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Effectiveness, Costs and Satisfaction of Telemedicine: Review of the Current State

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Abstract. The objective of this study was to summarize the evidence in relation to telemedicine systems as regards their effectiveness, costs and satisfaction in the last decade. A summary of main findings is presented. According to results telemedicine proved to be a feasible and effective tool to provide health care as a replacement or complement to usual care, especially when applied to chronic diseases.

Keywords. Telemedicine, telehealth

1. Introduction

Telemedicine was associated with greater access to health services, improvements in patient satisfaction, professional education, and lower costs [1] but more robust evidence regarding its health benefits and costs is still needed considering the low knowledge and use of telemedicine as the main barrier for the development of reliable indicators [2].

The objective of this study is to summarize the evidence in relation to evaluations of telemedicine systems in the last decade for their effectiveness, costs & satisfaction.

2. Methods

A search of the literature was carried out in the MEDLINE, LILACS and IBECS databases between March 23, 2010 and August 14, 2020 based on the combination of MeSH terms and keywords “telemedicine”, “telehealth”, “healthcare outcome assessment”, “patient outcome assessment”. Articles were selected according to predefined eligibility criteria. The full articles of all the abstracts considered relevant were included. Papers in English, Portuguese and Spanish that reported the use of

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telemedicine were included. Interventions based entirely on text messages, telephone, email and mobile applications without patient/professional interaction were excluded. Randomized clinical trials (RCTs), quasi-experimental and feasibility studies were included. Each work was classified according to: a) functionality; b) application; c) technology and d) participants. The articles were classified according to whether they analyzed: a) effectiveness; b) costs; c) satisfaction, considering the result of each intervention as superior, inferior or equivalent to the control.

3. Results

From 1,035 articles, 160 met the inclusion criteria and were grouped by specialty or disease. A summary of main findings is presented.

3.1. Diabetes and systemic hypertension

In diabetes, the effectiveness of telemedicine was superior in four studies and equivalent in six. Two did not find significant differences in satisfaction compared to face-to-face care. Although two studies report improvements in consultation times and lower transportation costs for patients, cost-effectiveness was not evaluated.

In Systemic Hypertension, the effectiveness of ambulatory telemonitoring of blood pressure was higher in six studies and equivalent in one. Another study demonstrated feasibility, acceptance of use, and preliminary effectiveness equivalent to control in post-stroke patients. Greater satisfaction and improvements in self-reported adherence to pharmacological treatment were also reported. One study reported significantly higher costs, without evaluating cost-effectiveness.

3.2. Chronic obstructive pulmonary disease (COPD) and other respiratory diseases

In COPD, Telemonitoring or telerehabilitation with decision support systems, showed superior effectiveness for quality of life (HRQoL), emergency visits, readmissions, hospital stay, need for intensive care or non-invasive ventilation, mortality, impact on dyspnea, perception of social support and rate of exacerbations. Five studies reported equivalent effectiveness in hospitalizations, mortality and/or impact on HRQoL and one inferior effectiveness in time to first hospitalization for exacerbation. Three studies showed favorable satisfaction and one suggested lack of cost-effectiveness in home telemonitoring in severe COPD.

In obstructive sleep apnea, the effectiveness of telemonitoring for the adherence to the use of CPAP (continuous positive airway pressure) was greater in two studies and equivalent in one. As regards satisfaction, one found no differences and the other worse results. One study reported a decrease in costs.

An asthma treatment monitoring system was not superior to conventional treatment, although it reported good satisfaction, while a school telemedicine program resulted in more days free of symptoms. A feasibility study showed high adherence to telemonitoring in patients with cystic fibrosis and superior preliminary effectiveness.

3.3. Congestive heart failure and cardiovascular disease and stroke

Asynchronous telemonitoring with automatic devices in pacemakers and implantable cardioverter-defibrillators (ICD) demonstrated superior or equal effectiveness in

hospitalization for Congestive heart Failure (CHF), mortality, time to diagnosis, treatment of ventricular tachyarrhythmias, occurrence of inappropriate cardiac-defibrillator discharges, optimal beta-blocker titration; occurrence of tachyarrhythmias, HRQoL and occurrence of major adverse events. One study concluded that remote monitoring of patients with ICD was cost-effective.

Regarding telerehabilitation in CHF or post cardiac surgery, one study showed superior effectiveness, five equivalent, and another no significant differences in exercise capacity but improvements in HRQoL. This modality demonstrated cost-efficiency as a supplement of usual care. In four studies of home telemonitoring of patients with CHF and/or cardiovascular disease, remote assessment of vital signs and electrocardiogram (EKG) added to synchronous teleconsultations was equivalent to usual care in readmission and mortality rates, while in two studies the effectiveness was higher. Satisfaction showed positive and equivalent results, while in terms of costs, one study reported no differences with the intervention and another concluded that the costs/diagnosed case were higher.

For stroke, telerehabilitation with home monitoring for post-stroke treatment demonstrated high adherence and superior effectiveness in patients with aphasia, while in the treatment of residual paresis in limbs, two studies reported equivalent effectiveness and one showed significant improvements in functional outcomes.

One study demonstrated the feasibility of telestroke (professional-professional second opinion teleconsultation for acute management), without significant differences in treatment and results, with adequate preliminary effectiveness. Another trial reported inconclusive results on the efficiency and safety of its use for the remote administration of thrombolytics compared to immediate transfer to an emergency unit within the therapeutic window.

3.4. Neurology

Telerehabilitation in patients with Parkinson's and Alzheimer's disease demonstrated non-inferiority, while for multiple sclerosis and cognitive impairment it was superior in terms of cognitive function. Vestibular telerehabilitation for adults with chronic vertiginous syndrome achieved significant symptomatic improvements. In pediatric patients with cerebral palsy, supervised telerehabilitation significantly improved functional outcomes, demonstrating cost-effectiveness and satisfaction.

Synchronous teleconsultation for patients with Parkinson's disease demonstrated feasibility; with one study finding no significant differences in HRQoL and another a shorter total time of visits without changes in economic outcomes. An on-call virtual clinic for patients with multiple sclerosis showed less severity of symptoms, improvements in HRQoL, and decreased relapses, with satisfaction rates of 90%. The implementation of group sessions by videoconference for epileptic patients showed a significant drop in negative health events, with high satisfaction. In the follow-up of primary headache, synchronous teleconsultations demonstrated non-inferiority in efficiency and safety. Synchronous teleconsultation with neurologists for screening of possible neurological injuries during the emergency proved to be reproducible and effective, with the potential to reduce hospitalizations, unnecessary referrals, and time from diagnosis to neurosurgery.

3.5. Mental health and psychiatry

Four studies demonstrated non-inferiority of synchronous teleconsultation in patients with post-traumatic stress syndrome (PTSD), two of them with high satisfaction. A fifth study showed superior effectiveness with multidisciplinary interventions, while in another, telemedicine was a predictor of early interruption of therapy. Telepsychiatry for depression proved to be effective and to improve accessibility, with high satisfaction. Their effectiveness on symptom severity and long-term sustained response to treatment were equivalent. The combination of telemedicine with face-to-face treatment on attention deficit hyperactivity disorder demonstrated effectiveness in patients with limited access to specialists and less caregiver stress. Tele-Tutorials for teachers of autistic children in rural areas were equivalent to face-to-face training.

In the treatment of obsessive-compulsive disorders, familiar therapy teleconsultations demonstrated high satisfaction and preliminary effectiveness in children and non-inferiority in adults. Cognitive behavioral therapy teleconsultations showed effectiveness and cost-effectiveness for anxiety disorders, improving symptoms and quality of life in social anxiety disorders.

3.6. Dermatology and ophthalmology

In Dermatology, asynchronous teleconsultations reported equivalent effectiveness for disease severity and quality of life for psoriasis and acne, with no significant differences in overall satisfaction.

Teleophthalmology for initial screening and follow-up of age-related macular disease did not show significant differences in time to diagnosis, referral for treatment, visual acuity, or satisfaction. In another study, physicians who completed the retinopathy of prematurity diagnostic tele-education program had significant improvements in diagnostic accuracy.

3.7. Surgery traumatology and orthopedics

Asynchronous teleconsultations between a specialized team and nurses proved to be effective for wound follow-up, showing that telediagnosis is reliable and correlates satisfactorily with clinical judgment.

A post-surgical care study reported that telemedicine increased early discharges and reduced time to adjuvant therapy and hospital costs, with no significant differences in complications and readmission rates. Postoperative remote monitoring of revascularization surgeries improved HRQoL, technological quality, accessibility, and satisfaction, with no changes in wound healing or 30-day readmissions. Synchronous teleconsultations for post-surgical cosmetic surgery follow-ups showed an increase in satisfaction, waiting and consultation times, but worsening doctor-patient communication.

For Orthopedics, post-surgical knee telerehabilitation programs confirmed non-inferiority. Another study reported the feasibility of synchronous teleconsultations for follow-up of fractures, with a significant decrease in times, distances traveled, and time away from work. Four studies found positive and equivalent satisfaction results, and another study found no differences in satisfaction or quality of life with synchronous teleconsultation between a surgeon and a patient/nurse in a primary care center.

4. Discussion

The evidence on telemedicine in the last decade, although its heterogeneity and fragmentation [3,4], shows feasibility and results at least comparable to the face-to-face modality while its results on clinical outcomes and cost-effectiveness are less conclusive [4,5]. Additionally, the regulatory framework of telemedicine needs to be evaluated [6]. According to our main findings, telemedicine proved to be an effective tool to provide health care as a replacement or complement to usual care, especially when applied to chronic diseases [7] and rehabilitation [8]. Several articles consider telemedicine as part of comprehensive multidisciplinary care programs [9].

5. Conclusions

The results of this study coincide with previous reviews on the need to generate more robust and homogeneous evidence in relation to telemedicine services, including all stakeholders & to search for evaluation designs that are better adapted to their context.

References

[1] Almathami HKY, Win KT, Vlahu-Gjorgievska E. Barriers and Facilitators That Influence Telemedicine-Based, Real-Time, Online Consultation at Patients' Homes: Systematic Literature Review. J Med Internet Res. 2020 Feb;22(2):e16407, doi: 10.2196/16407.

[2] Novillo-Ortiz D. Definición de indicadores para proyectos de Telemedicina como herramienta para la reducción de las inequidades en salud: documento de análisis y resultados de una comunidad de prácticas. Washington, DC: Organización Panamericana de la Salud. 2016.

[3] Bashshur R, Shannon G, Sapci H. Telemedicine evaluation. Telemed J E Health. 2005 Jun;11(3):296-316, doi: 10.1089/tmj.2005.11.296.

[4] Bashshur RL, Shannon GW, Smith BR, Alverson DC, Antoniotti N, Barsan WG, Bashshur N, Brown EM, Coye MJ, Doarn CR, Ferguson S, Grigsby J, Krupinski EA, Kvedar JC, Linkous J, Merrell RC, Nesbitt T, Poropatich R, Rheuban KS, Sanders JH, Watson AR, Weinstein RS, Yellowlees P. The empirical foundations of telemedicine interventions for chronic disease management. Telemed J E Health. 2014 Sep;20(9):769-800, doi: 10.1089/tmj.2014.9981.

[5] Painter JT, Fortney JC, Austen MA, Pyne JM. Cost-effectiveness of telemedicine-based collaborative care for posttraumatic stress disorder. Psychiatr Serv. 2017 Nov;68(11):1157–63, doi: 10.1176/appi.ps.201600485

[6] Becker CD, Dandy K, Gaujean M, Fusaro M, Scurlock C. Legal Perspectives on Telemedicine Part 1: Legal and Regulatory Issues. Perm J. 2019;23:18-293, doi: 10.7812/TPP/18-293.

[7] Hanlon P, Daines L, Campbell C, McKinstry B, Weller D, Pinnock H. Telehealth Interventions to Support Self-Management of Long-Term Conditions: A Systematic Metareview of Diabetes, Heart Failure, Asthma, Chronic Obstructive Pulmonary Disease, and Cancer. J Med Internet Res. 2017 May;19(5):e172, doi: 10.2196/jmir.6688.

[8] Charvet LE, Yang J, Shaw MT, Sherman K, Haider L, Xu J, Krupp LB. Cognitive function in multiple sclerosis improves with telerehabilitation: Results from a randomized controlled trial. PLoS One. 2017 May;12(5):e0177177, doi: 10.1371/journal.pone.0177177.

[9] Bertuzzi F, Stefani I, Rivolta B, Pintaudi B, Meneghini E, Luzi L, Mazzone A. Teleconsultation in type 1 diabetes mellitus (TELEDIABE). Acta Diabetol. 2018 Feb;55(2):185-92, doi: 10.1007/s00592-017-1084-9.