Current Journal of Applied Science and Technology

40(33): 1-9, 2021; Article no.CJAST.76417
ISSN: 2457-1024
(Past name: British Journal of Applied Science & Technology, Past ISSN: 2231-0843, NLM ID: 101664541)

Importance and Opportunities of Telemedicine in Resource-Poor Countries during Epidemic Situation

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/CJAST/2021/v40i3331559
Editor(s):
(1) Dr. Yahya Elshimali, Drew University of Medicine And Science, USA.
(2) Dr. Chen Chin Chang, Hunan Women's University, China.
Reviewers:
(1) Prasan Kumar Hota, Mamata Medical College / KNR University of Health Sciences, India.
(2) Isayeva Anna, L.T. Mala National Therapy Institute ,Ukraine.
(3) José López Castro, Spain.
Complete Peer review History: https://www.sdiarticle4.com/review-history/76417

Short Communication

Received 28 August 2021
Accepted 08 November 2021
Published 15 November 2021

ABSTRACT

This review article aims to present a general picture of what telemedicine entails and the importance of providing quality health care in various medical aspects. The field of telemedicine has noticeably grown-up, with a growing number of applications and a diversity of technologies in different medical specialties and clinical situations by using electronic signals to transfer the medical data from one place to another. At present, health authorities have high anticipation for telemedicine. It addresses several significant challenges to advancing healthcare access to overwhelm the scarcity of specialists tackling epidemic diseases. The article starts with a brief introduction to the evolution of telemedicine and its importance in the health care system. Then, we provide a conceptual context for the proliferation of related concepts, such as telehealth, e-health, and m-health. Our primary concern is to focus on telemedicine's role in epidemic situations, emphasizing the current pandemic

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Coronavirus Disease 2019 (covid-19) and demonstrating how it can be used to provide definitive information about the actual effects of telemedicine in terms of cost, quality, and access. However, there is an emergent interest among government authorities, health care providers and medical professionals to enhance the efficiency of providing a wide range of medical services in terms of cost and time. Thus, the effective use of telemedicine and related technologies will be able to assist with it. We conclude that telemedicine should be considered as a potential tool to react to an emergency. Therefore, further research should be conducted to understand better how telemedicine could be applied wisely in epidemic situations.

Keywords: Telemedicine; telehealth; e-health; epidemic; pandemic; poor resource setting.

1. INTRODUCTION TO TELEMEDICINE AND TELEHEALTH

Telecommunication technologies have been remarkable growth over the past several decades and involve various aspects of our life. Taking the benefit of telecommunication are expected to the rising of the information revolution. However, the developments in electronic advances have headed to an entire field of technology-mediated health care, referred to as telemedicine or telehealth; the terminology has emerged more than a century ago. Sometimes, the two terms are used interchangeably, but Telehealth is a broader term that carries telemedicine and a newer branch, Mobile health. The WHO differentiated between telemedicine and telehealth: "*If telehealth is understood to mean the integration of telecommunications systems into the practice of protecting and promoting health, while telemedicine is the incorporation of these systems into curative medicine, then it must be acknowledged that telehealth corresponds more closely to the international activities of WHO in the field of public health. It covers education for health public and community health, health systems development, and epidemiology. In contrast, telemedicine is orientated more towards the clinical aspect"* [1]. Telehealth refers to remote healthcare services while telemedicine indicates definitely to remote clinical services. The WHO also uses the term "telematics." It is defined as "*Telematics for health is a composite term for both telemedicine and telehealth, or any health-related activities carried out over distance by means of information communication technologies*." [2].

The concept started in 1924 as a "Radio Doctor" cover image of Radion News Magazine [3]. One of the actual applications of telemedicine was for transmission of radiologic images between West Chester and Philadelphia, Pennsylvania, about a distance of 24 miles [4,5]. In 1970, there was an actual application of telemedicine project between a community health center and Medical Centre of Toronto University and another project in Arizona [6,7]. In 1980 there was also the application of telepathology i.e. practice of pathology at a distance, by Winstein [8]. In 1990, due to the availability of the internet and improvements in technology, the application of telemedicine began to proliferate, and the paradigm shift was in 2001, the first transatlantic robotic operation was carried out by a surgeon in New York on a patient in Strasbourg [9]. Then later, the WHO stated the e-Health Strategy in 2005 and introduced the e-Health strategy toolkit n 2012 [10].

2. IMPORTANCE OF TELEHEALTH AND TELEMEDICINE

Telehealth and telemedicine have solved many challenging obstacles that face the current healthcare system, such as access to healthcare, cost-effective distribution of healthcare resources, access to information and the spreading of limited healthcare providers. In the general sense, it is a way to interchange knowledge and information between geographically separated centers of health care systems to improve health care delivery. Also, to provide management and intervention during epidemics, outbreaks, war, and natural disasters. In addition, they can help develop and improve health care outcomes in the following ways:

- Patients living in remote areas can get access to clinical health services.
- Referral hospitals can deliver emergency and intensive care services.
- Early intervention and diagnosis frequently improve prognosis with low cost and reduced mortality, complication, and hospitalization.
- A home monitoring system can decrease transfer and hospital visiting costs.
- Health professionals can provide health services to more patients.

- Health professionals in rural areas can more readily attain continuing education and specialist consultation.
- Remote patient monitoring of chronic diseases likes diabetes or chronic obstructive pulmonary disease (COPD), reduces hospital visits and hospital admission.
- Health workers in remote areas can access a second opinion from more skilled and trained medical professionals.
- Transferring laboratory results to adapt suitable medication plans.
- Provide patients in both urban and rural areas with the information and ability to participate in their cure.
- Improvement in epidemiological surveillance.
- Telemedicine solutions are commonly classified into two categories: synchronous (Realtime) and asynchronous (store-and-forward), and they have been applied in psychiatry [11], dermatology [12], and radiology [13].
- Forming a functional network between health care centers to provide information and education to health care professionals [14].

There are many branches of telehealth, such as telemonitoring of chronic diseases, telepsychiatry, teleophthalmology, telestroke, telerehabilitation, teleradiology for cancer treatment, and other services. In brief, telehealth and telemedicine are the right healthcare in the right place at the right moment with the right specialists. However, telemedicine's limitation is that the inability of the specialist to achieve a physical examination on a patient remotely may affect the physician-patient relationship and patients' satisfaction and privacy. The growing acceptance of telemedicine assistance demands the launch of international standards and guidelines so that patients obtain the best health care [15]. This step requires more studies to develop the best procedures, policies, and techniques directed to services in low-resource health care centers. In addition, there is an expansion of telemedicine activities by using the mobile phone.

3. USE OF ALL COMMUNICATIONS APPLICATIONS TO PROVIDE HEALTH SERVICES

Communication systems and devices are the heart of sharing information of patients to get appropriate management. In real-life scenarios, there are many communication ways, for instance, simpler services like voice-mail, electronic mail, medical records, telephone calls,..etc., are still scarcely used in telemedicine. The telemedicine must keep pace with development and innovation in communication devices. The increase of mobile devices such as mobile phones and tablets/iPads has dramatically improved patients' contact with such telehealth facilities. This communication is termed M-Health for services obtained via mobile wireless technologies. Consultations via mobile phones have revealed its effectiveness and acceptance to patients in developing countries [16-18]. Mobile phone communication can assist in an emergency case and control the priority of insufficient resources in health care centers. Some reports documented the M-Health intervention for chronic diseases such as diabetes, hypertension, asthma, eating disorders and HIV treatment, and other health services to eliminate smoking, alcohol intake, excess body weight, sexual infection [19-23].

4. TELEMEDICINE IN THE DEVELOPING WORLD

Many problems face the delivery of appropriate health care services in the remote and rural communities in developing countries, such as limited resources, funds, experience health care professionals, and transportation facilities. In developed countries, telemedicine has been recognized as a suitable means for allowing access to knowledge, permitting information exchange, and confirming the possibility of conveying good quality healthcare to remote societies [24]. Telehealth and telemedicine are growing tools for providing health care services in these areas [25]. However, many pitfalls may encounter the real and suitable application of telemedicine, for instance, lack or shortage of telecommunication, electricity, internet connections, transportation infrastructure, funds for such programs and availability and willingness to provide consultation by the specialists. The success of the concept in Europe and some developing countries does not mean success in other countries. Therefore, before applying telemedicine, all aspects and conditions for implementing technology should be studied carefully for potential telemedicine programs. These aspects can be summarized in three points: organization, technology, and finance [26].

Some articles discuss the application of telemedicine in developing countries as a

probable solution to improve the health care delivery system [27-30]. On the flip side, some articles revealed no pivotal indication of cost-effective or encouraging clinical outcomes in applying telemedicine to the clinical field [31-34]. However, the WHO e-Health Resolution acclaims that all member countries develop and apply a countrywide e-health strategy to overcome healthcare-related problems and dilemmas [35]. For the success of telemedicine, three principles must be encountered: (1) to be sure that quality health services are provided to the patients, (2) constancy of financially rewarding for the health care professionals who provide the services, and (3) more cost-effectiveness and health policy research about telemedicine [36]. Moreover, a national guideline, policy, and regulation must be considered where telemedicine is intended to be applied.

5. BENEFITS OF TELEMEDICINE IN TIME OF EPIDEMICS

Telemedicine plays a role in improving the health services for chronic diseases [37,38] and in emergency cases [39, 40], though telemedicine is not well applied as an effective tool during epidemics. The application of telemedicine can be a potential intervention for several medical cases during an epidemic episode, as stated by Ohannessian [41];

- Teleconsultation: Asymptomatic cases at home having doubtful symptoms may provide the advantage of telemedicine to contact the health care professionals to be sure they are infected or not. If the symptoms match the current infection, they can be safely transferred to the therapy center, or if not, they can seek the advice of primary health care centers.
- Telemonitoring: Asymptomatic people who have a history of contact with the infected patient can contact the epidemiologist to follow up on their health status.
- Teleconsultation helps directly isolate the symptomatic cases without exposure time between a healthcare worker and infected patients during the medical check-up procedure. Thus, it can help to reduce healthcare-associated infections and improve disease control.
- Tele-expertise: It is helpful for non-expert health care workers in the primary health centers to get advice from epidemiologists.
- Telemedicine: Taking care of the patients during quarantine who cannot reach the hospitals.

There are many reports of applying telemedicine in epidemic situations. In 2014, a hotline played a vital role in the Ebola virus disease (EVD) outbreak in Guinea [41,42], Liberia [43], Sierra Leone [44], and west Africa [45,46] to identify the suspected cases and for rapid transfer to the central hospital. Telemonitoring was reported in Western Australia to monitor the affected Ebola cases in Africa countries [47]. Teleconsultations were applied in Taiwan in 2003 throughout the Severe Acute Respiratory Syndrome (SARS) outbreak for hospital-isolated patients [48-51] and home isolated patients in 2009 during the H1N1 influenza pandemic [52]. In addition, teleconsultation was applied in China in 2013 with an H7N9 influenza epidemics [53, 54], and in the USA for an Ebola-infected patient returning from West Africa [55]. The teleprescriptions was reported in 2015 during the Middle-East respiratory syndrome (MERS) Coronavirus epidemic [56-59].

Covid-19 spread and transmitted somewhat more efficient than MERS or SARS. [60]. Telehealth is emerging as a potential and supportable solution for protection, reduction of spread, and treatment COVID-19. In addition, it helps provide necessary health care services to chronic disease patients or emergency cases without coming to medical care centers, diminishing the risk of contracting with the virus and reducing the work pressure on the health care professional in the medical centers. Moreover, Casariego_Vales et al. (2021) suggested telemedicine and telemonitoring for COVID-19 patients are associated with a lower mortality rate [61]. However, the health system's limitations during this pandemics are that not all hospitals and private health centers are equipped to provide telehealth care [53]. Furthermore, not all patients were educated and aware of using this technology i.e. digital illiteracy, the affordability of the services, and the limitation of network coverage area [62].

In China, at the point of the outbreak of COVID-19, the government and health have taken a practical step by establishing the “Anti-epidemic Expert Group” to provide different health care services to the people, including prevention of spreading, and therapy management, training, education, telecommunication, and teleconsulting

for the public and health care professional staff [63]. The services were directed to:

- Susceptible individuals for instance, pregnant women. Throughout this outbreak, only one pregnant woman was seriously infected in Shandong province with quite satisfactory outcomes.
- Teleconsultation for 24 h/day of community residents with the experts to provide the appropriate intervention to limit the spread of the disease.
- Telemedicine for chronic disease patients and severe illness.
- Telemonitoring of the recovering patients after discharge from the health center.
- Telemedicine is also directed to the medical staff to get the required training courses, advice, and education to manage COVID-19 and other severe diseases. In addition, health-related support was provided for China and worldwide to reduce the worldwide spread of COVID-19.

The Chinese had a positive experience with telemedicine during this outbreak, and they believe that working together could be lead to conquering this pandemic.

Some telemedicine resources are accessible from specialists and regulatory agencies in the USA during COVID-19 [64]. These services are directed to:

- Patients that are allergic, old, and have an underlying cause, to protect them from exposure to the infected patients.
- Home-based people to monitor the progress of COVID-19 symptoms if approved and taking the following required procedure of testing and isolation.
- Patients with a history of asthma and immunodeficiency because they are vulnerable to COVID-19.

In Italy, where the COVID-19 outbreak was more aggressive and dramatic, telemedicine was not implemented as effectively as in China and the USA [65]. The following are several obstacles that prevented the effective and efficient application of telemedicine for the management of COVID-19 and related chronic illnesses during the pandemic [66]: the inadequate accessibility and scattered distribution of telemedicine tools, poor telecommunications between health care services, inadequate infrastructure, weakness of the electronic health registration of the national medical organization, weakness of proper procedures for the management of different illnesses, and absence of an obvious protocol and reimbursement mechanism.

All these problems should encourage the application and adaptation of convenient, cost-effective telehealth and telemedicine care worldwide. In addition, these initiatives will relieve the burden of epidemic or pandemic situations. However, implementers of telemedicines should also consider the potential risk such as litigation, documentation and informed consent, security, privacy, policies, laws and procedures.

6. CONCLUSION

The application of telehealth and telemedicine have been widely used in the medical field. They are the current choice to overcome geographical distance, skilled specialist accessibility, restricted transportation and infrastructure, and socioeconomic status. Moreover, it helps to provide necessary intervention by the professionals during epidemics, pandemics, war and natural disasters. With the rapid expansion in digital technology, many user-friendly telehealth platforms will fit different people's health conditions and lifestyles. However, more effort should be provided to address the problem of the technical, legal, and sociopolitical aspects in remote areas to access the effective and safe use of telemedicine in the near future.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
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