health sector have tended to focus on individuals' personal preferences, such as doctors, nurses, IT staff, and patients within public healthcare settings (Kruszyńska-Fischbach *et al.*, 2022, Ball *et al.*, 2024). Mostly, the research designs in many studies have been limited by difficulties in investigating the topic with senior-level decision-makers (Vitari and Ologeanu-Taddei, 2018, Tsiampalis and Panagiotakos, 2023) because of privacy and other issues. No studies in the field have explored how the barriers of EHR systems adoption can be addressed by developing greater innovation capability within the context of KSs and LFs.

EHRs are an important aspect of health services required to increase the quality of care and service features by multiple healthcare providers by providing a patient-centered information repository. EHR systems refer to computer-based medical information systems used to collect, store, and access a patient's clinical information in the form of EHRs (Tsiampalis and Panagiotakos, 2023). More specifically, EHR systems are designed to keep records and access to information of patients organized and secure while replacing legacy and traditional paper-based medical record-keeping systems. Little is known about private healthcare providers' perspectives however on EHRs or the innovation processes and healthcare policies required for successful adoption of these systems.

Recent research has offered limited but valuable insight into the intersection of IT adoption, innovation, and knowledge management but mostly in different contexts. Agnes *et al.* (2023) for instance explored the critical success factors (CSF) for implementing Knowledge Management Systems (KMS) in Small Medium Enterprises (SMEs), while Gupta *et al.* (2022) investigated how knowledge management (KM) practices impact the adoption of cloud-based software services in distributed software development and innovation settings. Additionally, Pai *et al.* (2022) analysed the relationship between Artificial Intelligence (AI) and knowledge management, finding that AI enhances knowledge management quality and performance. Saratchandra *et al.* (2022: p. 12) moreover found that a knowledge ambidextrous approach was beneficial for SMEs but only after the intervention of cloud computing in SMEs which dramatically facilitated knowledge sharing opportunities. While these studies provide important related themes, they stop short in highlighting the interconnectedness between IT adoption, innovation capabilities, knowledge management and learning flows. Moreover, we argue that within the context of reducing barriers to technology adoption through knowledge stocks (Prieto and Revilla, 2006; Saratchandra *et al.*, 2022), learning flows become critical (Crossan *et al.*, 1999), thus extending scholarly understanding of how existing innovation capability can be enhanced. By learning flows we mean the feed-forward of learning at different levels and the feedback process as new knowledge is embedded (Crossan *et al.*, 1999; Murray *et al.*, 2009). The current study therefore closes these gaps by analysing the relationships between intersecting themes providing greater clarity and more granular insight of what these relationships look like for healthcare providers.

This study is the first to use the technology-organization-environment (TOE) framework (Tornatzky and Fleischer, 1990) to investigate EHR systems adoption issues within the Australian healthcare sector. While similar studies have noted the effects of TOE contexts on e-health and personal healthcare records (Faber *et al.*, 2017, Harahap *et al.*, 2022) including systematic reviews of barriers to EHRs adoption (Woldemariam and Jimma, 2023), very few studies have examined how healthcare providers more generally consider the stages of innovation with KSs and LFs. The researchers are not aware within a healthcare setting of any studies that illustrate the important role played by innovation stages grouped by knowledge stocks and learning flows, and how these stages help remove barriers to technology adoption within health settings. Yet, in many contexts other than healthcare, innovation capabilities are known to significantly increase organizational innovation efficiency and effectiveness (Chen *et al.*, 2021), new technology innovation success (Ali *et al.*, 2022) and high-tech company performance (Chen *et al.*, 2021). More often, studies have stopped short on theorizing the implications of TOE barriers which the current study

addresses, while exactly how TOE-related theories and ideas can be broadened within the context of healthcare innovations has not been a high priority in existing studies, for both public and private healthcare providers (Harahap *et al.*, 2022). Our findings for instance show how senior leaders will be better able to connect the innovation capabilities with learning routines and knowledge stocks thus increasing the effectiveness of digital technologies within the private healthcare sector. This has major implications for clinical best practices which we outline later.

The study explores the following research questions in relation to the Australian private healthcare sector:

Research Question 1: What are the barriers for adopting EHR systems within the private healthcare sector in the light of technological, organizational and environmental contexts?

Research Question 2: How can the barriers related to EHR systems adoption be mitigated when innovation capabilities defined by knowledge stocks and learning flows are better integrated?

2. Developing the Theoretical Construct

2.1 Technology-organization-environment framework

This study focuses on how healthcare providers adopt EHR systems within the private healthcare sector in Australia. Here, the technology, organization, and environment (TOE) innovation framework (Tornatzky *et al.*, 1990) helps to synthesize more precise justifications for implementing organizational innovation (Amini and Jahanbakhsh Javid, 2023). Within the TOE framework, the technological construct explores the attributes of the technological factors that must be considered before organizational adoption is successful (Bryan and Zuva, 2021). The organizational construct refers to the organization's resources, such as organization size, intra-firm communication, and linking structures among employees, including the availability of skilled resources (Narmetta and Krishnan, 2020). The environmental construct refers to the industry's structure, technology support, the extent of availability of technology service providers, competitors, and the regulatory environment (Narmetta and Krishnan, 2020). While the links between technological factors and new innovation is well known (Wang *et al.*, 2021), new innovations should be *compatible* with existing socio-cultural values and beliefs, past experiences and needs of potential adopters, and they should not be perceived as too *complex* according to Rogers (1995: p. 223).

The TOE framework is a useful way to explore the innovation barriers and problems that should be unravelled before a new innovation can be adopted. Several studies have applied the TOE framework within the healthcare sector such as in big data adoption readiness (Ghaleb *et al.*, 2021), and in developing policy related to the best ways of encouraging EHRs diffusion (Wang *et al.*, 2021). Faber *et al.* (2017) for instance explored e-health within medical hospitals in the Netherlands while Harahap *et al.* (2022) examined the barriers and facilitators of personal health care records in Indonesia. Other studies have examined different IT innovative features such as cloud computing in healthcare (Gao and Sunyaev, 2019). While collectively these studies provide integrative insights for healthcare professionals, scholars have stopped short in seeking to inform how TOE barriers can be mitigated by innovation capabilities which are made more transparent through knowledge stocks and learning flows. While scholars and practitioners know much about EHRs, they know much less about why innovation capabilities (discussed next) are important for innovation processes and health policies.

2.2 Innovation Capabilities, Knowledge Stocks, and Learning Flows

The adoption of EHR systems is a new innovation that will be influenced by the systemic capabilities and learning practices of a health organization. Scholars suggest that formal innovation adoption processes are decided by top managers while local adoption decisions are made by end users such as medical professionals (Ali *et al.*, 2022). Here we draw from the IT-implementation innovation model (Cooper and Zmud, 1990), that illustrates how organizations move through each innovation stage (Table I). Similar to Faber *et al.* (2017), we add the stages of interest and *ex-ante* evaluation to reflect not only the transition and final adoption phase but also the pre-adoption stage (Fichman and Kemerer, 1997).

Table I about here

In addition to TOE, a cross-theory approach for conceptualising integrative theories is used to explore the stages of innovation (Fichman and Kemerer, 1997), with knowledge stocks (Flatten *et al.*, 2011; Annosi *et al.*, 2020) and learning flows (Murray *et al.*, 2009; Crossan *et al.*, 1999). Here, an innovation stage can be matched to the density effect of KSs and the intensity effect of LFs. Building on the absorptive capacity literature with respect to how organizations acquire knowledge and share it (Zahra and George, 2002; Flatten *et al.*, 2011), we define the *density effect* of knowledge as the ability of an organization to convert existing knowledge into innovation capability viz. low to high. Similarly, building on the idea that learning flows between different

levels of the organisation between the individual, group, and organization (Crossan *et al.*, 1999; Murray *et al.*, 2009), we define the *intensity effect* of LFs as the quality and type of learning processes used to embed and share knowledge viz. low to high. Moreover, innovation capability should reflect how the type of learning translates into increased user knowledge (Arndt *et al.*, 2023) and Saratchandra *et al.*, 2022), across levels to the extent that this can be measured. Since innovation capability also reflects the “temporal and contextual dimensions of knowledge absorption” (Arndt *et al.*, 2023: p. 55), an organization’s capacity to adopt an innovation such as EHRs in the current study will be context specific and may vary depending on the context of each SME.

LFs and KSs form the basis of confronting the stability-change paradox common to many organizations and the difference between routine-level inertia and organizational-level inertia (Annosi *et al.*, 2020). That is, an organization’s learning innovative capability is a latent (dormant, covert, or underlying) construct that is influenced by the density of a firm’s existing KSs and the intensity of LFs. If KSs (e.g. existing information related to EHRs) is low, coupled with low LFs (e.g. how learning flows across the firm), then an innovative capability stage will be deemed as premature (Murray *et al.*, 2009). Here, the density effect of KSs will be low while the intensity effect of LFs will also be low. That is, the type and quality of learning mechanisms evident do not facilitate the conversion of existing knowledge into innovation capability. The *inclusive* innovative capability stage on the other hand reflects both high KS and LFs and is represented by successful technology adoption reflecting a high knowledge density effect and a high learning intensity effect. Later we discuss how these effects were measured. In the latter scenario, healthcare staff would not only know a lot about EHRs but would also possess knowledge about established learning systems. Relative capability stages can also exist between the two extremes of low and inclusive capability (Table II).

Table II about here

In adapting the knowledge stocks and learning flows model of Prieto and Revilla (2006), it is possible to observe the stages of IT innovation (Cooper and Zmud, 1990), with the current stage of innovative capability (Ortenblad, 2018), that is being measured. In the current study, a stage of innovation may not exactly match the density of knowledge required of that stage if the knowledge stock is stagnant or minimal. As illustrated in Table I and Table II, for the *awareness* and *interest* stage of IT innovation, *minimized capability* reflects low KS and LFs because stakeholders are

still learning about innovation and the knowledge is yet to be acquired. At the *ex-ante evaluation* and *adoption* stage, KSs are being boosted through evaluation and resources committed, however the knowledge learned is not evident in the LFs across the organization reflecting *static capability*. At the *Adapt and implement* and *Acceptance* stage of innovation, better streamlined LFs will be categorized as high reflecting *dynamic capability* as new knowledge flows across the organization. However, since this knowledge is yet to be embedded or institutionalized, the density of KSs remains low. Conversely, *inclusive innovative capability* stage reflects both high KS and high LFs since the innovation is routine and innovation adoption is fully acquired (Innovation stages of *Routinization* and *Full use*) reflecting the final stage of innovation capability. Consistent with our model, evidence of the density effect of high KSs is also supported by the evidence of the intensity effect of high LFs. In drawing therefore on the cross-theory benefits of these relationships, we believe the model in Table II is useful for exploring the relative nuances of the EHR systems adoption process from the view of innovation stages represented by KSs and LFs.

2.3 Matching Innovation Capabilities with Health Standards and Best Practice

Extant research of IT innovations from cloud computing across IT adoption related fields have surprisingly stopped short in addressing how EHR systems support policies that can be developed to reflect enhanced innovation capability. Yeh *et al.* (2015: p. 443) suggested that IT capabilities have a significant influence on the promotion of e-business while Harahap *et al.*, (2022: p. 7) noted that policies should be developed that support personal health records. Similarly, Faber *et al.* (2017: p. 84-86) suggested that new indicators for e-health measurement are required for IT governance and IT security, learning from trial and error in the first adoption stage, and sharing and collaborating with others in later innovation stages. Across all studies, scholars stop short in addressing how specific healthcare policies can be developed from EHR systems adoption that relate to innovation capabilities reflecting the unique context for knowledge and learning that exists within a healthcare setting.

Healthcare settings in particular must conform to industry standard best practice evident by a number of clinical measures (Watts *et al.*, 2021). Building on prior, typical clinical measures from an e-health perspective should relate to 1) improving the quality of care, 2) improving the finances of the organization, 3) the extent to which the EHR innovation is compliant with health standards, 4) improvements in monetary and IT-specific resources, 5) data security and privacy, and 6)

administrative involvement in medical services and input of stakeholders (Gao and Sunyaev, 2019). For instance, improvements in the quality of care reflects a health organization's core services yet managers will need to carefully assess how the new EHR systems enables goal attainment (Parthasarathy *et al.*, 2021). Further, the extent to which EHRs innovation is compliant with healthcare standards is a precondition of adoption. While clinical measures will help health organizations to assess the value of EHRs within context-specific circumstances, following strict regulatory environments reflects the organizations social values and concerns for public health (Jianxun *et al.*, 2021). However, different TOE factors (discussed next) represent barriers to not only the technology adoption process but also the best practices of health policy.

2.4 Technology, Organization and Environment Factors

The adoption of new technology is a complex process influenced by various factors. The TOE framework, developed by Tornatzky and Fleischer (1990) provides a comprehensive lens to examine these factors. The TOE framework highlights that barriers to technology adoption are multifaceted, involving technological, organizational, and environmental dimensions. Understanding these barriers can help organizations develop strategies to overcome them and successfully implement new technologies.

2.4.1 Technological factors

The technological barriers include the inherent characteristics of technology itself, i.e. EHR systems in this case. The key barriers are:

Perceived Cost, Installation, and Maintenance

High costs associated with acquiring, implementing, and maintaining new technologies can be a significant barrier. Implementing EHRs involves numerous technological factors, with cost of acquisition, maintenance, and external supplier expenses being significant barriers (Wikansari and Santoso, 2022). Enhancing skills for EHRs creation and implementation requires considerable management resources (Huang *et al.*, 2020).

Compatibility and Interoperability

Lack of compatibility with existing systems and processes can hinder technology integration. Compatibility refers to how well an innovation fits with existing technological and social environments (Rogers, 1995). Interoperability ensures efficient data exchange between providers, improving communication and efficiency (Li *et al.*, 2021). Poor interoperability is a major

challenge, leading to increased workload and fatigue among healthcare professionals (Muhiyaddin *et al.*, 2022).

Complexity arising from Security, Accuracy, and Reliability issues

Technologies that are perceived as complex can deter adoption due to the difficulty in understanding and using them. New IT adoption can lead to safety issues and reduced provider efficiency (Upadhyay and Hu, 2022). While EHRs increase efficiency, data accuracy and reliability (Mashoufi *et al.*, 2023), these issues affect service quality and collaboration (Kissi *et al.*, 2023), causing time strain and stress among nurses (Vehko *et al.*, 2019).

2.4.2 Organizational Factors

Organizational barriers are related to the internal environment of the healthcare provider itself. These barriers include:

ICT Skills

Lack of computer skills and poor understanding of IT features are primary barriers for EHR adoption (Fennelly *et al.*, 2020). Organizational factors include the lack of prior exposure to EHRs, and the time needed to integrate them into work practices. Likewise, a lack of innovative mindset among staff can slow down the EHR system adoption process.

Organization Structure & Involvement

Insufficient resources, such as skilled personnel and financial capacity, can limit an organization's ability to adopt new technologies. Complex organizational structures hinder change, causing slow adoption and inter-departmental conflict (Guimaraes Jr, 2020). Poor end-user involvement in planning and selection processes also hampers adoption (Fennelly *et al.*, 2020).

Top Management Support & Workforce Planning

The absence of strong leadership and support from top management can impede technology adoption. Here leadership is reflected by top management support for acquiring, implementing, and maintaining new systems (Scott and Lee, 2005). Lack of top management support thwarts innovative strategies (Singh *et al.*, 2019). EHR adoption issues impede job practices, leading to workarounds that compromise patient data and safety (Zheng *et al.*, 2020).

2.4.3 Environmental Factors

Environmental barriers stem from the external environment in which the healthcare provider operates. These include:

Environmental Uncertainty

Organizations in uncertain environments are more proactive in protecting resources (Pye *et al.*, 2024). Competition drives IT adoption, considering supplier and customer information demands as well as internal motives (Chouki *et al.*, 2020). How a health organisation responds to uncertainty is thus critical. High levels of competition can either drive or inhibit technology adoption, depending on the organization's strategic response.

External Experts/Technology Vendor Support

Healthcare organizations often seek external advice for innovation due to the limitations of internal expertise (Gui *et al.*, 2020). Lack of vendor technical assistance and communication skills hinders EHR adoption processes (Huang *et al.*, 2020). Additionally, rapid changes in the market conditions – both customers and vendors - can create uncertainty, making healthcare organizations hesitant to adopt new technologies.

Regulations & Healthcare Standards

Regulatory requirements can pose challenges, especially if they are stringent or unclear. Australia's multi-tiered government structure complicates e-health system design and implementation (Xu *et al.*, 2013). The National E-Health Transition Authority (NEHTA) sets national standards for electronic health information gathering and sharing, including the creation of Unique Healthcare Identifiers (UHIs) (Gajanayake *et al.*, 2012).

3. Research method

3.1 Study Sample and Setting

This study used an exploratory qualitative research design approach. The study was conducted at a private hospital in South-East Queensland - referred to as Allan's Private Hospital (APH) in this paper - for confidentiality purposes. Seven interviews were conducted both face-to-face (70 per cent) and online (30 per cent) following the implementation of an EHR system at APH. Purposive

sampling was used to select participants. According to Ellis (2016), a sample size of 6 to 20 participants is suitable for phenomenological studies, while Boyd (2001) suggests 2 to 10 participants are sufficient to reach saturation. Moser and Korstjens (2018) indicate that fewer than ten interviews may suffice when participants are senior decision-makers. Yardley (2000, p. 221) suggested that rigor in qualitative research depends on the sample's ability to provide comprehensive information. Therefore, the study sample consisted of only senior decision makers involved in the adoption of the EHRs innovation process (Table III).

Table III about here

3.2 Data Collection Tool

Semi-structured interviews were used for data collection, conducted in the participants' natural settings (Adhabi and Anozie, 2017). The interviews included heads of departments from various specializations at APH. Initial interviews were conducted with the hospital director and the ICT department director to gather background information. Through purposive sampling (Phillips-Pula et al., 2011), seven key decision-makers involved in the EHR planning process were selected. The data provided valuable insights into the challenges related to EHRs implementation. Research ethics approval was obtained from the supporting institution, with interviews conducted between June and December 2019. The TOE themes were subsequently matched to the stages of innovation, existing knowledge stocks and observed learning flows.

3.3 Data Analysis

To analyze the TOE themes, all interviews were audio-recorded, transcribed and analysed using qualitative data analysis software QSR NVivo 12. Different TOE factors were identified from the literature through thematic analysis, and the representation of these factors reflected the research questions. The thematic analysis used in this study is one of the most widespread approaches in qualitative studies (Joffe and Yardley, 2004), based on patterns and themes emerging from the data set under analysis (Braun and Clarke, 2006). Here, and consistent with the theoretical construct, the density of LFs and KSs was a key feature of analyzing the data. To achieve this, we established a vignette implied from the literature for KS related to high and low KS. This process of analysis was repeated for LFs using the Crossan et al. (1999) effects of learning between the individual to the group and the organization. For the latter, we developed three vignette's similar to assessing the evidence of KSs. The researchers developed a precursory coding dictionary based on the guide of semi-structured interviews and employed this dictionary to pare down any coding

variations. Three rounds of coding occurred consistent with developing emerging qualitative themes especially when new information came to light leading to old codes being discarded or updated. We thus reviewed all coded transcripts and themes and added new codes to the dictionary whenever new themes arose. The research team resolved any data discrepancies, such as missing data, and reached a consensus about the emerging themes.

4. Results

Figure 1 illustrates the TOE (Technological, Organizational, Environmental) factors and relevant barriers identified during EHR systems implementation at APH. This section discusses the results of the barriers which answers the first research question that asked: Which technological, organizational, and environmental barriers impact EHR systems adoption?

Insert Figure 1 about here

4.1 Technological Factors

4.1.1 Cost and Incompatibility

The results reveal that ongoing costs and system incompatibility are significant barriers to EHRs adoption. Participants highlighted the substantial costs associated with staff training and system maintenance: *“The cost of staff training is huge, and the new system has an ongoing cost as well”* (Participant 1). Compatibility issues with legacy systems and IT infrastructure posed challenges: *“Building to meet Australian standards has been the biggest challenge”* (Participant 3).

4.1.2 Readiness and Resources

Many staff members were accustomed to paper records, which posed a challenge for transitioning to digital systems: *“We have a lot of people where all they’ve ever known is the paper record for the last 20 to 30 years. So, unless you start bringing people on the journey, they won’t adapt to a digital record”* (Participant 3). Concerns were also raised about lacking appropriately trained resources for project implementation: *“We struggled with the fact that we didn’t necessarily have the appropriately trained, appropriate resources”* (Participant 3).

4.1.3 Interoperability

Interoperability issues emerged with reported difficulties in exchanging information between different parts of the system, leading to complaints and workarounds: *“There have been a lot of complaints and extra work-arounds due to difficulties in exchanging information”* (Participant 6).

4.1.4 Security and Reliability

Data privacy and system reliability led to unauthorized access and data breaches: *“Health data privacy breach and security matters and unauthorized access is a huge challenge”* (Participant 6). Reliability issues also contributed to frustration among users: *“Some processes in the system are slower or quicker, and not knowing how it all works has made it more difficult”* (Participant 7).

4.1.5 Initial and Past Medical Data

Managing initial and past medical data led to data entry complexities and contradictions between legacy systems: *“Uniform terminologies do not incorporate all conceptions associated with nursing care”* (Participant 4), while Participant 3 suggested that *“Contradictions between ICU information needs and EHR integration have been an ongoing issue.”*

4.1.6 Infrastructure and Capability

Infrastructure issues were noted, particularly in older hospital buildings that required updates to support the new systems: *“Our building is quite old, and infrastructure itself needs to be developed. We are concerned about the cost of resourcing it”* (Participant 7).

4.2 Organizational Factors

4.2.1 ICT Skills and Flexibility

Low levels of ICT skills and a lack of flexibility in adapting to new systems were a major issue: *“We have a workforce with some challenges with ICT skills. Most people have basic computer skills, but meeting new digital requirements will require a lot of training”* (Participant 6). The bureaucratic nature of the organization also hindered flexibility: *“Some big players here will make enough noise if they're resistant to a certain type of system that's being introduced”* (Participant 7).

4.2.2 Workflow Disruptions and End-User Participation

Workflow disruption related to software interfaces, multitasking, and inadequate training were common: *“Finding time to train a whole hospital is challenging, and there is very little downtime”* (Participant 5). Additionally, end-user participation in system design was limited: *“Sharing knowledge during the building stage has been challenging due to different practices in various areas”* (Participant 6). Some staff members were also resistant to the changes: *“Staff in some*

departments are not keen on the coming changes, and this could limit the success of the new system” (Participant 2).

4.2.3 Staff Shortages and Time Constraints

Staff shortages and time constraints were critical barriers. Finding qualified personnel for EHR systems management and managing the time required for data conversion were challenging: *“Finding professional users with the necessary qualifications is essential” (Participant 7)* while Participant 5 added *“The time and energy involved in collating data has created a lot of work stress.”*

4.2.4 Resistance to Change and Managerial Capability

Resistance to change from experienced staff were notable: *“Nurses who have been nursing for 15 years find moving to a computer challenging” (Participant 5)*. The need for experienced management was also highlighted: *“We need competent and experienced management, but currently lack adequate capability across the hospital” (Participant 1).*

4.2.5 Pressure of Change

The pressure of organizational change led to increased stress and resistance: *“Reorganizing the organization and handling this transformation is a massive job, and technical problems will increase pressure on the project team” (Participant 6).*

4.3 Environmental Factors

4.3.1 Healthcare Standards

Data formatting challenges were identified as a barrier, particularly in aligning paper-based practices with digital systems: *“Matching what we do well on paper with digital formats is a challenge” (Participant 3).*

4.3.2 Legislative and Regulatory Responsibility of the Vendor

Vendor responsibility issues and compliance with standards and regulations were highlighted: *“It’s the responsibility of the vendor to ensure we meet standards and regulations, but this hasn’t happened yet” (Participant 4).*

4.3.3 External Training and Vendor Options

External training and limited vendor options were significant concerns: *“We have to hire consultants for on-site training or use external courses, which limits availability”* (Participant 7). Dissatisfaction with vendor options was also noted: *“There are limited vendor choices, and the lack of support has made us underprepared”* (Participant 2).

Taken together, the results underscored the complex array of social and technical barriers influencing the EHR systems adoption process. Based on the cross-theory approach discussed earlier, the researchers then compared the level of existing knowledge stocks and learning flows by measuring these barriers and associated innovation stage against the desired or aspirational level of stocks and flows to gain a better understanding of the overall innovation capability of APH. Overall, what was noticeable was the lack of preparedness by APH in tackling the new innovation adoption process particularly in the technological and organizational areas, which placed increasing pressure on the existing capabilities of APH. This prevented new innovation capability to be developed. We next discuss how the existing literature can be broadened and extended by elaborating on the sample illustrations in Table IV.

Table IV about here

5. Discussion

The aim of this study was to identify the barriers to the adoption of EHR systems within the private healthcare setting in Australia. A secondary aim was to broaden scholarly understanding related to how different TOE contexts could be influenced by the stages of innovation, and knowledge stocks (KSs) and learning flows (LFs) with implications for innovation capability stages and policy settings.

5.1. Broadening Existing Literature

In relation to research question 1, organizations must consider the TOE barriers before EHR systems adoption is considered. For APH, these barriers were not considered within the context of their TOE contexts and/or were not fully articulated to operational staff so that a successful adoption could occur. Place about here the answers to density from methods section. Many operational staff were not involved in the EHR systems implementation process. With respect to Table IV and the emerging innovation capability stages and sample TOE data, APH displayed minimized and static capability, with less evidence of dynamic capability (low KSs and high LFs)

particularly in the technological area. Likewise, there was no evidence of inclusive capability across all TOE factors meaning that no mechanism existed for APH to generate high knowledge stocks and high learning flows, therefore a full use of EHR systems adoption did not occur. The higher innovation stages of the EHRs systems adoption was thus not well advanced and managers seemed confused about how their existing capabilities could be improved by the new learning features embedded within EHR systems. The lack of inclusive capability translated into suboptimal responses to new technology adoption. Participants for instance were unaware of the importance of the density effect of KSs coupled with the intensity effect of LFs suggesting that the innovation process was ad hoc and poorly understood.

In relation to research question 2, the results suggested a need to identify the clinical measures that best define the organizations values and goals after which leaders could identify the TOE barriers that prevented the clinical measures from being achieved from EHR systems implementation as expected. The findings suggest that when participants are subject to a new innovation adoption process, they must be cognisant of how KSs and LFs interact with stages of innovation. The research noted that without a recognition of stages of innovation, leaders and managers' innovation efforts will be unresolved falling short of the innovation capabilities required for successful IT adoption.

Second, this study broadens the existing literature related to EHRs by illuminating the importance of LFs and KSs by evaluating these against innovation capability stages. Using a cross theory approach, we showed that the stages of innovation (Fichman and Kemerer, 1997, Rogers, 1995) and a TOE approach (Tornatzky *et al.*, 1990), will be better assimilated when assessed against the density of KSs (Annosi *et al.*, 2020) and the intensity of LFs (Crossan *et al.*, 1999, Ortenblad, 2018). The categorization of knowledge and learning and their effects on innovation capability is a new approach which broadens the literature on the density effect of how firms convert existing knowledge into innovation capability. Likewise, the intensity effect related to the type and quality of learning extends the concept of learning flows (Crossan *et al.*, 1999), by the need to assess the type of learning used e.g., EHRs in the current study, with the quality of learning achieved (Murray *et al.*, 2009), evidenced in higher innovation capability.

Our findings in addition answer calls by recent scholars to extend knowledge related to the application of digital IT innovation in specific contexts (Saratchandra *et al.*, 2022). We believe that in matching an organization's existing capabilities with a desired stage of innovation will

help healthcare organizations to achieve their clinical goals more effectively. Once the innovation capabilities are identified, health organizations will be better placed to cultivate a range of policy levers for better healthcare services (Figure 2). Our findings suggest that there is a strong interconnectedness between LFs, KSs, and innovation capability. To this extent, overall *innovative capability* at least within the private hospital context. is a multidimensional process indicating that acquiring knowledge is not a one-time event of collecting knowledge that becomes static over time, but rather an ongoing process mobilising the “temporal and contextual dimensions of knowledge absorption” (Arndt et al., 2023: p. 55), that also depends on the quality and amount (density) of learning processes (Murray et al., 2009). Moreover, the current study broadens the findings of Agnes *et al.* (2023) related to the critical success factors (CSF) for implementing Knowledge Management Systems by focusing more attention on how innovation and learning spurs clinical best practices within a healthcare provider context. While Pai *et al.* (2022) and Saratchandra *et al.* (2022) found valuable insights between AI as an innovative technology and KM best practices, the current study broadens these findings by placing a greater focus on the interrelationships between innovation stages, knowledge stocks, and learning flows, with the effects of learning flows and knowledge stocks to innovation stages of IT adoption not previously measured in prior studies.

Figure 2 here

5.2 Practical Implications

In Figure 2, we suggest that managers will need to align the TOE barriers with the clinical measures which in turn inform various policy levers. Policy levers are manifested by the clinical measures since they form the basis of how a health organization adds value to its core business of providing health services. Broadening extant research from the current study more generally relates to: 1) The need to identify the clinical measures of healthcare services related to a specific healthcare provider, 2) The importance of assessing the barriers and limitations to EHR systems adoption that will prevent clinical measures from being achieved, 3) The need to determine how KSs and LFs inform the stages of IT innovation which in turn will help address the TOE barriers, and 4) The importance of developing a range of policy levers that bolster organizational innovation capability. In thus integrating insights from previous research, our theoretical framework in Figure 2 and Table IV should help healthcare organizations to navigate the internal and external factors influential to EHR systems adoption.

5.3. Research Limitations and Future Research

The present study is limited by differences in social, cultural, economic, regional, legal and other contextual aspects of hospital sectors across countries. We also studied the EHR Systems adoption related to a private hospital such that the results may not be generalizable to other public settings. It is recommended that a comprehensive methodology is employed to investigate the barriers to the adoption of EHRs in both private and public health care settings in future studies based on ownership of the hospital, location, size, and the hospital's accreditation level to reach a generalizable conclusion. We believe however that researchers could replicate the cross-theory approach adopted here as a valuable way to inform the IT adoption approach.

6. Conclusion

In conclusion, this qualitative study identified the critical barriers to EHR systems adoption from a TOE perspective. Despite the benefits and positive effects of adopting EHR systems, the adoption rate for EHR systems is still relatively low within the health care sector. In the current study, the researchers identified how healthcare organizations can adopt and implement IT innovation pertaining to EHR systems by matching the IT innovation stage with the organization's KSs and LFs.

References

- ADHABI, E. & ANOZIE, C. B. (2017). Literature review for the type of interview in qualitative research. *International Journal of Education*, 9, 86-97.
- AGNES, A., HUTAMA, A. T., SENSUSE, D. I. & LUSA, S. (2023). Knowledge Management System Adoption Approach and the Critical Success Factors in Small Medium Enterprise: A Systematic Literature Review. *Jurnal RESTI (Rekayasa Sistem dan Teknologi Informasi)*, 7, 996-1002.
- ALI, O., MURRAY, P. A., MUHAMMED, S., DWIVEDI, Y. K. & RASHITI, S. (2022). Evaluating Organizational Level IT Innovation Adoption Factors among Global Firms. *Journal of Innovation & Knowledge*, 7, 100213.
- AMINI, M. & JAHANBAKHS JAVID, N. (2023). A multi-perspective framework established on diffusion of innovation (DOI) theory and technology, organization and environment (TOE) framework toward supply chain management system based on cloud computing technology for small and medium enterprises. *Organization and Environment (TOE) Framework Toward Supply Chain Management System Based on Cloud Computing Technology for Small and Medium Enterprises (January 2023)*. *International Journal of Information Technology and Innovation Adoption*, 11, 1217-1234.
- ANNOSI, M. C., MARTINI, A., BRUNETTA, F. & MARCHEGIANI, L. (2020). Learning in an agile setting: A multilevel research study on the evolution of organizational routines. *Journal of Business Research*, 110, 554-566.
- BALL, S. L., KIM, B., CUTRONA, S. L., MOLLOY-PAOLILLO, B. K., AHLNESS, E., MOLDESTAD, M., SAYRE, G. & RINNE, S. T. (2024). Clinician and staff experiences with frustrated patients

- during an electronic health record transition: a qualitative case study. *BMC Health Services Research*, 24, 535.
- BOYD, C. O. (2001). Philosophical Foundations of qualitative research. *Nursing research: A qualitative perspective*, 14, pp.65-90.
- BRAUN, V. & CLARKE, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3, 77-101.
- BRYAN, J. D. & ZUVA, T. (2021). A review on TAM and TOE framework progression and how these models integrate. *Advances in Science, Technology and Engineering Systems Journal*, 6, 137-145.
- CHEN, Q., WANG, C.-H. & HUANG, S.-Z. 2021. Effects of organizational innovation and technological innovation capabilities on firm performance: evidence from firms in China's Pearl River Delta. *Inside the Changing Business of China*. Routledge.
- CHOUKI, M., TALEA, M., OKAR, C. & CHROQUI, R. (2020). Barriers to information technology adoption within small and medium enterprises: A systematic literature review. *International Journal of Innovation and Technology Management*, 17, 2050007.
- COOPER, R. B. & ZMUD, R. W. (1990). Information technology implementation research: a technological diffusion approach. *Management science*, 36, 123-139.
- CROSSAN, M. M., LANE, H. W. & WHITE, R. E. (1999). An organizational learning framework: From intuition to institution. *Academy of management review*, 24, 522-537.
- ELLIS, P. (2016). The language of research (part 8): Phenomenological research. *Wounds UK*, 12, 128-129.
- FABER, S., VAN GEENHUIZEN, M. & DE REUVER, M. (2017). eHealth adoption factors in medical hospitals: A focus on the Netherlands. *International journal of medical informatics*, 100, 77-89.
- FENNELLY, O., CUNNINGHAM, C., GROGAN, L., CRONIN, H., O'SHEA, C., ROCHE, M., LAWLOR, F. & O'HARE, N. (2020). Successfully implementing a national electronic health record: a rapid umbrella review. *International Journal of Medical Informatics*, 144, 104281.
- FICHMAN, R. G. & KEMERER, C. F. (1997). The assimilation of software process innovations: An organizational learning perspective. *Management science*, 43, 1345-1363.
- GAJANAYAKE, R., LANE, B., IANNELLA, T. & SAHAMA, T. (2012). Legal issues related to Accountable-eHealth systems in Australia.
- GAO, F. & SUNYAEV, A. (2019). Context matters: A review of the determinant factors in the decision to adopt cloud computing in healthcare. *International Journal of Information Management*, 48, 120-138.
- GHALEB, E. A., DOMINIC, P., FATI, S. M., MUNEER, A. & ALI, R. F. (2021). The assessment of big data adoption readiness with a technology–organization–environment framework: a perspective towards healthcare employees. *Sustainability*, 13, 8379.
- GUI, X., CHEN, Y., ZHOU, X., REYNOLDS, T. L., ZHENG, K. & HANAUER, D. A. (2020). Physician champions' perspectives and practices on electronic health records implementation: challenges and strategies. *JAMIA open*, 3, 53-61.
- GUIMARAES JR, P. R. (2020). The structure of ecological networks across levels of organization. *Annual Review of Ecology, Evolution, and Systematics*, 51, 433-460.
- GUPTA, C., FERNANDEZ-CREHUET, J. M. & GUPTA, V. (2022). Measuring impact of cloud computing and knowledge management in software development and innovation. *Systems*, 10, 151.
- HARAHAP, N. C., HANDAYANI, P. W. & HIDAYANTO, A. N. (2022). Barriers and facilitators of personal health record adoption in Indonesia: Health facilities' perspectives. *International Journal of Medical Informatics*, 162, 104750.
- HUANG, C., KOPPEL, R., MCGREEVEY III, J. D., CRAVEN, C. K. & SCHREIBER, R. (2020). Transitions from one electronic health record to another: challenges, pitfalls, and recommendations. *Applied clinical informatics*, 11, 742-754.
- JIANXUN, C., ARKORFUL, V. E. & SHULIANG, Z. (2021). Electronic health records adoption: Do institutional pressures and organizational culture matter? *Technology in Society*, 65, 101531.
- JOFFE, H. & YARDLEY, L. (2004). Content and thematic analysis. *Research methods for clinical and health psychology*, 56, 68.
- KISSI, J., ANNOBIL, C., TIJANI, A. & KISSI, A. A. (2023). Electronic health record impact on data quality: An integrated review. *Integrated Health Research Journal*, 1, 77-85.

- KRUSZYŃSKA-FISCHBACH, A., SYSKO-ROMAŃCZUK, S., NAPIÓRKOWSKI, T. M., NAPIÓRKOWSKA, A. & KOZAKIEWICZ, D. (2022). Organizational e-health readiness: How to prepare the primary healthcare providers' services for digital transformation. *International Journal of Environmental Research and Public Health*, 19, 3973.
- LI, E., CLARKE, J., NEVES, A. L., ASHRAFIAN, H. & DARZI, A. (2021). Electronic health records, interoperability and patient safety in health systems of high-income countries: a systematic review protocol. *BMJ open*, 11, e044941.
- MASHOUFI, M., AYATOLLAHI, H., KHORASANI-ZAVAREH, D. & BONI, T. T. A. (2023). Data quality in health care: main concepts and assessment methodologies. *Methods of Information in Medicine*, 62, 005-018.
- MOSER, A. & KORSTJENS, I. (2018). Series: Practical guidance to qualitative research. Part 3: Sampling, data collection and analysis. *European journal of general practice*, 24, 9-18.
- MUHIYADDIN, R., ELFADL, A., MOHAMED, E., SHAH, Z., ALAM, T., ABD-ALRAZAQ, A. & HOUSEH, M. (2022). Electronic health records and physician burnout: a scoping review. *Informatics and Technology in Clinical Care and Public Health*, 481-484.
- MURRAY, P. A., SYED, J. & ROBERTS, Z. (2009). Structures of learning for dynamic markets. *Management decision*, 47, 271-288.
- NARMETTA, M. & KRISHNAN, S. Competitiveness, change readiness, and ICT development: An empirical investigation of TOE framework for poverty alleviation. Re-imagining Diffusion and Adoption of Information Technology and Systems: A Continuing Conversation: IFIP WG 8.6 International Conference on Transfer and Diffusion of IT, TDIT 2020, Tiruchirappalli, India, December 18–19, 2020, Proceedings, Part II, 2020. Springer, 638-649.
- ORTENBLAD, A. (2018). What does “learning organization” mean? *The Learning Organization*.
- PAI, R. Y., SHETTY, A., SHETTY, A. D., BHANDARY, R., SHETTY, J., NAYAK, S., DINESH, T. K. & D'SOUZA, K. J. (2022). Integrating artificial intelligence for knowledge management systems—synergy among people and technology: a systematic review of the evidence. *Economic research-Ekonomska istraživanja*, 35, 7043-7065.
- PARTHASARATHY, R., GARFIELD, M., RANGARAJAN, A. & KERN, J. L. (2021). The case of organizational innovation capability and health information technology implementation success: As you sow, so you reap? *International Journal of Healthcare Information Systems and Informatics (IJHISI)*, 16, 1-27.
- PHILLIPS-PULA, L., STRUNK, J. & PICKLER, R. H. (2011). Understanding phenomenological approaches to data analysis. *Journal of Pediatric Health Care*, 25, 67-71.
- PRIETO, I. M. & REVILLA, E. (2006). Assessing the impact of learning capability on business performance: empirical evidence from Spain. *Management learning*, 37, 499-522.
- PYE, J., RAI, A. & DONG, J. Q. (2024). How Hospitals Differentiate Health Information Technology Portfolios for Clinical Care Efficiency: Insights from the HITECH Act. *Information Systems Research*.
- ROGERS, E. M. (1995). Diffusion of Innovation. 4th. New York: The Free.
- ROGERS, E. M. (1995). Diffusion of Innovations: modifications of a model for telecommunications. *Die diffusion von innovationen in der telekommunikation*, 25-38.
- ROGERS, E. M. (1995). Lessons for guidelines from the diffusion of innovations. *The Joint Commission journal on quality improvement*, 21, 324-328.
- SARATCHANDRA, M., SHRESTHA, A. & MURRAY, P. A. (2022). Building knowledge ambidexterity using cloud computing: Longitudinal case studies of SMEs experiences. *International Journal of Information Management*, 67, 102551.
- SCOTT, R. E. & LEE, A. (2005). E-health and the Universitas 21 organization: 3. Global policy. *Journal of telemedicine and telecare*, 11, 225-229.
- SINGH, S. K., DEL GIUDICE, M., TARBA, S. Y. & DE BERNARDI, P. (2019). Top management team shared leadership, market-oriented culture, innovation capability, and firm performance. *IEEE Transactions on Engineering Management*.
- TORNATZKY, L. & FLEISCHER, M. 1990. The process of technology innovation, Lexington, MA. Lexington Books.
- TORNATZKY, L. G., FLEISCHER, M. & CHAKRABARTI, A. K. 1990. *Processes of technological innovation*, Lexington books.

- TSIAMPALIS, T. & PANAGIOTAKOS, D. (2023). Methodological issues of the electronic health records' use in the context of epidemiological investigations, in light of missing data: a review of the recent literature. *BMC Medical Research Methodology*, 23, 180.
- UPADHYAY, S. & HU, H.-F. (2022). A qualitative analysis of the impact of electronic health records (EHR) on healthcare quality and safety: Clinicians' lived experiences. *Health Services Insights*, 15, 11786329211070722.
- VEHKO, T., HYPPÖNEN, H., PUTTONEN, S., KUJALA, S., KETOLA, E., TUUKKANEN, J., AALTO, A.-M. & HEPPONIEMI, T. (2019). Experienced time pressure and stress: electronic health records usability and information technology competence play a role. *BMC medical informatics and decision making*, 19, 1-9.
- VITARI, C. & OLOGEANU-TADDEI, R. (2018). The intention to use an electronic health record and its antecedents among three different categories of clinical staff. *BMC health services research*, 18, 1-9.
- WANG, X., SUN, J., WANG, Y. & LIU, Y. (2021). Deepen electronic health record diffusion beyond breadth: game changers and decision drivers. *Information Systems Frontiers*, 1-12.
- WATTS, P. I., MCDERMOTT, D. S., ALINIER, G., CHARNETSKI, M., LUDLOW, J., HORSLEY, E., MEAKIM, C. & NAWATHE, P. A. (2021). Healthcare simulation standards of best practice™ simulation design. *Clinical Simulation in Nursing*, 58, 14-21.
- WIKANSARI, N. & SANTOSO, D. B. (2022). What are the barriers to the implementation of electronic medical records? A review of recent studies. *Jurnal Riset Kesehatan*, 11, 83-88.
- WOLDEMARIAM, M. T. & JIMMA, W. (2023). Adoption of electronic health record systems to enhance the quality of healthcare in low-income countries: a systematic review. *BMJ Health & Care Informatics*, 30.
- XU, J., GAO, X., SORWAR, G. & CROLL, P. (2013). Implementation of e-health record systems in Australia. *The International Technology Management Review*, 3, 92-104.
- YARDLEY, L. (2000). Dilemmas in qualitative health research. *Psychology and health*, 15, 215-228.
- YEH, C.-H., LEE, G.-G. & PAI, J.-C. (2015). Using a technology-organization-environment framework to investigate the factors influencing e-business information technology capabilities. *Information Development*, 31, 435-450.
- ZHENG, K., RATWANI, R. M. & ADLER-MILSTEIN, J. (2020). Studying workflow and workarounds in electronic health record-supported work to improve health system performance. *Annals of internal medicine*, 172, S116-S122.

Tables

Stage	Description	Knowledge stocks (KS) & Learning Flows (LFs)
Awareness	Key decision makers are aware of innovation	<i>Minimized capability</i> (Low KS & Low LFs)
Interest	The organization is committed to active learning about the innovation	
Ex-ante evaluation	The organization has initiated ex-ante evaluation and trial	<i>Static capability</i> (High KS & Low LFs)
Adoption	A decision is reached to invest resources necessary to accommodate adoption effort	
Adapt & implement	The innovation is developed, installed and maintained, & available for use	<i>Dynamic capability</i> (Low KS & High LFs)
Acceptance	The innovation is fully employed in organizational work; personnel are committed	
Routinization	Use of the innovation is encouraged as a normal activity	<i>Inclusive capability</i> (High KS & High LFs)
Full use	Use of the innovation to its fullest potential and in a comprehensive way	

Adapted from Cooper and Zmud (1990); Faber et al. (2017), and Robert, Greenhalgh, MacFarlane, and Peacock (2009)

Table I: Aligning Organizational Innovation Adoption with Knowledge Stocks & Learning Flows

		Intensity of Learning Flows (LFs)	
		Low	High
Density of Knowledge Stocks (KS)	Low	Minimized innovative capability	Dynamic innovative capability
	High	Static innovative capability	Inclusive innovative capability

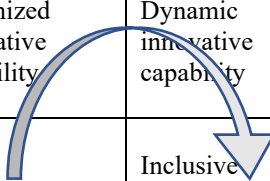


Table II: Knowledge Stocks and Learning Flows.
Adapted from Prieto and Revilla (2006).

Participant	Gender	Age Range	Education Level	Work Experience	Current Role
P1	Male	30 to 40 years	Bachelor's	6 to 10 years	Clinical Informatics Manager
P2	Female	20 to 30 years	Bachelor's	6 to 10 years	Clinical Educator
P3	Female	30 to 40 years	Bachelor's	More than 10 years	Nurse Unit Manager
P4	Male	40 to 50 years	Bachelor's	More than 10 years	ICT Manager
P5	Female	40 to 50 years	Bachelor's	More than 10 years	Director of Nursing
P6	Female	40 to 50 years	Diploma	More than 10 years	Patient Administration
P7	Female	20 to 30 years	Master's	6 to 10 years	Patient Administration

Table III: Participant demographics

Source: Authors

Innovation Stage	Description	Emerging Capability Knowledge stocks (KS) & Learning Flows (LFs)	Sample Key Emerging TOE Themes
Awareness	Key decision makers are aware of innovation	Minimized capability (Low KS & Low LFs)	Technical: <i>“Financially, of course, it will be an expensive journey.”</i> <i>“Just because they do something overseas and it's very different doesn't mean we do it here.”</i> <i>“All they've ever known is the paper record.”</i> Organization <i>“Change will be seen with contempt as soon as the technical problems occur.”</i> <i>“The organization lacks in-house expertise to train staff.”</i> Environment <i>“We do really well now on paper, and to be able to match that in a system, I think that's a challenge.”</i>
Interest	The organization is committed to active learning about the innovation		
Ex-ante evaluation	The organization has initiated ex-ante evaluation and trial	Static capability (High KS & Low LFs)	Technical <i>“The documents and the workflow involved with doing those processes is somewhat standardized.”</i> <i>“Just the whole structure of the building to be able to do that is critical”.</i> <i>“It's very important to have well-integrated systems and I can't say we have these.”</i> Organization <i>“Do we have enough staff in ICT? Probably not.”</i> <i>“Also, the management did not take immediate actions on issues about new system adoption.”</i> <i>“[doctors] are resistant to an electronic records systems.”</i> Environment <i>“We do really well now on paper, and to be able to match that in a system, I think that's a challenge.”</i> <i>“To meet those regulations is going to be very challenging.”</i>
Adoption	A decision is reached to invest resources necessary to accommodate adoption effort		

			<i>"We have to identify that the legislation has changed. We have to identify how and what impacts it has on the system."</i>
Adapt & implement	The innovation is developed, installed and maintained, & available for use	Dynamic capability (Low KS & High LFs)	Technical Unresolved response Organization <i>"We've had to work with teams from all over the hospital in the building on what we're doing now for our new system".</i> Environment <i>"It has not been an easy way to find the right vendors."</i> <i>"We chose the best option for us."</i>
Acceptance	The innovation is fully employed in organizational work; personnel are committed		
Routinization	Use of the innovation is encouraged as a normal activity	Inclusive capability (High KS & High LFs)	The TOE responses are unresolved . No evidence of inclusive capability
Full use	Use of the innovation to its fullest potential and in a comprehensive way		

Table IV: Alignment between innovation stages, knowledge stocks and flows, and TOE themes from data
Source: Authors

Figures

Figure 1: Research model of constraining factors influencing EHRs adoption.

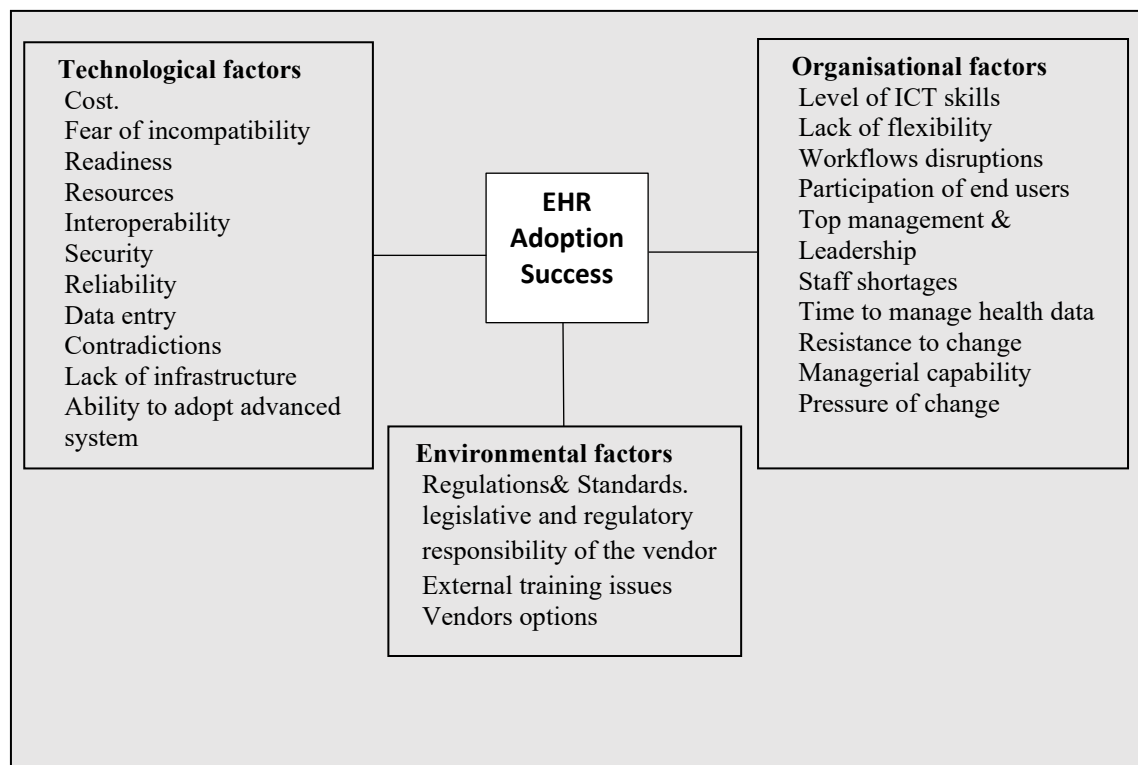


Figure 2: Integrating factors that influence EHR innovation adoption within healthcare settings.

