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Review

Emergence of telemedicine during COVID-19 pandemic: drawing upon an underrated modality in Vietnam

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Abstract: In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a global pandemic. In Vietnam, the incidence rate started climbing in May 2021, reaching an all-time high of 9,000 cases per day, and is projected to increase even further. Direct patient contact, as has always been the case in conventional medical practice, now constitutes significant transmission risk during the height of COVID-19. Healthcare workers, while accounting for a minor proportion of the population, are two to three times more likely to contract COVID-19, especially those who provide outpatient care or home-based service. The pandemic has led to a significant increase in the adoption of telemedicine, as hospitals are overwhelmed with critically ill patients, demand for healthcare soars, and transmission risk remains serious. With appropriate attention and further advancement of Vietnam's telehealth infrastructure, telemedicine will become an indispensable weapon to combat COVID-19 and an important modality of medical care during and after the pandemic.

1. COVID-19 SITUATION AROUND THE WORLD AND IN VIETNAM

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was first reported in Wuhan, China nearing the end of 2019, and since then has spread to almost every region of the globe. In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a global pandemic [1]. As of now, countries worldwide, including the most developed ones, are still struggling to contain COVID-19. Since the beginning of 2021, daily counts of COVID-19 new cases and deaths are reported to be more than 300,000 and 6,000, respectively [2]. In Vietnam, the incidence rate started climbing in May 2021, reaching an all-time high of 9,000 cases per day, and is projected to increase even further [3].

Currently, clinical management of COVID-19 mainly includes symptomatic treatment and supportive care. It is hoped that mass immunization campaigns will help us reach herd immunity and combat the pandemic. However, these goals remain elusive due to vaccine shortages and their uncertain effectiveness against new variants of the virus, which reportedly can escape the immune system, as well as being more contagious and lethal [4, 5, 6]. Therefore, it is imperative that control measures, such as wearing masks, avoiding crowds, and social distancing, remain in effect, in parallel with ongoing vaccine efforts.

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Healthcare is of paramount importance in any society. However, direct patient contact, as has always been the case in conventional medical practice, now constitutes significant transmission risk during the height of COVID-19. Healthcare workers, while accounting for a minor proportion of the population, are two to three times more likely to contract COVID-19, especially those who provide outpatient care or home-based service [7, 8].

Previous Ebola outbreaks have dramatically demonstrated the importance of protecting frontline healthcare workers [9]. The drop in medical personnel workforce eventually led to a disintegrated health system, leaving behind catastrophic consequences. Therefore, on 2020's World Patient Safety Day, WHO addressed the increasing rate of infections and illness among health workers fighting COVID-19 and stated, "Keep health workers safe to keep patients safe" [10]. In the midst of the pandemic, telemedicine would help provide continual care to patients while reducing the transmission risk of SARS-CoV-2. Various organizations, namely CDC (Centers for Disease Control and Prevention), AMA (American Medical Association), AAP (American Academy of Pediatrics), and AAFP (American Academy of Family Physicians), have encouraged the use of telehealth to maintain access to healthcare services, especially in countries that are hit hardest by the pandemic [11, 12, 13, 14].

2. TELEMEDICINE DURING COVID-19 OUTBREAK

Definition

While this technology dated back to the early 20th century, it was not until the 1970s that Thomas Bird first coined the term "telemedicine", meaning "*healing at a distance*" [15]. Over the years, telemedicine has expanded in scope and no longer simply denotes the concept of "healing". In 2007, WHO adopted a broader description: "*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*" [16]. Ten years later, the Vietnam Ministry of Health introduced their own definition: "*Telemedicine is the long-distance exchange of health-related information between individuals and healthcare workers, or among healthcare workers, by means of digital technology.*" [17].

In brief, telemedicine is the use of electronic information and communication technology to deliver universal healthcare, regardless of time and location [18, 19]. Another closely linked term, eHealth, indicates the "*intersection of medical informatics, public health, and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology*" [20]. Furthermore, as equipment and technologies evolve, mobile health (mHealth) has emerged as the delivery of healthcare

support and intervention through mobile devices (eg phone, PDA, tablet, ...) and the internet [21, 22].

Implementation of telemedicine

For the past century, great changes have been made in remote healthcare to respond to the ever-shifting needs of diverse patient populations. Remote monitoring devices and digital technologies have facilitated the process of medical data storage and exchange. In recent years, the emergence of infectious diseases and outbreaks has rapidly propelled telemedicine services to become the leading vehicle for remote treatment. Evidently, telemedicine is now employed widely in almost every aspect of healthcare including (1) virtual medical visits, via texting, email, or video appointments with patients and/or their healthcare practitioners, and providing guidance regarding laboratory tests, treatment modalities, or medications, (2) seeking and giving consultation with regard to challenging or severe cases, by use of remote patient monitoring technologies (electrocardiogram, electroencephalography, radiology, ultrasound, or real-time video feed), (3) virtual care for mental health support, nutrition counseling, weight management, disease prevention, and health promotion, (4) continuous monitoring of vital signs, laboratory test results, medications, and interventions, especially in patients with chronic care, to determine prognosis and next step in care, (5) providing consultation with regard to disease prevention and screening, and choice of screening tests, and (6) virtual healthcare education via email, video, or medical conferences [18, 19].

To ensure the quality and sustainability of telemedicine, four mechanisms are required. Firstly, governing bodies should ensure promoting effective and transparent intersectional collaboration. Thus, policies and strategies are the next requirements to outline the visions and objectives in terms of application, provision, control, standards, and ethics related to telemedicine solutions. Telemedicine is a technology-based healthcare service then scientific development is necessary which involves scientific institutions in developing and testing telemedicine initiatives, systematic evaluation, documentation, and dissemination. And lastly, evaluation processes should be considered since given the relative lack of empirical evidence, rigorous evaluation processes are key to ensuring the development of telemedicine. They can help generate reliable data to determine policy and strategy, streamline implementation, and inform the potential for enhancement and international transferability [16].

In the meantime, Vietnam's healthcare system has expeditiously accumulated up-to-date knowledge, developed investment strategies, and ultimately implemented six fields of telemedicine: tele-preventive medicine, teleconsultations, teleradiology, telepathology, telesurgery, and tele-education in medicine [17, 23]. Health information exchange regardless of time and location has significantly improved the speed, quality, safety, and cost of patient care, and allowed medical personnel to deliver timely and appropriate health advice.

Roles of telemedicine in clinical practice

According to time-based characteristics, there are three types of telemedicine services including synchronous, asynchronous, and remote monitoring. The former means to deliver health information in real-time which provides a live consultation with the patients. Even physical examination can be performed via synchronous telemedicine to some degree.

In contrast, asynchronous mode refers to store-and-forward information. Despite no direct communication, this type of telemedicine is very useful when well-prepared data is required for further analysis or utilization. Finally, remote monitoring involves continuous evaluation of a patient's clinical status through direct monitoring of the patient or via review of lab tests and images which are analyzed at the same time or later by a medical staff remotely. With the evolution of newer technologies, especially mobile applications on devices, more parameters can be collected for diagnostic and treatment expertise [24].

Nowadays, telemedicine can be deployed efficiently in many fields of clinical practice. In telecardiology – the transmission of cardiac diagnostic tests in conjunction with electronic stethoscope examinations allows the specialist to perform an assessment remotely using a digital bluetooth stethoscope and existing telemedicine equipment [25]. Besides, remote monitoring of ECG provides more information to optimize the treatment of heart failure [26]. The same value comes to blood glucose monitoring in case of

telediabetes [27]. Another example of synchronous telemedicine is telestroke, which enhances on-demand emergency acute stroke care in rural areas by using videoconferencing to connect neurologists with emergency departments [28]. The neurologists can communicate directly with the patient and family to discuss the treatment plan, and provide comprehensive and coordinated acute stroke care, reducing the time to receive treatment which is critical in improving prognosis. On the other hand, asynchronous mode is suitable for non-acute situations yet requires comprehensive data as in teledermatology. Stored pictures in a sequential manner help illustrate the disease progression and the diagnosis can be established from afar. Patient characteristics should be considered in telemedicine set-up that the elderly with limitations in technology and difficulty in cognition may prefer telephone to video visits [29]. Therefore, telemedicine obviously has a potential aid in the healthcare system given the appropriate choice of service types.
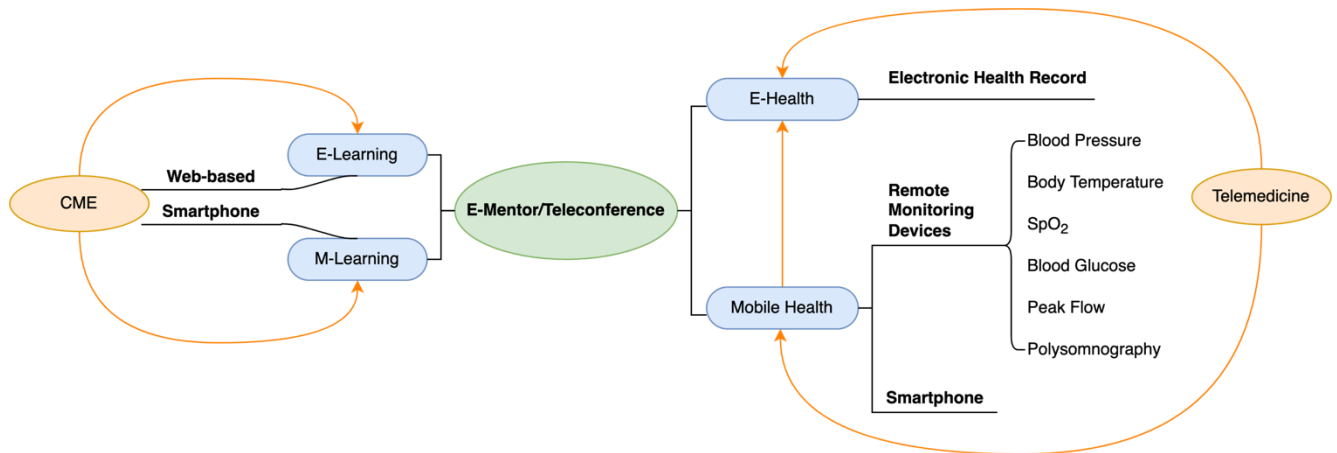
Benefits of telemedicine

Figure 1. Basic components of telemedicine in healthcare and continuing medical education

Until recently, the majority of healthcare services worldwide have taken place as in-person interactions. However, COVID-19 has affected all facets of care, and telemedicine has become a necessity, due to its convenience and numerous benefits (*Figure 1*). Specifically, this large-scale change in clinical practice not only minimizes transmission risk due to direct contact between providers and patients but also ensures that essential health services and systems are maintained. The expansion of telehealth across all regions, including coastal and rural areas, helps improve access to high-quality care and quality of life. Provider-to-patient encounters are less affected by time, distance, scheduling conflicts, weather, or traffic conditions, hence health services become more accessible and convenient for patients. Health information is readily retrieved from home or workplace that helps reduce the strain on hospitals and health facilities, as well as reduces virus transmission and unnecessary travel, thereby saving cost and time incurred by in-person visits. From patient's aspect, online courses of continuing medical education increase access, thus improving effectiveness and consistency of health knowledge. Patients with chronic conditions and co-morbidities can navigate their health, and medical trainees can navigate their study/training

to be well prepared for becoming medical personnel in the future, increasing overall care quality and cost-effectiveness [18, 19, 30].

Limitations and resolutions

While telemedicine offers a convenient and safe way for patients to receive care, a number of barriers remain in ensuring its best practice. Effective use of telehealth requires its users to have sufficient knowledge and skill in operating mobile devices, as well as a stable internet connection. Hence, certain populations, such as those residing in rural/coastal areas or the elderly, are more likely to encounter difficulties during remote visits. To overcome this, training sessions or support groups are warranted, as well as improved Internet access nationwide. Without direct examination, there are concerns that physicians will be more prone to making medical errors and compromise patient safety. However, established protocols and rigorous standards would ensure that best practices are respected, despite all interactions being virtual. It is not possible to deliver every type of care remotely, for instance, surgery, emergencies, or psychiatric acute care. Therefore, it is very important to triage patients prior to the

appointment to decide whether telemedicine is an appropriate model of care [18, 19].

In light of Vietnam's current situation, three factors must be taken into account when setting up telemedicine during this crucial time in COVID-19 pandemic. Lack of policies regarding legality, payment, and insurance for telemedicine has delayed its implementation, despite a number of proposed guidelines and initiatives. Next, lack of trust in telemedicine from both sides means health workers are concerned that a teleconsultation is not professional enough, while patients are wary of diagnoses and treatment delivered online. Finally, lack of equipment and medications, as seen in rural areas requires collaboration among health establishments located in different regions is necessary to ensure practical implementation of telemedicine in underprivileged communities.

Effectiveness of telemedicine during COVID-19 pandemic around the world

Despite its existence long before COVID-19 pandemic, telemedicine as a model of care was largely undervalued [31, 32]. As a result, there is relatively little evidence about its usefulness and implementation, and telemedicine has yet to gain widespread trust and universal promotion. The pandemic has led to a significant increase in the adoption of telemedicine, as hospitals are overwhelmed with critically ill patients, demand for healthcare soars, and transmission risk remains serious. COVID-19 brings with it a new era of virtual care, including telemedicine.

In 2020, CDC conducted a research to study the trend of telehealth in the US (the United States) during the pandemic, by comparing the encounter data from four of the US largest telehealth providers between two consecutive years, 2019 and 2020. The results revealed that during the first quarter of 2020, the number of telehealth visits increased by 50% compared with the same period in 2019. Most of these encounters were from patients seeking care for conditions other than COVID-19. However, the proportion of COVID-19-related appointments rose significantly (from 5.5% to 16.2%, $p < 0.05$) during the last 3 weeks of March 2020 [33].

Accumulating evidence also reveals a rising trend in using telemedicine during the pandemic, most notably at hardest hit regions, regardless of healthcare-wise role (provider or patient) or geographic area (urban or rural) [31, 34, 35, 36]. Furthermore, in a survey on telemedicine among 70 surgeons from 8 countries, 57.1% reported they would continue the use of this healthcare delivery mode even after the pandemic ends [31]. Another investigation among 169 pediatricians showed consistent results, in which they agreed upon the popularity of telehealth post-pandemic [35].

In order to further identify the role of telehealth services during COVID-19 outbreak, a systematic review including data from six countries was conducted. The authors highlighted the multilevel benefits of telehealth: reserving medical staff and equipment for seriously ill patients; healthcare workers with mild symptoms can continue working remotely with patients, thereby easing the strain on medical workforce; reducing transmission to the minimum; mobilizing all aspects of healthcare potentials to optimize care; and finally diminish the burden on healthcare providers and the health system [37].

COVID-19 pandemic has offered tremendous challenges, as well as opportunities in healthcare settings. Applying technologies and telehealth will help ensure medical care and education while maintaining social distancing. Ultimately, sharing experience in delivering diagnoses and treatments of COVID-19 would help find a way to control and mitigate the significant impact brought about by this pandemic [38]. In the 4th wave of COVID-19 with delta variant, Vietnamese healthcare system has been facing an unprecedented challenge in its history with the uprising burden in hospital admission that can recur due to outbreaks from new variants. Consequently, the need for supporting asymptomatic COVID-19 patients, post-vaccination subjects, and those with non-communicable diseases during the outbreak could be solved adequately with telemedicine yet improvement and stability should be paid more attention in the future [39, 40].

Conclusion

COVID-19 pandemic continues to run rampant in many parts of the world. It has introduced possibilities for a revolution in technology within the medical field. Telemedicine is not only a major breakthrough in delivering medical care but also in continuing medical education for healthcare workers during COVID-19 social distancing situation. With appropriate attention and further advancement of Vietnam's telehealth infrastructure, telemedicine will become an indispensable weapon to combat COVID-19 and an important modality of medical care during and after the pandemic.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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