Investigate the Adoption Barriers of Telemedicine

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1. Introduction

Today's rapid and dynamic changes increase the importance and value of technology management for any organization. Health care sector is one of the most important sectors for any country for two reasons; first, because it is related to people health and their live and the second reason is because of its high cost for both developed and developing countries. According to Centers for Medicare & Medicaid Services, Office of the Actuary, National Health Statistics Group; U.S. Department of Commerce, Bureau of Economic Analysis; and U.S. Bureau of the Census U.S. the national health spending in 2011 was just over $2.7 billions. This was about 17.9% of the U.S. Gross Domestic Product (GDP), which was $15,076 billions [1].

The national health expenditure will keep increasing and according to a study done by the center for Medicare and Medicaid services it will reach $4,638 billions by the end of 2020 and that about 20% of the U.S. GDP that will be $17,775 billions by the same year [1]

We can see form all of that data that health care expenditure will keep increasing and we have to take some advantages of Telemedicine applications that reduce the cost of healthcare for long term. Also, Telemedicine has many advantages in reducing the medical errors, and saving time for both patients and physicians. From table-1 bellow we can see the U.S. population keep increasing year by year and during the last decade it increased from 282 millions in 2000 to 311 millions in 2011, which is more than 9% during the same period. And from the same table we can see how the healthcare expenditures increased almost the double in the last thirty years ago between 1980 (9.2%) to 2011 (17.9%).

Item / Year	1960	1970	1980	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
U.S. Population (in Millions)	186	210	230	254	282	285	288	290	293	295	298	301	304	306	309	311
GDP (in Billions)	$526	$1,038	$2,788	$5,801	$10,952	$10,286	$10,642	$11,142	$11,853	$12,623	$13,377	$14,029	$14,292	$13,974	$14,499	$15,076
National Health Expenditures (Amount in Billions)	$27.4	$74.9	$255.8	$724.3	$1,377.2	$1,493.3	$1,638.0	$1,775.4	$1,901.6	$2,030.5	$2,163.3	$2,298.3	$2,406.6	$2,501.2	$2,600.0	$2,700.7
National Health Expenditures as a Percent of GDP	5.2%	7.2%	9.2%	12.5%	13.8%	14.5%	15.4%	15.9%	16.0%	16.1%	16.2%	16.4%	16.8%	17.9%	17.9%	17.9%

Table-1: U.S. population, GDP, national health expenditure, and national health expenditure as percent of GDP from 1960 to 2011 [1].

The data plotted in figure-1 bellow, where the blue line shows the percentage of the gross national product (GDP) to the national health expenditure, and it measured by the scale on the right axis. The red line is for national health expenditure, and it measured by the left axis scale billions of dollar.

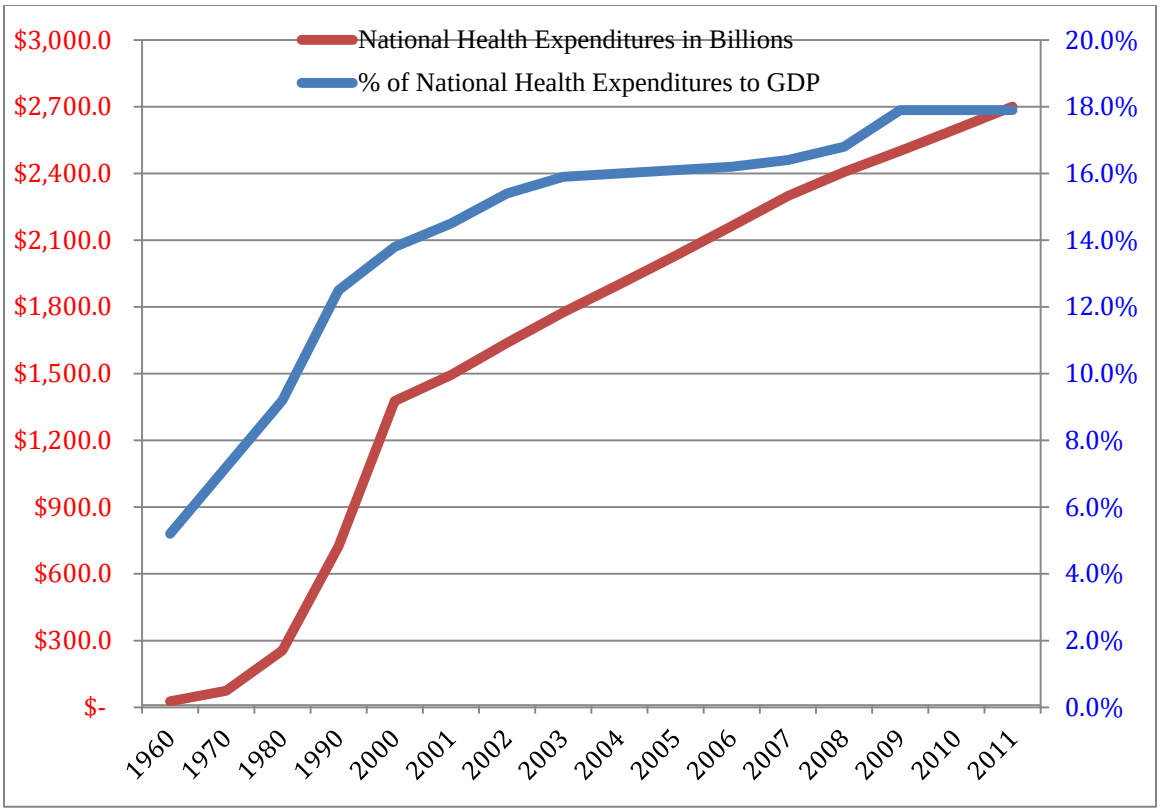

Figure 1: the percentage of the gross national product going to national health expenditure, and the national health expenditure between 1960 to 2011.

1.1 Definition of Telemedicine

The definition of telemedicine is different from organization to another organization and from industrial perspective to academia perspective, and for that there are many definitions and categories of Telemedicine depending on the background and the perspective. According to the American Medical Association (AMA) the definitions of "telemedicine" have developed over time starting from a wide definition to a narrow definition [2].

The World Health Organization (WHO) defined telemedicine as "The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities." [3].

The European Commission (EC) defined telemedicine more specific as "Telemedicine is the rapid access to shared and remote medical expertise by means of telecommunications and information technologies, no matter where the patient or the relevant information is located." [4]. The American Telemedicine Association (ATA) defines telemedicine as "the use of medical information exchanged from one site to another via electronic communications to improve patients' health status" [5].

The Agency for Healthcare Research and Quality (AHRQ) defined telemedicine as "the use of telecommunications technology for medical diagnostic, monitoring and therapeutic purposes distance the users." The AHRQ definition is focusing on areas that would substitute for face-to-face medical diagnosis and treatment of the Medicare population [6].

Fishman (1997) defined telemedicine as "the use of electronic information and communication technologies to provide and support health care when distance separates the participants." Also, Fishman clarified that "telemedicine is not a single technology or a discrete set of related technologies, but it is a large and very heterogeneous collection of clinical practices, technologies and organizational arrangements." [7].

Another definition of telemedicine is provided by Al-Qirim (2007) "The medicine from a distance where distant and dispersed patients are brought closer to their medical providers through the means of telecommunication technologies." [8]. Rooney (1999) defined telemedicine as the "use of electronic information and communication technologies to provide and support health care when distance separates the participants" [9].

From all these definitions of telemedicine we can conclude that there are three common elements in these definitions; first: telemedicine goal is to improve healthcare outcomes and deliver clinical support, second: to deliver clinical support intended to overcome geographical barriers, third: by using communication technologies.

1.2 History of Telemedicine.

From many centuries distance healthcare services have been provided to patients, and healers used the available communication services at their time. Ancient Egypt established a three steps system that exists to this day. The first step in this system is to listen to the patient, before any examination. Then, did a diagnosis after observation and examination. The last step is the treatment [10].

From this system we can figure out how significant is observation and examination before any treatment delver to the patient. The distance healthcare existed for more than 1500 years, and there were many elements that encourage this practice

such as limited transportations system, slow travel, and healing at home.

For example, mail was one of the first communication services that have been used, then telegraph that first used in the American Civil war [11]. After the innovation of Radio, soon been used in healthcare for long distance international communication [12].

In general, using the telecommunication network in order to get some medical examinations and evaluations is not new. The new discovery of radio brought new opportunities for distance diagnostic. During the early 1900s in Australia, the people living in remote areas communicate with the Royal Flying Doctor Service of Australia by using two-way radios that powered by a dynamo driven by a set of bicycle pedals [10].

During the mid 1920s both of Alfred Traeger and Flynn started their experiments with radio to connect the distant stations to the centralized medical base in order to replace the telegraph that was very complicated compared to radio [10]. The invention of the telephone, brought many ideas in the using expert to examine and evaluate some transmit heart and lung sounds, but unfortunately all failure and the poor transmission systems behind all these failures [10].

In 1903 the history recorded, the first experience of using telecardiology by sending electrocardiograph (ECG) from a hospital to a laboratory by Eithoven. Electrocardiograph (ECG) can be transferred using two ways either telephone or wireless [10]. During the first quarter of the 20^{th} century a huge innovation of broadcasting in brought more attention in how to get advantages from the radio communications in medicine.

In 1924, the science recorded one of the first conceptions of telediagnostic and televisit as they are quite used today, where a distance diagnostic examination to children with direct image [10]. During the 1920s Telemedicine was very useful, where physicians at the coast station assist ships with medical emergencies in the middle of the ocean by using radios. In April 1924, the “Radio News” magazine included article about telecare and put in its cover page as shown bellow in figure-2 [10].

Figure -2: “Radio News Magazine”, April 1924. (Adopted from Ramos 2010, [10])

In 1950, the history recorded the first broadcasts of radiological images between hospitals based on radio communications [10]. The invention of television brought a great impact on development of telemedicine. In 1955, the Nebraska Psychiatric Institute used the first interactive video communication in healthcare by getting advantages from two-way interactive television system for Telepsychiatry purposes [13].

Moreover, in 1967, the General Hospital in Massachusetts provided health services to airport employees and passenger. They used a two-way audiovisual microwave circuit (located 2.7 miles away) so that providing medical care to the patients at Logan International Airport Medical Station [14]. In 1971 the Nebraska Medical Center was linked with the Omaha Veterans Administration Hospital and VA facilities in two other towns [10].

In 1960s, in the early development of telemedicine, the National Aeronautics and Space Administration (NASA) played a crucial role, because it needs to monitor vital signals of astronauts. The Space Technology Applied to Rural Papago Advanced Health Care (STARPAHC) programmes was established by means of satellite based communication and space technology so as to bring medical care to the astronauts and residents of Papago, Arizona [15].

In 1970s, Europe started the first experiences in Scotland, by providing remote health attention to workers in the North Sea at the oil platforms [10]. In other European courtiers, such as Norway, the National programmes started provide some help to remote

rural centers. Also, during the 1970s the Satellite telemedicine begun Via ATS-6 satellites, and the paramedics in isolated Alaskan and Canadian villages were connected with hospitals in distant towns [10].

Table-2 summarized the phases of telemedicine developments as shown bellow:

Time Scale	Technology used	Examples/Description
Mid 19th century	Postal	Prescriptions and diagnosis exchanged between patient and physician by posts.
1835	Telegraphy	Used during American Civil War to send casualty lists and order supplies
1906	Telephone	Electrocardiograms sent using telephone networks
1920	Radio	Seaman's Church Institute of New York - first organization to provide medical care using radio
1950's onwards	Television and Space Technologies	Two way closed circuit television correspondence between Nebraska Psychiatric institute and Mental hospital in Norfolk
1967	Video conferencing	Station established at Massachusetts General Hospital/Logan International Airport to provide emergency medical care to airport employees and travelers
1990's onwards	Internet	Used in remote patient monitoring, store and forward modes using web for transfer of data
2000’s onwards	Mobile phones n Satellite communication	Web enabled mobile devices are used to transmit patient information from moving ambulances to hospitals

Table-2: Phases of Telemedicine development (Makena and Hayes, 2011 [16])

1.3 Categories of Telemedicine.

As the definition of telemedicine is different from organization to another and from industrial perspective to academia perspective, also the categories of telemedicine are different in the literatures. Depending on the background and the perspective the categories are different.

According to the World Health Organization (WHO) telemedicine can be classified based on the time of the information transmitted and the interaction between patient and the health professional into two basic types, store-and-forward (asynchronous) and real time (synchronous) [3&11]. Another classification by the American Telemedicine

Association (ATA) classified telemedicine services into five main categories: specialist referral services, patient consultations, remote patient monitoring, medical education, and consumer medical and health information [5]. Also, another classification done by Takahashi (2001) and he divided Telemedicine into three main categories: direct patient care, tele-consultation, and distant learning [17].

After reviewing many literatures in categorizing and classifying telemedicine, I found that we could group all of these categories and the classifications into three main categories: Real Time (Synchronous), Store-And-Forward (Asynchronous), and Remote Monitoring.

1.3.1 *Real Time (Synchronous)*

The real time telemedicine in simple way where patient and physician are located in two different locations at the same time and by using some interactive videoconference equipment they can interactive live as the traditional face-to-face practice [18]. Also, it includes phone conversations, online communication, and home visits.

In this category some devices can be connected to the computer in order to enable physician to get more information about his/her patients such as hearing patient heartbeat by using a device called "stethoscope". There are many specialties gain benefits from the real time consultation such as psychiatry, internal medicine, rehabilitation, cardiology, pediatrics, obstetrics and gynecology and neurology.

1.3.2 Store-And-Forward (Asynchronous)

In this category both of patient and health specialist located in two different locations and times. Store-and-forward telemedicine involves acquiring medical data (text, data, images, audio, biosignals etc.) from the patient and then transmitting this data to a doctor or medical specialist at an appropriate time to be evaluated by a specialist at another time and location.

This category requires a good medical record system with flexible and secure of receiving and transferring medical information such as x-ray and some digital pictures. The top three specialties that widely recognized and used this type of store-and-forward consultation are dermatology, radiology, and pathology.

A good example of store-and-forward consultation is x-rays where a provider at a remote site typically takes x-rays of the patient and then uploads those images to a secure server along with other clinical information about the patient. After that, a specialist at

another time and location login and review both the x-rays pictures and the clinical information and then write his/her treatment recommendations [16].

In 1993, the Harris Corporation, headquartered in Melbourne, Florida, stated using this level of telemedicine in order to reduce the cost of radiology, which increased by 22%. Harris Corporation established a business with the University of California at Los Angeles (UCLA), and created the Medical Technology Transfer Corporation (MTT) placed in Melbourne, FL. MTT provided several radiology services such as MRI, Ct scans, ultrasound, and X-ray. The system works simply by transferring any radiology services, for example X-ray, taken at MTT to UCLA for consultation or second opinion by some specialists in California. The Harris Corporation has a seven-year contract with UCLA and they expect to reduce the radiology costs from $10 to $15 million over the seven-year contract [19].

1.3.3 Remote Monitoring.

Remote patient monitoring enables medical professionals to monitor a patient remotely using various technological devices. Remote patient monitoring uses devices to remotely collect and send data to a home health agency or a remote diagnostic testing facility (RDTF) for interpretation. Such applications might include a specific vital sign, such as heart disease, diabetes mellitus, asthma, or a variety of indicators for homebound patients [5]. According to Field and Grigsby (2002) “the continuing improvements in technology have made home monitoring applications more clinically useful and easier for patients to use without onsite help from health care personnel” [20].

2. Benefits of Telemedicine

Telemedicine has many benefits for patients, providers and economics. The demand for telemedicine has continued to increase in both of patients and providers. Patients like telemedicine for two main reasons save time and more convenience. On the other hand, providers like telemedicine also for two main reasons better monitoring and deliver earlier treatment. In general, this will improve the healthcare system and reduce the cost of the treatment. We will talk in some details about each one these three compounds of telemedicine system that are patients, providers and economics.

2.1 Patients

There are many benefits of using telemedicine by patients, some these benefits related to time, money, and quality. The classical health cares system like any service delivery system, where the clients travel to the service provider in order to get the seeking service. In our case the patients have to travel physically from their rural areas to the metropolitan areas in order to consult with a medical specialist. By using telemedicine patients' gain the consulting they want from their home or the rural primary care provider through the telecommunications facilities. As we know The United States has large rural areas, and it is very clear patients' opportunity to save millions spent annually on patient vehicle travel expenses.

Also, many patients prefer to stay in their home as they can before they go to a health care provider. Also, as part of reducing the health care services cost many patient leaving hospital earlier and taking their additional care at home while they recover because treating patient at home is not as expensive as the hospital. According to a new research in home care nurses they found that telehome care minimized the nurses visiting time and reduced the cost up to 33-50% than the traditional home care visit.

Moreover, quality is one of the most advantages of the telemedicine, where patients in the rural areas can access the high quality healthcare services. According to one study there are about 20% of the U.S. population (55 million) reside in rural areas and as they are citizens they deserve high quality healthcare services as the other 80% who reside in metropolitan areas and have high quality healthcare services. And telemedicine will improve the healthcare quality by increasing the collaboration between providers in order to enhance the services that provide to the patients.

2.2 Providers

Providers by applying telemedicine they could gain many benefits such as access to information, reduce medical errors, and increase the working efficiency. In business time is money, but in Emergency Room time is life. Telemedicine provides immediate access to information for either patient or any medical topic fast and accurate at the same time.

Also, telemedicine improve the accuracy of diagnosis and that will reduce the medical errors, which is very important for the medical community. The simplest practice is the "tele-assistance" where a physician can get either a second or specialist opinion on their patients' diagnosis. Correct diagnosis at the first time has many benefits for both patients and hospitals, where it will reduce the average recovery time, less use of unneeded medicines, and at the end reduced the costs to patients and hospitals.

Another benefit related to efficiency, as we mentioned before telemedicine will reduce the travel time for both of patients and doctors, and that will lead to increase the efficiency. Also, it will decrease the use of paper work and research time of medical records. According to the U.S. Armey telemedicine speedup the whole process in the foreign military bases. They can gain consultant from anywhere and reduce the decision-making time.

Continuance education is very important in any field, and it is essential in healthcare. Telemedicine can enhance the providers' education and keep them up to date about any medical topic. Physicians could improve their education with the latest knowledge at their offices and saving providers time and money.

2.3 Economics

Also, economics will gain some benefits by applying telemedicine such as enhance local economy and increase business retention and recruitment. Telemedicine can improve the healthcare services delivery system. The new telemedicine technologies increase the home health providers' efficiency by reducing the travel time to patients' homes. Also, patients have more opportunity to be seen by specialists by using the new telemedicine technologies.

Healthcare is very expensive, especially in rural economies where spending in the health care has major segment of the economy. As the telemedicine reduce the spending money non-locally, as the local economy enhance by spending more dollars locally. Telemedicine can increase the ability to provide healthcare services to the rural areas. In general, this capability will increase the retention and recruitment in the healthcare sector, and especially in the rural areas.

Also, some people in rural areas cannot travel outside the community for training or studying. Telemedicine can provide high quality healthcare education and training partnership with educational institution by using videoconferencing in rural communities. This will help to cover the shortage of medical staff in rural hospitals by hiring more locale people. Telemedicine provide quality healthcare services for people in rural areas, and also improve the quality of healthcare services provided in both of metropolitan and rural areas.

3. Adoption Theories

In this section we will review the famous and important adoption theories in some details. Four important theories described bellow as following order: 1) The Theory of Reasoned Action (TRA), 2) The Innovation Diffusion Theory (IDT), 3) The Technology Acceptance Model (TAM), and Theory of Reasoned Action (TRA).

3.1 The Theory of Reasoned Action (TRA)

The Theory of Reasoned Action (TRA) was developed in 1967 by Fishbein and Ajzen in order to predict behaviors and outcomes as shown in figure-3. They assumed, ”individuals are usually quite rational and make systematic use of information available to them. People consider the implications of their actual behaviors before they decide to engage or not engage in a given behavior” [21].

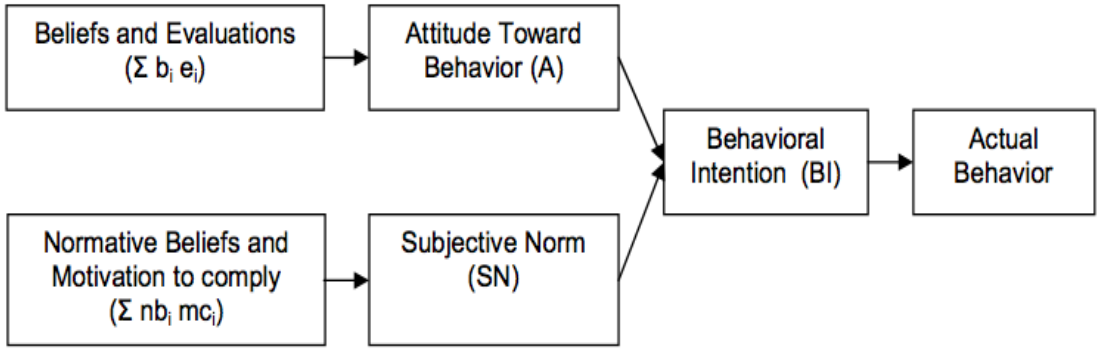

Figure-3: Theory of Reasoned Action (TRA) (Aizen and Fishben. 1980) [21].

They developed a theory that could predict and understand behavior and attitudes after studying all the available studies in behavior and attitudes. They introduce a new framework, where the behavioral intention is the main predictors of actual behaviors rather than attitudes, which have become known as the Theory of Reasoned Action (TRA).

Ajzen and Fishbein revised and expanded the Theory of Reasoned Action (TRA) in the early 1970s. The theory was used to study human behavior and develop appropriate interventions by 1980 [22&23]. The social psychology models were the most studied by TRA that is concerned with the factors of consciously intended behaviors [24].

By applying TRA we can identify how and where to target strategies for changing actual behavior. Also, we can explain virtually any human behavior, and predict and

understand motivational influences on actual behavior that is not under the individual's volitional control.

According to TRA, in order to define a person's performance of a specified behavior we have to determine his or her behavioral intention (BI) and BI is jointly determined by the person's attitude towards using (A) and subjective norm (SN) concerning the behavior in question.

3.2 Innovation Diffusion Theory (IDT)

Rogers established Innovation Diffusion Theory (IDT) in 1962 and became a well-known theory for user adoption [25-27]. The end user is the core element in innovation diffusion. Innovation diffusion can be achieved through users' by accepting and using of new ideas.

The Innovation Diffusion Theory (IDT) is very helpful in explaining the innovation decision-process. The theory can explain the elements of rate of adoption, and the other categories of adopters. Also, it helps predict the probability and the rate of an innovation being adopted.

Tornatzky and Klein (1982) found that only relative advantage, compatibility and complexity were consistently related to the rate of innovation adoption by applying meta-analysis of 75 diffusion articles [28].

In general, we can call diffusion as a special type of communication, but only concerned with the spread of messages that are perceived as new ideas. The diffusion consists of four main elements that are the innovation, communication channels, time, and the social system.

3.3 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) derived from the Theory of Reasoned Action (TRA), and it was first time proposed by Davis in 1989 as shown in figure-4 [29]. TRA is a specific model to measure the usage of information system. On the other hand, TRA is just a theory to explain the human behavior. Understanding the relation between user acceptance of PC-based applications and the other external variables are the reasons behind the TAM [30&31].

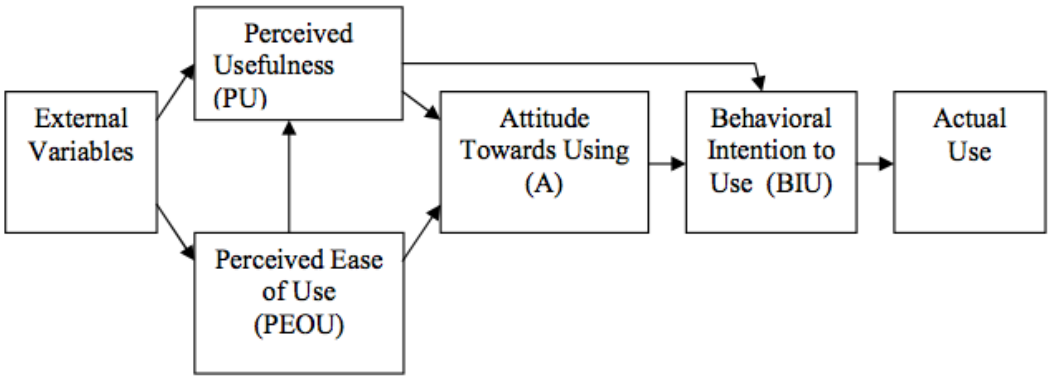

Figure-4: The Technology Acceptance Model (TAM) (Davis, F. D. 1989) [29].

TAM became common in many studies related to technology acceptance, and has been widely used as theoretical framework in the latest studies to explain technology acceptance. There are many studies explaining technology acceptance such as the study of the Internet and World Wide Web (WWW) [32-34].

Davis (1989) defined Perceived Usefulness (PU) as "the degree to which a person believes that using a particular system would improve his or her job performance" and Perceived Ease of Use (PEOU) as "the degree to which a person believes that using a particular system would be free of efforts" [29]. The perceived usefulness (PU) and perceived ease of use (PEOU) are the two main elements of TAM that came from the basis of TAM as we mentioned before that the TAM derived from the TRA.

3.4 The Theory of Planned Behavior (TPB)

Theory of Reasoned Action (TRA) has some limitation such as when it applied to the actual behaviors that are not fully under a person's volitional control. The Theory of Planned Behavior (TPB) is just an extension of the Theory of Reasoned Action (TRA) [31&34]. The central factor in the TPB is the individual's intention to perform a specific behavior as the TRA as shown in figure-5 [35].

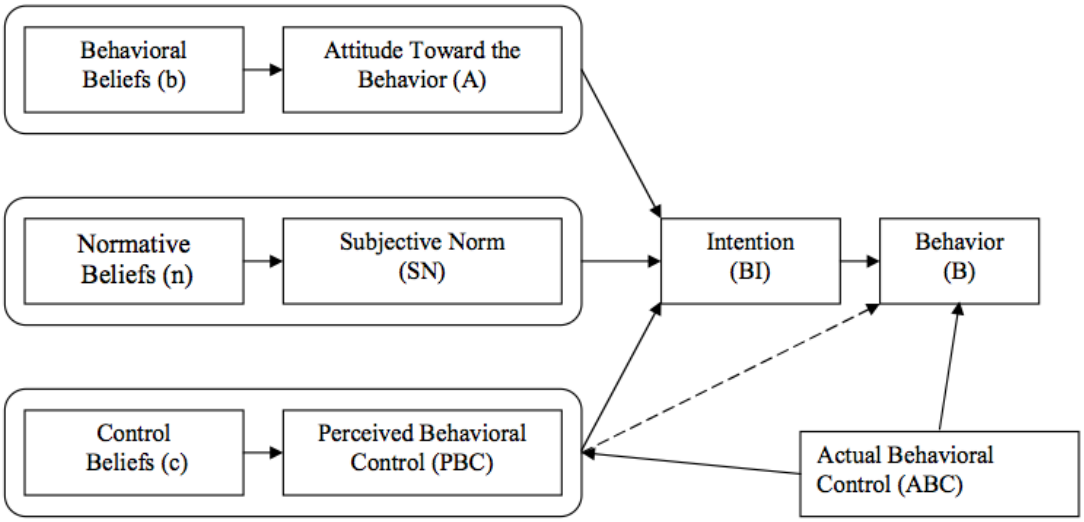

Figure-5: Theory of Planned Behavior (TPB) (Ajzen, I. 1991) [35].

The motivational factors that influence actual behavior can be captured by intention such as how much of an effort people are planning to apply, how hard they are willing to try in order to achieve the actual behavior. In general, as strong the intention to engage in actual behavior, as likely should be its performance.

4. Barriers of Adoption

While telemedicine holds great promise for new, cost-effective, high quality healthcare services, and efficient methods of delivering healthcare across geographic distances. However, these benefits are constrained by many barriers and we can group them to four main barriers: Financial barriers, Technical barriers, Logistical barriers, and Cultural barriers.

4.1 Financial barriers

Developing and implementing a telemedicine system is a financially challenging task. The financial barriers include everything that related to the financial issue involved in implementation of telemedicine. Cost is one of the most important organizational barriers to the adoption of new technology. Both start-up costs and maintenance costs can be high for any new technology especially in the healthcare industry.

There are two studies estimating the cost of implementation of HIS application in healthcare; the first study focused on single and small group practices and found that the

average costs of EHR system about $44,000 and the ongoing costs average about $8,500/year. The second study focused on annual technology budget and found that after implementing the HER system the budget increased from $10,000 to $40,000 with about $5,000 ongoing costs for five years [36&37].

Consulting Group researchers develop a model for estimating hospitals' costs for adopting a computerized physician order entry CPOE system and they used five hospitals or multihospital groups in their case studies [38] and their result summarized in table-3 bellow:

Hospital Size	Initial Costs	Annual Operating Costs
≥ 500 Beds	$7.9 million	$1.35 million
≤ 250 Beds	$3 million	$700,000
Average	$14,533 / bed	$2,733 / bed

Table -3: The initial and annual operation cost per hospital size

There are many factors under the telemedicine financial barriers in the literatures, and the top three factors under the financial barriers are start-up cost, ongoing costs, and reimbursement or incentives.

4.1.1 High start-up costs

The main factor under the financial barriers is the high start-up costs that include all the money needed to implement the telemedicine. The start-up cost includes initial fixed cost of the hardware, software, and technical assistance necessary to install the system, licensing fees, and the expense of maintaining the system. Some example of elements under the start-up costs such as the purchase of software and hardware, installation, and training. Also, during estimating of the start-up cost, training for both bedside and remote care teams needs to be addressed and should be continuing to the end of the project. There are some studies concluded that high start-up costs as one of the main financial barriers of adoption telemedicine [39-43].

4.1.2 Ongoing cost

Moreover, the ongoing cost is another factor under the telemedicine financial barriers. The ongoing costs include all the financial payment after implementing telemedicine in order to work effective and efficient such as system administration, support, control, and maintenance [44]. Staffing cost is one of main important cost that usually consuming more than half of annual operational costs. The staffing cost includes the daily operation costs such as the information technology (IT) expert and the salaries [45&46].

4.1.3 Reimbursement

Payment or reimbursement is very important barrier for telemedicine adoption and it has been identified as one of main barriers for health systems to begin adopts telemedicine services. According to Chaudhry physicians' reimbursement is identified as a key topic in policy discussions [47].

Telemedicine have potential benefit of improving the quality of medical care. However, unless physicians see some personal benefit from using telemedicine, they will stick to their traditional working procedures instead of switching to the new process. There are two studies in implementing telemedicine by physicians conclude that unless physicians have some personal incentives during the implementation, the adoption will not reach the expected level [42&48].

4.2 Technical barriers

Telemedicine is high technology systems and consist of complex hardware and software that required specific level of computer skills for providers, physicians, and patients. There are some factors under this barrier such as computer skills, training and technical support, and infrastructure.

4.2.1 Computer skills

Lack of computer skills includes the skills that necessary to use new equipment or learning how to use current equipment in different ways. Physicians need some generic skills, such as computer skills, in addition to clinical skills. Physicians and patients in many researches found insufficient in technical and computer skills that required for applying telemedicine [49&50]. This factor is very importing and it reduces the adaptation rate of the telemedicine [51]. For example, many physicians "consider EMRs to be challenging to use because of the multiplicity of screens, options, and navigational aids" [52]. Some physicians have limited computer skills that reduced their ability to conduct a telemedicine consultation.

4.2.2 Training & Technical Support

Training is one of the most technical barriers, and many physicians complain of poor services such as lack of training and support [39]. According to study by Ludwick (2009) he concluded that physicians struggle to get appropriate technical training and support for the systems from the vendor [52]. Another study by Hayward-Rowse and Whittle (2006) shows that lack of training to operate a specific application is a barrier

that also affects not only physicians, but also the nursing community [53]. In another study by Simon (2002), he found that two-thirds of physicians indicated a lack of technical support as a barrier to them adopting EMRs [46], while Ludwick noted that some physicians reported a lack of access to vendor technical support [52].

4.2.3 Infrastructure

The stepping-stone of the entire telemedicine project is the telemedicine network. Infrastructure is one of the most challenges barriers under the technical barriers. There are some common characteristics that each telemedicine network has to be able to connect to the Internet, high-speed, standardized, secure, private, redundant, and reliable.

Also, there are some other barriers under the technical barriers such as the complexity of initial installation and operation, lack of high-speed connectivity and access, and the unstandardized healthcare information or documentation systems. Lack of uniformity regarding security, privacy, and confidentiality of electronic information are considered as technical barriers to adopt telemedicine.

4.3 Logistical barriers

The logistical barriers of telemedicine represent a significant barrier to its widespread implementation. Regulatory issues have been identified as a barrier to implementing telemedicine programs. According to recent survey out of state physicians licensing, the credentialing for medical staff privileges at individual facilities, and concern about malpractice liability are the three significant impediments for implementing a telemedicine solution [54].

4.3.1 *Licensure*

The major legal barriers issue to implementing telemedicine activities is physicians' licensure. Currently, each state is responsible to police the practice of medicine to practice the art and science of medicine based upon strict requirements by issuing licenses to qualified medical professionals. States have legal authority to launch lows to protect the health, and for that the regulations are different from state to another and still the physicians have to be licensed in each stat before they can practice medicine.

However, standards for practicing medicine are relatively uniform across the country. Thus, telemedicine use across state borders is impossible without securing multiple state licenses, interstate licenses or federal licenses to practice medicine. According to the U.S. Constitution, states have the right to decide how they will regulate health care and as of 2006, 32 states did not have legislation that addressed telemedicine

[55].

According to Dr. Rogove, the process for a physician to receive interstate medical licensing is a complicated, unnecessary and expensive process that represents a major barrier. The U.S. medical system is state-based that means in order to be licensed to practice physicians have to pass tests managed by the state and a pay a fee directly to the state. This barrier would significantly limit the benefits of telemedicine because physicians have to take additional tests, filing papers and paying fees in order to practice medicine at another state and most of them would not want to do all of that again and again.

States have differing policies on telemedicine licenses: California, Florida, and New York require full licensure to perform any function relating to patient care. Alabama, Montana, Minnesota, New Mexico, Ohio, Oklahoma, Oregon, Texas, and Tennessee have telemedicine licenses and Nevada has a special purpose telemedicine license. The other states are exploring the issue of telemedicine and its regulation [56&57].

In general, licensure can be a problem for several reasons, including variations and sometimes conflicts among laws in different states, and the licensing process can be complicated, lengthy and expensive.

4.3.2 Credentialing

The second logistical barrier to implement telemedicine is credentialing of medical professionals. The Centers for Medicare and Medicaid, the National Committee for Quality Assurance (NCQA), and the Joint Commission issue credentialing regulation for medical boards, hospitals, and healthcare insurance plans. According to the Centers for Medicare and Medicaid Services (CMS) hospitals have the right to make all privileging decisions based on the recommendations of its own medical staff. For every single practitioner, medical staff examined and verified the credentials of applying privileges irrespective of whether that practitioner was providing services in at the hospital or remotely through a telecommunications system.

4.3.3 Malpractice

Malpractice coverage is always present in a doctor-patient relationship. The risk of additional malpractice liability constitutes another barrier to the practice of telemedicine. Telemedicine covers a wide geographic region and that make it difficult for physicians to get the suitable coverage because many medical malpractice insurance companies do not prefer this feature. In general, providing medical liability insurance for telemedicine is complicated task.

Telemedicine across state borders create several questions regarding the malpractice liability such as where a malpractice lawsuit may be filed and the law that will be used. In simple example, if a doctor in any state makes a treatment decision for a patient in a different state, and the decision turns out to be questionable, which state's malpractice laws will rule? Which state's a consent law apply? Theses just simple questions and for sure many other questions will rise in the same case

4.4 Cultural barriers

Cultural barriers is one of the most important barriers that decelerate the adoption of telemedicine for widespread. There are two main categories of cultural barriers: physician acceptance and patients satisfaction. Physician acceptance includes everything related to their discomfort of using the new technology equipment in their daily practices and treating patients at a distance. Medical staffs and physicians are worried about being replaced by the new medical technology. Physician acceptance of telemedicine includes quality, personal preference, previous experience, control of patient care, convenience, and reimbursement potential. Patient satisfactions include anything that could decrease their satisfaction with using telemedicine. Patients in general are worried about the quality of remote health care service. They basically do not trust the technologies have been appropriately advanced for medical practices.

5. Proposed Model

We will use AHP model in order to prioritize the telemedicine adoption barriers that identified from the literature review. The proposed model is shown bellow in figure-6. In this stage of the model we will use pairwise comparison in order to rank the main four identified adoption barriers that are financial barriers, technical barriers, logistical barriers, and cultural barriers.

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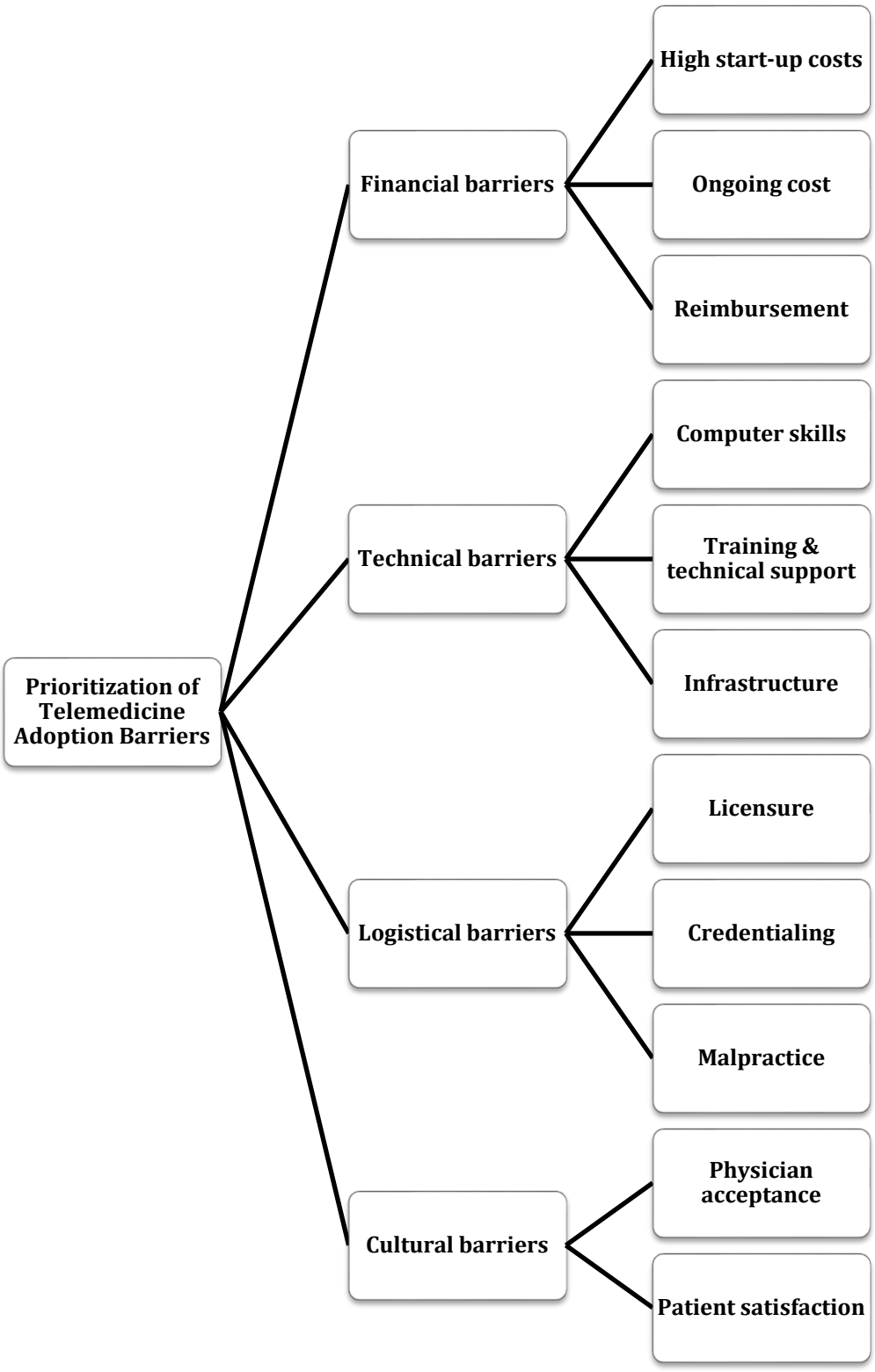

Figure-6: AHP model for prioritization the telemedicine adoption barriers.

In order to test the model we asked some of ETM Ph.D. to fill the pairwise comparison as there are experts in this study. We used scale from 1 to 10 where 10 are most important and 1 is the least important and the result shown in the six tables bellow.

Participant 1

	Financial barriers	Technical barriers	Logistical barriers	Cultural barriers	Weights
Financial barriers	1	2	0.167	4	16.7%
Technical barriers	0.500	1	0.167	6	13.7%
Logistical barriers	6	6	1	8	65.2%
Cultural barriers	0.250	0.167	0.125	1	4.4%

Participant 2

	Financial barriers	Technical barriers	Logistical barriers	Cultural barriers	Weights
Financial barriers	1	3	0.200	4	20.8%
Technical barriers	0.333	1	0.200	6	13.5%
Logistical barriers	5	5	1	8	61.2%
Cultural barriers	0.250	0.167	0.125	1	4.5%

Participant 3

	Financial barriers	Technical barriers	Logistical barriers	Cultural barriers	Weights
Financial barriers	1	4	0.250	6	26.6%
Technical barriers	0.250	1	0.250	4	11.7%
Logistical barriers	4	4	1	8	57.3%
Cultural barriers	0.167	0.250	0.125	1	4.4%

Participant 4

	Financial barriers	Technical barriers	Logistical barriers	Cultural barriers	Weights
Financial barriers	1	6	0.250	6	16.7%
Technical barriers	0.167	1	0.500	6	13.7%
Logistical barriers	4	2	1	9	65.2%
Cultural barriers	0.167	0.167	0.111	1	4.4%

Participant 5

	Financial barriers	Technical barriers	Logistical barriers	Cultural barriers	Weights
Financial barriers	1	0.500	0.250	4	15.7%
Technical barriers	2	1	2	8	44.0%
Logistical barriers	4	0.500	1	6	35.5%
Cultural barriers	0.250	0.125	0.167	1	4.8%

Participant 6

	Financial barriers	Technical barriers	Logistical barriers	Cultural barriers	Weights
Financial barriers	1	0.500	0.167	6	14.9%
Technical barriers	2	1	0.500	6	25.9%
Logistical barriers	6	2	1	8	54.9%
Cultural barriers	0.167	0.167	0.125	1	4.3%

Table-4: pairwise comparison for six participants.

The final result shown in table-5 bellow and it is very clear that logistical barriers are the most telemedicine adoption barriers with 55.9% weight. The second barriers are financial barriers with 20.9% weight. The third barriers are technical barriers with 18.9% weight, which is too close to the financial barriers. The last barriers are cultural barriers with 4.5% weigh, which is too low.

	Financial barriers	Technical barriers	Logistical barriers	Cultural barriers	Weights	Rank
Financial barriers	1	1.817	0.210	4.899	20.9%	**2**
Technical barriers	0.550	1	0.401	5.883	18.7%	**3**
Logistical barriers	4.752	2.493	1	7.777	55.9%	**1**
Cultural barriers	0.204	0.170	0.129	1	4.5%	**4**

Table-5: the final ranking of identified adoption barriers.

6. Conclusion

Although telemedicine has many definitions and different categories and classification, but no one can ignore its benefits for patients, physicians, and community. Telemedicine is still a rich area for more innovations and more investments and the future will bring more opportunity as the new technology improve the quality of telemedicine services and at the same time the huge improve of the telecommunications technology.

Telemedicine faces many challenges in legislation and regulation, financially, and also technical and culture challenges, but still the future is for telemedicine as there are many evidences support its cost benefits and improve the quality of healthcare services. Telemedicine needs support from individuals, communities, government, and healthcare providers and payers in order to be the first option to take over the traditional face-to-face practice.

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