

CONCEPTUAL FRAMEWORK FOR TELEHEALTH ADOPTION IN INDIAN HEALTHCARE

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ABSTRACT

India is a developing country with a large landmass and a huge socio-culturally, economically and, ethnically diverse population. The healthcare system for such a diverse and complex country could entail challenges and difficulties in execution and outreach. Here, the emerging area of Telehealth could afford a place for itself in providing healthcare and health education to a large section of people residing in areas where there is acute shortage of healthcare professionals. Almost, seventy per cent of the population in India are rural. The infrastructure in India, similar to other developing countries, is erratic and differs throughout the country. Similarly, the ICT infrastructure is developed in the urban areas whereas there are insufficient ICT facilities in the rural areas. As telehealth depends on the utilisation of ICT infrastructure it is essential to conduct a study to find out the determinants of ICT adoption in the Indian telehealth environment. Moreover, as evident from relevant literature, telehealth is in a nascent stage in India, with most of the projects currently in a pilot study level. As such, it would be practical to conduct the study from an organisational point of view because the organisational adoption of ICT will eventually foster the implementation of telehealth in the domain of Indian healthcare. The study focuses on developing a conceptual framework of ICT adoption in the Indian telehealth environment, as limited research has been conducted in this area. The study highlighted the drivers and barriers of telehealth around the world, reviewed the relevant models of ICT adoption and generated themes to develop the conceptual framework. Empirical testing of the conceptual framework may have the potential to establish and confirm the determinants of ICT adoption in the Indian telehealth environment. The conceptual framework may be utilised for governmental and non-governmental policy level decision making.

KEYWORDS

Telehealth, Indian telehealth, ICT Adoption

INTRODUCTION

The foundation of telecommunication in healthcare domain at the global level began with the advent of telegraphy in the early twentieth century (Farnham, 2006). Telehealth in its modern form commenced its journey in the seventh decade of the mid-twentieth century when, two healthcare projects in the USA delivered healthcare services at a distance involving television communication between a psychiatric teaching centre and an isolated state hospital, and by linking patients at the Logan International Airport Medical Station to Massachusetts General Hospital utilising audio-visual mediums (Benschoter, Wittson, & Inngam, 1965; Murphy Jr. & Bird, 1974). Telehealth pools high fidelity electronics, information and communications technology (ICT), and other related technology and applications for delivering healthcare services and providing education to patients and healthcare professionals, at a distance (Wootton, 2009). Thus, telehealth is not a technology itself; neither is it a distinct branch of medicine, and not new in healthcare context (Craig & Patterson, 2005). The Arkansas Medical Board define a “proper physician-patient relationship” to include “a face-to-face examination using real time audio and visual telemedicine technology that provides information at least equal to such information as would have been obtained by an in-person examination”(Arkansas State Medical Board, 2016).

ICT (Information and Communication Technology) can act as a medium for delivering information and (Ganapathy, 2014). As such, it can be argued that utilising ICT for implementing telehealth can possibly permit the transferability of health services to distant territories, thereby enhancing accessibility, affordability and quality of healthcare services (R. K. Chandwani & Dwivedi, 2015). Currently several government and private telehealth programs are catering to some sections of Indian society such as Apollo Hospitals, in collaboration with ISRO (Indian Space research Organisation), All India Institute of Medical Sciences (AIIMS), Narayana Hrudayalaya etc. (Telemedicine Society of India, 2017).

Telehealth is anticipated to renovate healthcare through reforming and restructuring the policies and procedures prevailing in the healthcare organisations and systems. Current researches investigating the cost effectiveness of telehealth programmes are of the opinion that telehealth can lessen the cost of healthcare services, thereby effecting an affordable and, accessible healthcare services (Torre-Díez, López-Coronado, Vaca, Aguado, & Castro, 2015). Also, a large part of India has shortages in healthcare manpower (Bodavala, 2002). A contemporary Indian research

found that majority of the patients who were treated through the telehealth facility in the All India Institute of Medical Sciences, New Delhi (AIIMS) are of the opinion that telemedicine is time saving and cost-effective and particularly beneficial for rural patients (Meher & Kant, 2014). Nevertheless, inherent benefits of ICT have been unrealized globally (Lal, 2017).

Hence, telehealth has the potential to provide affordable healthcare services addressing the inaccessibility and, shortage of healthcare professionals in India. Further, it is noted that, though there is a substantial knowledge base of telehealth adoption factors globally, there are a limited number of studies regarding telehealth adoption factors in India and, most of them focusses on telemedicine adoption factors, neglecting the broad telehealth environment (R. Chandwani & De, 2015; R. K. Chandwani & Dwivedi, 2015; Dasgupta & Deb, 2008; Dattakumar, 2012; Dodel, 2015; Durrani & Khoja, 2009; Ganapathy, 2002, 2014; Ghia, Ved, & Jha, 2013; Iyer, 2014; Kumar & Ahmad, 2015; Pak et al., 2008; Pal, Pandey, Kesari, Choudhuri, & Mittal, 2002; Standing, Volpe, Standing, & Gururajan, 2011). The objective of this study is to develop a conceptual framework for telehealth adoption in India and identify future research directions to enrich the viability of telehealth in India.

ICT infrastructure in telehealth

Infrastructure is the foundation or framework that supports a system or organization. In computing, information and communications technology infrastructure (ICT infrastructure) is composed of physical and virtual resources that support the flow, storage, processing and analysis of data (Gichoya, 2005). Infrastructure may be centralized within a data centre, or it may be decentralized and spread across several data centres that are either controlled by the organization or by a third party, such as a colocation facility or cloud provider (Hanafizadeh, Saghaei, & Hanafizadeh, 2009).

ICT Infrastructure encompasses all the devices, networks, protocols and procedures that are employed in the telecommunications or information technology fields to foster interaction amongst different stakeholders including computer hardware (servers and related workstations), network connectivity with accessories, and all necessary equipment (Dodgson, Gann, & Salter, 2006).

Blount and Gloet (2015) have itemised the ICT Infrastructure, which enables a Telehealth service to deliver efficiently. The technology and equipment in use are internet access, high speed broadband, landline phone, desktop computer, docking station, laptop, tablet, double monitor screen, telephone headset, smartphone, examining camera, digital stethoscope, printer, portable printer, fax machine, phone headset, modem, computer camera, Bluetooth, specialised software, blood glucose machines, scales, pulse oximeters, sensors and alarms. Furthermore, the researchers also noted the significance of communication through the support of ICT infrastructure amongst client, telehealth workers, management and, organisation. A robust round the clock ICT infrastructure support plays an essential part to the delivery of telehealth service by the workers.

ICT Infrastructure in India

The Indian ICT infrastructure has grown substantially over the years with current tele density of eighty-nine per cent sustained by a tower network of more than half a million towers along with fibre network of more than one million kilometres (Confederation of Indian Industry, 2017). Notwithstanding these progresses, there is still scope of improvement in broadband speed and increasing rural connectivity which is still low (Confederation of Indian Industry & KPMG, 2017).

Overview of Telehealth, telemedicine, telecare, ehealth and mhealth

Various authors have defined Telehealth as data transmission, through voice, image and video, which might comprise mobile and web technologies to prevent, promote and deliver curative healthcare at a distance (Dyk, 2014). The author also distinguished between telehealth and telemedicine as to the latter providing only curative service. As such telemedicine is a part of telehealth. In this respect, it can be argued that Telecare is also part of telehealth though not a part of telemedicine because of its sole intention to deliver preventive care (Wade, Gray, & Carati, 2017). It was also noted that ehealth (not limited to delivering healthcare at a distance) is used interchangeably with telehealth. Further, mhealth (using mobile technology) cuts across categories of telehealth, telemedicine, telecare and ehealth (Dyk, 2014). Carati and Margelis (2013) while framing the national strategy for telehealth has defined telehealth as healthcare and related processes or medical education enabled using ICT over a distance to minimise the shortfall, gap or lack of skill in healthcare resources.

Telehealth in India

Telehealth infrastructure is already existing in India (R. K. Chandwani & Dwivedi, 2015; Meher & Kant, 2014). In India, online consultations regarding medical advice, nutrition, pre-surgical consultation and, patient education are the potential and emerging areas of telehealth with pan country outreach apart from the primary care

telemedicine centres focussed on rural areas (Al-Mahdi, Gray, & Lederman, 2015; Brindha, 2013; Gupta, 2013; Prasad et al., 2010; Sivagurunathan, Umadevi, Rama, & Gopalakrishnan, 2015). There are Govt. and private initiatives to cater to the section of people who lives in remote areas or lives in such areas which has a deficiency in developing a proper healthcare system. The telehealth scenario though promising has not yet achieved growth and development in infrastructure to cater to large number of people or areas (Marcelo et al., 2015). P. J.-H. Hu, Chau, and Liu Sheng (2002) observed that telehealth technology is an important and exciting technological innovation that has potential for bringing about a paradigmatic shift in healthcare service delivery and collaboration. Furthermore, Mathur, Srivastava, Lalchandani, and Mehta (2017) concluded in their research that telehealth could be utilised at its farthest in the domain of public healthcare. The authors also observed that the role of telehealth could be extended to promotion of health including improvement of knowledge, beliefs and attitudes of the medical consumers.

METHODOLOGY

The study involved a searching of the relevant literature in the area of telehealth technology adoption around the globe and India. EBSCO, Google Scholar, Proquest, Science Direct and Scopus databases were explored in the search. The procedure involved formulating search keywords (Kitchenham, 2004) which were (telehealth OR "mobile health" OR m-health OR telemedicine OR telecare OR e-health) AND ("ICT infrastructure" OR "information systems" OR ICT) AND (India OR Subcontinent OR "South Asia"). Other search keywords excluding the keywords India, Subcontinent and South Asia were formulated to yield results from around the world such as (telehealth OR "mobile health" OR m-health OR telemedicine OR telecare OR e-health OR healthcare) AND ("ICT infrastructure" OR "information systems" OR ICT). The results were further refined to obtain only peer reviewed literature and a timeframe of seventeen years from 2000 to 2019 were imposed (Petticrew & Roberts, 2006). The timeframe was taken in consideration of the fact that early to mid-2000 were the prime period in which research on ICT Adoption in Telehealth environment has been conducted globally. Another exclusion was literature not written in English. A review of the obtained literature has been performed to assess the different approaches to ICT Adoption in the healthcare domain. The Technology Adoption models used in the studies were also noted. A synthesis of the literature has been performed whereby the determinants or the drivers and barriers of telehealth had been extracted. Afterwards, a conceptual framework was developed utilising the selected determinants and technology adoption models.

DRIVERS AND BARRIERS OF TELEHEALTH

The literature was synthesised to extract the determinants that had an impact on telehealth adoption. The initial determinants include awareness, cost factors, advantages and disadvantages, medical errors, information sharing, current state of technology, usefulness and role of wireless technology, and technology awareness. On the basis of the literature review, the determinants were classified into drivers and barriers in general as shown in Table 1.

Table 1: The drivers and barriers of telehealth in general

	Telehealth Drivers in General	Telehealth Barriers in General
Investment	Organisational culture	Local Capacity
Service Availability	Health culture	Technical capacity
Usefulness	Benefits	e-readiness
Ease of use	Current competence	Lack of ICT equipment
Attitude	Alert Clinicians	Lack of ICT infrastructure
Subjective norm	Adverse event	Cost of Access
Behavioural Control	Advantages	Regulatory Environment
Behavioural Intentions	Remote monitoring	Local Environment
Policies	Group dynamics	Illiteracy
Actions	Managerial factors	Localisation
Appropriate usage	Collective Attitude	Access to mobile telephony
Cost of personal computer	Service needs	Access to internet
Improved usage	Safe Technology	Unreliable
Technological Innovations	Socio-political context	Short staff
Organisational Behaviour	Organisational innovation	Health policy
Networking aspects	Facilities for innovation	Coverage
Target	Organizational readiness	Confidentiality
Purpose	Adoption by patients	Lack of Awareness
Efficiency	Technical knowhow	Lack of fit
Logic of Choice	Computing knowledge	Lack of evaluation methods
Logic of care	Social Influence	Poor project management
Access	Unhealthy lifestyles	Organisational uncertainty
Usage	Health education	Complexity of Healthcare systems
Appropriation	Time saving	Ethics
Societal factors	Comfort using video link	Practice
Ageing population	Personal experience	Hacking of health data
Willingness to share knowledge	Standardisation	Unintentional consequences
Environment / climate change	ICT utilisation	Scientific requirement
Shortage of healthcare professionals	Documentation	Legal requirement
Consumerism driving demand	Knowledge	Additional workload
Disparity	Understanding of value	Health insurance
Economy	Performance	Funding
Diversity in religion	Effort	Need for specialists
Diversity in language	Voluntariness	Lack of organization support
Changes in generational needs	Adoption by healthcare staff	Conveying the doctors message
Acceptance for diagnostic purposes	Information sharing	Lack of information about costs
Technical knowhow		Extra Burden for doctors
Top management support		Less comfort factor
Compatibility		No priority of health
Information Security		Responsibility
Self-efficacy		Ignorance of decision factors
Facilitating conditions		End-user training
Govt. Policy		Technical training
External Supplier's capacity		Quality of video
Project team's capacity		System reliability
Size of hospital		Inconvenience of using equipment

Process orientation	Lack of knowledge
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Further, a list has been prepared with focus on Indian telehealth, as shown in Table 2. This list of drivers and barriers are expected to provide a direction for the development of the conceptual framework for telehealth adoption in India.

Table 2: The drivers and barriers of telehealth in India

Telehealth Drivers in India	Telehealth Barriers in India
Accessibility	Laggards
Improved ICT Infrastructure	Government Policies
Shortage of healthcare professionals	Organisation Readiness
Vast rural and remote areas	Lack of trained health workers
Willingness to share knowledge	Broadband speed in rural areas
Educating patients	Revenue model
Usefulness	Technology safety
Collective attitude	Lack of awareness
Service needs	Lack of organization support
Demographics	Service Quality
Disease Profile	Non tech savvy healthcare professionals
Competitive advantage	Broadband speed

DISCUSSION

The literature review has recognised the drivers and barriers of ICT adoption in the healthcare domain as well as in the telehealth environment around the world. The literature review suggests that there is a considerable gap regarding the absence of a theoretical framework regarding study of ICT Adoption in healthcare organisations (R. Chandwani & De, 2015; R. K. Chandwani & Dwivedi, 2015; Dodel, 2015; Ganapathy, 2002; Standing et al., 2011). Elder and Clarke (2007) stressed about the need for conducting research in ICT adoption in healthcare according to the local environment. Carati and Margelis (2013) suggested the identification of barriers and enablers of telehealth implementation in different environments. R. K. Chandwani and Dwivedi (2015) suggested further research in ICT adoption in Institutional and other perspectives. Further, Dodel (2015) suggested the need to construct cost-effective and quality research instruments and to test the ICT assets of access, usage, and appropriation as independent variables in research of ICT adoption of healthcare. Most of the studies were also inadequate in population or response (Gschwendtner, Netzer, Mairinger, & Mairinger, 1997; Mairinger, Gable, Derwan, Mikuz, & Ferrer-Roca, 1996). The framework might be different in developing countries as different cultures and geographic barriers could alter behaviour as pointed out by De Rosis and Seghieri (2015). Further, limited research on Indian telehealth technology adoption (R. K. Chandwani & Dwivedi, 2015; Dasgupta & Deb, 2008; Ghia et al., 2013; Iyer, 2014; Kumar & Ahmad, 2015; Marcelo et al., 2015; Mathur et al., 2017; Pal et al., 2002) and, a lack of theoretical framework (Acharya & Rai, 2017; R. Chandwani & De, 2015; Ganapathy, 2002), to guide telehealth adoption in India, compels the need to define the determinants of ICT adoption in Indian Telehealth environment.

As pointed out by the literature review, there is a lack of theoretical framework to guide the research on ICT adoption in telehealth environment (Acharya & Rai, 2017; R. Chandwani & De, 2015; R. K. Chandwani & Dwivedi, 2015; Dodel, 2015; Ganapathy, 2002; Standing et al., 2011). A conceptual framework may provide deeper understanding of the resultant determinants in future research on Indian telehealth adoption. Matching the resultant data to the conceptual framework can yield a new theoretical framework for use in the domain further. In future research, new determinants that are unknown prior to the research can come out. Therefore, apart from identifying the drivers and barriers it is necessary to have a working conceptual framework to make future research effective and easily understandable through a theoretical perspective. A theory could not only provide potential constructs in relation to ICT adoption but can also provide a pathway to establish relationship between the constructs (Denzin, 1973; Shoemaker, Tankard Jr, & Lasorsa, 2003).

The most prominent and influential theories in the ICT adoption field are Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975, 1976), Theory of Planned Behaviour (TPB) (Ajzen, 1991), Technology Acceptance Model (TAM) (Davis, 1989), Diffusion of Innovations (DOI) (Rogers, 1995), Activity Theory (Kuutti, 1996; Nardi, 1996), Task-Fit-Technology (TFT) Model (Goodhue & Thompson, 1995), Technology-Organisation-Environment Model (TOE) (Depietro, Wiarda, & Fleischer, 1990), Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003; Venkatesh, Thong, & Xu, 2012, 2016). Other notable theories include Normalisation Process Theory (C. May & Finch, 2009; C. R. May et al., 2009), Systems and Complexity Theories (Benbya & McKelvey, 2006), Selwyn's Digital Divide Theoretical Model (Dodel, 2015) and, Socio-Technical theories (Geels, 2004; Trist, 1981). Among these theories TAM, TPB, TRA, DOI, and, UTAUT has been used primary in individual level studies (Chang et al., 2015; Cimperman, Brenčić, & Trkman, 2016; Holden & Karsh, 2010; P. J. Hu, Chau, Sheng, & Tam, 1999; Lee, Helal, & Johnson, 2010; Sugarhood, Wherton, Procter, Hinder, & Greenhalgh, 2014). Ammenwerth, Iller, and Mahler (2006) noted the lacunae of the TFT model in its inability to include interaction between the user and the task. Davidson and Chismar (2007) noted that the activity theory is concerned with the interaction of individual level and social levels of ICT adoption. The

Selwyn's Digital Divide Model is mostly user centric and focusses on the independent variables of access, usage, appropriation, and outcome along with a dependent variable of wellbeing (Dodel, 2015). The Normalisation Process Theory is useful to study the adoption process of technologies which are difficult to embed into everyday use (Pope et al., 2013). Systems Complexity Theory has been used in studies relating to knowledge management systems and organisational learning (McElroy, 2000). Socio-Technical Theories are tested in organisational technology adoption process but much more suits a case study or, action research design of research (Dillon & Morris, 1996). Technology-Organisation-Environment Model (TOE) (Depietro et al., 1990) has been tested in organisational settings in various domains of ICT adoptions including healthcare. TOE is a comprehensive framework (P. J.-H. Hu et al., 2002) and yields a consistent conclusion or results, regarding ICT adoption in the healthcare and other domains. This is supported by the researches of (Ahmadi, Nilashi, & Ibrahim, 2015; Alaboudi et al., 2016; Brancheau & Wetherbe, 1990; Bretschneider, 1990; Cooper & Zmud, 1990; Fichman, 1992; Ghani & Jaber, 2015; Kimberly & Evanisko, 1981; Lian, Yen, & Wang, 2014; Zmud, 1982). The different knowledge and technological barriers found through literature review (Adamson, 2016; Faber, Van Geenhuizen, & de Reuver, 2017; Paul, Pearlson, & McDaniel, 1999; Tanriverdi & Iacono, 1998; Zailani, Gilani, Nikbin, & Iranmanesh, 2014) are well represented through the TOE framework. Since the study aims to identify the different drivers and barriers of telehealth technology adoption in an organisational setting, the TOE framework adapted from Depietro et al. (1990); P. J.-H. Hu et al. (2002) can lend a hand to modify and create a new theoretical framework for telehealth technology adoption in the Indian healthcare domain. The different constructs of the TOE framework are ease of use, technology safety, service benefits, service risks, collective attitude of healthcare staff, organisational policies and management, and service needs (P. J.-H. Hu et al., 2002).

A host of other determinants has been derived from the literature review as listed in Table 1 and Table 2. Considering the determinants specific themes have been formed to create a conceptual framework to study the adoption in Indian telehealth environment. The conceptual framework is represented in Figure 1 below.

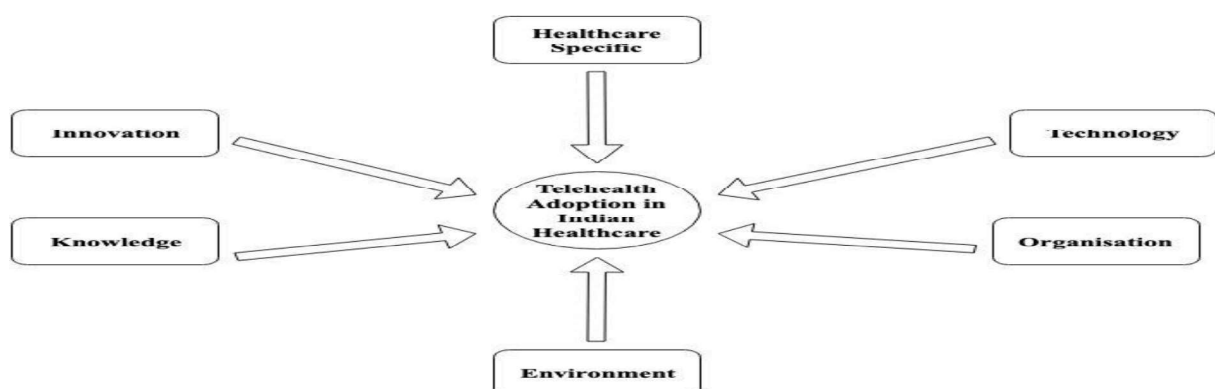


Figure 1: Conceptual framework for telehealth adoption in Indian healthcare

The themes formulated for the conceptual framework to study Indian telehealth adoption are Technology, Organisation, Environment, Knowledge, Innovation and, Healthcare Specific.

Technology

The ease of use construct has been criticised by Chau and Hu (2002); Chismar and Wiley-Patton (2003); Keil, Beranek, and Konsynski (1995). The researchers were of the view that the physicians rely on the usefulness of ICT instead of relying on the ease of using it. The physicians' emphasis is more on the utility, functionality and effective patient outcomes. The results obtained by Lin, Lin, and Roan (2012) show that usefulness has a greater impact than ease of use.

Technology safety can be a hindrance in influencing an organisations ICT adoption. Physicians are concerned with the safety of the equipment and technology used in their patient's care (P. J.-H. Hu et al., 2002). A technology which can affect patient's care outcome can be considered as risky.

In India, although the urban ICT infrastructure has improved significantly, there is still scope of improvement in broadband speed and increasing rural connectivity which is still low (Confederation of Indian Industry & KPMG, 2017).

Organisation

Collective attitude of healthcare staff was found to be the most significant factor influencing ICT adoption in telehealth environment (P. J.-H. Hu et al., 2002). The same research concludes that organisation policies and management was non-significant. The collective attitude of the healthcare staff towards telehealth can regulate an organisation's readiness for adopting ICT. The collective attitude may include willingness to share knowledge as well as willingness to learn from training.

A healthcare organisation's main purpose is to provide service to the people who need medical services because of service access or quality. In India there prevails a tremendous health inequality as observed by Balarajan, Selvaraj, and Subramanian (2011). Exploring alternative arrangements for service delivery is one of the priority for a healthcare organisation.

Environment

The vast rural and remote areas of India are plagued by accessibility to healthcare and shortage of healthcare professionals (Rathi, 2017). A standardised government policy and framework regarding telehealth can foster telehealth adoption in India catering to a larger section of the society (Singh, 2005). Further, the demographics and disease profile in urban and rural areas can be a significant driver for adoption of telehealth (West & Milio, 2004).

Knowledge

Easy access to information for healthcare professionals, patients and healthcare workers is the need of the day for adoption of telehealth in India (Dwivedi, Bali, James, & Naguib, 2001). Further, the training needs of the healthcare workers and for non tech savvy healthcare professionals are also significant barriers to adoption of telehealth in India (R. K. Chandwani & Dwivedi, 2015; Dwivedi et al., 2001). Interestingly, majority of the healthcare professionals are willing to share their knowledge and participate in the telehealth adoption process (Ghia et al., 2013).

Innovation

The majority of the efforts in the telehealth environment in India are late adopters (Kumar & Ahmad, 2015). The competitive advantage of telehealth, as to, face-to-face consultations, need to be studied in details (Cho, Mathiassen, & Gallivan, 2009). The scope of innovation in providing telehealth services in various forms such as telemedicine for primary care, online consultations by physicians, dietitians etc. and the adoption rates varies according to the domain (Cho, Mathiassen, & Robey, 2007).

Healthcare Specific

In India there have been efforts to provide telemedicine services in the rural areas focussing on primary healthcare (Kumar & Ahmad, 2015). Various healthcare professionals including physicians, surgeons, dietitians, dentists, physiotherapists have started to provide online consultations in the urban areas, at least in the initial level of consultation. The online consultations has a broad outreach at a pan-India level (Brindha, 2013; Sivagurunathan et al., 2015). As such, future study of telehealth adoption in specific healthcare domains may extend the viability of such efforts.

CONCLUSION

The conceptual framework for telehealth adoption in Indian healthcare has been developed after reviewing a wide range of ICT adoption literature from global and Indian healthcare domains. The identified themes of technology, organisation, environment, knowledge, innovation and, healthcare specific, may provide a platform for future adoption studies in Indian telehealth environment, as well as, in ICT adoption studies in other healthcare domains. The conceptual framework could be used in framing policies and procedures at governmental and non-governmental organisations. This study, being limited to literature review, broadens the scope for future empirical research on telehealth adoption in India and in other developing countries.

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REFERENCES

Acharya, R. V., & Rai, J. J. (2017). Evaluation of patient and doctor perception toward the use of telemedicine in Apollo Tele Health Services, India. *Journal of Family Medicine and Primary Care*, 5, 798-803.

- Adamson, G. (2016). The persistent challenge of health informatics. *Information, Communication & Society*, 19(4), 551-558.
- Ahmadi, H., Nilashi, M., & Ibrahim, O. (2015). Prioritizing critical factors to successful adoption of total hospital information system. *Journal of Soft Computing and Decision Support Systems*, 2(4), 6-16.
- Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, 50(2), 179-211.
- Al-Mahdi, I., Gray, K., & Lederman, R. (2015). *Online Medical Consultation: A review of literature and practice*. Paper presented at the Proceedings of the 8th Australasian Workshop on Health Informatics and Knowledge Management.
- Alaboudi, A., Atkins, A., Sharp, B., Balkhair, A., Alzahrani, M., & Sunbul, T. (2016). Barriers and challenges in adopting Saudi telemedicine network: The perceptions of decision makers of healthcare facilities in Saudi Arabia. *Journal of infection and public health*, 9(6), 725-733.
- Ammenwerth, E., Iller, C., & Mahler, C. (2006). IT-adoption and the interaction of task, technology and individuals: a fit framework and a case study. *BMC Medical Informatics and Decision Making*, 6(1), 3.
- An amendment to Regulation 2.8 governing physician/patient relationships, § 8A1B (2016).
- Balarajan, Y., Selvaraj, S., & Subramanian, S. V. (2011). Health care and equity in India. *Lancet*, 377(9764), 505-515.
- Benbya, H., & McKelvey, B. (2006). Toward a complexity theory of information systems development. *Information Technology & People*, 19(1), 12-34.
- Benschoter, R. A., Wittson, C. L., & Ingham, C. G. (1965). Teaching and consultation by television: I. Closed-circuit collaboration. *Mental Hospitals*, 16(3), 99-100.
- Blount, Y., & Gloet, M. (2015). *Adoption of ICT Enabled Telehealth Services in the Australian Context: Implications of Technology Use for Telehealth Workers*. Paper presented at the 48th Hawaii International Conference on System Sciences, Hawaii.
- Bodavala, R. (2002). ICT applications in public healthcare system in India: A review. *ASCI JOURNAL OF MANAGEMENT*, 31(1 & 2).
- Brancheau, J. C., & Wetherbe, J. C. (1990). The adoption of spreadsheet software: testing innovation diffusion theory in the context of end-user computing. *Information systems research*, 1(2), 115-143.
- Bretschneider, S. (1990). Management information systems in public and private organizations: An empirical test. *Public Administration Review*, 536-545.
- Brindha, G. (2013). Emerging trends of telemedicine in India. *Indian Journal of Science and Technology*, 6(sup 5).
- Carati, C., & Margelis, G. (2013). *Towards a National Strategy for Telehealth in Australia 2013-2018*. Paper presented at the Global Telehealth 2012, Sydney. aths.org.au
- Chandwani, R., & De, R. (2015). The institutional dynamics perspective of ICT for health initiatives in India. In A. Chib, J. May, & R. Barrantes (Eds.), *Impact of Information Society Research in the Global South* (pp. 167-185): Springer Open.
- Chandwani, R. K., & Dwivedi, Y. K. (2015). Telemedicine in India: current state, challenges and opportunities. *Transforming Government: People, Process and Policy*, 9(4), 393-400.
- Chang, Y.-Z., Ko, C.-Y., Hsiao, C.-J., Chen, R.-J., Yu, C.-W., Cheng, Y.-W., . . . Chao, C.-M. (2015). Understanding the Determinants of Implementing Telehealth Systems: A Combined model of the theory of Planned Behaviour and the Technology Acceptance Model. *Journal of Applied Sciences*, 15(2), 277-282.
- Chau, P. Y. K., & Hu, P. J.-H. (2002). Investigating healthcare professionals' decisions to accept telemedicine technology: an empirical test of competing theories. *Information & Management*, 39(4), 297-311.
- Chismar, W. G., & Wiley-Patton, S. (2003). *Does the extended technology acceptance model apply to physicians*. Paper presented at the Proceedings of the 36th Annual Hawaii International Conference on System Sciences, 2003.
- Cho, S., Mathiassen, L., & Gallivan, M. (2009). Crossing the diffusion chasm: from invention to penetration of a telehealth innovation. *Information Technology & People*, 22(4), 351-366.
- Cho, S., Mathiassen, L., & Robey, D. (2007). Dialectics of Resilience: A Multi-Level Analysis of a Telehealth Innovation. *Journal of Information Technology*, 22(1), 24-35.
- Cimperman, M., Brenčić, M. M., & Trkman, P. (2016). Analyzing older users' home telehealth services acceptance behavior—applying an Extended UTAUT model. *International Journal of Medical Informatics*, 90, 22-31.
- Confederation of Indian Industry. (2017). *Evolution of ICT Infrastructure Industry in India*. viewed 28 March 2019 Retrieved from cii.in

- Confederation of Indian Industry, & KPMG. (2017). *Building ICT Infrastructure - Connecting the unconnected*. viewed 28 March 2019 Retrieved from cii.in
- Cooper, R. B., & Zmud, R. W. (1990). Information technology implementation research: a technological diffusion approach. *Management science*, 36(2), 123-139.
- Craig, J., & Patterson, V. (2005). Introduction to the practice of telemedicine. *Journal of Telemedicine and Telecare*, 11(1), 3-9.
- Dasgupta, A., & Deb, S. (2008). Telemedicine: A new horizon in public health in india. *Indian Journal of Community Medicine*, 33, 3-8.
- Dattakumar, A. (2012). *Adoption of Telemedicine in India: Perceptions of Decision Makers and Clinicians*. (Doctor of Philosophy Standard), Monash University, Melbourne.
- Davidson, E. J., & Chismar, W. G. (2007). The interaction of institutionally triggered and technology-triggered social structure change: An investigation of computerized physician order entry. *MIS Quarterly*, 739-758.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 319-340.
- De Rosis, S., & Seghieri, C. (2015). Basic ICT adoption and use by general practitioners: an analysis of primary care systems in 31 European countries. *BMC Medical Informatics and Decision Making*, 15(70).
- Denzin, N. K. (1973). *The research act: A theoretical introduction to sociological methods*: Transaction publishers.
- Depietro, R., Wiarda, E., & Fleischer, M. (1990). The Context for Change: Organization, Technology and Environment. In L. G. Tornatzky & M. Fleischer (Eds.), *The processes of technological innovation* (pp. 151-175). Lexington, MA: Lexington Books.
- Dillon, A., & Morris, M. G. (1996). User acceptance of new information technology: theories and models *Annual review of information science and technology*: Medford, NJ: Information Today.
- Dodel, M. (2015). An Analytical Framework to Incorporate ICT as an Independent Variable In A. Chib, J. May, & R. Barrantes (Eds.), *Impact of Information Society Research in the Global South* (pp. 125-144): Springer Open.
- Dodgson, M., Gann, D., & Salter, A. (2006). The role of technology in the shift towards open innovation: the case of Procter & Gamble. *R&D Management*, 36(3), 333-346.
- Durrani, H., & Khoja, S. (2009). A systematic review of the use of telehealth in Asian countries. *Journal of Telemedicine and Telecare*, 15(4), 175-181.
- Dwivedi, A., Bali, R. K., James, A. E., & Naguib, R. N. G. (2001, 25-28 Oct. 2001). *Telehealth systems: considering knowledge management and ICT issues*. Paper presented at the 2001 Conference Proceedings of the 23rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society.
- Dyk, L. v. (2014). A review of Telehealth Service Implementation Frameworks. *International Journal of Environmental Research and Public Health*, 11, 1279-1298.
- Elder, L., & Clarke, M. (2007). Past, present and future: experiences and lessons from telehealth projects. *Open Med*, 1(3), 166-170.
- 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.
- Farnham, J. W. (2006). Disaster and emergency communications prior to computers / Internet: A review. *Critical Care*, 10, 207.
- Fichman, R. G. (1992). *Information technology diffusion: a review of empirical research*. Paper presented at the ICIS.
- Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behavior: An introduction to theory and research*.
- Fishbein, M., & Ajzen, I. (1976). Misconceptions about the Fishbein model: Reflections on a study by Songer-Nocks. *Journal of Experimental Social Psychology*, 12(6), 579-584.
- Ganapathy, K. (2002). Telemedicine and Neurosciences in Developing Countries. *Surg Neurol*, 58, 388-394.
- Ganapathy, K. (2014). Telehealth in India: The Apollo contribution and an overview. *Apollo Medicine*, 11(3), 201-207.
- Geels, F. W. (2004). From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. *Research policy*, 33(6-7), 897-920.
- Ghani, M. K. A., & Jaber, M. M. (2015). Willingness to adopt telemedicine in major Iraqi hospitals: a pilot study. *International journal of telemedicine and applications*, 2015, 6.
- Ghia, C. J., Ved, J. K., & Jha, R. K. (2013). Benefits of Telemedicine and Barriers to its Effective Implementation in Rural India: A Multicentric E-Survey.

- Gichoya, D. (2005). Factors affecting the successful implementation of ICT projects in government. *the Electronic Journal of e-government*, 3(4), 175-184.
- Goodhue, D. L., & Thompson, R. L. (1995). Task-technology fit and individual performance. *MIS Quarterly*, 213-236.
- Gschwendtner, A., Netzer, T., Mairinger, B., & Mairinger, T. (1997). What do students think about telemedicine? *Journal of Telemedicine and Telecare*, 3(3), 169-171.
- Gupta, S. G. (2013). Tips for telephone and electronic medical consultation. *The Indian Journal of Pediatrics*, 80(11), 944-948.
- Hanafizadeh, M. R., Saghaei, A., & Hanafizadeh, P. (2009). An index for cross-country analysis of ICT infrastructure and access. *Telecommunications Policy*, 33(7), 385-405.
- Holden, R. J., & Karsh, B.-T. (2010). The Technology Acceptance Model: Its past and its future in health care. *Journal of Biomedical Informatics*, 43(1), 159-172.
- Hu, P. J.-H., Chau, P. Y. K., & Liu Sheng, O. R. (2002). Adoption of telemedicine technology by health care organizations: An exploratory study. *Journal of Organizational Computing and Electronic Commerce*, 12(3), 197-221.
- Hu, P. J., Chau, P. Y. K., Sheng, O. R. L., & Tam, K. Y. (1999). Examining the technology acceptance model using physician acceptance of telemedicine technology. *Journal of Management Information Systems*, 16(2), 91-112.
- Iyer, M. (2014). Telemedicine Adoption in India: The new Drivers. *Health and Medicine*.
- Keil, M., Beranek, P. M., & Konsynski, B. R. (1995). Usefulness and ease of use: field study evidence regarding task considerations. *Decision Support Systems*, 13(1), 75-91.
- Kimberly, J. R., & Evanisko, M. J. (1981). Organizational innovation: The influence of individual, organizational, and contextual factors on hospital adoption of technological and administrative innovations. *Academy of management journal*, 24(4), 689-713.
- Kitchenham, B. (2004). *Procedures for performing systematic reviews* (Keele University Technical Report TR/SE-0401). viewed 28 March 2019
- Kumar, A., & Ahmad, S. (2015). A Review study on utilization of Telemedicine and e-Health services in Public Health. *Asian Pacific Journal of Health Sciences*, 2(1), 60-68.
- Kuutti, K. (1996). Activity theory as a potential framework for human-computer interaction research. *Context and consciousness: Activity theory and human-computer interaction*, 1744.
- Lal, K. (2017). Investigating ICT infrastructure to develop an information society in India. *Universal Access in the Information Society (UAIS)*, 16, 517-528.
- Lee, D., Helal, S., & Johnson, B. D. (2010). *An action-based behavior model for persuasive telehealth*. Paper presented at the International Conference on Smart Homes and Health Telematics.
- Lian, J.-W., Yen, D. C., & Wang, Y.-T. (2014). An exploratory study to understand the critical factors affecting the decision to adopt cloud computing in Taiwan hospital. *International Journal of Information Management*, 34(1), 28-36.
- Lin, C., Lin, I. C., & Roan, J. (2012). Barriers to Physicians' Adoption of Healthcare Information Technology: An Empirical Study on Multiple Hospitals. *Journal of Medical Systems*, 36(3), 1965-1977.
- Mairinger, T., Gable, C., Derwan, P., Mikuz, G., & Ferrer-Roca, O. (1996). What do physicians think of telemedicine? A survey in different European regions. *Journal of Telemedicine and Telecare*, 2(1), 50-56.
- Marcelo, A., Ganesh, J., Mohan, J., Kadam, D., Ratta, B., Kulatunga, G., . . . Marcelo, P. (2015). Governance and Management of National Telehealth Programs in Asia. *Global Telehealth 2015: Integrating Technology and Information for Better Healthcare*, 209, 95.
- Mathur, P., Srivastava, S., Lalchandani, A., & Mehta, J. L. (2017). Evolving Role of Telemedicine in Health Care Delivery in India. *Primary Healthcare*, 7, 260.
- May, C., & Finch, T. (2009). Implementing, embedding, and integrating practices: an outline of normalization process theory. *Sociology*, 43(3), 535-554.
- May, C. R., Mair, F., Finch, T., MacFarlane, A., Dowrick, C., Treweek, S., . . . Rogers, A. (2009). Development of a theory of implementation and integration: Normalization Process Theory. *Implementation Science*, 4(1), 29.
- McElroy, M. W. (2000). Integrating complexity theory, knowledge management and organizational learning. *Journal of knowledge management*, 4(3), 195-203.
- Meher, S. K., & Kant, S. (2014). Awareness and attitudes of geriatric patients towards telemedicine in India. *Gerontechnology*, 13(2), 262.

- Murphy Jr., R. L. H., & Bird, K. T. (1974). Telediagnosis: A New Community Health Resource Observations on the Feasibility of Telediagnosis Based on 1000 Patient Transactions. *American Journal of Public Health*, 64(2), 113-119.
- Nardi, B. A. (1996). *Context and consciousness: activity theory and human-computer interaction*: mit Press.
- Pak, H. S., Brown-Connolly, N. E., Bloch, C., Clarke, M., Clyburn, C., Doarn, C. R., . . . Rasche, J. (2008). Global forum on telemedicine: Connecting the world through partnerships. *TELEMEDICINE and e-HEALTH*, 14(4), 389-395.
- Pal, S. K., Pandey, G. S., Kesari, A., Choudhuri, G., & Mittal, B. (2002). Telemedicine: E-Health and Hospital of the Future. *Journal of Scientific & Industrial Research*, 61, 414-422.
- Paul, D. L., Pearlson, K. E., & McDaniel, R. R. (1999). Assessing technological barriers to telemedicine: Technology-management implications. *IEEE Transactions on Engineering Management*, 46(3), 279-288.
- Petticrew, M., & Roberts, H. (2006). *Systematic Reviews in the Social Sciences A PRACTICAL GUIDE*: Blackwell Publishing.
- Pope, C., Halford, S., Turnbull, J., Prichard, J., Calestani, M., & May, C. (2013). Using computer decision support systems in NHS emergency and urgent care: ethnographic study using normalisation process theory. *BMC Health Services Research*, 13(1), 111.
- Prasad, D. D., Ray, S., Majumdar, A. K., Mukherjee, J., Majumdar, B., Paul, S., & Verma, A. (2010). Real time medical image consultation system through Internet. *Journal of Healthcare Engineering*, 1(1), 141-154.
- Rathi, A. (2017). Inequalities in financing of healthcare in India. *Trends in Immunotherapy*, 1(1), 50-51.
- Rogers, E. M. (1995). *Diffusion of Innovations*. New York: Free Press.
- Shoemaker, P. J., Tankard Jr, J. W., & Lasorsa, D. L. (2003). *How to build social science theories*: Sage publications.
- Singh, K. (2005). Biotelemetry: could technological developments assist healthcare in rural India. *Rural and Remote Health*, 5(2), 234.
- Sivagurunathan, C., Umadevi, R., Rama, R., & Gopalakrishnan, S. (2015). Adolescent health: present status and its related programmes in India. Are we in the right direction? *Journal of clinical and diagnostic research: JCDR*, 9(3), LE01.
- Standing, C., Volpe, I., Standing, S., & Gururajan, R. (2011). *Making the Most of Virtual Expertise in Telemedicine and Telehealth Environments*. Paper presented at the IEEE Ninth International Conference on Dependable, Autonomic and Secure Computing.
- Sugarhood, P., Wherton, J., Procter, R., Hinder, S., & Greenhalgh, T. (2014). Technology as system innovation: a key informant interview study of the application of the diffusion of innovation model to telecare. *Disability and Rehabilitation: Assistive Technology*, 9(1), 79-87.
- Tanriverdi, H., & Iacono, C. S. (1998). *Knowledge Barriers to Diffusion of Telemedicine*. Paper presented at the Proceedings of the International Conference on Information systems.
- Telemedicine Society of India. (2017). *About TSI* viewed 28 March 2019 Retrieved from <http://www.tsi.org.in/about.html>
- Torre-Díez, I. d. l., López-Coronado, M., Vaca, C., Aguado, J. S., & Castro, C. d. (2015). Cost-utility and cost-effectiveness studies of telemedicine, electronic, and mobile health systems in the literature: a systematic review. *TELEMEDICINE and e-HEALTH*, 21(2), 81-85.
- Trist, E. (1981). The evolution of socio-technical systems. *Occasional paper*, 2, 1981.
- Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly*, 27(3), 425-478.
- Venkatesh, V., Thong, J. Y., & Xu, X. (2012). Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS Quarterly*, 36(1), 157-178.
- Venkatesh, V, Thong, JY & Xu, X 2016, 'Unified theory of acceptance and use of technology: a synthesis and the road ahead', *Journal of the Association for Information Systems*, vol. 17, no. 5, pp. 328-76.
- Wade, V., Gray, L., & Carati, C. (2017). Theoretical frameworks in telemedicine research. *Journal of Telemedicine and Telecare*, 23(1), 181-187.
- West, V., & Milio, N. (2004). Organizational and Environmental Factors Affecting the Utilization of Telemedicine in Rural Home Healthcare. *Home Health Care Services Quarterly*, 23(4), 49-67.
- Wootton, R. (2009). *Telehealth in the developing world*. London;Ottawa, ON;: International Development Research Centre.
- Zailani, S., Gilani, M. S., Nikbin, D., & Iranmanesh, M. (2014). Determinants of Telemedicine Acceptance in Selected Public Hospitals in Malaysia: Clinical Perspective. *Journal of Medical Systems*, 38(9), 1-12.
- Zmud, R. W. (1982). Diffusion of modern software practices: influence of centralization and formalization. *Management science*, 28(12), 1421-1431.