

Telehealth modulation and new proposals during the Covid-19 pandemic: a literature review

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Abstract

The Covid-19 pandemic has completely modified the Healthcare organization. This review aims to analyze the evolution of the different Telemedicine areas during pandemic. Electronic Health Records allows accelerating the study of patients suffering from Covid-19 disease, supporting their clinical assistance. The decreasing rehabilitation programs have determined a deterioration of the patient quality of life. Teleradiology was necessary to discard the increased requests and dab the shortage of staff, and to guarantee the interaction between specialist and patient. Telecardiology was fundamental determining a reduced of secondary mortality for cardiological complications of the infection. Teledermatology has permitted an early identification of the patients affected through diagnoses of cutaneous signs, reducing clinical visits. Telelegal-medicine changed through a law, that was introduced allowing a remarkable use of videoconferencing in the different stages of judicial and extrajudicial process. The digital consultations and home drug delivery were implemented in telepharmacy area. Artificial Intelligence allows an early diagnosis of the infection, monitoring the treatment through an intelligent platform. Robotic assisted telemedicine minimizes the risk of exposure allowing the disinfection of the places, drugs and meals delivery, the measurement of vital signs. Mobile Health facilitated the collection and the automatic transfer of the patient's parameters. Telemedicine would constitute still today as complementary but not substitutive to the traditional medicine. During the pandemic telemedicine has resulted important to guarantee continuity cures. Radiology and Dermatology showed a major telemedicine application. *Clin Ter 2022; 173 (5):489-495 doi: 10.7417/CT.2022.2467*

Key words: telehealth, telemedicine, artificial intelligence, mobile health, covid-19 pandemic

Introduction

During the virtual personal relationships' era, even the relation between doctor-patient became digital (1). Teleme-

dicine is the crossing among one of the most ancient sciences, Medicine, and one of the most modern ones, computer science, and it allows to provide remote health services (2). Today, Telemedicine constitutes an innovative instrument in the medical field, if it is used correctly, it would provide a higher quality of emergency treatments in association with a drastic reduction of medical costs and, also, would allow the population who live in disadvantaged rural areas a favorable access to health services (3, 4).

Telemedicine allows a better distribution of health treatments to be achieved, especially in the least industrialized and isolated areas, increasing the service qualities given (5). This is possible thanks to the speed of electronic means, that allows an immediate access of the specialist to the patient's data, monitoring in real time the clinical parameters and modulating therapy with no delay. Telemedicine also allows to create a universal health profile, allowing to overcome the barriers among the different States (6), making the health profile easily accessible, and also to "globalize" medicine. The video-consultations constitute one of the most recent applications guaranteed by electronic means; these, if they are diffused on large scale, will consent to simplify the access loads of hospitals, limiting them to the critical cases, reducing the waiting time for the emergency room and specialist checkups (7). These aspects are also essential during the pandemic, like Covid-19, that has completely modified the local and national Healthcare organization, dramatically increasing the number of backward medical examinations that have accumulated and need to be discarded with time. It is actually in this particular time that Telemedicine has eased the health workers' jobs and the relation between doctor and patient (8). How much has the Covid-19 pandemic influenced on Telemedicine? And how much has Telemedicine influenced the Covid-19 pandemic? This literature review aims to analyze the evolution of the different Telemedicine areas during the Covid-19 pandemic to comprehend which have undergone more modifications and in which area Telehealth has been more relevant and enforced.

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Electronic Health Records

The anamnestic collection in a digital format is named Electronic Health Records, and presents many advantages allowing a constant update of the clinic history of the patient, an uplift of the standard treatments and a remarkable advantage of the clinical-diagnostic-therapeutic process, that results so on-going and significantly accelerated (9). The digital healthcare identity, making the medical information more accessible, can facilitate the healthcare system especially those with an elevated operational administrative difficulty, like those given by unconscious patients with an obfuscation of the limbs, with psychological alterations and free from family support, reducing the rate of medical errors and the medico-legal dispute regarding the anamnestic collection and the therapeutic strategy. Indeed, the creation of a digital healthcare file, would facilitate the access both of the health workers and even the patient himself to the clinical data of each patient, their conservation, optimizing even the execution of clinical trials on the population and the recruitment of patients for the research (10-16). These advantages of the electronic health records have been precisely exploited during the Sars-Cov2 pandemic resulting very useful to accelerate the study of patients suffering from Covid-19 disease, supporting their clinical assistance (17), and to observe the outcome of the class of patients at risk, like those affected by substance use disorders (SUD) (18), dementia (19). A digital electronic record would also result essential in case of a Covid-19 pandemic, characterized by an elevated number of hospitalizations, with reduced time for each patient, with reduced personnel in comparison with the healthcare needs and with a reduced communication with the patients' relatives that can't access into the hospitals. This digital healthcare record would consent, actually, in the European field, where the healthcare assistance covers the medical costs of the people belonging to the European Union, a fast access to the clinical history of the patient eliminating any kind of linguistic barriers.

Telerehabilitation

Telemedicine aspect concerns the transfer of rehabilitation from a hospital reality to a home. The efficiency was observed even "objectively": it was demonstrated that, people that underwent telerehabilitation will activate the same brain areas compared to those treated with traditional therapy (20). The people who live in more remote areas and/or more rural areas have obtained more benefits from Telerehabilitation; so, an elevated satisfaction of the patients was recorded for this kind of therapeutic approach (21, 22). From the comparison with the traditional approach a consistency regarding the obtained results emerged. Finally, the massive use of this approach would consist in decreasing the health expenses on the basis of the reduction of the hospitalization numbers, as well as a more appropriate release without useless delays (23). Even today, there are not final results because of the low numbers of study samples on this field. During the Covid-19 pandemic, the Global Confederation for Physical Therapy recommended that the rehabilitation organizations would postpone non urgent treatments to limit the risk of infection and to guarantee the urgent services during a time with an

overload of the global Healthcare (24). The declining of rehabilitation programs has determined a deterioration of the patients' life quality and a clogging of the structures of the post Covid era with difficulties in disposing of assets and a declining of the provided services (25, 26). Accordingly, different members organizations, like the Italian Physiotherapy Association, Australian Physiotherapy Association and the American Physical Therapy Association, have increased the resources designed to Telerehabilitation (27). Since, the Thoracic Therapy can improve the symptomatology, the breathing parameters and the quality of life of these patients, a Thoracic Telerehabilitation was proposed, with rehabilitation protocol proposals (28, 29); the Thoracic Telerehabilitation, reducing the risk of infection in case of contagious patients, would constitute an advantageous instrument. A further proposal was to perform a Telerehabilitation for the stroke, during pandemic, overlapping the results of the traditional rehabilitation and Telerehabilitation referring to a clinical improvement (30). However, in developing areas, data on Telerehabilitation during Covid-19 pandemic were not comforting (31). This subcategory would have been considered essential, because of the decreasing rehabilitation programs have determined a deterioration of the patient quality of life and the clogging of the structures during post-covid pandemic with difficulties of activity disposal and the decrease of the provided services (32, 33).

Teleradiology

The possibility of a radiologic consultation from other specialists allows an optimization of the timing even in the most critical hours in the hospital, during which the medical personnel is limited, thanks to the increased availability of Picture Archiving and Communication Systems (PACS) and also the diffusion of the broadband. PACS have allowed the use of radiology in telematic terms and more accurate and fast diagnoses, reducing at the same time, the health costs related to the transportations. Nowadays, it constitutes a favorite approach especially among the young who can experiment flexible kinds of Teleworking (34). In an emergency condition like the pandemic, especially caused by a virus that makes a diagnostical approach and radiological follow-ups mandatory, the Teleradiology was necessary to discard the increased requests and dab the shortage of staff, and to guarantee the interaction between specialist and patient reducing the risk of infection (35, 36). The application of Teleradiology was faster in comparison with other branches, because Teleradiology is one of the medical branches with an elevated degree of digitalization, facilitates its use in many practices (37).

Telecardiology

This Telemedicine aspect constitutes one of the most important ones because especially in this medical branch where the time factor has a fundamental importance influencing the outcome of the patient. One of these aspects regards what in Cardiology is defined the patient Golden hour with a myocardial heart attack. It was observed that the electronic transmission of the electrocardiogram performed in the ambulance on-the-go, and in remote areas, can modulate in a favorable sense the patient outcome (38-44).

So, this approach can allow the triage to be more rapid, allowing a rapid revascularization and decreasing the time of the patient hospitalization reducing also the mortality both early and late (45, 46).

The implementation of this approach was fundamental in the Covid -19 pandemic, determining a reduced of secondary mortality both for cardiological complications of the infection itself and also, for the hospitalized contagions (47). Mixed protocols have been applied with the alternation between telephonic follow-up and a live support system and digital protocols, with first check-ups and remote follow ups. These protocols need the same number of specialists in respect to the traditional approach, but reduce the risk of infection of the personnel (48). A further application of Telecardiology during the pandemic regarded the cardiac rehabilitation in people subject to cardiac surgery or coronary revascularization; this field has given excellent results, because a significant increase has been registered on survival in the people who have undertaken this kind of innovative typology of rehabilitative treatment (49). Finally, further proposals were given regarding the remote control of the disposals that were implantable during the pandemic; even in this field, past studies have demonstrated an association with a better treatment levels and a reduction of the healthcare costs (50). The limit of a wider application can be in the lack of randomized controlled trials studies that confirm what has been analyzed in the observational studies (51).

Teledermatology

Dermatology represents a medical branch that lends itself to Telemedicine, particularly in the last years the technological advance of digital devices allowed to obtain photos and videos of a higher quality, useful for a first diagnostical approach; indeed, in Dermatology the objective visual exam represents the first important step. Today three kinds of platforms inherent to Dermatology exist: synchronous, asynchronous and hybrid (52). The problem related to the videos reside in the quality of the images clearly inferior in comparison with the pictures. The asynchronous modality that consists in the collection of images from the patient and the submission of these to the dermatologist to obtain a consultation, results in the most diffused modality for the quality of the pictures, today obtained through technological devices. The disadvantage of this modality resides in a limited medical history collection of the patient, resulting in, therefore, announcing some cases of inaccuracies.

The hybrid modality consistent both in the Teledermatology real time by video supports as well as in the photo collection of the patient should be, therefore, the preferable modality. Finally, it is important to consider how many studies have highlighted an accuracy and efficiency equal to and greater in comparison with the dermatological traditional check-up (53). Other studies, although in minority, support that this approach could have a lower performance (54). It results very important to underline how the literature evidence confirms some very high performances; although these are very strictly independent from the technological progress in the Telecommunication field and in the mobile devices technology. During the Covid pandemic this approach has permitted an early identification of the

patients affected through diagnoses of cutaneous signs and symptoms presumptive of Covid infections (55), also the reduction of clinical visits for dermatological pathologies and the saving of personal protective equipment (PPE) (56). Finally, the asynchronous modality would play an important preventive role facilitating an early approach to injuries of questionable nature.

Tele-forensic and legal medicine

Telemedicine and its different articulations offer different ideas and implications on the medical-legal point of view. The conventional approaches relate instead to the possibility to consent the not-expert personnel, such as autopsy technician or resident, to perform autopsies, using pathologists as tutors, that can through a video connection obtain in real time the images of the autopsies and eventually to provide advice, even though some information given by the sensory organs are missing, like smell and touch (57). Some forensic pro bono evaluations have been taken about the mental health, by phone or video for the asylum seekers (58). For what concerns the medical-legal implications of Telemedicine in the different specialistic fields, the legislator in Italy established that each telematic medical activity can result liable to a medical fault. During the Covid pandemic a recently law was introduced that allowed a remarkable use of videoconferencing in the different stages of judicial and extrajudicial process. Finally, another medical-legal field regards the privacy aspect and the treatment of personal data, regulated by the legislative decree n 196 of the year 2003, with a following implementation involving the respect for the privacy and the cryptography of multimedia files.

Telepharmacy

Therapeutical prescriptions through Internet allow to accelerate the time and consent a better planification such as the terms of preparations and also regarding drug delivery to the patients (59). The digital consultations, the home drug delivery and the patient's education have been activities more implemented during the Covid-19 pandemic (60).

Artificial Intelligence and Telemedicine

A further appendix of Telemedicine, regards the application of artificial intelligence in the medical field, that is born from the pervasive diffusion of electronic devices, some of them equipped with apps, able to reveal the vital signs. These innovations open new scenarios, in the field thanks to the relation among medicine, Telemedicine and artificial intelligence (61).

Surely the artificial intelligence allows to resolve big problems, especially in the contexts characterized by a remarkable quantity of data (62). On the other hand, the missing contextualized information elaborated in association to the strictness of the decisional algorithms and the missing discernment of the useful information from the less useful ones, all these allow some challenges not completely resolved (63). Recently, the most important artificial intelligence applications that can ease the way to manage the pandemic have been analyzed, namely: early detection and diagnosis

of the infection, through tools that allow to identify early signs and symptoms related to the Sars-Covid 2, alarming patients and health authorities, and develop a new diagnosis and management system for those infected through useful algorithms; monitoring the treatment, through an intelligent platform that allows to modulate therapy based on the change of the patient's conditions; contact tracing of the individuals, to abbreviate the time of communication with potentially infected people, and anticipate the diagnosis of the infection reducing the infections; projection of cases and mortality, through algorithms that analyses the progress of the infections and mortality, identifying the areas more at risk, and adopting appropriate measures; development of drugs and vaccines, analyzing the reactions and the trend of drug administration and vaccines, to always develop better therapies and prevention; reducing the workload of healthcare workers, reducing the hospitals entry; prevention of the disease, allowing useful information updated through the analysis of data in real time (64).

Robotic assisted telemedicine

A further artificial intelligence field, that is named robotic assisted telemedicine, presents positive implications, especially in the case of a pandemic, as we assisted with Covid-19 or even the Ebola virus, to minimize the risk of exposure (65) allowing the disinfection of the places, drugs and meals delivery, the measurement of vital signs reducing the risk of infection (66). There are few practical implications, although these promising expectations exist. The artificial intelligence has shown big potentialities, like for some diseases as cardiologic diseases, or the ictal disease, such as in some context we can reduce timing and promote a more correct and fast approach, modifying the outcome in a favorable way (66).

Mobile Health

Another subcategory of the artificial intelligence regards "Mobile Health", this telehealth subcategory that appeared only ten years ago, was born from the integration of the mobile communication and the network technologies through medical applications. This kind of Telehealth has some interesting implications, especially in the field of the promotion of health behaviors or still in the treatments' management and chronic diseases, so that it brings an increase on the patients' compliance compared to the prescribed therapy. During the Covid-19 pandemic, this service was able to facilitate the collection and the automatic transfer of the patient's parameters improving the monitoring and reducing the start time or modulation of therapy.

Discussion

The use of Telemedicine is favorable according to a more diffused opinion, because it is associated with an improvement both in the outcome and the patients' quality of life, reducing the hospitalization rate and the health costs. Telehealth presents many advantages, among those a better management of chronic diseases and chronic-degenerative

that represent a growing development field, ensuring a better continuity in the cure and the monitoring of it. In the field of these chronic diseases, most efficient results have been achieved in the cardiological and pneumological fields. In general, very diffused diseases like diabetes mellitus, chronic kidney failure treated with dialysis and hypertension have drawn more benefits from the applications of Telemedicine. Surely, the continuity of the cure represents one of the unquestionable advantages of Telemedicine, through a continuous monitoring and follow up of the patient from his discharge. A further favorable point would be a substantial reduction of the national health costs, thanks to a reduction of hospitalization or improper diagnostic-therapeutical courses, times of ordinary hospitalization and the medical-legal dispute connected to the delay or omission of treatment. Unfortunately, Telemedicine has still some limits. Among the major problems we can see the reduced quality of video images, especially in the case of teler dermatology (synchronous forms), that can influence the follow up making it necessary the use of intermediate forms called hybrid, or in person follow up. One of the most important problems is still the depersonalization of the medical check-up, that is trying to overcome with some attention, like maintaining, as much as possible, the visual contact with the patient or using computer instead of smartphones, to focus better on the patient and putting him on ease. On the other hand, the check up in person offers unquestionable advantages, especially linked to the clinical objective exam: indeed, the contemporary technologies have not allowed to fill the sensorial gap in respect to the objective exam itself. Therefore, Telemedicine would constitute still today as complementary but not substitutive to the traditional check-up, especially for those subjects in which the clinical exams are important. Finally, they should be more focalized on the patient's problems although the digital checkups are faster. The implementation of this new border of telemedicine is fundamental for a new management of the therapeutic-diagnostic course, especially in the field of global pandemic, and an improvement of the given cures. For this reason, telemedicine has been profoundly helpful for the Covid-19 pandemic, and it has accelerated the implementation and the diffusion of this new branch. During the pandemic telemedicine has resulted important to guarantee continuity cures, although the reduction of the personnel, due to the contagion and forced quarantine, and the overcrowding of the departments; also it has allowed to dispose of accumulated check-ups due to the suspension of the regular health activities. Vice versa, the pandemic context allowed to achieve already realized projects, or to create new ones. Not all the branches have had the same kind of evolution. Indeed, contrary to expectations, the medical branches where it was shown a major Telemedicine application were the ones more digitalized, like: Radiology, that allows to see the records and the interaction between patient and specialist even remotely, reducing the risk of infection; Dermatology, specialization based more by "visive diagnosis", that through always more technological devices allow to make diagnosis or to monitor diseases, by modulating the therapeutic strategy through the need of photos or videos, of an always more elevated quality. The use of videos and photos was exploited even in forensic medicine to make

remote autopsies, or preliminary valuations of the biological damage, with a performance of remotely technical consultation. Obviously, Telemedicine in this case has resulted useful, but not always decisive, not allowing, sometimes, to conduct a check up on live patient or to utilize smell and touch in the judicial autopsies. With surprise, Telehealth was very helpful, even in some clinical branches, like Cardiology, a medical branch very often based on life saving interventions, in which the health assistance is important to maintain unaffected, even in the case of lack of personnel. In contrast with the expectations, there were more suggestions than concrete applications in the Telerehabilitation branch, that is one of the most ideal sectors for the application of Telemedicine, as it was demonstrated in many studies that showed the activation of brain areas in the people treated with Telerehabilitation and those treated with a traditional therapy. Probably, the rehabilitation was considered among the postponable treatments; also, the patients can be skeptical in relation to Telerehabilitation, considering this branch an operator-dependent. Also, Telemedicine can be used for the remote monitoring and the modulation of the patients' therapy affected by Sars- Cov-2, reducing the infections of the personnel and the nosocomial infection of the patients themselves. The Telemedicine digital turning point doesn't allow only a better management of the positive cases to SARS-CoV-2, but allows, especially, to resolve the most important problem connected to the pandemic: the interruption of continuity cures for patients not affected by Covid-19 disease. In a time where the interpersonal relationships have to be limited, Telemedicine seemed, right away, the only way to maintain the connection between doctors and patients. Also, this allowed many health workers, obliged to a precautional quarantine, but perfectly able to practice their profession, to continue being recruited remotely, reducing the gap between requests and offer of health services.

Conclusions

This pandemic has showed the necessity to realize idealized Telemedicine projects implementing them and extending them to all branches. Covid-19 pandemic has accelerated the development of the digital Healthcare; it's now time for the institutions, for healthcare and the patients, not to go back and consider Telemedicine as a "potential option" but rather, exploit this development and include new perspectives given by Telehealth with the actual therapeutic and benefit systems paths.

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