

CO-INNOVATION: THE FUTURE OF TELEMEDICINE IN DEVELOPING COUNTRIES

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ABSTRACT:

Telemedicine which has been widely adopted in developed countries to reach all its citizens irrespective of their location is only being used for education purposes or disaster relief in developing countries. Since developing countries already suffer inadequate healthcare provision especially in remote areas, it would be essential to implement telemedicine practices for daily clinical uses rather than education use. This research argues that to understand the future of telemedicine in developing countries, both well-established technology innovations adoption factors as well as co-innovation factors should be addressed. In the context of healthcare provision, we propose a conceptual framework that integrates the healthcare resources and the organisational affiliations in co-innovation.

Key words: Telemedicine, Innovation adoption, Co-Innovation

1. INTRODUCTION

A great challenge face the healthcare sector globally especially in the management of chronic and multiple diseases due to the high rise of the aging population [62]. However, use of Information and Communication Technologies (ICT) has bridged the gap especially in the exchange of medical information from one site to another. Aided by high capacity digital networks, powerful computer hardware and software as well as high resolution digital image compression, the healthcare sector has been greatly transformed in areas that have adopted the technologies [21].

To explain the phenomenon, the term telemedicine was coined by Thomas Bird in 1970s [54] which literally means healing at a distance [78] [69]. The prefix *tele* is a Greek word meaning far or distance [78] [14] [69]. Nevertheless, the implementation of telemedicine is primarily used in developed countries due to the high levels of economic and infrastructure development [44]. According to [75], implementation of telemedicine in the U.S.A healthcare system could save the country approximately \$4.28 billion just from reducing transfers of patients from one location such as a nursing home for medical exams at hospitals, physicians' offices or other caregiver locations. In addition, the UK National Health Service anticipates slashing the healthcare costs by adopting ehealth procedures. However, groups that suffer from inadequate healthcare services mainly the under-developed and developing countries have the least implementation of telemedicine.

The World Health Organization (WHO) claims that less than half of the population in developing countries have adequate access to healthcare. According to [30] and [31], poor infrastructure and economic level has contributed to failure in the delivery of quality healthcare these countries. However, [41] claim that politicians have a great impact on the development of a country irrespective of its economic status.

Telemedicine is a technology that bridges the gap between healthcare providers and the patient which is mainly as a result of geographical separation [65]. This is a common phenomenon in underserved communities especially in developing countries [43]. Therefore, telemedicine allows physicians in remote areas to liaise with specialised consultants who are located both locally and internationally without leaving their physical location. Although telemedicine cannot increase the number of specialised doctors in a country, it helps use the scarcely available resources more efficiently [3]. In addition, scholars have argued that telemedicine saves lives since it links the unequipped healthcare centres in remote areas with the equipped healthcare centres in urban areas [43] [20] [64] [35].

Telemedicine is considered as an innovation like any other technological innovation [54] [68]. However, studies show that the cost of implementing a telemedicine project is high and a single organisation is likely to face challenges in funding the project [54] [32] [68] [12].

According to [49] [2] and [8], innovation collaboration among various organisations can ease the burden of cost on an individual organisation. Therefore, the research concepts of this study will be drawn from the following areas as shown in Figure 1.

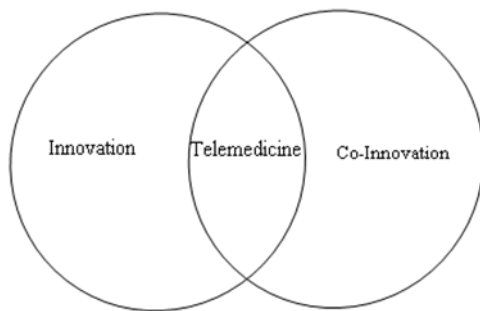


Figure 1: Research concepts of the literature

Various researchers claim that lack of funding to sustain telemedicine projects in developing countries is the main hindrance to its implementation [66] [6] [12]. Nevertheless, recent studies show that co-innovation can enable both private and public organisations pool resources and share high costs involved in healthcare technological innovations [32] [12]. Aided by the literature concepts gathered, this study will be aimed at demonstrating that co-innovation can benefit the complex telemedicine innovation process.

1.1 Background information to telemedicine in healthcare

[66] broadly defines telemedicine as delivery of health care services where distance is a critical factor by all health care professionals using ICT for the exchange of valid information for diagnosis, treatment and prevention of diseases and injuries, research and evaluation and for continuing education of health care providers, all in the interest of advancing the health of individuals and their communities.

Various researchers have defined the term telemedicine in different ways as shown in Table 1.

Table 1: Definition of telemedicine

Terminology	Definition	Reference
Telemedicine	The use of ICT in the delivery of health services to enable provider–patient and provider–provider consultation despite geographical separation.	[43]
	Exchange of medical information from one site to another via electronic communications for the health and education of the patient or health care provider and the purpose of improving patient care.	[21]
	The utilization of communication technologies to deliver or support any aspect associated with medical care, regardless of physical distances separating patient and provider.	[44]
	Telemedicine is an integrated system of healthcare delivery that employs telecommunications and computer technology as a substitute for face-to-face contact between provider and client.	[6]
	The use of medical information exchanged from one site to another via electronic communications such as two-way video, email, smart phones, wireless tools and other forms of ICT to patient’s clinical health status.	[65]
	The practice of medicine using audio, visual and data communications.	[60]

1.2 History of telemedicine

The exact date when health care was administered from a distance is unknown [78]. However, [16] claim that in the 15th century, information about bubonic plague was transmitted across Europe using bonfires. Later in mid-19th century, telegraphy was used to transmit casualty list and medical supplies list during the American civil war [69]. Also x-ray images were transmitted [16]. In late 19th century to early 20th century, Einthoven transmitted electric cardiac signals of patients in a hospital 1¹/₂ km away using a string galvanometer and telephone wires.

Telephone network was also used to transmit amplified sounds of stethoscope. Later in 1920s, radio links were used by Norwegian doctors to provide advice to sick ship crew [54]. This was initially made possible by the introduction of Morse code and later voice. Starting early 1950s, the analogue methods that were used earlier were replaced by digital communication techniques through the introduction of television. This was a major influence to the development of the current telemedicine [16] [69]. By late 1950s, closed circuit television and video communication was made possible [78]. This has been in use up to date.

According to [64], telemedicine is a technology that bridges the gap between healthcare providers and the patient which is mainly as a result of geographical separation. Geographical barrier is a common phenomenon in underserved communities especially in developing countries [44]. As reported by [13], telemedicine allows less experienced doctors to liaise with specialised consultants who are hundreds of miles away. In addition, it helps use the scarcely available resources more efficiently [3]. Furthermore, telemedicine cannot increase the number of physicians in a country or influence their location [51].

Scholars have argued that telemedicine saves lives since it links the unequipped healthcare centres in remote areas with the equipped healthcare centres in urban areas [9] [20] [64] [35].

1.3 Telemedicine evaluation

Various factors have to be considered to determine the type of telemedicine application to be used. According to [6], the decision on the type of telemedicine to be used should be viewed from healthcare providers and societal perspective where each perspective has various concerns as shown in Figure 2. In addition, each perspective must take into account of the intended application of the telemedicine technology as well as the type of technology available. Therefore, each consideration must take a three dimensional matrix cube which considers the perspective, application and technology to be used.

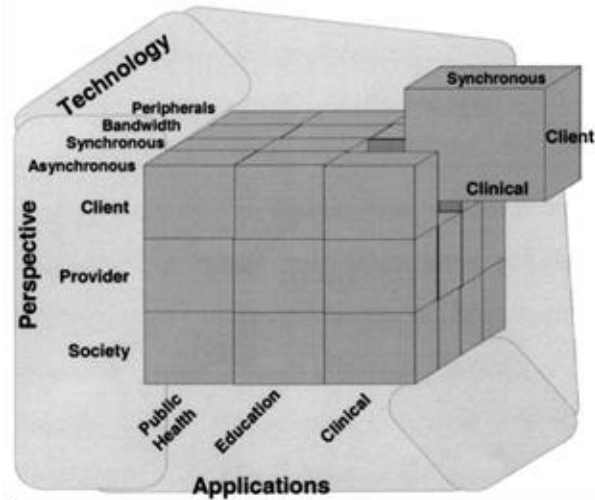


Figure 2: Three-Dimensional Model for Telemedicine Evaluation [5]

1.4 The future of telemedicine

According to [31] and [70], the future of telemedicine is determined by three key factors as shown in Figure 3.

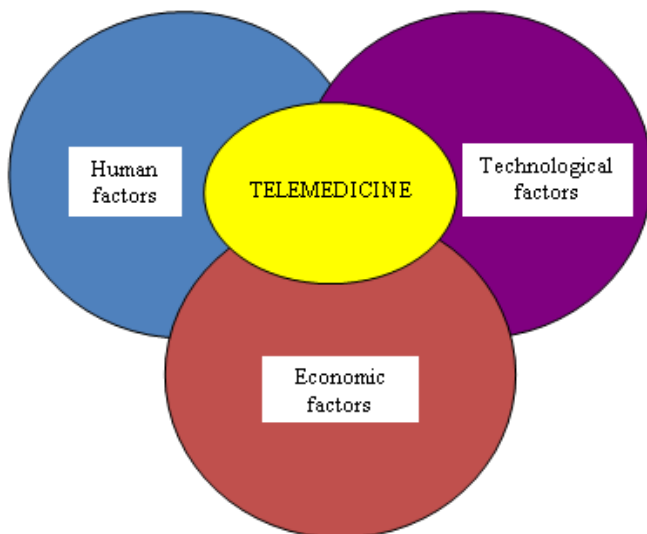


Figure 3: The future of telemedicine

Economic factors

According to [31], most health systems are supported through public funding as well as contribution of the private sector. [76] claim that economic evaluation of telemedicine provides reliable information for decision makers before the implementation of the technology. However, although economic analysis takes different perspectives, [63] claim that cost effectiveness analysis is vital since without funding the technology will be rendered unsustainable [51].

Human factors

Shortage of radiologists, increase of the aging population as well as cases of chronic diseases requiring round the clock checks has increased the need for the adoption of telemedicine [46][31]. In addition, the acceptance to adopt the new technology will greatly influence the diffusion of telemedicine [45] [70].

Technological factors

According to [21], the growth of technological innovations such as high-capacity digital networks, powerful computer hardware and software, high-resolution digital image compression and the Internet has had a great impact on the process of health care delivery.

In addition, scholars claim that healthcare technological innovations will enable healthcare to be more efficient and accessible to all [15] [75] [46] [40].

2. CONCEPT OF TECHNOLOGY INNOVATION ADOPTION

Technological innovation is claimed to be the major driving force in the expedition to balance cost containment and quality [46]. In healthcare sector, telemedicine is considered as an innovation since it is a new technology in the sector. However, [68] claim that despite the potential benefits of telemedicine, its diffusion rate is very slow especially in developing countries. According to [13], the universal shortage of nurses and other key health practitioners advances the argument in favour of more technology innovation in healthcare. Nevertheless, [41] claim that technology adoption in healthcare is generally slow and disparate. However, the innovation adoption curve of telemedicine is similar to that of other health technologies and follows an S-shaped logistic growth curve [50] illustrated by [47] as shown in Figure 4.

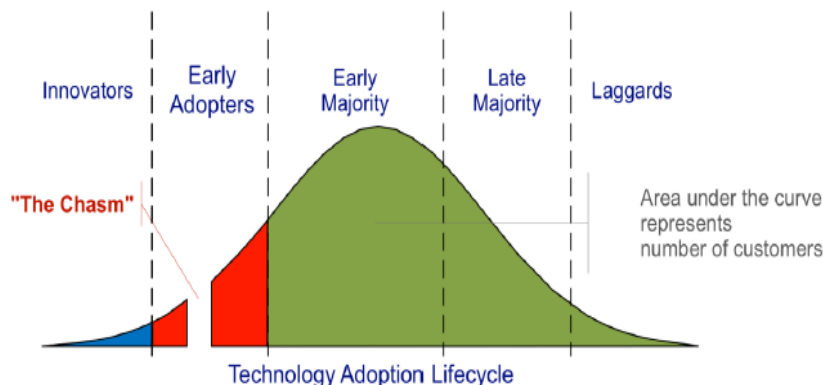


Figure 4: Technology adoption lifecycle [47]

2.1 Factors influencing the technology adoption

According to [47], five aspects influence the technology adoption lifecycle of any innovation. These aspects will be used to form the basis of the organisational aspect of the conceptual model illustrated later in Figure 8.

- Relative advantage

The degree to which an innovation is perceived as better than the idea it supersedes. The degree of relative advantage may be measured in economic terms, but social-prestige factors, convenience, and satisfaction are also often important components.

- Compatibility

The degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters. An idea which is not compatible with the prevalent values and norms of a social system will not be adopted as rapidly as an innovation that is compatible with the prevalent values and norms of a social system.

- Complexity

The degree to which an innovation is perceived as difficult to understand and use. Some innovations are readily understood by most members of a social system; others are more complicated and will be adopted more slowly.

- Trialability

The degree to which an innovation may be experimented with on a limited basis. New ideas that can be tried on the instalment plan will generally be adopted more quickly than innovations that are not divisible.

- Observability

The degree to which the results of an innovation are visible to others. The easier it is for individuals to see the results of an innovation, the more likely they are to adopt.

Since telemedicine is an innovation like any other technological innovation [24] the above mentioned aspects have to be considered during the implementation of telemedicine to enhance the level of acceptance by the stakeholders [44][46]. However, telemedicine is an expensive project to implement [54] where a single organisation is likely to face challenges in funding the project. One of the major problems presented in healthcare innovations is funding the innovative projects such as telemedicine [32] [68] [12]. Such problems have been highly faced by the developing countries leading to low healthcare technological innovation adoption rate as shown in Figure 5.

As shown in Figure 5, advanced continents such as America and Europe have a higher telemedicine growth rate in comparison to other continents.

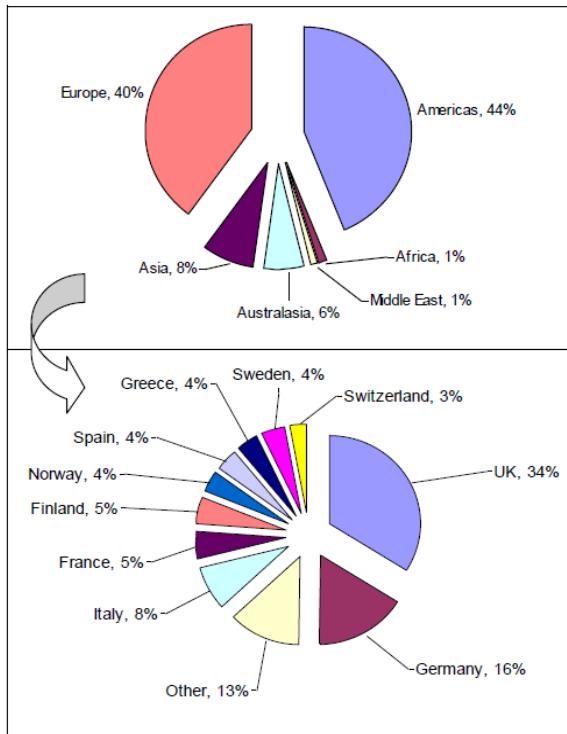


Figure 5: Adoption of telemedicine globally [68].

According to [78], availability of grants funded by the federal government for telemedicine projects has greatly enabled the implementation of telemedicine in these continents. However, [41] claim that telemedicine programs need to move from relying on grants to a profit-centered status.

In addition, this will enable them sustain their existence by moving away from challenge related to financial sustainability [31]. Since development of financially sustainable telemedicine programs has been pointed out as one of the barriers to telemedicine adoption [1] [32] [20] claim that collaboration with other organisations is needed for smooth implementation of telemedicine projects.

3. THE CONCEPT OF CO-INNOVATION

Co-Innovation is an innovation that necessitates collaboration among various organisations, actors, levels or segments [49]. According to [16], innovation is experiencing a paradigm shift from closed innovation to open innovation to co-innovation. In closed innovation, organizations generate their own ideas, implement and distribute them to the end users. Due to the rapid changes and increase in market demand, closed innovation does not allow organisation expand their capabilities rapidly due to the narrow knowledge silos. As a result, open innovation emerged which assumes that organizations can use internal and external ideas to advance their technology [16]. With rapid increase in market demand, open collaboration among organisations enabled greater innovation capabilities. According to [48] co-innovation provide a competitive advantage by combining the best skills or core competencies and resources of two or more organisations, as well as customers knowledge of a product or a service to co-create a value proposition more compelling and relevant to the consumers' needs and expectations. The level of collaboration can be between departments of an organisation or amongst various organisations either nationally or internationally [8] [22]. When the organisations decide to co-innovate, they enter into contracts with each other and agree on the distribution of costs and revenues incurred during the co-innovation process [9].

According to the Singapore government, co-innovation is about the public and private sector joining hands to create innovations that can help the government do its job better [53]. Execution of costly projects such as telemedicine

may require sharing of costs and risks associated with it. Since co-innovation allows partnership where various actors with a shared vision collaboratively create an environment for innovation [49] [2] [8], implementing expensive and expansive projects can be effectively managed and risks shared across the partners. However, [42] claim that organisations tend to establish partnership at early phases of innovation even before the object of collaboration is defined. According to [52], the ability to manage such collaborations efficiently is likely to be complicated because there are no mutual liabilities at the early stages of the collaboration. In addition, since the organisations have very little knowledge of each other, time is needed to understand the corporate cultures and strategies of every organisation involved in the partnership [10].

Since co-innovation network consists of various parties having their own organisational policies coming together to solve a joint task, [22] points out five elements used to unify these parties. However, the collaborating parties must overcome the problems of distrust, disrespect, and outright antagonism in order to accomplish their mission [3] [7].

3.1 Elements of Co-Innovation network

According to [22] organisation network is the basic social form that permits inter-organizational interactions of exchange, converted action and joint production. Co-innovation network consist of five elements as shown in Figure 6.

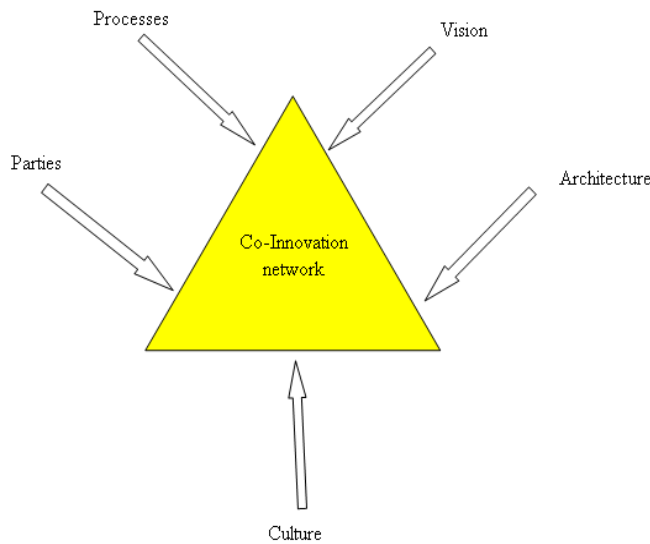


Figure 6: Elements of Co-Innovation network

Table 2: Elements of Co-Innovation

Vision	The purpose and values of the collaborating organisations
Parties	Resources of the co-innovation network i.e. the collaborating organisations. A fundamental element between the collaborating parties is trust.
Processes	Procedures needed in order to accomplish the vision of the collaborating organisations. They are centered on exchange of coordination, information and joint problem-solving between the organizations.
Architecture	The structural framework for collaboration. It shapes the structural framework for collaboration.
Culture	The norms and values for interaction among the organisations.

According to [26], the stakeholders of healthcare environment create a complex innovation network so as to effectively respond to macro changes such as economic, technological and social changes as shown in Figure 7.

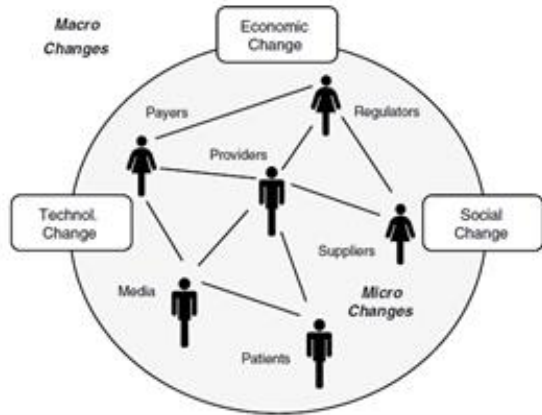


Figure 7: Healthcare collaboration network [26]

However, studies indicate that the complex networks complicate the decision making process since the members of a network must come to an agreement [47] [76].

4. PRELIMINARY CONCEPTUAL MODEL OF CO-INNOVATION AND TELEMEDICINE ADOPTION

To undertake the research, various aspects underpinned by the literature are considered. As shown in Figure 8, five areas will be considered in the study. The organisations that work in partnership with healthcare sector such as non-profit organisations and government bodies [26] will be considered. In addition, patient views on healthcare innovations and factors influencing its adoption rate will also be considered. On the left hand side of the model are the co-innovation inputs to the healthcare provider. The main part of the model comprises of the healthcare provider aspects (shown on the middle block) identified from the extant literature. The effects of ICT on the co-innovation inputs as well as healthcare provider will also be considered. The outcomes of the model are yet to be defined.

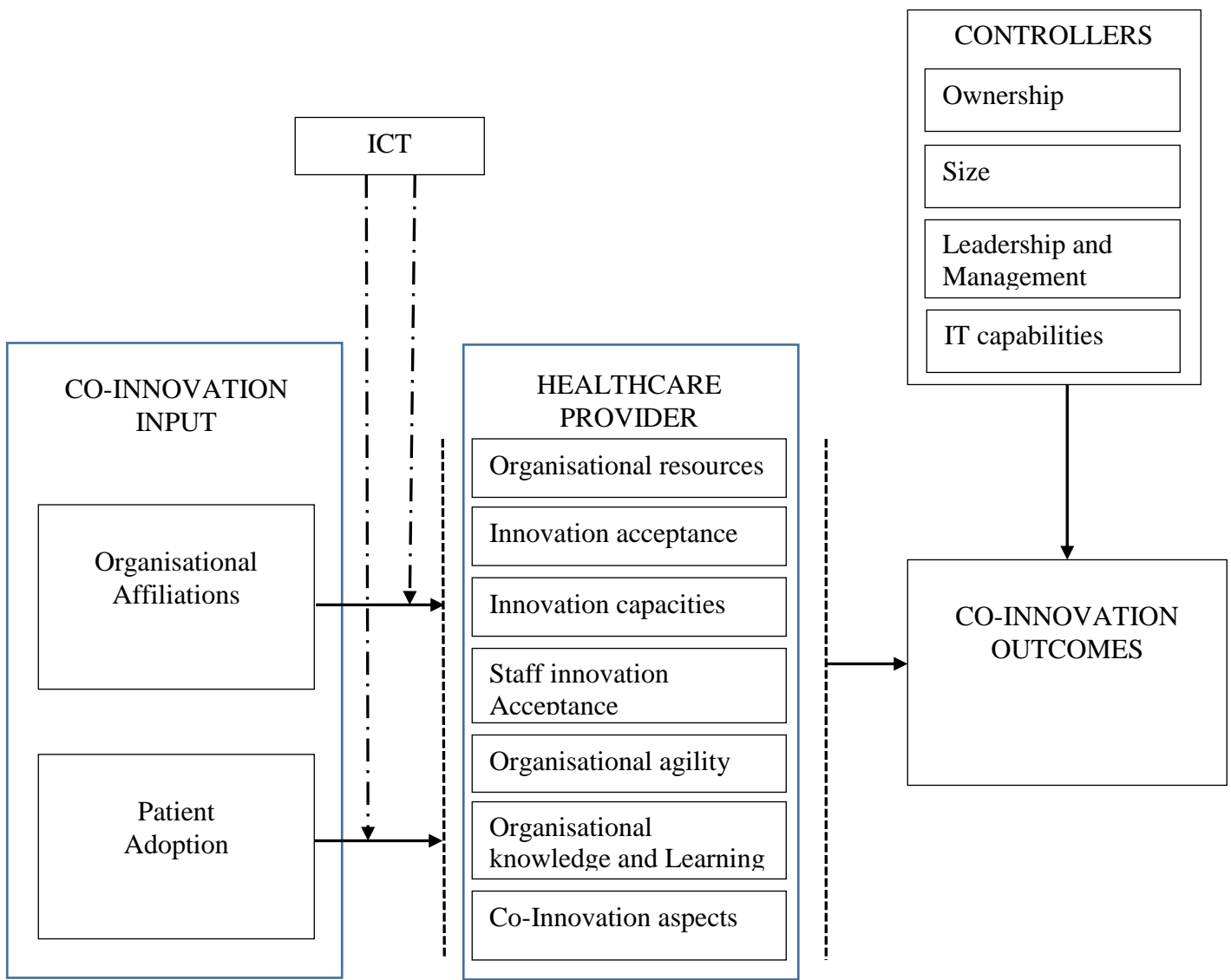


Figure 8: PRELIMINARY CONCEPTUAL MODEL

5. DISCUSSION AND CONCLUSION

By developing a model that conceptualises co-innovation as a facilitator for telemedicine adoption in healthcare, this paper contributes to the understanding of the factors affecting organization innovation in the healthcare context. Our approach goes beyond the widely utilized literature on open innovation to acknowledge the costs and organization challenges faced by healthcare providers undertaking ICT based innovations. Hence we propose that the developed conceptual model offer a valuable theoretical framework for future studies on telemedicine adoption

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