

A Telemedicine Rural Suggested Testbed

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Summary

Various disciplines have been concerned by digital transformation. One can name examples, attesting that worldwide trend, like smart homes, transport, Health, Industry. . . Particularly, medicine practices were widely enhanced by taking advantages of information processing added by a more developed communication technology (ICT). This paper talks about Telemedicine in rural zones. 5G Mobile networks have the potential to bring advancement to this digital transformation in healthcare sector. Various services are reviewed and updated. This will surely help to easily offering medical services for rural and isolated zones as deprived areas. This will be deeply shown towards our paper.

Keywords:

Rural zone, Radio Mobile Networks 5G, Telemedicine, service.

1. Introduction

In recent years, firms and various life sectors have implemented many initiatives to explore and leverage new digital technologies. Basically, digital transformation is introduced to improve the business and life. This modern and technological trend can be seen via many daily life situations. The goal is to provide a better standard of living using all available digital technologies. The advent of new digital technologies has led to a clear change. Individual's way and organizations work, allowing them to evolve their work processes. Roughly speaking, one gains saving time and making gradual progress [1]. We can cite examples of digital transformation in different areas such as Nespresso, which is a company that has succeeded in its digital transformation, the coffee machine manufacturer has deployed a customer relationship management system (CRM) cloud offering its customers access to its products which they can join the company through the website and the mobile application. Also Netflix, launched in 1997, as a DVD rental company by mail, today is the online video streaming service offers personalized offers according to the preferences of each customer. We can also mention Amazon, created in 1994 as a simple online bookstore, distributes physical bookstores and distance selling catalogs. But by transforming itself into a "Market place" it has completely changed in nature and size thanks to technology until it has become today one of the giants of IT with its subsidiary AWS (Amazon Web Services) is a complete scalable platform of cloud computing offered by Amazon

[1]. In this paper, we will show how this has been reached in number of life sectors and example will concern a medical service. This is not adequately nor sufficiently guaranteed in rural zones. Potential benefits of digitalization are diverse, including increased sales and productivity, value creating innovations, and new forms of customer interaction. Nevertheless, some notions must be cleared to avoid confusion and disliked trends. So, we will see some notions in health sector and practices of Telemedicine then we will focus on the history appearance of the Telemedicine's concept in Tunisia. Finally, we will show our Suggested Rural Telemedicine Testbed.

2. Basic definitions: Telehealth Telemedicine

I the beginning, it will be useful to give an accurate meaning and what difference is between telehealth and telemedicine. In fact, Telehealth is defined by the Federal Telehealth Group as "a broader concept than telemedicine and addresses the use of information technologies not only for delivering medical care remotely, but also for delivering preventive health and other public health interventions remotel" [2]. Then, Telehealth equipment refer to complementary health information and preventive services without necessarily involving medical professionals [3]. Let us remember that the term "Telemedicine" was firstly used in the late 18th century [3] and was one of the first addition in the early 20th century. In that era an electrocardiograph data was transmitted over a telephone line [4]. Nowadays Telemedicine really began in 1960. What's this? As it will be developed in this paper, Telemedicine means "The practice of medicine or teaching of the medical art, without any physical patient's presence nor physical contact. Examination is conducted via an interactive audio-video system employing tele-electronic devices" [5]. Let's before give what accurately will distinguish a Telehealth from a Telemedicine one.

A. Difference between Telemedicine and Telehealth

The health sector can be more efficient and improvised by using modern ICT solutions. New wireless communication technologies (e.g. 5G) and big data analysis, can be cited to offer a great help making easy a telehealth actions. This refers to a complementary health information and

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prevention services. In such manner, health professionals aren't necessarily involved (service to the person for his well-being, example m-health) [6] [7]. Telemedicine has the advantage to dematerialize the intervention. This is simply remotely done and we haven't obligation to move medical tools and equipment nor the patient [6] [7]. Digital transformation in the healthcare sector includes the integration of digital technologies into healthcare to provide and support services. By integrating these technologies, we can significantly both improve [8] the quality of care and patient experience also operational efficiency. Such practice surely meets better the needs of an ever-growing population. In this regard, robotics, artificial intelligence (AI), the Internet of Things (IoT), and big data will be taken to the next level under 5G, driving the digital transformation of healthcare. So, we talk about e-health. Following the evolution of the way to provide an available level care, with a same or enhanced quality, two concepts have appeared. These concepts concern Telemedicine and Telehealth. Nevertheless, an ambiguity could concern the difference between these two words/notions. Consequently, a number of questions arise, does Telehealth has the same meaning as telemedicine? and are these two terms interchangeable? If not, what are the main differences between the two? That's why during 2014, the US federal government tried to answer these questions. As a result, a special task force has been convened in order to "identify and assess definitions of telemedicine/telehealth across the U.S. government to provide a better understanding of what each agency or department means when using these terms" [9]. Then telehealth was defined by the Federal Telehealth Group as "a broader concept than telemedicine and addresses the use of information technologies not only for delivering medical care remotely, but also for delivering preventive health and other public health interventions remotely" [2]. In the other hand Telemedicine is defined by the Health Resources and Services Administration (HRSA) as [10]: "the use of electronic information and telecommunications technologies to support and promote long-distance clinical health care, patient and professional health-related education, public health and health administration". Technologies include videoconferencing, the internet, store-and-forward imaging, streaming media, and terrestrial and wireless communications.[10]. Telehealth and telemedicine do not share the same concept and do not involve the same parties as it was formerly indicated. In the context of telemedicine, technological devices offering the possibility of providing remote medical care are potentially numerous. As it was underlined, one can see that medical care integrates a wide variety of applications and communication technologies [11]. By facilitating communication and collaboration between doctors, nurses and patients, the medical care may also improve the quality of life [12]. Thanks to remote medical care, it would be possible to reduce geographic and social inequality for

diagnosis and medical needs [13]. On the other hand, telehealth devices refer to complementary health information and preventive services without necessarily involving medical professionals [14]. Those options, dealing with remote and practical actions, will not have any meaning if one ignores how he will really conduct interventions. This will be explained in the section below.

3. Telemedicine practice

Technologies, including information and communication technology (ICT), have played an important role to enhance advances in medicine and healthcare. These advancements can be shown, in many applications such [15]: -Teleconsultation. has been available for several years as a usual service worldwide. This allows to connect a health professional and a patient. Teleconsultation operates in two situations types. The most common case was particularly used for medical deserts. There the patient wishes to carry out a simple exchange via his link because he can't nearly succeed. The other type of Teleconsultation could concern an eventual consultation between two doctors when one Dr is close to his patient but an advisement is to be approved by the other. -Remote monitoring: differs from teleconsultation since it concerns a patient already known by the doctor or the healthcare team. The aim is to allow a doctor to remotely collect and analyze the data of his patient collected either by the patient himself or by another health professional. The doctor will only remotely interpret that data and modifies the treatment, if needed. -Tele expertise: concerns a professional exchange between two or several doctors. This allows a healthcare professional and his patient to call on for an expertise offered by another professional remotely located. Remote expertise is done through electronic transmission of clinical, biological, and / or imaging data, rather than moving the patient. -Medical teleassistance: corresponds to an act during which a doctor technically assists an intervention from a distance. The most well-known application from the perspective of telemedicine support is remote surgery. Nowadays, this the most futuristic and underutilized technology, allowing remote surgery to be performed using robot-mounted medical equipment or a fully automated operating room.

4. Telemedicine and its history in Tunisia [16, 17, 18]

Telemedicine was launched in Tunisia in October 1996, with occasional links between the Rabta and Paul Brousse hospitals in Paris. In the same year, the Ministry of Health decided to include telemedicine in its strategic IT plan and, given the benefits to be gained from this new practice, decided to create a National Commission for

Telemedicine. The first law came out in 2018, defining it as a way of practicing medicine and dentistry. The Covid-19 pandemic has reinforced the place of telemedicine, which is no longer perceived as a complement to conventional medicine but as a field of practice in its own right. Telemedicine legal framework in Tunisia In relation with the technological lived progress, authority has chosen to adopt this application named telemedicine to be implemented in public's rabta hospital. Telemedicine was introduced in Tunisia through Law No. 2018-43 of July 11, 2018 [17] having amended Article 23 of Law No. 91-21 of March 13, 1991 relating to the practice and organization of the profession of physician and dentist [19]. This amendment had introduced telemedicine as a sixth type of authorized medical act for medical professionals [20]. Telemedicine was intended to address the shortage of doctors in the inland and less health promoting regions of Tunisia. This includes streamlining the management of dependent patients and chronic diseases, access to quality care. They aim to minimize travel from less specialized areas to the capital. A promotion of health and medical care will result. This causes a health's professional cooperation, securing financial savings for health institutions and in the regions. According to Law 2018-43, telemedicine is defined as the practice of telemedicine using ICT [17]. The law states that telemedicine allows communication with other physicians, patients and physicians, or one or more health professionals, including at least one physician, for the purpose of diagnosis, obtaining medical advice, monitoring and ensuring surveillance of a patient or other medical services and procedures [17].

5. Rural area

In Tunisia, rural areas suffer from many problems and deficiencies at different levels. A lack of infrastructure, hospitals, specialists, illegality in the priority between patients and financial problems, could obviously be noted. So, considering the difficulties that rural populations know dealing with health. Several patients lost their life caused by the bad conditions having longtime existed. It is time to take advantage from the technological progress to facilitate the care and to improve the existing conditions in order to guarantee an easy and equal access to all the patients whatever their location especially in the rural areas suffering from the sick and unable to move.

A. Suggested Rural Telemedicine Testbed

The Considering that the field of health is very important since it is directly related to the life of human beings, telemedicine facilitates medical care and tackles many problems in this field. In this work we are interested in a famous problem in Tunisia which is the mortality of

pregnant women and newborns. According to World Health Organization (WHO) estimates for 2015, 303,000 women died during pregnancy, childbirth or in the postnatal period, while 2.6 million babies were stillborn and 2.7 million babies died during the first month after birth. The majority of these deaths occur in low- and middle-income countries and are preventable [20] [25]. According to the MOH epidemiological report, it appears that one of the major factors in maternal deaths is health system dysfunction. This dysfunction is characterized by the following three delays [25]:

- delay in making the decision to use health services, mainly at the time of delivery - delay in referral to an appropriate health service

- Delay in care after arrival at the health facility [21]. Although a decline in maternal mortality has been noted, thanks in particular to the generalization of prenatal consultations and assisted delivery by qualified personnel, the reduction remains below the 2015 millennium development goal of an annual decline of 4.5% and appears to be stagnating. Regional disparity is also notable, with maternal mortality varying by a factor of two between regions. These regional disparities, as well as social and age disparities, are also observed in terms of access to reproductive health services (contraception, pre- and post-natal consultations, assisted deliveries, etc.). Maternal and child health, in particular the reduction of maternal and neonatal mortality, is still a major challenge for our country [22]. We know that the shortcomings observed in many countries in the area of safe motherhood initiatives are not due to a lack of knowledge or a lack of technology. They are usually due to the lack of a clear, concise, and feasible strategy [23]. Nearly one hundred women still die each year in Tunisia from complications related to pregnancy or childbirth [25]. The causes of maternal death are mainly hemorrhage, infections and cases of pregnancy toxemia [24]. In this work we are interested in a famous problem in Tunisia which is the mortality of pregnant women and newborns in order to participate in resolution of a problem threatening lives in our country by realizing a platform which facilitate access of pregnant women and newborns to health services in order to decrease the percentage of death.

6. Conclusion

In this work we are interested in a famous problem in Tunisia, and particularly in some deprived zones, which is the mortality of pregnant women and newborns. In order to participate in resolution of a problem threatening lives in our country, we suggest realizing a platform which facilitates access of such cases to health services in order to decrease the percentage of death. This would form the core of a future paper under development.

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