



**FACTORS INFLUENCING ADOPTION OF TELEMEDICINE
TECHNOLOGY AMONG HEALTH FACILITIES IN YEMEN**

By

BASSAM ALI ALI ALJAMRH

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirements for the Degree of Doctor of Philosophy**

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

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June 2021

Chairman : Professor Azmawani binti Abd. Rahman
School : Business and Economics

Telemedicine technology refers to the use of advanced telecommunication technologies for exchanging information related to health or providing healthcare services from distant places. Telemedicine technology has become common worldwide, even in the least developed countries like Yemen, since it helps provide healthcare services over distances, saving time and cost. It helps to provide health care to patients in the remoted areas. In the context of Yemen, the adoption of telemedicine technology in Yemen is limited even though such technological services are needed due to the shortage of healthcare facilities and health physicians. Hence, this study aimed to develop a new model to examine the influence of technological, organizational and environmental factors on the intention to adopt telemedicine technology with awareness and voluntariness as the moderators of these factors. The study employed a quantitative research design, and the data were collected through a survey distributed to 317 managers of healthcare facilities in Yemen through stratified random sampling. The data analysis was done through structural equation modelling SEM, using Smart-PLS since it helps to analyze direct and indirect relationships among research variables. This study integrated Unified Theory of Acceptance and Use of Technology (UTAUT) and Technology-Organization-Environment (TOE) in addition to other factors, including IT infrastructure, perceived security, health facility size, top management support, and trading partner readiness to create the theoretical framework of the study. Besides, awareness and voluntaries were used as the moderators in this framework. Before collecting the primary data, the survey was validated by five experts and then distributed to 30 participants as a pilot test for the survey's reliability. In the analysis of the pilot test using Cronbach's Alpha, the factors have values over .70, which shows that the survey has good internal consistency. In terms of the main data, the results showed a significant positive effect for technological factors (IT infrastructure, perceived security, performance expectancy), organizational factors (facilitating condition, health facility size, top management support), and environmental factors (trading partner readiness, and government's support) on intention to adopt telemedicine technology. However, effort expectancy as a

technological factor, social influence as an organizational factor, and competitive pressure as an environmental factor were found insignificant in effect on the intention to adopt telemedicine technology. Besides, the most influential factor on intention to adopt telemedicine technology was organizational factors, followed by environmental factors, and technological factors, respectively. From the results of “awareness” and “voluntariness” as moderators, it was found that awareness negatively moderates the effects of the technological and environmental factors on the intention to adopt telemedicine technology; however, it positively moderates the relationship between organizational factors and intention to adopt telemedicine technology. In terms of voluntariness, the findings of the analysis showed that it has a positive moderation on the relationship between technological factors and intention to adopt telemedicine technology; nevertheless, it negatively moderates the relationship between organizational and environmental factors and intention to adopt telemedicine technology. These findings resulted from the investigation through the proposed hypotheses of the theoretical framework showed new relationships and new directions resulted for the moderators’ effects. The outcomes of the research led to implications and recommendations for governments in the least developed countries, the Yemeni Ministry of Public Health (MOPH), policy-makers, and health service providers. This research contributes to the literature in the area of telemedicine adoption by investigating the technological, organizational, and environmental factors influencing telemedicine adoption in the least developed countries through identifying and validating new constructs and integrating the two theories of TOE and UTAUT. In terms of the limitations, the current research is quantitative, and the investigation was limited to the managers of healthcare facilities, while users of telemedicine technologies were excluded. These limitations are provided as directions for future studies to focus on the adoption of telemedicine technologies among users and to use mixed-method design to get an in-depth understanding of the low adoption of telemedicine technologies in the context of Yemen.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

**FAKTOR MEMPENGARUHI PENERIMAGUNAAN TEKNOLOGI
TELEPERUBATAN DALAM KALANGAN KEMUDAHAN
KESIHATAN DI YEMEN**

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Teknologi teleperubatan merujuk kepada penggunaan teknologi telekomunikasi lanjutan bagi pertukaran maklumat yang berkaitan dengan kesihatan atau memberikan perkhidmatan penjagaan kesihatan ke kawasan yang jauh. Teknologi teleperubatan telah menjadi umum di seluruh dunia walaupun di negara termundur seperti Yemen disebabkan ia membantu menyediakan perkhidmatan penjagaan kesihatan melampaui jarak yang menjimatkan masa dan kos, dan ia membantu memberikan penjagaan kesihatan kepada pesakit di kawasan terpencil. Dalam konteks Yemen, penerimgunaan teknologi teleperubatan di Yemen adalah terhad walaupun perkhidmatan tersebut diperlukan akibat kekurangan fasiliti penjagaan kesihatan dan doktor kesihatan. Oleh sebab itu, tujuan kajian ini adalah untuk membangunkan suatu model baharu bagi meneliti pengaruh faktor teknologikal, organisasi dan persekitaran ke atas hasrat untuk mengadaptasi teknologi teleperubatan dengan kesedaran dan kesukarelaan sebagai moderator bagi faktor tersebut. Kajian ini menggunakan reka bentuk penyelidikan kuantitatif, dan data dikumpul melalui tinjauan yang diedarkan kepada 317 orang pengurus penjagaan kesihatan di Yemen melalui persampelan rawak bertingkat. Analisis data adalah melalui pemodelan persamaan struktur SEM, menggunakan Smart-PLS memandangkan ia membantu untuk menganalisis hubungan langsung dan tidak langsung antara pemboleh ubah penyelidikan. Kajian ini mengintegrasikan Teori Penerimaan Bersatu dan Penggunaan Teknologi (UTAUT) dan Persekitaran Organisasi Teknologi (TOE) di samping faktor lain, termasuk infrastruktur IT, keselamatan anggapan, saiz kemudahan kesihatan, sokongan pengurusan atasan, dan kesiediaan rakan kongsi perniagaan bagi membina kerangka teoretikal kajian ini. Di samping itu, kesedaran dan kesukarelaan telah digunakan sebagai moderator dalam kerangka kerja ini. Sebelum pengumpulan data utama, tinjauan telah divalidasi oleh lima pakar dan kemudiannya telah diedarkan kepada 30 responden sebagai ujian rintis bagi tujuan kebolehpercayaan tinjauan. Dalam analisis ujian rintis menggunakan Cronbach Alpha, faktor mempunyai nilai melebihi .70, yang menunjukkan bahawa tinjauan tersebut mempunyai ketekalan dalaman yang baik. Dari

segi data utama, dapatan menunjukkan kesan positif yang signifikan bagi faktor teknologikal (infrastruktur IT, keselamatan anggapan, ekspektansi prestasi), faktor organisasi (keadaan memudahkan, saiz kemudahan kesihatan, sokongan pengurusan atasan), dan faktor persekitaran (kesediaan rakan kongsi perniagaan, dan sokongan kerajaan) ke atas hasrat untuk menerima guna teknologi teleperubatan. Walau bagaimanapun, ekspektansi usaha sebagai faktor teknologikal, pengaruh sosial sebagai faktor organisasi, dan tekanan kompetitif sebagai faktor persekitaran didapati tidak signifikan dari segi kesan ke atas hasrat untuk menerima guna teknologi teleperubatan. Di samping itu, faktor yang paling berpengaruh ke atas hasrat untuk menerima guna teknologi teleperubatan, masing-masing ialah faktor organisasi, diikuti oleh faktor persekitaran, dan faktor teknologikal. Dari dapatan “kesedaran” dan “kesukarelaan” sebagai moderator, didapati bahawa kesedaran secara negatif memoderasi kesan faktor teknologikal dan persekitaran ke atas hasrat untuk menerima guna teknologi teleperubatan; walau bagaimanapun, ia secara positif memoderasi hubungan antara faktor organisasi dan hasrat untuk menerima guna teknologi teleperubatan. Dari segi kesukarelaan, dapatan analisis menunjukkan bahawa ia mempunyai moderasi yang positif ke atas hubungan antara faktor teknologikal dan hasrat untuk menerima guna teknologi teleperubatan; namun, ia secara negatif memoderasi hubungan antara faktor organisasi dan persekitaran dan hasrat untuk menerima guna teknologi teleperubatan. Dapatan tersebut yang diperolehi daripada penelitian melalui hipotesis kerangka teoretikal yang disyorkan menunjukkan hubungan yang baharu dan arah yang baharu, akibat kesan moderator. Hasil kajian membawa implikasi dan syor bagi kerajaan di negara termundur, Kementerian Kesihatan Awam Yemen (MOPH), penggubal polisi, dan penyedia perkhidmatan kesihatan. Penyelidikan ini memberi sumbangan kepada literatur dalam bidang penerimgunaan teleperubatan melalui pengkajian faktor teknologikal, organisasi dan persekitaran yang mempengaruhi penerimgunaan teleperubatan di negara termundur melalui pengenalpastian dan pengesahan konstruk baharu, dan pengintegrasian dua teori tersebut, iaitu TOE dan UTAUT. Dari segi limitasi, penyelidikan semasa ini adalah kuantitatif dan pengkajian ini adalah terhadap kepada pengurus fasiliti penjagaan kesihatan, manakala pengguna teknologi teleperubatan adalah terkecuali. Limitasi ini disediakan sebagai arah bagi kajian masa hadapan untuk memberikan fokus terhadap penerimgunaan teknologi teleperubatan dalam kalangan pengguna dan untuk menggunakan reka bentuk kaedah campuran bagi mendapatkan pemahaman akan penerimgunaan teknologi teleperubatan yang rendah dalam konteks Yemen.

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LIST OF ABBREVIATIONS

OCHA	United Nations Office for the Coordination of Humanitarian Affairs
WHO	World Health Organization
MOPH	Ministry of public health
MOPHP	Ministry of public health and population
USAID	United States Agency for International Development
LDCs	Least Developed Countries
TOE	Technology-organization-environment framework
UTAUT	Unified Theory of Acceptance and Use of Technology

CHAPTER 1

INTRODUCTION

The world has significantly changed in the last few decades. Technology has made great changes in the way we do our daily activities and the way we work. Technology innovations are considered to be one of the most important factors for the organization's success (Michaelis & Markham, 2017; Qalati, Li, Ahmed, Mirani, & Khan, 2021). Moreover, the extent of using Information and Communications Technology (ICT) for providing services to the public is a very important sign that can measure the progress and development of countries. (Adwoa, 2016)

Organizations allocate a high budget on IT, expecting high business performance (Kim, Mithas, and Kimbrough (2017); Rai, Patnayakuni, & Patnayakuni, 1997) and high productivity (Bui, Hansen, Liu, & Tu, 2018). Hence, understanding the factors influencing technology adoption is important before the organization invests or decides to bring in an innovation (Yu, Lin, & Liao, 2017).

Identification of the factors that lead to technology adoption is related to the acceptance of the users to technology (Binyamin & Zafar, 2021; Kundu & Roy, 2010). According to (Prasanna and Huggins (2016); Sweis et al. (2021)), understanding the factors that increase acceptance and reduce resistance is crucial for the successful implementation of new technology.

Researches on intention to adopt new technology are recommended by (Ekanoye et al. (2017); Seen, Rouse, and Beaumont (2007)) because adoption increases when we determine the success of telemedicine technology implementation (Rho, Chang, & Lee, 2013). The new innovation is also considered an indicator of the success of an organization (Kundu & Roy, 2010; Urbinati, Manzini, Piacentini, & Carretti, 2021).

1.1 Background of the study

Technologies can overcome obstacles (Hota, Qiu, & Bhatt, 2021), solve problems (Bukhman, 2021), and increase productivity in organizations (Danquah & Owusu, 2021) in different industries such as healthcare sector challenges (Bazel, Mohammed, & Ahmed, 2021). The advantages of technologies in healthcare systems include the quality of healthcare received by patients. Patients nowadays prioritize convenient and inexpensive care (Duffy & Lee, 2018; Hollander & Carr, 2020). Healthcare in the least developed countries offers poor quality of medical care in rural facilities due to the fact that qualified doctors are available in urban areas where they can get high wages and avoid professional isolation (Som, Norali, & Ali, 2010). However, it is considered to be very difficult to provide continuous medical education for those doctors who work in

rural areas (Al-Fadhli, Othman, & Al-Jamrh, 2017a). Thus, developing countries are still investing in health sectors and looking for sustainable solutions. Health information systems and telemedicine technology have the potential to overcome the challenges encountered in healthcare systems in least developed countries (Ekanoye et al., 2017; R. Wootton, 2008).

With the development of science and technologies, there are improvements in the provision of healthcare services over distances which is called telemedicine. Generally, ICT is an enabling technology to provide various solutions in the healthcare sector. Telemedicine has been defined by Reid (1996) as “the use of advanced telecommunication technologies to exchange health information and provide healthcare services across geographic, time, social, and cultural barriers.”

In fact, telemedicine technology in developing countries might have a more profound influence than the influence in developed ones (Edworthy, 2001; Suhaiza Zailani, Mina Sayyah Gilani, Davoud Nikbin, & Mohammad Iranmanesh, 2014).

According to A systematic review of telemedicine assessments by Hailey, Roine, and Ohinmaa (2002) Three-quarters of scientific studies reviewed highlighted that telemedicine had advantages over the alternative approach. Moreover, the studies showed powerful evidence on the effectiveness and efficiency of telemedicine applications such as teleradiology, the transmission of echo-cardiographic images, telemental health, telemental health, teledermatology, and home telecare. Telemedicine can play an important role as to overcome several issues; for example, it provides high-quality medical care over distance treatment advice (Borscheva, Fedorova, Mityaeva, Gerchikova, & Fedorov, 2021) and diagnosis (Willis, Tyler, Schiff, & Schreiner, 2021).

Moreover, telemedicine has the potential to provide continuous education for professionals in remote areas (Traube, Cederbaum, Taylor, Naish, & Rau, 2021). Implementing technology like telemedicine can improve the quality of healthcare services in remote communities (Nesbitt, Marcin, Martha, & Cole, 2005). Patients are likely to use telemedicine if they are advised by doctors (Marie Pierre Gagnon, Estibalitz Orruno, José Asua, Anis Ben Abdeljelil, & José Emparanza, 2012). According to Al-Shamahy, Ishak, and Al-Jaifi (2020), legal, Technical, administrative impediments and related issues such as internet connectivity and consequent system reliability should be discussed for successful telemedicine in Yemen.

With the development of telecommunication technology and the internet revolution, technology spread in several industries, and the cost became cheaper. With limited resources in developing countries, organizations can invest in technology to improve the productivity and reduce the cost. Investing in technology can reduce the cost and reduce the required workers involved in a normal setting. Moreover, telemedicine proves cost-effectiveness, and the studies demonstrate that telemedicine can reduce the costs (De La Torre-Díez, López-Coronado, Vaca, Aguado, & de Castro, 2015), and in resource-poor

settings, telemedicine can bring relief to the inadequate healthcare systems (Yinka et al., 2021). In the healthcare sector and with the availability of advanced telecommunication technologies, the investment of such health information systems and telemedicine technologies is affordable by developing countries and rural health facilities. In fact, offering healthcare services to poor societies under the traditional healthcare system is inefficient and requires high cost to operate (Gollogly, 2009). Health information technology has great opportunities for improving efficiency and reducing medical costs, which has been proved by researchers; however, these technologies have not been utilized properly despite their availability (Ahlan & Ahmad, 2015). There are several types of telemedicine as reported in the past literature, which can be categorized into four types Teleconsultation, Tele-education, Telemonitoring, and Telesurgery.

Teleconsultation is the interactions that happen between a clinician and a patient as to provide medical consultation, which may take place between two or more careers. For example, telephone conversation, videoconferencing real-time or interactive feedback. Teleconsultation is classified into three categories, erratic, lumpy, and slow (Chen & Li, 2021).

Tele-education Recruit and retain health professionals in rural areas is very difficult due to professional isolation. Telemedicine involves a variety of digital and telecommunications tools which can link between health professionals and academic hospitals and reduce isolation (Zollo, Kienzle, Henshaw, Crist, & Wakefield, 1999). The types of tele-education include clinical education from teleconsultation, clinical education via the Internet, academic study via the Internet, and public education via the Internet.

Telemonitoring is defined as the use of information technology to monitor patients at a distance (Meystre, 2005). The significance of telemonitoring helps in the early detection of symptoms and early identification of deteriorations in patient condition. Moreover, monitor the adequate medication and decrease in blood pressure (Jaana, Paré, & Sicotte, 2009; Paré, Jaana, & Sicotte, 2007).

Telesurgery is defined as operating with hands at a distance (Angelini & Paspaspyropoulos, 2000). Telesurgery is becoming more feasible by allowing surgeons to use telecommunications and robotic technologies to operate patients at a distance with accurate surgical procedures regardless of surgeons and patients' locations (Choi, Oskouian, & Tubbs, 2018).

Telemedicine solutions have the potential to improve the quality of healthcare and offer an efficient way to access medical expertise at a low cost (Menko, Visser, Janssen, Hettinga, & Haaker, 2013). Researchers have indicated that telemedicine will become an essential part of healthcare to fill up the need of healthcare to societies (H. Khan, Qurashi, & Hayee, 2007). Patients in remote communities would decrease the travel cost to urban areas to get healthcare services if telemedicine technologies are available in

rural areas, which makes telemedicine has an economic contribution to rural areas (McCarthy, 1995). Accordingly, telemedicine has the potential to make healthcare services accessible regardless of the obstacles such as social and economic challenges and place and time challenges (Jennett et al., 2005). In this case, rural providers and patients are expected to be highly satisfied with telemedicine (Nesbitt et al., 2005).

Usually, when organizations want to implement new technology, the reaction of managers differs from one to another. They may partially adopt technology, resist the adoption, fully accept the technology, or completely reject it (R. A. Khan & Quadrat-Ullah, 2021; J. Marshall & Conner, 1996). Rejection has been defined by Oxford English Dictionary as “dismissing as inadequate or faulty and refusing to consider or agree to something, meanwhile, resistance as the action of resisting, which means withstanding an action or effect and trying to prevent by action or argument.” Also, before the adoption decision, managers first assess the technology in terms of features, based on the quality and threat of the technology, then they may decide whether to accept or resist the technology (Lapointe & Rivard, 2005). According to Marakas and Hornik (1996), the resistance of technology may appear at the individual level. Moreover, the organization is considered to be a source of resistance to technology adoption (Ang & Pavri, 1994; Phillips-Wren & McKniff, 2019).

One reason for countries to invest in technologies is to improve healthcare services. Investment in the health sector is a vital process for economic and social progress. The level of healthcare status of a country is an important indicator of its development (Kickbusch & Nutbeam, 1998; Michalos, 2017). For example, the advancement of technology plays a crucial role in the healthcare status of the country (Dhall, Patiyal, Sharma, Usmani, & Raghava, 2021). This is not only in healthcare service content but also in the way healthcare is delivered. In developing countries, access to healthcare services is one of the critical issues from which the health system suffers. According to (Renfrew et al. (2014); UNFPA (2014)), about 3 million newborn babies around the world and approximately 289,000 women died in the year of 2013. Most of the cases died worldwide because of the illnesses and complications that could be prevented with basic antenatal care and the availability of midwives during delivery.

In developing countries, several problems involved in delivering health care services countrywide such as shortage of trained and experienced doctors, imbalance of healthcare professionals (Alshakka et al., 2014), lack of funds and constraint resources, limited healthcare facilities, and unequal distribution of operating facilities (Al-Fadhli et al., 2017a; Gollogly, 2009). All these obstacles make it hard for patients to access healthcare services when needed. Besides, patients in rural areas encounter poor roads, limited transportation, and a high cost of travel to the nearest health care facility (Al-Fadhli et al., 2017a; Van Dyk, 2014). Telemedicine technology is underutilized in Yemen, even though it showed positive achievements in many cases (Al-Shamahy et al., 2020). Based on the preceding discussion, the next section will continue the discussion on the problem that is relevant to the current study.

1.2 Problem statement

Health systems around the world are looking for the development of the healthcare services that they offer to the population. Therefore, they invest more in technologies to improve the quality, effectiveness, and service delivery time. Nevertheless, not all organizations have adopted and used the technology effectively as expected. In fact, not all users use the technology which they accept effectively or give clear reasons for their resistance towards the new technology (Alatawi, Dwivedi, Williams, & Rana, 2012; Cimperman, Brenčič, & Trkman, 2016; Dünnebeil, Sunyaev, Blohm, Leimeister, & Krcmar, 2012). Consequently, there is a need to study the factors that influence health facilities' intention to use the new technology. In this study

Yemen's healthcare system has difficulties in delivering healthcare countrywide due to the lack of health facilities and health physician shortages (A. W. Al Serouri, Al Rabee, Afif, & Al Rukeimi, 2009; Alshakka et al., 2014; Sana'a, 2011; USAID, 2011). It is reported that the physician-patient ratio in developing countries is very low, which is really a great concern (Ahlan & Ahmad, 2015; del Rio, Mehta, Lyon, & Guarner, 2014). According to WHO (2010a), Yemen's health care system covers only 38% of the total population. More than 71% of the total population lives in rural areas where there are significant levels of unmet health needs; however, almost 42% of the total physicians are concentrated only in four governorates (A. Al Serouri, Al-Mudhwahi, Øvretveit, & Al-Gonaid, 2011; MoPHP, 2010).

Not only do health professionals shortages affect healthcare systems delivery, but also the distribution of human resources of healthcare (Alshakka et al., 2014; Okyere, Mwanri, & Ward, 2017; WHO, 2009, 2010a). The healthcare facilities in rural areas have only 20% of the total healthcare professionals, while 80% of healthcare professionals are concentrated in urban hospitals (Al-Fadhli et al., 2017a). According to Dussault and Franceschini (2006), the reason why health professionals are imbalanced is the qualified personal availability. Other reasons behind geographical imbalances of health doctors are low wages and professional isolation, so doctors are not willing to work in the hospitals available in rural areas (Bukach, Ejaz, Dawson, & Gitter, 2017; Mars, Wootton, Patil, Scott, & Ho, 2009; Richard Wootton, 2009).

Therefore, the current Yemeni healthcare system is looking for a way to improve the quality and performance of healthcare services (Al-Fadhli et al. (2017a), and the ministry of public health has a great interest in implementing health information technology for making health care services accessible in remote areas. All health facilities need to reconsider any type of treatment encounter with doctors and face-to-face health care (Klein & Busis, 2020). Other studies by (Duffy and Lee (2018); Hollander and Carr (2020)) just suggest whether in-person visits should become the second, third, or even last option for meeting patient needs. Meanwhile, (Martínez, Villarroel, Seoane, & Pozo, 2004) stated that telemedicine is proved to be effective in delivering high-quality healthcare services to remote areas. Telemedicine technology enhances healthcare service in developing countries where there is a shortage of health physicians and a lack

of health facilities, and there is a high cost of medical consultation (Ahlan & Ahmad, 2015; Boucher, 2007).

Telemedicine technology adoption received less attention in the environment of developing countries (Ami-Narh & Williams, 2012; Dash, Das, & Mohanty, 2016; Mezni & Zeribi-Benslimane, 2008; Suhaiza Zailani et al., 2014). Telemedicine technology acceptance has been studied widely in the context of developed countries (Cimperman et al., 2016; Segrelles-Calvo, Chiner, & Fernández-Fabrellas, 2015a). However, there are differences between developed, developing, and least developed countries in the gap of using ICT (Stamm, 2004), economic condition, rural areas and health systems (Al-Fadhli et al., 2017a; Gicheru, 2016). According to Khoja et al. (2007), there are differences between developed and developing countries and the technology adoption models that are used for developed countries may not be suitable to be used in the context of developing countries. Telemedicine is widely spread in several countries; therefore, it is important to understand the determinants of the intention to adopt telemedicine technology in the Yemen environment. Previous studies on telemedicine adoption are conducted in where environment, government policy, awareness about the technology and its benefit and health facilities IT infrastructure are different from Yemen.

Yemen is one of the 48 least developed countries, as reported by the United Nations (Asomani-Boateng, Fricano, & Adarkwa, 2015; UN, 2016). Despite the importance of telemedicine to the least developed countries, especially in remote areas, there have been lacks in research that investigate these issues from the perspectives of least developed country like Yemen. While there are differences in the several aspects between developed, developing, and least developed countries, the existing telemedicine technology adoption frameworks of developed countries and also developing countries may not be suitable for the Yemeni environment. Thus, it is important to develop a suitable framework for the intention of adopting telemedicine technology in the least developed countries like Yemen.

According to the existing literature, studies have investigated telemedicine technology adoption for different reasons before and after implementation. For example, (Chau and Hu (2001); Cimperman et al. (2016)) investigated telemedicine adoption as to solve the problem of increased patients of chronic diseases (Evers, 2014; Kalema & Musoma, 2019), leading to increasing demand for an improved healthcare system (Suhaiza Zailani et al., 2014). Another reason is to overcome physicians and nurses shortages (Ghani & Jaber, 2015). Researchers also study the adoption of telemedicine to improve patient-to-doctor communication expediency (Dash et al., 2016).

Besides, researches were conducted to understand the factors affecting telemedicine technology due to that only a few telemedicine projects have utilized and used these systems properly (Cilliers and Flowerday (2013) or assessed the acceptance of technologies among users (Segrelles-Calvo et al., 2015a). Yemen's healthcare system has interlaced problems and needs (A. W. Al Serouri et al., 2009; Alshakka et al., 2014;

Sana'a (2011); USAID, 2011). Thus, telemedicine can play an important role in improving the current health status (Al-Fadhli et al., 2017a).

The process of adoption usually depends on the decision of an individual or on the decision-makers of an organization (Kundu & Roy, 2010; Lippert & Govindarajulu, 2015; Van de Ven, 1986). According to Bashshur, Bashshur, Shannon, and Sanders (1997), studying the adoption of new technologies is very important in order to have a successful implementation of telemedicine technology, and they have mentioned the failure of the implementation of telemedicine systems in the past due to the lack of understanding technology adoption.

Studies have highlighted the difference of telemedicine from other technologies when studying technology adoption and have considered the acceptance of healthcare technology as a very important issue in the successful implementation (Kohnke, Cole, & Bush, 2014; Wills, El-Gayar, & Bennett, 2008; Zai et al., 2013). The adoption of telemedicine technology is different due to the nature of the technology itself (Perednia & Allen, 1995). Also, the difference can be highlighted in different adopting groups, which include physicians, patients, hospital administrators, and payers (Menachemi, Burke, & Ayers, 2004). However, in hospital adoption of new technology like telemedicine, the influence from environmental factors will be higher (Naranjo-Gil, 2009). Existing literature has very limited empirical research on telemedicine technology adoption that used the organizational and organizational contexts.

Previous studies (Cimperman et al. (2016); Dünnebeil et al. (2012); Kohnke et al. (2014); J. Moeckli, P. Cram, C. Cunningham, and H. S. Reisinger (2013); Segrelles-Calvo, Chiner, and Fernández-Fabrellas (2015b)) has given less attention on environmental factors. Based on this gap, the current study will consider and highlights the environmental factors in the context of both technological and organizational adoption of telemedicine.

The greater part of research in telemedicine technology adoption is concentrated on individual prospective physicians and patients, as indicated in the literature. However, health facilities and hospitals have received less attention (P. J.-H. Hu, Chau, & Sheng, 2002; Maarop, 2013; Suhaiza Zailani et al., 2014). The probability of bringing in new innovations to any organization depends highly on management decisions. Thus, the hospital intention to use new technology is very important for successful implementation (Harfoushi, Akhorshaidah, Aqqad, Al Janini, & Obiedat, 2016; Mamatela, 2014). Studies, where the organization is the unit of analysis, should be considered for the successful presentation of telemedicine in Yemen (Al-Fadhli, Othman, & Al-Jamrh, 2017b). The adoption of new technology will be considered positive by organizations if they have positive involvement from the side of the management (Lian, Yen, & Wang, 2014). Moreover, the study will contribute to extending the literature by providing a better understanding of technology adoption by applied (TOE) and examining the intention to adopt telemedicine technology from both individual and organizational factors.

Sufficient assessment of technology adoption could not be fully explained by one acceptance dimension, and using individual-based theory is not useful in technology adoption in organizations (Parker & Castleman, 2007). Previous studies (Cilliers and Flowerday (2013); Dash et al. (2016); Evers (2014); M. P. Gagnon, E. Orruno, J. Asua, A. B. Abdeljelil, and J. Emparanza (2012); Kohnke et al. (2014); Y. Kowitlawakul (2011); J. Moeckli et al. (2013)) have used individual-based theory; however, the process of adoption happens between the stages of initiation and implementation before the acceptance of new technology (Lippert & Govindarajulu, 2015). This research will bridge this gap by integrating individual-based theory unified theory of acceptance and use of technology (UTAUT) and organizational theory of technology organization environment framework (TOE).

During the process of decision-making to implement telemedicine technology, different factors play different roles regarding health facilities' intention to use new telemedicine technology. Existing literature that used technology organization environment framework (Awa, Ojiabo, & Emecheta, 2015; Irwan, 2016; Y.-H. Lee, Hsu, Chang, & Cheng, 2016; Tiago Oliveira & Maria Fraga Martins, 2010a; Rosli, Yeow, & Siew, 2012a), have shown less attention of two important factors. First, an awareness which has highlighted the important influence in technology adoption by (Abubakar & Ahmad, 2013; Alzubi, Farea, & Al-Dubai, 2017; Hanafizadeh & Khedmatgozar, 2012; Mansor, Shariff, & Manap, 2012), Thus, low awareness or less information about telemedicine technology benefits among health facilities and prospective decision-makers may lead to lack of interest on adopting the telemedicine. Studies found that less information on the innovation is the main obstacle toward intention to use the innovation (Al-Somali, Gholami, & Clegg, 2009; Howard & Moore, 1982; Zolait, 2010).

Second, Voluntariness has highlighted the important influence in technology adoption (Karuri, Waiganjo, & Orwa, 2014; G. C. Moore & Benbasat, 1991; Ramayah, 2010b; Sharma, Ganpati, & Kumar, 2013; Venkatesh & Davis, 2000). Voluntariness indicates whether the adoption is mandatory or not and the way it might affect the adoption decision (G. C. Moore & Benbasat, 1991). This refers as there is no obligation for health facilities to adopt telemedicine technology.

Based on the preceding discussion, this research aims to fill the literature gap, which will contribute to theoretical contribution by testing the relationships of technological, organizational, and environmental factors and technology adoption with awareness and voluntariness as new moderators, which will be empirically validated using a proposed research framework.

Most early studies, as well as current work, have paid less attention to critical factors in telemedicine adoption. Identification of the factors that lead to technology resistance is a critical issue (Keen, 1981; Kundu & Roy, 2010). It is important to know what makes prospective decision-makers accept or resist technology unless it becomes gradually difficult to ignore the factors that may cause the adoption failure. Top management support is considered the most crucial factor for the successful adoption of information

technology systems (Aremu, Shahzad, & Hassan, 2020; Igbaria, Zinatelli, Cragg, & Cavaye, 1997). Firm size is also considered by Siew, Rosli, and Yeow (2020) as an important factor for the adoption of new innovation. Previous studies have proven that the more sophisticated IT infrastructure organizations have, the more chances of successfully implementing of new innovations (Fiedler, Grover, & Teng, 1996; Hassan, 2020; Lin & Lin, 2008; Zhu, Kraemer, & Xu, 2003)

To narrow the mentioned gaps, this study has identified and used important factors such as IT infrastructure, health facilities size, and top management support. Mentioned factors have proven to have significant influence in other areas of technology adoption, such as cloud computing (Alshamaila, Papagiannidis, & Li, 2013; Gutierrez, Boukrami, & Lumsden, 2015; Hassan, 2020), e-business adoption (Lin & Lin, 2008; Zhu et al., 2003), and e-commerce adoption (M. Liu, 2008; Mohtaramzadeh, Ramayah, & Jun-Hwa, 2017)

Responding to the above gaps in the literature and (MOPH) desire to bring in the innovation, this research developed and tested a comprehensive model to explore the relationship between technological, organizational, and environmental context and intention to adopt telemedicine technology. The explanatory would better have enhanced by extending and integrating TOE and UTAUT, which provides more complete constructs which have proven significant influence in other adoption areas for understanding the intended behavior of telemedicine. Unlike previous research, the integration of both theories will take into consideration the important factors and how they are related to the voluntariness, awareness, and intention to adopt telemedicine technology from an organizational perspective in the least developed countries' environment. The next section will discuss research questions and research objectives that will guide the study.

1.3 Research Questions

Discussion in the previous section has elaborated on the research gaps in the literature which guide the current study. In order to examine the framework, this research is guided with the following research questions:

1. To what extent are technological factors influencing the intention to adopt telemedicine technology among health facilities in Yemen?
2. To what extent are organizational factors influencing the intention to adopt telemedicine technology among health facilities in Yemen?
3. To what extent are environmental factors influencing the intention to adopt telemedicine technology among health facilities in Yemen?
4. In what ways does the moderating variable of awareness moderate the relationship between technological, organizational and environmental factors and intention to adopt telemedicine technology?

5. In what ways does the moderating variable of voluntariness moderate the relationship between technological, organizational and environmental factors and intention to adopt telemedicine technology?

1.4 Research Objectives

The aim of this research is to develop a framework that examines the intention of adopting telemedicine technology at the organizational level in the least developed countries, and the case is Yemen. Therefore, the study has the following specific objectives:

1. To examine the impact of technological factors on the intention to adopt telemedicine technology among health facilities in Yemen.
2. To examine the impact of organizational factors on the intention to adopt telemedicine technology among health facilities in Yemen.
3. To examine the impact of environmental factors on the intention to adopt telemedicine technology among health facilities in Yemen.
4. To investigate the effect of awareness as the moderating variable on the strength of the relationship between technological, organizational and environmental factors and intention to adopt telemedicine technology.
5. To investigate the effect of voluntariness as the moderating variable on the strength of the relationship between technological, organizational and environmental factors and intention to adopt telemedicine technology.

1.5 Significance of the Study

Providing health facilities with telemedicine technology aims to help the health sector to deliver healthcare services over distance and overcome the professionals' isolation. Telemedicine is a thrilling technology that can positively change healthcare in terms of collaboration and service delivery. This study of health facilities in terms of intention to use telemedicine is significant because it helps to predict the reaction to health facilities when implementing new technology and how technological, organizational, and environmental factors influence the change in the perception towards health facilities. Therefore, this study provides recommendations in preparing the appropriate environment before implementing telemedicine technology in health facilities.

Findings from the study shall also benefit and offer guidelines for health facilities managers and information system developers who are interested in implementing telemedicine technology. The findings of the study are valuable for support MOPH decision in per implementation stage of telemedicine technology adoption in Yemen

This study will contribute to a growing body of research on technology adoption, highlighting the role of telemedicine adoption by health facilities. This study agrees with the opinion that introducing innovation to any organization managers' views toward technology are very important which cannot be ignored. Unlike previous studies that focus on health recipient and health professional intention, this research contributes to growing research by study the adoption from management intention to adopt the telemedicine technology. This research also explores and examines the top management and middle management intention decision towards the telemedicine technology that might be introduced to health facilities in Yemen.

This research develops the TOE and UTAUT theories by extending the theories with new constructs and identifying new moderators in the telemedicine adoption context. This research is testing the relationships of technological, organizational, and environmental factors and technology adoption with awareness and voluntariness as new moderators empirically validated to the research framework. This study contributed to the existing literature by using IT infrastructure, health facility size, and competitive pressure as factors that may influence the manager's decision to adopt telemedicine technology which has been operationalized in another field of technology adoption.

1.6 Definition of Key Terms

The definition of key terms of the study is based on relevant literature, and it is used as guidelines to avoid any potential confusion or ambiguity related to this study.

Telemedicine technology: in this research, telemedicine has been identified as providing health services at a distance via electronic information and telecommunication technologies. According to Reid (1996), *“the use of advanced telecommunication technologies to exchange health information and provide healthcare services across geographic, time, social, and cultural barriers.”*

Awareness: In this research, Awareness has been identified as a Prior knowledge of the technology and its benefits. E. Rogers (1995) has defined awareness as the “user's knowledge about the capabilities of a technology, its features, potential use, cost and benefits.”

Voluntariness: In this research, voluntariness refers to the extent to which health facilities are free to adopt or not to adopt telemedicine technology. J. Wu and Lederer (2009) described voluntariness as the “degree of free will involve in the adoption of an information system.”

Health professional includes medical doctors both generalist and specialist practitioners, including Public health doctors, nursing professionals, including public

health nurses, dentists, pharmacists and excludes traditional and complementary medicine professionals, paramedical practitioners, dieticians and nutritionists and physiotherapists (Ganzeboom, 2010)

Health Facilities are places that provide health care, which include hospitals, clinics, and outpatient care centers (Ahmadi-Javid, Seyedi, & Syam, 2017). This research has also covered specialized care centers such as birthing centers and psychiatric care centers.

IT infrastructure refers to technologies that provide a foundation for Internet-related businesses. IT infrastructure is the physical IT assets, including physical technologies such as computers, communication facilitates, sharable technical platforms, and databases (Ross, Beath, & Goodhue, 1996).

Perceived Security: in this study, Perceived Security refer to the degree to which using information technology enables the administration of personal health information “the beliefs of the buyers on the ability and willingness of the technology to keep save the users' information from security breaches during transmission and storage” (Salisbury, Pearson, Pearson, & Miller, 2001)

Performance expectancy: in this study, performance expectancy is the degree to which a health facility feels that adopting the telemedicine will help the health facility to attain gains in job performance. “defined as the degree to which an individual believes that using the system will help him or her to attain gains in job performance” (Venkatesh, Morris, Davis, & Davis, 2003).

Effort Expectancy: Effort Expectancy is “defined as the degree of ease associated with the use of the system” (Venkatesh et al. (2003).

Facilitating Conditions: Facilitating Conditions is defined as “the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system” (Venkatesh et al., 2003).

Social Influence: Social Influence is defined as “the degree to which an individual believes that important others believe he or she should use the system”(Venkatesh et al. (2003).

Health Facility Size: Health Facility Size in this study refers to the number of patients serviced at this health facility and the employees (healthcare professionals, administrative and support staff) within the health facility (Jia, Guo, & Barnes, 2017; Zhu, Kraemer, & Dedrick, 2004)

Top management support: Top management support refers to the degree to which top management understands the importance of telemedicine adoption and the extent to which top management is involved in the telemedicine projects (Lin, 2014).

Trading partner readiness: Trading partner readiness refers to the willingness and ability of potential partners to adopt the innovation (Ferguson, 1992).

Competitive pressure: Competitive pressure refers to the degree of pressure resulting from a threat of losing competitive advantage, which forces firms to adopt the technology (Lin & Lin, 2008).

Government support: Government support in this study is referred to the assistance that the government offers to encourage the adoption of telemedicine. The degree to which government policies affect innovation diffusion (Mamatela, 2014)

1.7 Scope of Study

This study focused on the Yemen health sector and Yemen health facilities, and only health facilities listed in the ministry of public health were examined. Health facilities are places that provide health care, which include hospitals, clinics, and outpatient care centers. This research has also covered specialized care centers such as birthing centers and psychiatric care centers. This study focused on determining the main factors that influence the adoption of telemedicine technology in Yemen health facilities. The study used questionnaires to collect the data from the top managers of the health facilities. Managerial levels are the members who are authorized to make decisions, including top-level, middle-level, and executive-level.

1.8 Summary

This chapter presented the research background, including technology adoption and Yemen's health status. It describes the role of technology in healthcare and highlights the role of telemedicine technology to overcome such challenges. This chapter also presents the statement of the problem, research objectives, and also research questions. Besides, it highlights the study's significance, its scope, and the definition of key terms. The last section presents the summary.

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