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Exploring the driving forces behind healthcare provider adoption of e-health technology

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Abstract: This study aimed to investigate the factors influencing the adoption of e-health technology in India. The study employed a descriptive survey design and structured questionnaires to evaluate the impact of individual, clinical and organisational factors on adopting the proposed system. The study underscores the importance of intrinsic motivation factors in influencing physicians to adopt and sustain EHT systems. Moreover, the study highlights the critical role of accessibility of medical records, healthcare provider-patient relationship and patient accessibility in disseminating EHT. The study's theoretical model expands our understanding of how individuals make decisions and accept technology, emphasising the relevance of personal factors such as self-efficacy, personal innovativeness and compatibility. The practical implications of this study are that managers must prioritise improving individual, clinical and organisational aspects of e-health to facilitate adopting the system.

Keywords: e-health; adoption; individual factors; clinical factors; organisation factors; technology acceptance.

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1 Introduction

'E-health' is a broad term associated with information and communications technology to facilitate health or healthcare. According to the World Health Organisation (WHO), e-health is defined as the cost-effective and safer usage of ICT to support health and health-related areas, including healthcare solutions, health surveillance, health literature and health education.' (WHO, 2005). There has been a surge in the use of e-health during the COVID-19 period (Wosik, et al., 2020). e-health has played a crucial role in the pandemic where there is a high risk in the outside environment, with the government imposing temporary curfews and lockdowns of entire regions. ICT has jointly overshadowed the traditional offline model of diagnosis and treatment in hospitals; by looking at this, e-health has been a highly attractive and alternative option in a risky and insecure period (Wang et al., 2021).

The use of e-health in emerging and developing countries aims to provide access to basic healthcare services for underserved populations with limited resources by utilising low-cost communication infrastructure (Rinty et al., 2022). E-health has the potential to revolutionise medical services by improving their effectiveness, expanding their range and engaging patients and healthcare professionals alike. It can also democratise, decentralise and demystify the practice of medicine. However, in developing countries, e-health adoption has faced significant challenges due to infrastructure barriers and non-technological factors such as individual, organisational, cultural, clinical and socio-economic factors (Almathami et al., 2019; Meier et al., 2013; Kaur and Gupta, 2006; Aas, 2001; Anderson, 2000). In India, like many other developing countries, the Ministry of Health (MOH) struggles to meet the growing demand for healthcare services with limited resources. In their search for alternatives to overcome the health system's problems, key government officials in the Indian Ministry of Health (MOH), healthcare organisations, health professionals, patients and the public, have all realised the potential of e-health applications and services to improve healthcare service delivery. But the logical questions are: What e-health solutions are needed, how ready are the healthcare providers to adopt and use them, and how is the adoption of e-health in India among the organisation? These questions have not been investigated. Therefore, to decrease the effect of the barriers to e-health and the risk of failure, it is essential to apply sound scientific methods for e-health adoption by healthcare providers to determine their preparedness for ICT-related change. Two main trends are apparent in Healthcare: improving the quality of care and cost-effective solutions. E-health promises to deliver more benefits to organisations, doctors, nurses, patients and others involved in healthcare. Healthcare innovations, including e-health technologies, aim to support faster, more reliable and transparent medical services. These e-health technologies may facilitate the design and delivery of high-quality Healthcare, improve patient safety, and

further generate innovation in healthcare processes (Bangert and Doktor, 2020). It helps both medical practitioners and nurses in reducing errors. Also, it helps in taking decisions at critical times. Simultaneously, the diagnosis may be more straightforward as far as a physician is concerned. Additionally, using information and communication technology in healthcare industries may lead to safety, productivity and success regarding healthcare delivery (Wickramasinghe et al., 2005; Ford et al., 2006). The benefits of e-health include reducing costs, increasing patient empowerment, enhancing access to healthcare services, facilitating information and communication exchange and increasing the quality of care in healthcare organisations.

1.1 E-health adoption challenges

However, e-health technologies in healthcare organisations involve complex socio-technical issues and often fail. Adopters of e-health technologies face challenges such as the complexity inherent to the healthcare services context and many risk factors in the e-health development/procurement and adoption processes. These challenges must be understood and promptly addressed to support successful adoption and sustained health innovations. As such, one fundamental starting goal for any method of e-health evaluation is to evaluate adoption, particularly in terms of the acceptance of technology by the intended end-users. For example, healthcare providers are generally identified as end-users in healthcare settings and are often anxious about using available computer systems in their medical practice (Akhlaq et al., 2016). New technology in the medical environment often leads to healthcare providers' frustration, curiosity and anxiety.

Nevertheless, they attempt to adjust to the innovation while considering their patients. Healthcare providers face specialised hardships while utilising PCs, leading to reluctance to use the new tools (Ventola, 2014). Consequently, healthcare providers will tend to refuse to use computers. A survey conducted by various organisations shows healthcare providers' low transmission of information technology is due to inadequate investment in Information and Communication Technology (ICT) (Baniasadi et al., 2020).

During a visit to a hospital by the researcher, it was found that many healthcare providers are reluctant to use e-health technology. They complained about accomplishing additional work, losing independence, conflicting orders from two specialists (on-location and off-site) and copying documentation. Although some healthcare providers had positive experiences utilising e-health technology, they struggled while managing specialised barriers to using e-health technology. In addition, they were under pressure when they couldn't import or enter the information as needed. These situations caused dissatisfaction among healthcare providers, top management issues and adverse patient outcomes. Therefore, some healthcare providers use paper-based rather than e-health to compose clinical notes and are hesitant to utilise this technology.

Despite India's burgeoning health technology industry and strategic prioritisation of eHealth initiatives, adoption of eHealth technologies among healthcare professionals remains low compared to global standards. A WHO report ranked India 112th worldwide for eHealth usage, contrasted against the country's position as the 4th largest spender on healthcare IT (WHO, 2019). This highlights a disconnect between the substantial investments towards eHealth in India, projected to reach USD \$10.6 billion by 2025 (Khanna, 2019) and the slow uptake among intended end-users like healthcare providers. Factors such as lack of training, complexities of Indian healthcare ecosystems,

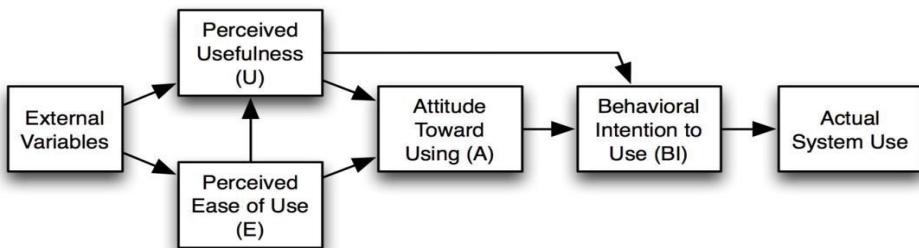
medicolegal concerns and interoperability challenges (HIMSS, 2018) may contribute to this adoption gap, underscoring the need for context-specific research to clarify drivers and barriers within the Indian healthcare milieu. Bridging this divide between eHealth investment and adoption will be critical for India to fully capitalise on the promise of health technology innovation.

2 Literature review

Based on the barriers and issues in adopting e-health, the Technology Acceptance Model (TAM) is used in this study. The Technology Acceptance Model (TAM) is used in this study to understand the challenges and issues in adopting e-health. TAM was first developed in social psychology to predict and explain why some systems are accepted or rejected by users. It links users' beliefs, attitudes, intentions and behaviour to their acceptance or rejection of innovations (Davis, 1989). TAM is based on the Theory of Reasoned Actions (TRA), which focuses on consciously intended behaviours and has been used to explain human behaviour across different fields. Although the significant factor of usage behaviour in both TAM and TRA is the intention to use technology, the usage behaviour is primarily predicted by intention, which directly and indirectly influences any associated factor (Davis et al., 1989). Although both TAM and TRA consider the intention to use technology as the key factor in determining behaviour, TAM proposes that perceived usefulness and ease of use are the primary drivers of acceptance. The intention to use technology in TAM is influenced by attitude towards the technology and its perceived usefulness and ease of use, while in TRA, it is influenced by subjective norms.

In conclusion, TAM is a better theory to apply, and it provides very general information on end users' opinions about the technology (Mathieson, 1991). TAM has been widely used in various fields, such as business, information technology and education (Liao et al., 2022; Davis, 1989; Davis et al., 1989; Erkan and Evans, 2016; Pappas et al., 2017; Van et al., 2021). Nevertheless, there have been studies in healthcare settings (Lee et al., 2021; Kamal et al., 2020; Zhou et al., 2019; Pai and Huang, 2011).

Figure 1 TAM model



Source: Davis (1989)

2.1 Behavioural intention

Fishbein and Ajzen (1975) characterised intention as ‘the motivating factors that influence a particular behaviour; the stronger the intention to perform the behaviour, the greater the likelihood that the behaviour will be performed’. Intentions refer to the extent to which a person’s probability of performing some action. The TRA model describes the association and difference between attitude and intention (Fishbein and Ajzen, 1975). They assumed that the more favourable a person’s attitude toward some object, the more they intend to perform positive behaviour.

Many research studies have used intention as a dependent variable (Mathieson, 1991; Zhou et al., 2019; Lee et al., 2021; Elaklounk et al., 2015). If an individual intends to use the technology, they will use that technology. However, the organisation has a significant impact on the actual usage behaviour. If it is mandated, whether or not the employees intend to use the innovation, they must use it. The difference is that when the innovation is used with willingness, the outcomes will be more positive than when used with unwillingness. Therefore, this study will focus on individual intention rather than organisational intention.

2.2 Factors influencing e-health adoption

While existing technology acceptance models provide a useful foundation, there remains a need to supplement this knowledge by elucidating the multi-level factors and challenges specific to eHealth adoption in the unique context of Indian healthcare. As Bhatia et al. (2018) discussed, Indian public healthcare faces system-level barriers like underinvestment in ICT infrastructure and training, high-patient volumes and lack of electronic records – issues that may hinder eHealth uptake. At the organisational level, leadership support, technology compatibility and policies that incentivise digitisation can shape providers’ adoption (Venkatesh et al., 2011). Additionally, Indians show high-power distance and uncertainty avoidance in their culture (Hofstede, 2001), potential societal-level influences on technology acceptance. Clarifying how these various levels of context interact to impact Indian healthcare providers’ perceptions and use of eHealth tools is critical to advancing theoretical knowledge and informing targeted interventions in this understudied milieu. The researcher observed that the eight factors influencing e-health technology acceptance, as shown in Table 1, are Self-Efficacy (SE), Personal Innovativeness (PI), Compatibility (COM), Accessibility to Medical records (AMR), Accessibility to Patient Information (API), Healthcare Provider-Patient Relationship (HPPR), Management Support (MS) and Adequate Training (AT). The combined use of these factors strongly predicts healthcare providers’ intention to use EHT. Thus, the focus was on incorporating these factors in this research study. Furthermore, the eight factors of e-health adoption covered almost all the healthcare providers’ behavioural intentions towards e-health given by other researchers cited below in Table 1. The researcher has only studied the factors influencing e-health adoption rather than the implementation of e-health. Therefore, this study focused on factors of e-health adoption because they positively impact healthcare providers’ behavioural intention towards e-health. Table 1 shows the literature from various past studies describing the impact of the factors of e-health adoption on the behavioural intention towards e-health adoption.

Table 1 Impact of the factors of technology adoption on behavioural intention using health technology

<i>Dependent variable: Behavioural intention</i>		
<i>S. No</i>	<i>Independent variable</i>	<i>Supporting literature</i>
1	Self-efficacy	(Alotumi, 2022; Zhang et al., 2019; Singh and Srivastava, 2020; Venkatesh et al., 2003)
2	Compatibility	(Ni, 2020; Hsiao et al., 2011; Wu et al., 2007)
3	Personal innovativeness	(Hoque et al., 2016; Liang et al., 2003)
4	Accessibility of medical records	(Sandberg et al., 2009; Rho et al., 2014)
5	Accessibility of patients	(Rho et al., 2014)
6	Healthcare provider-patient relationship	(Rho et al., 2014; Abdekhoda et al., 2015)
7	Management support	(Ni, 2020; Abdekhoda et al., 2015; Yang and Wang, 2012; Kowitlawakul, 2011)
8	Adequate training	(Abdekhoda et al., 2015)

- 1 *Self-efficacy (SE)*: Efficacy refers to a belief that a person can perform a specific behaviour. In Bandura's Social Cognitive Theory (SCT), self-efficacy is one of the principal concepts. Self-efficacy is people's assumption concerning their ability to systematise and enforce the measures to perform a given task. It determines the type of individual behaviours, the commitment they choose to make and the length of their resilience in overcoming obstacles (Bandura, 1996). People with strong beliefs in efficacy tend to use more effort and are more persistent than people's low-efficacy beliefs. Zhang et al. (2019) claimed that individuals' level of emotion is based on their health conditions, which affects their decisions, e.g., their intentions to use healthcare-related technologies. Previous studies Alotumi (2022); Zhang et al. (2019); Singh and Srivastava (2020) and Venkatesh et al. (2003) examined that individual with more computer SE tends to perceive technology with ease of use and usefulness. It implies that if an individual understands that the tasks associated with a computer can be done correctly, the PU and PEOU will undoubtedly be increased. Self-efficacy was found to be a highly significant predictor of e-health acceptance. Physicians are known as professional health experts, and they claim that they lose confidence in their clinical practice while using new technology. In contrast, certain physicians with improved self- efficiency through devices and telemedicine have demonstrated a proactive acceptance attitude.
- 2 *Compatibility (COM)*: Compatibility refers to the degree of correspondence between innovation and existing values, past experiences and needs of the potential adopter (Rogers, 2003). Compared with TAM and IDT (Innovation diffusion theory), IDT's empirical studies have used a more complex set of beliefs to predict adoption. In IDT, compatibility is one of the beliefs influenced by adoption behaviour. TAM is differential in compatibility because perceived usefulness is equivalent to IDT's relative advantage, and PEOU equals complexity. PU, PEOU and compatibility were significantly related to predicting the usage of innovation (Hsiao et al., 2011). The importance of compatibility was also consistently accepted in predicting technology acceptance (Ni, 2020). In their study on the factors affecting the acceptance of

Hospital Information Systems (HIS) among nurses, Hsiao, Chang and Chen (2011) utilised both the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) as conceptual frameworks. The authors found that compatibility significantly predicted perceived usefulness, ease of use, and behavioural intention towards using HIS. The results suggest that ensuring HIS compatibility with the existing work processes and systems of the nurses could enhance their perception of the usefulness and ease of use of HIS, leading to a greater intention to adopt and use it. Overall, the study highlights the importance of considering compatibility when designing and implementing health information systems to promote their acceptance and use among healthcare professionals.

- 3 *Personal innovativeness (PI)*: Some scholars argued that individual factors induce the nearest influence on an individual's cognitive interpretation of a target. Agarwal and Prasad (1997) stated that based on Rogers's theory of the diffusion of innovations, individuals with higher personal innovativeness are most likely to adopt an innovation earlier. They believe this construct must be reconceptualised in a specific field; instead, human behaviour towards innovation is expected. Personal innovativeness then emerged as an individual's ability to explore new ITs. Researchers described personal innovativeness as a symbol of the risk-taking propensity in some and not others. Persons with higher personal innovativeness will likely develop a more favourable view of innovation and positively use new IT / IS. The implications are evident – personal innovativeness is better used in assessing innovations since it represents the normal tendency of a person to explore new technology in multiple domains of acceptance. In mobile settings, each psychological factor has attracted more attention. The general understanding is that a lack of understanding of personality factors will make intentions more rational than they are. In some studies, Personal Innovativeness was a strong antecedent (Hoque et al., 2016; Liang et al., 2003). Previous e-health studies have identified personal innovativeness as a key factor influencing adoption (Liang et al., 2003), but its impact in the post-adoption context remains unexplored.
- 4 *Accessibility of medical records (AMR)*: Accessibility of medical records relates to the degree to which a physician believes that using e-health services can increase patient health conditions and provide accurate and up-to-date patient information. Sandberg et al. (2009) argued that if more physicians obtained medical records through e-health services, it is more likely that physicians would find it useful. In addition, Rho et al. postulated that physicians with greater access to medical records through e-health services were likely to have more positive perceptions of PEOU and PU and showed significant differences (Rho et al., 2014).
- 5 *Accessibility of patients (AP)*: Accessibility of patients is related to the degree to which a physician believes the use of e-health services will increase contact with underserved patients who live in regions that are geographically distant from medical facilities. In e-health services, the Accessibility of patients was not only an important factor but also a basic characteristic of e-health service. For instance, physicians could meet with patients to provide care through the e-health service anytime they are separated by distance (Palmas et al., 2008). If physicians have a large enough caseload to warrant contact through e-health service, they may feel that e-health service increases the efficiency of patient care (Balasingham et al., 2007). Martínez

et al. (2006) also found that home monitoring positively impacted the Accessibility of geographically isolated patients by extending Healthcare to remote places. Rho et al. (2014) found that greater Accessibility of patients would lead to increased perceived usefulness by healthcare providers. Based on the preceding discussion, the researcher suspects that the greater Accessibility of patients would lead to increased perceived usefulness and perceived ease of use by healthcare providers.

- 6 *HP-patient relationship (HPPR)*: Effective communication between healthcare providers and patients is an important mode for educating patients on their healthcare needs, including disease evaluation, diagnosis and prognosis. Successful communication involves creating a positive atmosphere, accurately interpreting communication signals and actively listening. It is crucial to deliver high-quality patient care and establish a strong Healthcare Provider-Patient Relationship (HPPR) (Abdekhoda et al., 2015). The term HPPR has been defined in the literature as the degree of familiarity, trust and interaction between healthcare providers and patients regarding healthcare planning. HPPR has been identified as a critical factor that impacts the quality of medical care (Rho et al., 2014; Abdekhoda et al., 2015). A focus group study also revealed that patient-driven communication and mutual trust between healthcare providers and patients are essential for patients' perceived usefulness of online Electronic Medical Records (EMRs) (Winkelman et al., 2005). Ventres et al. (2006) suggested that how physicians and patients perceive Electronic Health Records (EHRs) and how these perceptions affect their usage is known as the relational effect, which can significantly impact the development, sustainability and implementation of health promotion and prevention interventions. Abdekhoda et al. (2015) also indicated that HPPR relates to intentions to use health-related information technology. Rho et al. (2014) incorporated the Health Provider-Patient Relationship (HPPR) into the Technology Acceptance Model's (TAM) constructs of Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) to examine the factors that impact behavioural intentions towards using e-health services. Their study revealed that HPPR and PU were significant predictors of behavioural intentions, while PEOU indirectly affected behavioural intentions through PU. Based on these findings, the researcher speculates that HPPR has a direct influence on perceived ease of use and usefulness.
- 7 *Top management support (TMS)*: While prior research has demonstrated the value of management support for using technology, less work has linked this principle directly to technological beliefs. The institutional theory offers a fundamental concept for how and why the dominant organisational principles, values, culture and history profoundly influence individual thoughts and actions in Organisations. Support by the top management refers to the extent of commitment and resources the top management provides or adopting e-health innovation and related adaptation processes in the organisation (Premkumar, 2003). According to Jeyaraj et al. (2006), top management support also acts as one of the three best predictors of IT adoption by organisations, which can be explained in two ways. First, top management support ensures a commitment to spend the required resources on testing and implementing an innovation. Secondly, top management can stimulate change (or overcome resistance) by communicating and reinforcing values through an articulated vision. That is crucial in influencing employees to accept an innovation (Jeyaraj et al., 2006). Top management support has also been shown to play an

important role in health IT adoption in organisations (Ni, 2020; Yang and Wang, 2012; Kowitlawakul, 2011). For example, Abdekhoda et al. (2015) found that management support and PU significantly affected BI to use of e-health services. Similarly, the PEOU also significantly affected the BI (Abdekhoda et al., 2015). Based on the above discussion, the researcher suspects that management support directly affects perceived ease of use and usefulness.

- 8 *Adequate training (AT)*: Moreover, Wu et al. (2007); Aaronson et al. (2001) and Gadd and Penrod (2000) said adequate training and technical support will efficiently enhance individual skills and perceptions and increase ease of use and usefulness in adopting technology (Aaronson et al., 2001; Gadd and Penrod, 2000). Abdekhoda et al. (2015) found that adequate training did not significantly affect PU and PEOU. Based on the preceding discussion, the researcher suspects adequate training shows a significant positive difference in perceived ease of use and usefulness.
- 9 *Perceived usefulness (PU) and Perceived ease of use (PEOU)*: PU and PEOU in the initial TAM were the most dominant factors of technology use (Davis, 1989). Additionally, e-health service providers' PU and PEOU were very important in e-health technology acceptance (Wu et al., 2007; Lanseng and Andreassen, 2007). PU was originally defined as the extent to which a person believed using the system would enhance their intention to use EHT. In this study, PU was re-defined because usefulness intention in Healthcare has slightly different meanings from those included in the original TAM. Physicians felt that e-health was useful when it improved the care of the patients, led to faster delivery of care, improved documentation, reduced healthcare service time and allowed for accurate, low-cost medical monitoring (Sandberg et al., 2009; Olver and Selva-Nayagam, 2000). Generally, PEOU was also defined as the degree to which a person believes using a particular system would be free of effort (Davis, 1989). In this study, high PEOU was meant to suggest that the e-health service is easy to learn and use by physicians (Kalayou et al., 2020). Therefore, PU and PEOU were crucial factors for accepting new technology (Sandberg et al., 2009; Martínez et al., 2006; Olver and Selva-Nayagam, 2000; Dünnebeil et al., 2012; Hsiao et al., 2011). Previous studies in the healthcare field have also emphasised the influence of PU and PEOU on behavioural intention to use (Nguyen et al., 2021; Kalayou et al., 2020; Alhashmi et al., 2019). Given these relationships, the researcher might expect that healthcare providers will use an e-health service when they feel that it is easy to use, use, effective and leads to good healthcare outcomes.
- 10 *Attitude towards innovation (belief and affect)*: A person accepts innovation based on a given innovation formulated by their 'beliefs and affects' (Fishbein and Ajzen, 1975; Davis et al., 1989; Rogers, 2003). The beliefs refer to 'perceived usefulness' and 'perceived ease of use'. An individual affects points to elicited emotions associated with using the technology, e.g., like-dislike, pleasant-unpleasant, interesting-uninteresting (Davis et al., 1989). ICT studies strongly support the importance of cognitive and affective elements in describing the potential acceptance of technology (Igbaria et al., 1997; Trevino and Webster, 1992). There is research evidence that a person's attitudes mediate the influence of external variables and stimuli. At the same time, external influences also affect beliefs (Davis et al., 1989). Attitude is also influenced by its usefulness and ease of use as perceived by a

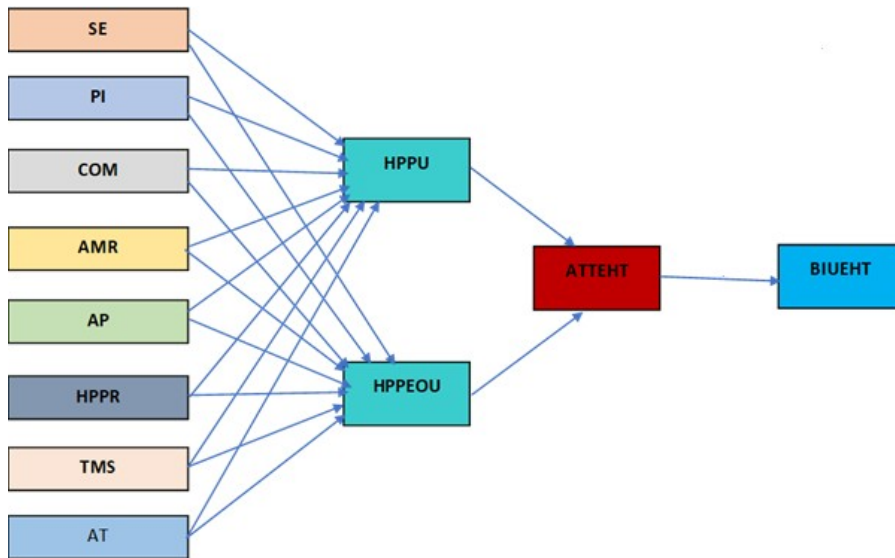
healthcare provider. Ultimately, the healthcare providers' intention to use e-health technology can be explained or predicted by their attitude (toward using the technology) (Ifinedo, 2016; Kowitlawakul, 2011). Above discussion, the researcher suspects that there is a mediating effect of attitude between perceived usefulness and behavioural intentions; Similarly, there is a mediating effect between perceived ease of use and behavioural intention.

2.3 Need for the study

Healthcare Providers (HP) are the backbone of any healthcare organisation, but there is a shortage of healthcare providers in India. The doctor-population ratio in India has been around 1 per 2000. However, the disparity in urban and rural doctor distribution is dismal. It is as low as one doctor per 25000 people in rural settings. It is mainly because 68.8% of the population lives in villages, but only about 2% of doctors practice in rural areas, about 75% in urban areas and 23% in semi-urban regions.

Moreover, many young medical professionals are reluctant to work in rural areas due to ill-equipped hospitals in poorly accessible locations with limited physical facilities. Therefore, e-health can be a potential answer to the arduous task of reaching the masses and delivering essential health services to everyone. According to Gagnon et al. (2016), their systematic literature review on healthcare professionals' barriers to e-health technology adoption is related to organisational aspects, human elements, policy, socio-economic factors and cultural issues, clinical aspects and individual aspects. Therefore, to reduce those barriers, the researcher has included all these barriers in this study and understand e-health technology adoption by healthcare providers. Although health policy planners and decision-makers must support information to guide the successful planning and implementation of e-health services, in Scopus and WoS, no known study has examined e-health adoption by healthcare providers within India. This study aims to investigate healthcare providers' intention to adopt e-health technology in Chennai, known as the Healthcare-capital of India (Hamid, 2012). Chennai was selected as an ideal data collection site for several key reasons. As the capital of Tamil Nadu and the fourth largest metropolitan city in India, Chennai represents a major urban healthcare hub, home to over 100 hospitals and healthcare facilities (ICMR, 2019). This provided access to a large and diverse sample of healthcare providers working in a range of clinical settings and roles, granting broader insights into eHealth adoption compared to smaller towns. Additionally, with a population exceeding 10 million, Chennai reflects India's cultural and linguistic diversity, improving the generalisability of findings (Census of India, 2011). Chennai has also been dubbed India's 'healthcare capital' for pioneering medical advances and quality care, along with a growing technology focus (Times of India, 2018). This positioned the city at the forefront of India's eHealth transformation, making it an opportune environment to study adoption patterns and challenges. Chennai thus offered an optimal balance of healthcare scale, infrastructure, diversity and technology orientation to understand eHealth acceptance among Indian providers.

Additionally, the study seeks to identify key factors that may pose challenges to implementing the technology in the Indian healthcare system. To achieve this, the researcher has surveyed the literature, including relevant theories, to develop a conceptual framework. Then, it examines various pertinent issues (from the perspective of Individual, Clinical and Organisational) and their interrelationships.

Figure 2 e-health technology acceptance model (EHTAM)

3 Research method

The research design is a non-experimental, descriptive design. This design allowed examination of the relationship among the variables and facilitated testing of the e-health model with a healthcare provider's population. In addition, this design assisted in identifying predictors that influence healthcare providers' intentions to use E-Health Technology (EHT). The primary data regarding factors of e-health adoption, the technology acceptance factors and healthcare providers' behavioural intentions were collected using a survey-based self-administered structured questionnaire to the healthcare providers in Chennai. The secondary data about the details of healthcare providers, various theories and prior works in the e-health adoption were collected from published reports, books, research papers and articles. A survey format was chosen because it offers a highly structured set of questions, enabling the researcher to derive comparable data from different hospitals and clinics. Simple random sampling was used – the sample selection, approx. Two hundred twenty-four (224) hospitals are in Chennai (NIC, 2020); from 224 hospitals, 142 are selected based on sample size determination and random tables. Healthcare providers were eligible to participate if they directly interacted with patients and used e-health technology in their work. Providers in purely administrative roles were excluded from the study. Questionnaires were distributed to these 142 hospitals. With the help of the hospital's human resource department, distributed the online and offline e-health technology survey questionnaires to the healthcare providers. The population of the research study is healthcare providers. A total of 414 healthcare providers responded to the questionnaires. The study analyses the demographic profiles of the respondents (see Table 2) and examines the constructs and dimensions in detail. The reliability of all the constructs is calculated using Cronbach

Alpha and Composite reliability, and the results are then listed. The convergent validity of the constructs and the discriminant validity of all the constructs are calculated based on the exploratory factor analysis, and the results are then listed. All the above tests are conducted using SPSS version 23. Further, the moderating effect of organisational culture on HP's behavioural intention to use EHT and the mediating effect of HP's attitudes towards EHT is conducted using SPSS version 23 with a plugin Process Macros. Finally, the structural equation modelling is carried out by using AMOS.

Table 2 Classification of demographic variables of healthcare providers

<i>Demographic variable</i>	<i>No. of respondents</i>	<i>Percentage</i>
<i>Gender</i>		
Male	169	40.4
Female	245	59.6
<i>Age</i>		
Under 30 years	179	43.2
30–39 years	70	16.9
40–49 years	44	10.6
50–59 years	77	18.6
60 years and older	44	10.6
<i>Years of experience</i>		
Less than five years	164	39.6
5–10 years	47	11.4
11–15 years	80	19.3
More than 15 years	123	29.7
<i>Education background</i>		
Diploma	10	2.4
Bachelors	140	33.8
Masters	217	52.4
Doctorate	47	11.4
<i>Work location</i>		
Urban	258	62.3
Rural	60	14.5
Mixed	96	23.2
<i>Work sector</i>		
Public	56	13.5
Private	358	86.5

Table 2 Classification of demographic variables of healthcare providers (continued)

<i>Demographic variable</i>	<i>No. of respondents</i>	<i>Percentage</i>
<i>Type of e-health user</i>		
Novice	95	22.9
Technician	44	10.6
General	111	26.8
Advanced-experienced	70	16.9
Extra-seasoned, the most accomplished in the field	94	22.7

Source: Primary data.

4 Data analysis and findings

According to Cronbach (1951), any measurement-based research must address reliability or accuracy, termed measurement reliability. Table 3 shows that the reliability test is done to verify the 'Cronbach's Alpha' value of the studied constructs to determine the factors influencing healthcare providers' behavioural intentions to use e-health technology. According to Nunnally and Bernstein (1994), the minimum threshold value must be 0.70. Any value greater than 0.70 is good and adequate, according to Holden et al. (1991), Janssen and Ostrom (2006), Peterson (1994), Clark and Watson (1995) and Bagozzi and Yi (2012).

Table 3 Cronbach alpha & composite reliability

<i>Variables</i>	<i>No of items</i>	<i>Cronbach alpha</i>	<i>Composite reliability</i>
Self- efficacy	6	.90	.87
Compatibility	3	.83	.84
Personal Innovativeness	4	.91	.90
Accessibility to medical records	3	.89	.90
Access to patients	3	.87	.90
Patient relationship	3	.89	.87
Top management support	4	.90	.91
Adequate training	2	.89	.89
Perceived usefulness	7	.92	.91
Perceived ease of use	6	.91	.90
Attitude towards e-health	5	.90	.89
Behavioural intentions	4	.89	.91

Table 3 shows the Cronbach Alpha and composite reliability values. In this study, all the Cronbach Alpha & Composite reliability values resulted greater than 0.80, so the instrument is reliable. The factors that influence healthcare providers' behavioural intentions to use e-health technology encompass self-efficacy ($\alpha = 0.90$), compatibility ($\alpha = 0.83$), personal Innovativeness ($\alpha = 0.91$), Accessibility to medical records ($\alpha = 0.92$), access to patient information ($\alpha = 0.92$), healthcare provider-Patient

relationship ($\alpha = 0.89$), top management support ($\alpha = 0.90$), healthcare provider perceived usefulness ($\alpha = 0.91$), healthcare provider perceived ease of use ($\alpha = 0.90$), healthcare providers' attitude towards EHT ($\alpha = 0.89$) and healthcare provider behavioural intention to use EHT ($\alpha = 0.91$). Additionally, some values are above 0.90, and most are above 0.80, which shows that the EHT instrument is highly reliable.

Factor analysis is a technique that examines the complete set of interdependent relationships between variables and presents them in terms of a few underlying factors (Malhotra, 2003). The highly correlated variables and largely independent of other subsets of variables are combined into factors. After factor analysis, the independent variables comprising 27 statements have been reduced to 23 statements that converged into three components, viz. Individual factors (Self-efficacy, Compatibility and Personal Innovativeness), Clinical factors (Accessibility to medical records, Access to patient information and patient relationship) and Organisational factors (Top management Support, Adequate Training). The resultant three components with higher eigenvalue (>1), factor loadings ($>.05$) and about 63.96% of variance explained by these factors indicate that the data is valid and therefore used for analysis/interpretation. The researcher termed the first factor the 'individual factor', with 11 items. The researcher termed the second factor the 'clinical factor', which has eight items. Finally, The Researcher termed the 'organisational factor' the third factor, which has six items. *Individual factor (IF)*: The first component comprises (Self-efficacy, Compatibility and Personal Innovativeness) ten statements with Eigen value of 14.072, showing factor loadings of .834, .846, .810, .797, .722, .649, .739, .806, .842, .842. This factor explains 63.96% of a total of 75.35 % variance. *Clinical factor (CF)*: Second component comprises (Accessibility to medical records, access to patients' information and HPPR) eight statements with Eigen value of 1.39 with all factor loading values of .805, .869, .720, .825, .925, .853, .922, .923. This factor explains 6.33% of cumulative variance. *Organisational factor (OF)*: The third factor, named organisational Factor (Top Management Support and Adequate Training), consists of four statements and an Eigenvalue of 1.112, showing factor loadings of .794, .947, .878, .920, .911 and .960. The factor explains 5.053% of the cumulative variance. Consequently, it can be concluded that all items with similar values have been grouped under one factor, and all explain a fairly good percentage of the variance of the dependent variable.

4.1 Hypotheses

After the factor analysis, the hypotheses for this study are as follows:

H1: Individual factors have a significant positive effect on Behavioural Intention to Use eHealth Technology (BIUEHT).

H2: Clinical factors have a significant positive effect on BIUEHT.

H3: Organisational factors have a significant positive effect on BIUEHT.

H4: Technology acceptance factors have a significant positive effect on BIUEHT.

H5: Perceived Usefulness (PU) has a significant positive effect on BIUEHT.

H6: Perceived Ease of Use (PEOU) has a significant positive effect on BIUEHT.

H7: Attitude Toward eHealth Technology (ATTEHT) has a significant positive effect on BIUEHT.

H8: Healthcare providers' ATTEHT mediates the effect of technology acceptance factors on BIUEHT.

H9: ATTEHT mediates the effect of PU on BIUEHT.

H10: ATTEHT mediates the effect of PEOU on BIUEHT.

4.2 Structural equation modelling (SEM)

The Structural Equation Model (SEM) is conducted using AMOS 23, and the following results of model fit and estimates are obtained as shown in Tables 5 and 6.

From Table 4, it could be inferred that the hypothesised measurement model provides a good fit to the data, with the goodness of fit index being 0.90. similarly, CFI is 0.96, suggesting a good fit. RMSEA is 0.08 and lower than the threshold value of 0.08, which is generally necessary for a good model fit. The value of RMR is 0.04, which is also within the suggested range. The AGFI is 0.92, greater than the recommended acceptance level of 0.80. the NFI value is 0.95, which again suggests a good fit. Although the value of NFI generally lies between 0 and 1, larger values indicate a higher level of goodness of fit, as evidenced in the table.

Table 4 Factor loadings matrix of the factors of e-health adoption

<i>Variables</i>	<i>Component</i>		
	<i>1</i>	<i>2</i>	<i>3</i>
SE1		.834	
SE2		.846	
SE3		.810	
SE4		.797	
SE6		.722	
COM1		.649	
COM3		.730	
AMR1	.805		
AMR3	.869		
ATP1	.720		
ATP2	.825		
ATP3	.925		
PR1	.853		
PR2	.922		
PR3	.923		
PI1		.806	
PI2		.842	
PI3		.842	
TMS1			.794

Table 4 Factor loadings matrix of the factors of e-health adoption (continued)

Variables	Component		
	1	2	3
TMS2			.947
TMS3			.878
TMS4 AT1		.920	
AT2		.911	
		.960	

Notes: Extraction Method: Principal Component Analysis.
 Rotation Method: Oblimin with Kaiser Normalisation' a. Rotation converged in 6 iterations.

Table 4 shows that individual, clinical, and organisational factors are statistically significant with HPPU & HPPEOU. HPPU is statistical significantly with ATTEHT. HPPEOU is statistical significantly with ATTEHT. ATTEHT is statistical significantly with BIEHT. Individual factors are statistical significantly with ATTEHT. HPPEOU is statistical significantly with BIUEHT. Individual factors and Clinical factors are statistical significantly with BIUEHT.

PerUse Healthcare provider's perceived usefulness; PerEseUse: Healthcare provider's perceived ease of use; AttEHT: Attitude towards e-health technology; BIEHT: behavioural intention to use e-health technology.

Figure 3 Structural equation modelling

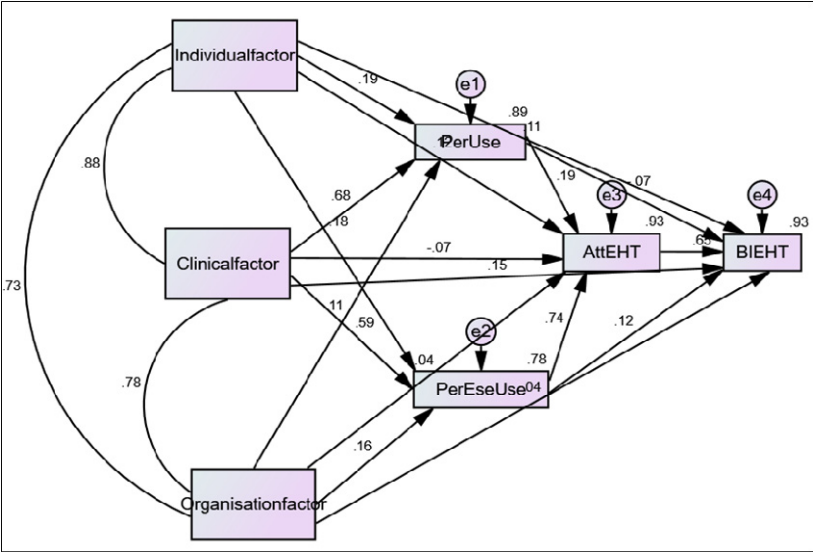


Table 5 Summary of model fit – structural equation modelling

CMIN	DF	CMIN/DF	GFI	AGFI	CFI	RMR	RMSEA	NFI
415	99	4.1	0.90	0.92	0.96	0.04	0.08	0.95

Table 6 Results of structural equation modelling

<i>Relationship</i>	<i>Estimate</i>	<i>SE.</i>	<i>t-values</i>	<i>P</i>
Individual Factors → HPPU	.191	.017	5.422	.000
Individual Factors → HPPEOU	.176	.023	3.585	.000
Clinical Factors → HPPU	.678	.021	17.689	.000
Clinical Factors → HPPEOU	.592	.028	11.053	.000
Organisation Factors → HPPU	.113	.023	4.278	.000
Organisation Factors → HPPEOU	.161	.031	4.366	.000
HPPU → ATTEHT	.185	.034	4.123	.000
HPPEOU → ATTEHT	.739	.025	22.970	.000
Clinical Factors → ATTEHT	-.072	.016	-1.786	.074
Individual Factors → ATTEHT	.117	.010	4.049	.000
Organisation Factors → ATTEHT	.037	.014	1.726	.084
ATTEHT → BIUEHT	.649	.053	13.376	.000
HPPU → BIUEHT	-.069	.037	-1.516	.130
HPPEOU → BIUEHT	.120	.041	2.496	.013
Individual Factor → BIUEHT	.111	.011	3.825	.000
Organisation Factors → BIUEHT	.037	.015	1.723	.085
Clinical Factors → BIUEHT	.151	.018	3.776	.000

Table 7 shows the results of a study that used structural equation modelling to examine the relationships between various factors and their impact on Healthcare Providers' Perceived Usefulness (HPPU), Perceived Ease of Use (HPPEOU), Attitude Towards E-Health Technology (ATTEHT) and Behavioural Intentions to Use E-Health Technology (BIUEHT). The results suggest that individual, clinical and organisational factors significantly impact HPPU and HPPEOU, with clinical factors having the strongest effect. There is also a significant relationship between HPPU and ATTEHT, with HPPEOU having a stronger impact on ATTEHT. The attitude towards e-health adoption is also significantly related to BIUEHT. The individual factor significantly impacts BIUEHT, while the relationship between organisational factors and BIUEHT is not significant. Finally, the clinical factor has a positive impact on BIUEHT. However, HPPU has a negative impact on BIUEHT, while HPPEOU has a positive impact on BIUEHT.

Table 7 Hypothesis testing results

<i>Hypothesis</i>	<i>Relationship tested</i>	<i>Result</i>
H1	Individual Factors → BIUEHT	Supported
H2	Clinical Factors → BIUEHT	Supported
H3	Organisational Factors → BIUEHT	Supported
H4	Technology Acceptance Factors → BIUEHT	Supported
H5	PU → BIUEHT	Not Supported
H6	PEOU → BIUEHT	Supported

Table 7 Hypothesis testing results (continued)

<i>Hypothesis</i>	<i>Relationship tested</i>	<i>Result</i>
H7	ATTEHT -> BIEHT	Supported
H8	ATTEHT mediates Technology Acceptance Factors -> BIEHT	Partial Mediation
H9	ATTEHT mediates PU -> BIEHT	No Mediation
H10	ATTEHT mediates PEOU -> BIEHT	Mediation Supported

5 Discussion and implications of the study

The research indicated that the factors influencing healthcare providers' intentions belonged to five major factors: individual, clinical, organisational, HP's perceived usefulness and HP's perceived ease of use. Physicians were more positively influenced by intrinsic motivation factors (individual, technical and organisation) to effectively utilise and sustain EHT systems than extrinsic motivation factors such as government incentives/rewards or penalties. In addition, this research study established a significant impact of individual factors (Self-efficacy, personal innovativeness and compatibility) on HP's perceived usefulness. Various research studies confirmed the significant positive impact of individual factors on HP's perceived usefulness and HP's perceived ease of use (Aldosari, 2014; Nguyen et al., 2021; Kalayou et al., 2020; Alhashmi et al., 2019; Chau and Hu, 2002; Hu et al., 1999, 2002). The Accessibility of medical records, the HP-patient relationship and the Accessibility of patients (clinical factors) were essential to disseminating the EHT. The EHT was originally designed to increase the Accessibility of patient medical records and offer healthcare access to patients separated from physicians by geographic distance. Thus, this research study established a significant impact of clinical factors such as Accessibility to medical records, Accessibility to patient information and healthcare provider's-patient relationship on HP's perceived usefulness and HP's perceived ease of use (Sandberg et al., 2009; Rho et al., 2014). This research study also established a significant impact of organisational factors (Management support and adequate training) on HP's perceived usefulness and HP's perceived ease of use. Morton (2008) and Kowitlawakul (2011) shown that organisational factors significantly positively impact perceived usefulness and ease of use of e-health technology. Following findings are consistent with the findings of Judi et al. (2009) and Shaqrah (2010), who suggested that top management support is crucial for successful implementation and diffusion of e-health technology in hospitals.

This study applied the TAM model to determine healthcare providers' behavioural intention to use e-health in the Indian context. Overall, the study provides empirical support for the hypotheses proposed in the research. The findings agree with the results of previous studies on applying TAM in e-health adoption (Maarop and Win, 2012; Chau and Hu, 2002). HPPU is found to be a significant predictor of BIEHT. Therefore, users are likely to use e-Health if the technology appears useful. The results support the hypothesis that HPPEOU has a significant influence on BIEHT. Again, the results align with previous research studies Kowitlawakul (2011) and Maarop and Win (2012).

5.1 Theoretical implications

Several theories in IS have addressed the issue of technology acceptance. However, most of these theories did not include individual, clinical and organisational as significant considerations. This study showed the importance of these three constructs in impacting the acceptance of EHT as a vital healthcare domain. Our results suggest that for EHT systems to be accepted and used, they need to facilitate according to the individual, clinical and organisational levels.

From a theoretical perspective, we expand the view on individual decision-making and technology acceptance and show the importance of an individual factor, including self-efficacy, personal innovativeness and compatibility. Previous research considered only one use of these factors rather than combined use. According to Kukafka et al. (2003), failure in information systems is due to the inability to think individually and organisationally. In investigating common user adoption models, Kukafka et al. (2003) determined that these models discourse factors at only one level when used independently. Kukafka et al. (2003) suggested that information systems fail due to a lack of individual and organisational thinking. Their investigation of user adoption models found that such models often only consider factors at one level. This study uses an integrated theoretical model that considers all elements proposed by Lorenzi and Riley (2000) to identify the interrelationships among influences at all three levels (individual, clinical and organisational). Another contribution of this research arises from our expanded view of organisational culture's moderating effect on healthcare providers' attitudes towards EHT and behavioural intentions to use EHT. Prior organisational culture research has found a moderating effect. However, the results indicate that this effect is strongly moderated. This expands our knowledge of the nature of organisational culture on technology usage.

Three primary theories support this research model. The Theory of Reasoned Action (TRA), the Theory of Planned Behaviour (TPB) and the Technology Acceptance Model (TAM). From the theoretical perspective combining these three theories with external variables like individual factors, clinical factors and organisational factors resulted in a proper and better model in the healthcare domain to assess the healthcare providers' adoption. These three models include several similarities and are integrated with prior research studies. For example, common factors include the characteristics of the individual, the innovation (or the technology) and the social context (Hu et al., 1999; Venkatesh et al., 2003). Therefore, researchers have recognised commonalities in these three theories and have developed combined models to study user acceptance of technological innovations.

Most theoretical models in IS research focus on individual beliefs as significant factors of intentions and use of new technology; however, little attention has been given to how beliefs are formed and what factors may affect these beliefs. We have shown a complete path of IT adoption by focusing on factors that may affect these beliefs. We empirically demonstrate in this study that these three factors (individual, clinical and organisation) are the factors that have both direct and indirect effects on the acceptance and use of e-health technologies. All dimensions of these three factors affected HP's perceptions of ease of use and HP's perceived usefulness of the technology in question. By incorporating these three factors within the technology acceptance model, we could explain a significant and sizable portion of the variance in perceived usefulness and ease of use, increasing the utility of the theory.

Prior research in IS with a focus on health care and research in the medical informatics field has tried to uncover potential causes of the slow progress of EH technology as it relates to user acceptance (LaPointe and Rivard, 2005; Sittig et al., 2005; Pare et al., 2006; Davidson and Chismar, 2007). In this study, the researchers reinforced in India the root cause of user reluctance to adopt complex IT in a healthcare environment due to the lack of these three factors (individual, clinical and organisational factors) to EHT.

In comparing well-known information technology acceptance models, Venkatesh and his colleagues identify common limitations of most prior research studies. First, most of these studies have been conducted with simple rather than complex information technologies. Second, the respondents in most previous research have been students rather than employees in organisations. Third, in most cases, the study was done after users had been introduced to the system and decided whether or not to adopt it (Venkatesh et al., 2003). The models have also been examined in situations where use is optional rather than mandatory in most previous investigations. Users may be needed to use clinical information systems in numerous locations so that this last issue could be problematic in the healthcare sector. The current study is innovative because it addresses factors related to a complex information system and data collected from users in a work-related context before implementation. These results might also be relevant in contexts where system use is mandated. Finally, while EHT usage in this research environment will be voluntary initially, reasonable participation from the physicians is expected. This study incorporates a multi-level approach to provide insight into factors affecting EHT adoption attitudes and intentions.

5.2 Managerial implications

The research study found that only the optimistic approach affected the HPPU of EHT. This approach suggests that hospitals recruit more self-efficacy, compatible and innovative healthcare providers as champions of EHT by leveraging the EHTAM instrument proposed in this study. This HP may then recommend EHT to their colleagues after they fully comprehend the benefits of EHT. Moreover, HPPEOU and HPPU affect HP's willingness to use EHT. Therefore, it is important to fully understand Healthcare Providers' (HPs) requirements during the development of EHT to ensure that it can meet their real needs. The user interface of EHT should also be user-friendly and compatible with HP's work practices, as this can significantly enhance their willingness to use it. The results of this study indicate that individual, clinical and organisational factors influence HP's acceptance of EHT. Therefore, the effects of EHTAM should not be overlooked, and hospitals should consider including healthcare providers' characteristics beyond socio-demographic profiles in their personnel databases.

The predictive power of ATTEHT towards usage indicates the need to develop positive attitudes among HP to ensure their acceptance and continued use of EH applications. The successful management of HP's attitude and usage intentions will also be highly dependent on the ability of public and private health organisations to clarify, demonstrate and communicate the relative benefits of using EHT systems (i.e., their usefulness) over traditional paper-based methods. Information and training sessions, and specialised forums such as conferences, should be used to communicate the instrumental benefits of health IT systems – i.e., to improve HP evaluations of the increased performance resulting from health information systems such as EHT. In the

implementation and adoption process of e-health, top management needs to consider the financial gains and other advantages. It enables better cost control and organising a successful business protocol (Al-Qirim, 2007). Likewise, managers need to support the system financially in healthcare organisations. Still, they must also recognise and modify their attitudes, which influences the organisational adoption of technology and affects their practices and services to the patients (Hu et al., 2002).

5.3 Conclusions

This research explored the Indian healthcare system and healthcare providers to adopt e-health technology. Three factors of e-health adoption were identified (individual, clinical and organisational factors) as those likely to affect the acceptance and adoption of E-Health Technology (EHT). The first factor relates to the individual level of healthcare providers' self-efficacy, personal innovativeness and compatibility to enhance healthcare providers' acceptance and adoption of e-health technology. The second factor is related to the clinical level. Here, the healthcare providers identified clinical factors such as Accessibility to medical records, access to patient information and HP's-patient relationships as necessary to enhance the process of adoption and acceptance of EHT. Finally, the third factor is related to organisational factors, which consist of top management support and adequate training that could facilitate or impede the adoption of e-health by healthcare providers.

Like many other developing countries, India faces a significant need for adequate and quality healthcare services. With a growing population and limited resources, the Indian healthcare system is under immense pressure to provide accessible and affordable healthcare to its citizens. To address this challenge, it is important to implement innovative solutions, such as e-health technologies, to enhance healthcare delivery and improve patient outcomes. E-health has significantly contributed to facilitating healthcare services in the industrial world. Nevertheless, adopting this technology in developing countries faces many challenges because of technological, economic, organisational and cultural issues. These include a lack of reliable and affordable infrastructure, high cost, resistance to change and government awareness.

Given that developing countries have health problems and those resources (financial and infrastructure) are limited, looking for simple and economically affordable e-health solutions will be essential for successful adoption and positive outcomes. Therefore, matching actual needs with low-cost e-health applications that do not demand sophisticated equipment becomes necessary. Simple and economically affordable e-health solutions are essential for successful adoption and positive outcomes in developing countries with limited resources. These solutions can include store and forward approaches for teleradiology, telepathology, tele-dermatology and patient information exchange via the internet. In addition, the E-Health Technology Adoption Model (EHTAM) established a valuable model for predicting the adoption of e-health technology with healthcare providers in Healthcare. Therefore, it suggests that the EHTAM has applicability across disciplines and settings in explaining, predicting and identifying an acceptance of e-health technology.

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