

Impact and future of telemedicine amidst the COVID-19 pandemic: a systematic review of the state-of-the-art in Latin America

Impacto e futuro da telemedicina em meio à pandemia de COVID-19: uma revisão sistemática do estado da arte na América Latina

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Abstract Significant progress has been made in using information and communication technologies in medicine, by impacting the quality of health-care delivery system and patient care, and paving the way for ground-breaking tools for e-health and clinical decision-support systems. This study investigates the extent to which the evolution of telemedicine applications has been used to support patient care in Latin America (LATAM) amidst the pandemic. Theoretically, the study applied the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology to identify the impact of telemedicine in the region. Practically, the paper provides a systematic mapping study of the different domain areas and methodological progress in Telemedicine that occurred during the pandemic, and applied a text mining technique to understand the intensities of the terms expressed by the analyzed studies. The results show that while telemedicine has not been extensively used, a greater percentage of the studies report that telemedicine was effective. Approximately 70% positive emotional valence score was found. The paper also provides an empirical discussion and recommendations for the next steps in ample adoption of telemedicine.

Key words Telemedicine, LATAM, Patient care, Medical-service management, Consultation, COVID-19

Resumo Foram feitos progressos significativos na utilização de tecnologias de informação e comunicação na medicina, com impacto no sistema de prestação de cuidados de saúde e nos cuidados aos doentes, e abrindo caminho a ferramentas inovadoras para sistemas eletrônicos de saúde e de apoio à decisão clínica. O presente estudo investiga até que ponto o crescimento das aplicações da telemedicina tem sido utilizado para apoiar os cuidados aos doentes na América Latina (LATAM) em meio da pandemia. Teoricamente, o estudo aplicou a metodologia Preferred Reporting Items for Systematic Reviews e Meta-Analyses (PRISMA) para identificar o impacto da telemedicina na região. Na prática, o artigo apresenta um estudo de mapeamento sistemático das diferentes áreas de domínio e progresso metodológico em telemedicina que ocorreram durante a pandemia, e aplicou uma técnica de text mining para compreender as intensidades dos termos expressos pelos pesquisas analisadas. Os resultados mostram que, embora a telemedicina não tenha sido amplamente utilizada, um maior percentual de estudos informa que a telemedicina foi eficaz. Foi encontrada uma pontuação de valência emocional positiva de aproximadamente 70%. O documento também traz uma discussão empírica para os próximos passos na adoção da telemedicina.

Palavras-chave Telemedicina, LATAM, Cuidados com o paciente, Gestão de serviços médicos, Consulta, COVID-19

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Introduction

Pandemics poses important challenges to health care provision, especially in vulnerable countries, such as those in Latin America (LATAM)¹. On March 11, 2020, the World Health Organization (WHO)² declared the novel coronavirus SARS-Cov-2, also known as COVID-19, a global pandemic outbreak³. In the LATAM region, Brazil reported the first case by the end of February 2020, and by the end of March, every country in LATAM reported at least one death in the daily online tracker of the American Society/Council of America. After the first cases were reported, the first responses in LATAM involved the isolation of positive patients and evaluation of arriving travelers, continuing with the decrease in social contact, and implementation of telework; as a national health emergency state was declared in every country of the region³.

The high occupational risk generated by the saturation of health services and the shortage of protective equipment (PPE) for health personnel required the implementation of strategies to respond efficiently to increase in the demand for attending to COVID-19 positive patients, while decreasing social contact, since the main route of transmission is through respiratory secretions^{1,4}. In this sense, telemedicine, defined as a “service that seeks to improve a patient’s health by permitting two-way, real-time interactive communication between the patient and the physician at a distant site”^{5,6}, presented itself as an important tool during this health crisis. In comparison with developed countries where telemedicine is practiced side-by-side with more conventional health care, in developing countries, it is mostly used as an alternative to conventional health care⁷.

The absence of technological resources, lack of training and/or provision of platforms for telemedicine consultations have been crucial obstacles in its use and development^{8,9}. Amidst the COVID-19 pandemic; evidence of increased access to telemedicine, to evaluation and follow up of patients among healthcare workers in LATAM¹⁰, and development in its practice in the several medical fields and specialties is addressed in this paper. This includes an empirical outlook on important advances in Telemedicine that could potentially extend its future use.

The rationale of this study

The aim of this study was to conduct a systematic review of the existing works of literature

within the area of telemedicine to understand its impact and future directions amidst the COVID-19 pandemic in Latin American (LATAM) region. To this effect, the research objectives of this study were to uncover: (i) why telemedicine may have become a good option during the pandemic in LATAM, (ii) extent to which the practice (telemedicine) has been helpful during the COVID-19 pandemic, and (iii) its implication for future medical practice particularly in leu (aftermath) of the pandemic (post-COVID era).

Background information

In developed countries, it is evident that the telemedicine market had been growing even before the COVID-19 pandemic^{11–14}. For example, the European telemedicine market grew from US\$ 3.1 billion in 2010 to almost triple to US\$ 12.6 billion in 2019 at a compound accelerated growth rate of 12.82%. Whereas, less effort has been invested in developing countries due to a limited budget to install technological infrastructure, and telemedicine was just an alternative to healthcare⁷. This scenario suddenly changed when COVID-19 pandemic forced every country to promote preventive measures such as physical isolation and no country was spared from those measures^{15–17}.

In practice, we note that *telemedicine* has made a significant impact on the medical practice or profession by influencing the way patients receive care and/or interact with the care providers (doctors, consultants, etc)^{18–23}. This growth ranges from remote patient monitoring, to secure storage/management of patients’ medical data, real-time audio and video communication (consultation), and compliance, recommendations, or support, etc. For example, the American Health Information Community was a federal advisory body established by The American Telemedicine Association (ATA)²¹ to make recommendations to the Department of Health and Human Services (HHS) on how best to accelerate the adoption and development of e-health in the United States. The four main themes that emerged from the framework proposed by ATA²¹ were:

- . Consumer empowerment: by providing a user-centric secure e-record system for management of patient care information.
- . Chronic care: by allowing secure communication tools or platforms for care delivery between doctors and patients.

. Biosurveillance: by providing standardized and anonymous health data points for transferring health care delivery to authorized public health organizations.

. e-Health records: through creation of widely available and secure standardized IT systems for laboratory results and interpretations.

In LATAM context, The Latin American Federation of the Pharmaceutical Industry (FIFARMA)^{23,24} in its response to the COVID-19 pandemic, is a research and development (R&D) biopharmaceutical organization dedicated to discovering and developing patient-centred innovative, quality and safe health products and services to facilitate a sustainable health system, regulatory standard, and ethical principles in the region. During the pandemic, FIFARMA²³ noted that while telemedicine may not solve all the challenges with patient care and management, they opined that the technology (telemedicine) has provided the stakeholders with the benefit of “accessibility”, “productivity” and “better results”. They stressed that the main implication of the outcomes will be to make “telemedicine” a central part of medicine especially in the aftermath of COVID-19 (post-COVID era) across the region. It is also noteworthy to mention that telemedicine was created to operate in complex scenarios, e.g., by allowing the medical practitioners access to hard-to-reach location such as the rural areas, and in turn, lowering the cost of healthcare for those patients in the region through increase in number of patients who are able to receive medical consultation, improvement of the healthcare workforce and productivity, and delivery of better clinical outcomes²³.

Considering the reasons as to why *telemedicine* may have become a good option in the LATAM region; we note that the technology (telemedicine) has moved from being a form of caring for the health of “the next generation” of patients to “revolutionizing” the way in which the medical care is administered²⁴. Although this shift (traditional to telehealth) conceivably comes with some limitations such as scenarios whereby physical examination are necessary (e.g., taking heart rate, inserting contraceptive devices, or giving injections, etc.), lack of practitioners with the required skills and experience to implement virtual health projects, high cost of the IT infrastructures and electronic gadgets and devices, and lack of electricity and limited internet access²⁴. Nonetheless, FIFARMA²⁴ following reports by The Inter-American Development Bank (IDB)^{25,26} and The Organisation for Economic

Co-operation and Development (OECD)²⁷ has no doubt that “telemedicine” is here to stay in LATAM and across the world at large. Moreover, FINE²⁸ the go-to field agency for LATAM that was in the front-line in drawing evidence and insights about the impact of the COVID-19 pandemic in LATAM region confirmed in its report that despite the limitations of the hospital infrastructure, most countries in the LATAM region have improved in terms of e-health, perhaps, thanks to the practical implications of telemedicine and the resultant technologies.

Methodology

To uncover the objectives of this study as noted in the rationale of this study (see Introduction section); this work performed a systematic review of the relevant literature within the telemedicine, COVID-19, and LATAM context. The study criteria was grounded on a set of theoretic factors that we have chosen based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology²⁹⁻³². The PRISMA approach for evaluation of the literature was chosen in order to allow the authors to determine the key factors and success rate reported across the LATAM region. This was done considering the impact and use of *telemedicine* during the pandemic, as well as, enables the study to point out the main implications and road map for future adoption of the associated technologies for medical practice.

Search process

The study conducted its search in different international databases that are related to the medical profession and academic publications. The search for articles was done in three main electronic databases within the medical field: PubMed, Scielo, and Redalyc. No unpublished information was obtained. The literature search was performed for the period between 2019 to 2021 to cover the COVID-19 era, including any pre-COVID or post-COVID insights that may have inadvertently been discovered.

Search terms

The study used a combination of keywords to extract the relevant studies from the academic databases. The selected keywords were as follows:

PubMed: (((((((telemedicine) OR (teleconsulting)) OR (telehealth)) OR (e-health)) OR

(virtual care)) OR (telemonitoring)) AND (coronavirus)) OR (COVID-19)) AND (Latin America)) OR (LATAM)

Scielo: (telemedicine) OR (teleconsulting) OR (e-health) OR (telemonitoring) OR (virtual care) AND (coronavirus) OR (COVID-19) AND (latin america) OR (LATAM)

Redalyc: included a search of the keywords (Telemedicine and Covid-19 or Latin America) in the “Knowledge base on epidemics and COVID-19” section that houses more than 13,000 research items on the topic, and filtered based on the countries in LATAM.

Inclusion and exclusion criteria of the literatures

The extracted papers from the databases were selected based on the following criteria²⁹⁻³² (see Figure 1): 1) Description or title of the paper is related to telemedicine, COVID-19, or LATAM? 2) If the full text is available? 3) Publication date

between 2019 to 2021? 4) Was the method or approach clearly described in the paper? 5) Did the paper report the main contributions in terms of the study criteria or area of topic (telemedicine)? 6) Whether the study reported some kind of road map or implications for practice when/towards the adoption of telemedicine in healthcare and patient treatment with focus on COVID-19 effects? 7) How sizable is the scope and methodology of the paper applicable to this study? 8) Has the paper undergone the scientific peer review process with source/DOI?

Search outcome and results

The systematic search and review process focused on the impact and future of telemedicine amidst the COVID-19 pandemic in LATAM. It tries to uncover the state-of-the-art and/or gaps in the literature that are yet to be addressed. As shown in Figure 1, the first stage of retrieving the relevant

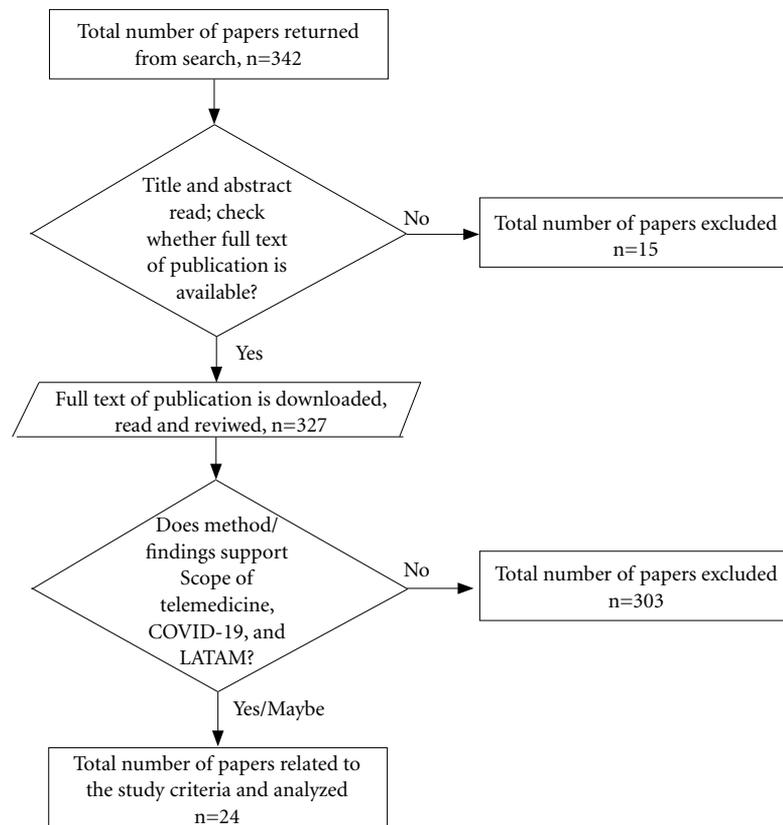


Figure 1. The incremental Search criteria or flowchart for relevant studies in telemedicine, COVID-19, and LATAM.

studies based on the “search criteria” (see Search terms) resulted in a total of $n = 342$ papers. We then subsequently screened the retrieved papers based on their perceived suitability for this study criteria (e.g., title of paper, domain area of application, availability of full-text, peer-reviewed, research article). This resulted in $n = 15$ papers being excluded, of which the remainder ($n = 327$) papers were selected, read, and reviewed. Consequently, after examining the selected papers based on the suggested outcomes or whether the method/findings supports the scope of this study (i.e., telemedicine, COVID-19, and LATAM); a further $n = 303$ papers was excluded which were not related to the main three keywords. Thus, a total of 24 studies were identified and included in the systematic review and analysis of this study. The results are as reported in the following chart (Chart 1).

As gathered in Chart 1, the study notes that current studies representing the recent developments and use of telemedicine for patient care and management in LATAM during the COVID-19 pandemic were from six main countries (Mexico, Colombia, Peru, Brasil, Chile, Argentina) in the region (see Figure 2), with Brasil having reported the most number of sources with ten studies (~41.7%) out of the 24 analyzed papers (Figure 2). When considering the main domain areas in which telemedicine was applied amidst the COVID-19 in LATAM, we note that while the analyzed papers are all focused on the COVID-19, telemedicine, and LATAM; there was a variation in the areas in which the different studies were conducted. Ranging from patient management and healthcare, to cancer, radiology, and renal health. There was also nursing, pediatric oncology, cardio-oncology, to neuro-

Chart 1. Systematic mapping study on the impact and future of telemedicine amidst the COVID-19 pandemic in LATAM based on PRISMA methodology (literatures between 2019-2021).

Authors	Year	Country	Method/tool Used or Proposed	Findings/main contribution	Domain/area of application	Scope related to research question	Method applicable to research objective	Source/DOI
Montenegro et al. ³³	2021	Peru	Survey of experience and workflow in telemedicine	impact of telemedicine amidst the COVID-19 (case study of Peru)	COVID-19, Cancer, Telehealth, Telemedicine, Patient management	Yes	Yes	https://doi.org/10.1016/j.critrevonc.2020.103129
Silberman et al. ³⁴	2020	Argentina	Tele-Magazines in ICU (TR-ICU) applied to optimize the care of patients with COVID -19 hospitalized in serious condition	describe the process and results of the first 50 days of the TR-ICU implementation	COVID-19, UTI	Yes	Yes	http://www.scielo.org.ar/scielo.php?script=sci_arttext&pid=S1853-810X20000300006&lang=en
Cabrera et al. ³⁵	2020	Colombia	Virtual surgical teaching project	Innovative approach to surgery residents	COVID-19, Surgery, Education	Yes	Yes	https://doi.org/10.30944/20117582.632
Melo Maciel et al. ³⁶	2020	Brasil	Review regarding key aspects that include the use of telehealth based on analysis of premises of primary health care on the axes of CHW work	This study concluded that the Covid-19 pandemic demanded reorganization of the work processes and assistance flows in the field of basic care	COVID-19, Primary Health Care	Yes	Yes	https://doi.org/10.1590/1413-812320202510.2.28102020

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Authors	Year	Country	Method/tool Used or Proposed	Findings/main contribution	Domain/area of application	Scope related to research question	Method applicable to research objective	Source/DOI
Capoulade & Pereira ³⁷	2020	Brasil	Implementation of a psychoanalytic care service with virtual support in nascent context of the COVID-19 pandemic and the issues arising from this experience	-	COVID-19, Psychology	Yes	Yes	https://doi.org/10.1590/1415-4714.2020v23n3p534.6
Valdez-García et al. ³⁸	2020	Mexico	Proposal of a model of guidelines as an action plan in the face of the expansion of COVID-19.	Proposes some guideline as an action plan to face the expansion of COVID-19 that includes the use of telemedicine	COVID-19, Education	Yes	Yes	https://doi.org/10.22201/facmed.20075057e.2020.35.20230
Peres et al. ¹⁵	2020	Brasil	Descriptive study reporting experiences that three distinct dental schools (one of them in Brazil) faced during the COVID-19 pandemic	Proposes the need to review clinical practices, e.g., biosafety and be forever, stimulated to try new ways to teach to the next generation of dentists	COVID-19, Education	Yes	Yes	https://doi.org/10.1590/pboci.2020.130
Denadai ³⁹	2020	Brasil	Comment on the advantages of using telemedicine and the need to break down barriers once the pandemic is over	Suggests that standard of care may change compared to the pre-pandemic standard, expects that barriers restraining the widespread use of telemedicine can also be overcome	COVID-19, Telehealth	Yes	Yes	https://dx.doi.org/10.6061%2Fclinics%2F2020%2Fe1967

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gastroenterology, mental health, and psychology. palliative care, mobile app development, and education were also key areas of its (telemedicine) application. However, it is important to mention that while the analyzed studies have focused on the aforementioned areas, the main emphasis was on “telehealth” (~45.8%) (see Chart 1, Figure 3), another synonym for “telemedicine” that constituted the main scope of this study. It is also noteworthy to mention, as shown in Figure 3,

that a majority of those studies (99%) have been carried out in 2020 at the peak of the Covid-19 era, with only one study conducted in 2021 at the time of conducting this review (Figure 3).

As gathered in Chart 1, figures 2 and 3, this review was an attempt to shed light on specific challenges and impact that Telemedicine and its underlying practices and technologies has on the patient care and management in LATAM amidst the COVID-19 pandemic. It is noteworthy to

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Authors	Year	Country	Method/tool Used or Proposed	Findings/main contribution	Domain/area of application	Scope related to research question	Method applicable to research objective	Source/DOI
Galindo Neto et al. ⁴⁰	2020	Brasil	cross-sectional study that included 52 mobile applications on COVID-19	Association between target audience and the subtheme of symptoms, prevention, and care, and between patient monitoring and professional training	COVID-19, Telehealth, mobile apps	Yes	Yes	https://doi.org/10.1590/1980-265x-tce-2020-0150
Sampaio Florêncio et al. ⁴¹	2020	Brasil	Literature review on the incorporation of palliative care in scenario of the COVID-19 pandemic	Strategies for implementation of palliative care with use of protocols and telemedicine to facilitate communication	COVID-19, Telehealth, palliative care	Yes	Yes	https://doi.org/10.37689/acta-ape/2020ao01886
Carlos et al. ⁴²	2020	Brasil	Semi-structured interviews conducted via an open access virtual communication platform.	Indicates the need for structural institutional policies for equality and safety in the medical profession and a healthy intra-family relationship, e.g., for mother-nurses	COVID-19, Telehealth, Nursing	Yes	Yes	https://doi.org/10.1590/1980-265x-tce-2020-0329
Vasquez et al. ⁸	2020	Peru	Cross-sectional survey of paediatric onco-haematologists in April 12-19, 2020.	Large coverage that helped examine the potential impact of COVID-19 on the management of children with cancer in Latin America	COVID-19, pediatric oncology	Yes	Yes	https://doi.org/10.1016/S1470-2045(20)30280-1

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mention from the studies we analyzed that the concept (telemedicine) has not been extensively applied either in the source coverage or in their breadth of dimensions towards a comprehensive view of the entire domain of medical practice in the region. Also, noteworthy is the fact that the most pertinent studies were recently done amidst the period of the COVID-19 outbreak (Figure 3). Perhaps, this could be owing to the fact that the

unprecedented COVID-19 outbreak is recent and currently a hot topic being addressed both by the researchers, medical professionals, and the governments in the diaspora. Therefore, whereas the current review explores telemedicine within the context of LATAM during the pandemic, there may also be studies that could have addressed and applied the concept (telemedicine) for patient care and medical practice pre-Covid and/or

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Authors	Year	Country	Method/tool Used or Proposed	Findings/main contribution	Domain/area of application	Scope related to research question	Method applicable to research objective	Source/DOI
Schmulson et al. ⁴³	2020	Mexico	Online anonymous survey on demographics, clinical practice and procedure characteristics, impact of the pandemic, Telemedicine, and involvement in COVID-19 patient care	Negative impact of the pandemic on neurogastroenterology practice, e.g., lack of remunerated practice by telemedicine	COVID-19, Neurogastroenterology	Yes	Yes	https://doi.org/10.1097/mcg.0000000000001413
Schinköthe et al. ¹⁸	2020	Argentina	Unstructured interviews recollected from physicians around the world including Argentina which explained challenges with COVID-19 patient care	Physicians identified a number of different scenarios where telemedicine or the connected care solutions could rapidly improve patient care	COVID-19, Telehealth	Yes	Yes	https://doi.org/10.2196/19033
Trujillo et al. ⁴⁴	2020	Chile	LAPP methodology. Laparoscopy feedback.	Demonstrated effective transfer of skills from a validated surgical instruction program	COVID-19, TeleEducation	Yes	Maybe	https://doi.org/10.1002/bjs.11923
Sánchez et al. ⁴⁵	2020	Mexico	Internet-based survey among presidents and members of the societies of The Latin American Federation of Neurosurgical Societies	Reported having suspended regular activities and local congresses, due to mandatory isolation by government, although telemedicine Projects were instituted	COVID-19. TeleHealth	Yes	Yes	https://doi.org/10.1016/j.wneu.2020.04.226

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outside the context of LATAM which would perhaps form another direction for future studies.

Having said that, this study deemed it important to implement a text mining⁵³⁻⁵⁶ analysis of the main findings and contribution of the analyzed (24 studies) papers. This was done in order to identify the most frequent and correlation (association) of the used words by the authors in describing the impact of telemedicine and its practice amidst the COVID-19 in LATAM.

The method (emotional valence), a text analysis method, was consequently used to analyze and understand the level of impact (intensities of the words expressed by the studies) in their findings and/or main contribution.

To do this, first, we built a corpus⁵⁷ (library of words) of the main findings (see Chart 1) in the studies using R statistics⁵⁸ to determine the top most frequent terms (Figure 4) that the authors perceived as important or key in their different

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Authors	Year	Country	Method/tool Used or Proposed	Findings/main contribution	Domain/area of application	Scope related to research question	Method applicable to research objective	Source/DOI
Saenz et al. ⁴⁶	2020	Colombia	Establish guidelines towards attending to patients in electrophysiological unit	Recommended transitioning to virtual consultation (via telephone or video) for majority of first assessments and/or follow-ups during the COVID-19 pandemic	Covid-19, TeleHealth	Yes	Yes	https://doi.org/10.1007/s10840-020-00747-5
Yokoo et al. ⁴⁷	2020	Brasil	Describe a Radiology Department's policies in a private hospital in preparedness to the coronavirus disease	Provides useful information and examples of innovations that can help other radiology departments	Covid-19, TeleHealth, Radiology	yes	yes	https://doi.org/10.31744/einstein_journal/2020gs5832
Sorbara et al. ⁴⁸	2020	Argentina	Descriptive, observational, and cross-sectional study based on data collected through an online survey	50% of respondents had sought medical consultation by electronic means	COVID-19, Mental health	Yes	Yes	https://doi.org/10.1016/j.nrleng.2020.07.014
Sadler et al. ⁴⁹	2020	Brasil	Electronic survey by a cardio-oncology collaborative network through regional and state chapters of the American College of Cardiology, American Society of Clinical Oncology, and International Cardio-Oncology Society	Propose initiatives to promote expanded coverage for telemedicine, increased access to PPE and medical professional in preparedness for future health care crisis	COVID-19, cardio-oncology	Yes	Yes	https://doi.org/10.1186/s40959-020-00085-5

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studies and findings. Second, we then determined the correlation of the top 5 most used words (terms) by measuring the probability (i.e., likelihood) of the authors using the associated terms in the analyzed data. The measurements of the correlation were between 0 and 1, representing 0% to 100%. The results of the different terms we found and their association (correlation) are reported in Table 1. As shown in Figure 4 and Table 1, the text mining analysis of the findings by

the different studies allowed us to determine the top five words or terms that the authors referred to when presenting their main findings. In the wider spectrum and medical practice in LATAM, particularly as it concerns the use of telemedicine for patient care and management amidst the COVID-19 pandemic; the outcome of the analysis purportedly suggests that the main scope of the studies we analyzed was mainly to grasp the patients' satisfaction and opinion regarding re-

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Authors	Year	Country	Method/tool Used or Proposed	Findings/main contribution	Domain/area of application	Scope related to research question	Method applicable to research objective	Source/DOI
Rodriguez et al. ⁵⁰	2020	Colombia	Electronic survey based on recommendations from international societies. Studied consultation care, preinvasive cervical pathology, and cervical, ovarian, and endometrial cancer	Respondents favored offering teleconsultation as triage for post-cancer treatment follow-up (94.6%)	COVID-19, Cancer, Telemedicine	Yes	Yes	https://doi.org/10.1002/ijgo.13272
Bunch et al. ⁵¹	2020	Colombia	Changes in standard care for renal patients	Home care for patients on APD with RPM program could be successfully implemented by increasing interaction between patient and the renal clinic staff	COVID-19, renal health	Yes	Yes	https://doi.org/10.1159/000511407
Salvalaggio et al. ⁵²	2020	Brasil	Survey responses from 204 transplant centers, internationally, from May to June 2020 on impact of the COVID-19 pandemic towards living donor kidney transplantation (LDKT) practices.	For the centers that continued donor evaluations, 40% performed in-person visits, 68% by video, and 42% by telephone	COVID-19, renal health	Yes	Yes	https://doi.org/10.1111/tid.13526
Marquez-Velasquez ²⁰	2020	Colombia	Design of a teleconsultation program	Revealed an execution rate of 94% and a resolution of 78%. Shows that telemedicine, like other telework-based activities, is here to stay and brings with it high levels of satisfaction for physicians	COVID-19, telehealth	Yes	Yes	https://doi.org/10.22516/25007440.543

Source: Authors.

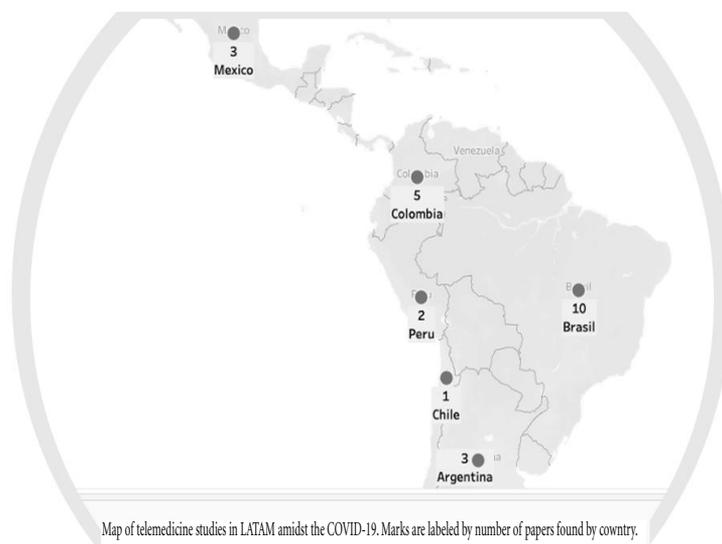


Figure 2. Demographic distribution of the main studies that addresses telemedicine, COVID-19, and LATAM represented by country and number of papers.

Source: Authors.

mote care which was implemented suddenly due to a mandatory physical isolation, but was not extensively focused on how telemedicine and its application have helped drive the medical practice and patient care and management forward¹⁴, which constitutes one of the main contributions of this present study.

Furthermore, we analyzed the impact (intensity or emotion levels) of the different reported studies in respect to the way they perceived the use of telemedicine amidst the COVID-19 pandemic in LATAM based on their main findings. To do this, we applied the emotional valence (text mining) analysis in R⁵⁸ which fundamentally focuses on identifying (through polarization or quantification)⁵⁹ the intensities of the different emotions that are expressed in the reported findings (i.e., the 24 studies we analyzed) by extracting and assigning a score (valence) to each emotional term it finds. Practically, we made use of the *get_nrc_sentiment* method in R to extract the different scores (emotional valence). Typically, the method functions by extracting and quantifying the intensities (polarization) of the different terms or emotions using the positive (+), neutral (0) and negative (-) values^{55,56,60} to represent each relevant term it finds in each run scenario. As represented in Figure 5, we report the results of the text mining method (emotion-

al valence) considering the main findings of the analyzed studies.

As shown in Figure 5, the positive valence (+) scores represent an attractive emotion, whilst the negative (-) scores signify an aversive emotion. The zeros represent emotions that were classified as neutral (0) with no emotions or sentiment attached. Overall, we note that a larger margin of emotions expressed by the different studies in their main findings are classified or falls along the +1 (positive) score (see: Figure 5), which signifies attractive emotions, with the summary of the collective scores recorded in the studies presented as follows; min = -2, mean = 0.79, and max = 5.

The definition of emotional valence, otherwise allied to the text mining or sentiment analysis method, and its application within the medical domain has been illustrated in the literature^{57,59-62}. As a matter of fact, as demonstrated in this study, such type of analysis is achieved by leveraging the underlying information (textual data) that are contained in the captured datasets to draw useful information in respect to the studied phenomenon. As reported in Figure 6, the study adopted the emotion (sentiment) polarization/classifications of medical datasets as described in Yadav et al.⁶¹ and Niu et al.⁶² to classify the different emotions types we have found based on the analyzed studies. This was done in order

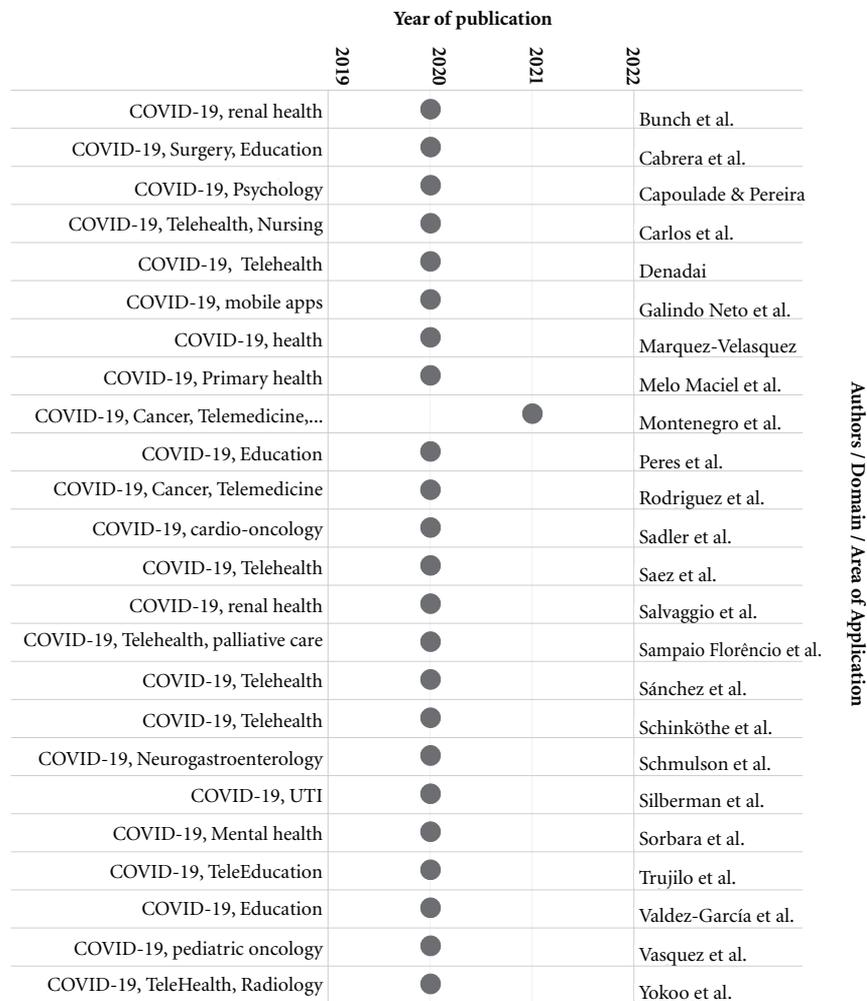


Figure 3. Representation of the relevant studies according to year and domain areas/application.

Source: Authors.

Table 1. Correlation or association of words based on the most frequently used terms (Figure 4).

Correlational study of the main findings and contribution of the analyzed studies						
Frequency of words		Correlation of words				
Term	Freq	Associated words with average probability (%)				
Telemedicine	9	physicians	activities	care	amidst	facilitate
		0.39	0.39	0.31	0.27	0.27
Care	8	patient	connected	improve	solutions	monitoring
		0.68	0.63	0.63	0.63	0.25
COVID-19	5	impact	amidst	case	Latin America	consultation
		0.43	0.41	0.41	0.41	0.22
Impact	3	amidst	Latin america	management	practice	COVID19
		0.55	0.55	0.55	0.55	0.43
Patient	3	care	monitoring	prevention	improve	interaction
		0.68	0.55	0.55	0.55	0.55

Note: cor limit = 0 to 1 where 0 represents 0% and 1 represents 100% likelihood of the individual terms associated with the corresponding freq. term.

Source: Authors.

to determine the overall impact or implication of the reported emotions particularly in terms of the use of telemedicine and its associated practice/ technologies in LATAM amidst the COVID-19 pandemic. Overall, we found that the large proportion or majority of the emotions expressed by the different studies in their findings in respect to the use of telemedicine in LATAM amidst the COVID-19 were classified as attractive with approximately ~70% positive emotional valence score reported. Besides, it is noteworthy to mention, as presented in Figure 6, when considering the individual emotion' types or categories that a greater percentage of the studies believes that

the impact of the telemedicine during this period was “effective” (approximately ~30%). Although, on the other hand, it can be said that while some of the studies felt that the use of the telemedicine, e.g., for patient care or management was “ineffective” (< 20%) (Figure 6), other studies were equally “uncertain” (< 20%) (Figure 6) about the impact or efficiency of the technology or practice (telemedicine) during this period (COVID-19).

Discussion

Researchers, medical practitioners, and the government have invested huge resources in the use of telemedicine³⁹ in fostering patient care and their management during the unprecedented time of the Covid-19 pandemic in LATAM⁴⁰⁻⁴². Telemedicine has become an inevitable means towards ensuring an effective patient care, monitoring, and medical service delivery particularly following the different contingency plans and lockdown strategies put in place by the different governing bodies and policy makers. To this end, the aim of this study was to establish the current state-of-the-art within the aforementioned area (telemedicine) to understand its impact and future directions amidst the Covid-19 pandemic in LATAM region. The main focus of our study was particularly to uncover (i) why telemedicine may have become a good option during the pandemic? (ii) the extent to which the practice (telemedicine) has been helpful during this period? and



Figure 4. Representation of the top key words extracted from the relevant literatures in terms of the findings and main contribution.

Source: Authors.

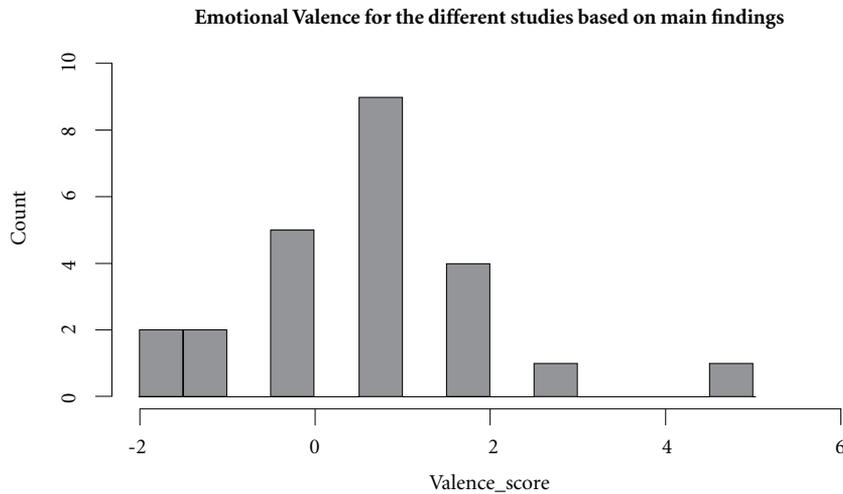


Figure 5. Emotional valence scores found for the analyzed studies based on their main findings.

Source: Authors.

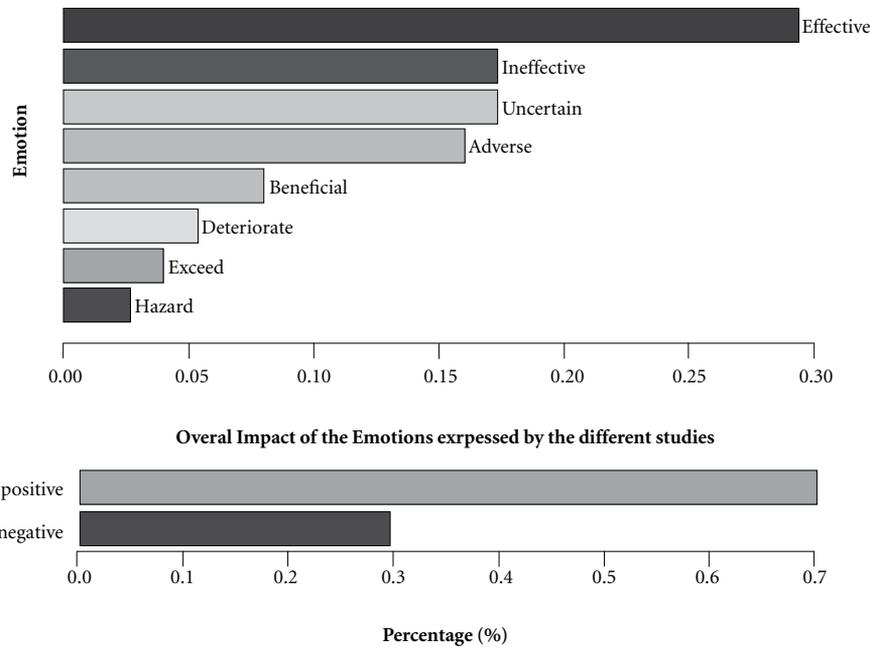


Figure 6. Chart representing the overall emotions (classification) found for the different studies across the data.

Source: Authors.

(iii) its implication for future medical practice particularly in anticipation (aftermath) to the post-COVID era.

Along these lines, we looked into the implication of *telemedicine* for medical practice by considering the reason why it may have become a good option during the pandemic in LATAM. We note based on the recent studies (24 papers) we analyzed, that the technology (telemedicine) has been “effective” (see: Figure 6) for healthcare and patient management during this period (COVID-19). Moreover, the pieces of evidence we drew from the literature shows that telemedicine has moved from being a form of caring for the health of “the next generation” of patients to “revolutionizing” the way in which medical care is delivered^{23,24}. Although this aforementioned *technological* and *professional* shift, i.e., from the *traditional* to *telehealth* (e-health) medical practice, is perceived to come with some limitations as summarized in the Background Information section of this paper.

Unveiling the extent to which the practice (telemedicine) has been helpful during the COVID-19 pandemic; we note that while there is evidence of comprehensive review in Telemedicine across the globe in terms of its *opportunities* and *developments* according to the World

Health Organization (WHO) which comprised of 59% of its member states (144 countries)¹⁴. In theory, we note that in LATAM there has not been rigorous and up-to-date studies conducted that completely reveal the extent of its use to foster patient care and management in the region amidst the recent COVID-19 pandemic, which in turn, forms one of the main contributions of this paper. Although there is evidence, in practice, that the technology (telemedicine) has constituted one of the recent advancement to delivery of healthcare for patients in the region^{23,24,26,27}.

Finally, when considering the implication of the technology (telemedicine) for future medical practice particularly in anticipation (aftermath) to post-COVID era in LATAM; the evidence we drew from the literature^{27,28} and the systematic study conducted in this paper (see Chart 1, Table 1 and figures 5 and 6) shows that the anticipated post-COVID period, particularly for medical practice, implies an important impact on both the *carнал* and *emotional* health of the region. Practically, this includes an introspective and thoughtful transformation of the current health ecosystem, new protocols, modes or routines for delivering of medical care and patient management, that in the wider spectrum, calls for an increase in use and adoption of telemedicine²⁸.

Therefore, from the wider spectrum of scientific research and medical practice; we note that telemedicine has been *routinely* offered in industrialized regions, otherwise referred to as high-tech countries, to remotely monitor and manage patients with chronic and severe diseases (hospital-to-clinic@home mode)¹⁴. Low-income countries are faced with multiple barriers and use telemedicine in a limited manner to connect providers to referral centers or specialties. While telemedicine can be sustainable and scalable in such settings (low-tech), it has not been used for direct patient care⁶³. Globally, telemedicine has been shown to enhance the quality, access, efficiency, and cost-effectiveness of healthcare services^{14,63,64}. For instance, it has proved its effectiveness in overcoming the problem of distance and time barriers between the medical practitioners (care providers) and the patients^{21,63}. However, in spite of the promising benefits and capabilities of the technology which inadvertently varies in the several regions¹⁴, both the industrialized and developing countries are yet to consistently employ or fully adopt the technology in the different healthcare systems¹⁴. Ranging from the challenges of human and cultural factors (linguistic and cultural differences), to lack of digital literacy skills by the medical practitioners to effectively use the telemedicine applications, limited studies that accounts for economic and cost-effectiveness (benefits) of the underlying telemedicine technology and applications, to lack of policy-makers to embrace and invest in telemedicine, technological and human-resource liability risks, and lack of international legal framework that allows the medical professionals to deliver e-services or e-consultations in different countries or jurisdictions^{11,13,24,26,27,63-69}.

It is noteworthy to mention that in developed countries, telemedicine is conducted side-by-side with more conventional health care, complementing it. While, in developing countries, telemedicine in most cases is an alternative, or even the only alternative, to conventional health care⁷. Despite the demonstrated benefits of those care strategies for patient access to health services, reduction of costs, and the rapprochement by institutions and specialists, to distant communities; obstacles such as the absence of technological resources and communications in the Different regions, and the lack of training in the operation of digital platforms, among others, have deterred the dissemination of telehealth⁹. Moreover, a cross-sectional online survey which enrolled 936 healthcare workers in Latin America regarding

access to telemedicine to evaluate and follow up patients, showed that 572 (61.1%) healthcare workers had access, and 364 (38.9%) did not have access¹⁰. Nearly 60% of the respondents reported a decrease in their paediatric onco-haematology staff because of COVID-19 infection or quarantine. Half of the surveyed respondents reported that their centres did not provide a platform for telemedicine consultations, although non-professional social media channels were used⁸. The aforementioned affirmations, perhaps, calls for a broader and collective research and development plan or strategies that involves the several stakeholders (medical practitioners, health bodies and policy-makers, researchers and educational institutions, government, patients themselves and the care givers, etc.) in ensuring that the benefits of using the telemedicine for patients care and management does not dwindle but rather is embraced and promoted in the different settings of its use.

Conclusion

This study looked at the state-of-the-art in use of “telemedicine” to support patient care and management in Latin America (LATAM) during the COVID-19 pandemic, and empirically discussed its future implication for practice in the region. To do this, we applied the PRISMA methodology to identify the level of impact and opportunities of the technology (telemedicine), and why it may have become a good option in the region (LATAM). Twenty-four (24) relevant studies were identified and analyzed based on the different domain areas of their application and main findings/contribution. The outcome of our analysis shows that while telemedicine may have not been extensively applied in the source coverage or in their breadth of dimensions to cover the entire domain of medical research/field in the region (LATAM), a greater percentage of the (24 related) studies reported that the impact of telemedicine during the COVID-19 in LATAM was “effective” in addition to the approximately ~70% that expressed a positive feeling in use of the technology (telemedicine) for patients care and management in practice. Future studies can apply the method described in this paper to understand the extent and application of telemedicine in their different domain settings or demographic distribution, or yet, extend and/or remodification of the method to include further criteria or components that may have not already been introduced in this paper.

Collaborations

B Nieblas: conceptualization; data curation; formal and review analysis; investigation; software; validation; discussion, writing – original draft; writing – review and editing. K Okoye: conceptualization; data curation; formal and review analysis; investigation; methodology; software;

validation; discussion, writing – original draft; writing – review and editing; correspondence. B Carrión: conceptualization; data curation; formal and review analysis; investigation; validation; discussion, writing – original draft; writing – review and editing; correspondence. N Mehta and S Mehta: data curation; investigation; discussion; writing – review and editing.

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