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Original Articles

Cost-effectiveness of telemedicine in the follow-up of asthmatics: a systematic review

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ABSTRACT

Aim: systematic review of the literature on the cost-effectiveness of telemedicine in the follow-up of asthmatics. **Method:** Systematic review of the PUBMED / MEDLINE, LILACS and Cochrane Central databases. Articles published in English, Portuguese or Spanish were considered in the period from 2005 to 2018 according to the PRISMA guidelines. **Results:** A total of 1363 articles were identified, of which 59 were read in their entirety. Only five met the eligibility criteria, and all were made in European countries and totaled 2,497 participants. The interventions were performed by nurses (4 of 5 studies), remaining from 16 weeks to 12 months. Telemedicine costs were similar or slightly lower compared to usual treatments. Telemedicine had a beneficial effect on asthma control (1 of 5 studies), quality of life (3 out of 5 studies) and hospitalizations (1 of 5 studies). **Conclusion:** Telemedicine slightly reduces costs with asthma management and may have an impact on morbidity indicators.

Descriptors: Telemedicine; Asthma; Cost benefit analysis.

INTRODUCTION

Telemedicine is a resource that helps health professionals to provide continuous and individualized care through information and communication technologies, being a resource of low cost and easy access, considered a support tool in the control and treatment of various chronic diseases[1]. Studies in several countries have demonstrated that telemedicine can be used for remote monitoring, vital signs monitoring, transfer of images for analysis and production of test reports, with effective results, especially in the management of asthma[2].

Asthma is one of the most prevalent chronic diseases in adults, estimated at 4.3%, affecting more than 334 million people worldwide[3,4]. In Brazil, there are approximately 6.4 million asthmatics over 18 years of age, with an average prevalence of 13%[3,4]. Asthma is also responsible for high hospitalization rates and high-cost emergency visits, reaching approximately 1% to 2% of the health budget in developed countries[5].

In a controlled study conducted in the UK, the impact of the use of telemedicine on increasing adherence to drug treatment in asthmatic patients in an intervention group has been assessed in comparison to a control group[6]. The authors concluded that online communities, through which patients can exchange experiences and ask questions, are very useful for patients with low adherence to asthma treatment. In a Canadian study, Licskai et al.[7] provided cell phones to patients with asthma to send educational messages, a low-cost intervention and, through the application of evaluation questionnaires, observed improvement in disease control.

Observing the publications of the last 11 years on national and international bases, Mariani and Pego-Fernandes recorded a concentration of telemedicine and asthma studies in high income countries. However, the impact of this tool is still not well reported in developing countries[2].

For the above, this article aimed to systematically review the literature on the cost-effectiveness of telemedicine in the follow-up of asthmatics.

METHOD

This is a systematic review of the literature of experimental studies, which investigates the cost-effectiveness of telemedicine in the follow-up of asthmatics. The evaluation and structuring of this study followed the criteria of the Preferred Reporting Items for Systematic Reviews and Meta-Analyzes (PRISMA)[8].

The search for articles was performed using the following electronic databases: Medical Literature Analysis and Retrieval Sistem Online (MEDLINE) via PUBMED, Latin American and Caribbean Literature in Health Sciences (LILACS), and the Cochrane Central Register of Controlled Trials (CENTRAL) in Brazil. Although the articles in the Scientific Electronic Library Online (SciELO) were largely present at LILACS, a search on this site was also made so that any publications that had not yet been retrieved could be retrieved. Duplicates were deleted. Articles that were not selected through the search strategy, but that were identified in the references of the articles selected and that met the inclusion criteria, were also evaluated. The data were collected in the period from August 2017 to May 2018.

The following descriptors were used to search for articles: telemedicine, asthma, cost-benefit analysis and cost-effectiveness. These were crossed out according to the language

and other associations by the boolean operator "AND", as demonstrated in the following topics: (i) asthma AND Telemedicine; (ii) asthma AND cost-benefit analysis; (iii) asthma AND cost-effectiveness; (iv) asthma AND telemedicine AND cost-benefit analysis; (v) asthma AND telemedicine AND cost-effectiveness. This strategy sought to comply with the PICO strategy (P = asthmatics; I = Telemedicine; C = standard outpatient follow-up procedure for asthmatics without telemedicine and O = cost-effectiveness of treatment).

Articles published between 2005 and May 2018 were consulted. Studies that discussed the costs generated by telemedicine interventions of any kind, aimed at the care of the person with asthma, conducted by health professionals were included.

The articles were selected and reviewed by two authors: A1 and A2. A1 performed the searches in the databases and A2 revised them. A1 and A2 discussed the results for the standardization of information according to the previously defined search strategy. After exclusion of duplicates, articles whose titles or summaries cited information on cost-effectiveness of telemedicine interventions for asthmatics were obtained in their entirety and were analyzed according to the inclusion and exclusion criteria (Box 1).

For the solution of disagreements regarding each topic discussed in the article, a third author (A3) was responsible for analyzing and making a final evaluation. The outcomes analyzed were: cost-effective with asthmatics accompanied by telemedicine (primary outcome); cost-effective treatment with asthmatics accompanied by telemedicine related to quality of life, asthma control and hospitalizations (secondary outcomes).

Box 1. Inclusion and exclusion criteria used in the systematic review. Brazil, 2018

Inclusion criteria	Exclusion Criteria
Experimental / interventional studies: uncontrolled trial; controlled trial (randomized, quasi-randomized, non-randomized); quasi-experimental studies	Studies directed to the academic / professional formation of health professionals, studies with pregnant women.
Studies with adult participants	
Articles published between 2005 and May 2018, in English, Portuguese or Spanish	Duplicate studies

RESULTS

Selection of studies

A total of 1,363 articles were identified in the selected databases. After excluding duplicates and reading titles and abstracts, 59 articles were potentially eligible and selected for full reading; of these, 54 were excluded according to the reasons described in Figure 1, which presents the process of selecting the studies according to the PRISMA items.

Characteristics of the studies

According to the estimated major outcomes, all five articles selected described telemedicine costs[9-13], 3 (60%) addressed quality of life[9, 10, 13], 3 (60%) control of asthma[10,12,13] and only 1 (20%) investigated hospitalization[13].

All articles selected are international, three of which were carried out in the United Kingdom[10,11,13] and the rest in the Netherlands[9] and Croatia[12].

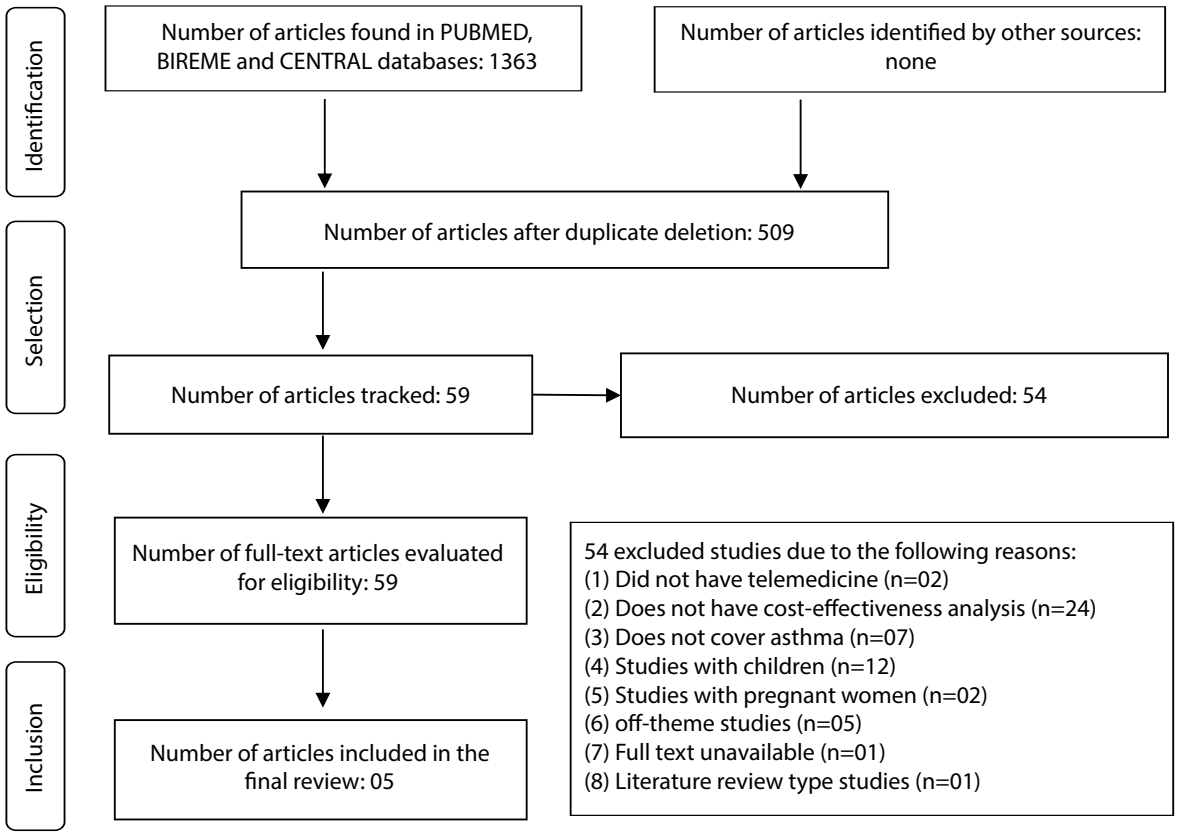

Figure 1. Flowchart of articles included and excluded in the systematic review. Brazil, 2018

All studies had as a methodological design the randomized controlled trial (RCT) [9-13], in which one was without blinding[9] and another one open[13]. As part of the study, the interventions were carried out by an asthma nurse, in one article[9], by nurse, in two articles[10,11], by health professionals, in one article[12] and by specialist nurse, in one article[13]. The other characteristics related to the duration of the studies, participants and types of interventions and controls evaluated are described in Chart 2, below.

Results associated with the primary outcome: cost-effectiveness with asthmatics accompanied by telemedicine

Regarding the cost-effectiveness relationship with asthmatics accompanied by telemedicine, the five articles analyzed (9-13) presented a slight reduction in costs in the group followed by telemedicine compared to those by usual clinical follow-up (Chart 3).

Randomized clinical trials, with and without blinding, were performed in 200 adult patients in the Netherlands, 278 in the United Kingdom and 194 in England, divided into groups that were routinely monitored for asthma and monitored with telemedicine [9,11,13]. These studies performed revision consultations via a pre-established telephone call, with the following objectives: to seek information about the presence of symptoms, hospitalization needs, current treatment and Inhaler Technique; undertake advice on the use of action plan; do self-management education for asthma and other conditions. These articles presented a slight reduction in costs

Chart 2. Description of the articles analyzed in the systematic review. Brazil, 2018

Author/Year	Local	Duration	Type of Study	Participants	Type of intervention
MEER et al., 2011(9)	Nether-lands	12 months	RCT*	Usual treatment = 99 Telemedicine = 101	Self-management based on internet use
PINNOCK et al., 2007(10)	UK	12 months	RCT*	Usual treatment = 557 Telemedicine = 598 Face-to-face only = 654	Telephone inquiries
PINNOCK et al., 2005(11)	UK	03 months	RCT*	Usual treatment = 137 Telemedicine = 141	Telephone inquiries
OSTOJIC et al., 2005(12)	Croatia	16 weeks	RCT*	Controle = 08 Telemedicine = 08	Mobile Messaging Service (SMS)
GRUFFYDD--JONES et al., 2005(13)	England	12 weeks	RCT* open	Usual treatment = 97 Telemedicine = 97	Telephone inquiries

*Source: Own authorship. * RCT: Randomized clinical trial*

when compared to the usual treatment groups and telemedicine.

In the study conducted with 16 patients in Croatia[12], monitoring was performed via short message service (SMS), whereby patients had a 1-hour asthma education session with a specialist who discussed the symptoms of asthma, indicators of control and exacerbation, drug use and the correct technique for using inhalers and peak expiratory flow (PEF). Patients in the intervention group were instructed to submit their PEF results on a daily basis via SMS and also received weekly messages containing guidance on asthma management. However, this study presented an additional SMS monitoring cost of € 1.67 (approximately R$ 7.30) compared to the usual treatment.

The 12-month randomized, non-blinded clinical trial evaluated asthma self-management based on the use of an educational platform via the Internet[9], conducting a weekly monitoring program for asthma and lung function control through an individualized and computerized action plan, online and group education and counseling through the Web. This telemedicine strategy presented a significant result in reducing both total and per patient health costs: there was a reduction of US$ 641 from a social perspective and, from a health point of view, the difference in cost was US$ 37.

Results associated with secondary outcomes: cost-effectiveness with individuals accompanied by telemedicine related to quality of life, asthma control and hospitalizations

The parameters of quality of life, asthma control and hospitalization costs were identified from the reading of the articles included in the analysis as secondary outcomes. In the analysis of the articles, the impact of telemedicine intervention on quality of life was evaluated in three of the publications evaluated[9,10,13], in the control of asthma in 60% of the articles[10,12,13] and in the number of hospitalizations in only one of the selected studies[10].

The results of the articles that evaluated the quality of life evidenced that there was an improvement in this parameter in patients enrolled in the telemedicine programs in the purchase of the usual treatment, especially

Chart 3. Main outcomes found in the articles analyzed in the systematic review. Brazil, 2018

Author/ Year	Intervention description	Main outcomes			
		Intervention costs	Quality of life	Asthma control	Hospitalizations
Meer et al, 2011(9)	Internet-based self-management program with weekly monitoring of the control da asthma e pulmonary function, personal computerized action plan, online and group education, web counseling	Total costs: US$ 25675 Cost Per Patient: US$ 254 (IC95%, US$243 to US$ 265) Social perspective: difference in cost from US$ 641 (95% CI, US$ 21957 to US$ 3240) Health Perspective: difference in cost from US$ 37 (IC 95%, US$ 2874 to US$ 950)	Usual treatment = 0.91 Telemedicine =.0.92 Difference: 0.006 (20.042 - 0.054; p=0,8)		
Pinnock et al, 2007(10)	Telephone review consultation for patients at pre-set time. The content was in accordance with the clinical needs of the patient (current treatment, Inhaler Technique, provision of self-management education and discussion of other conditions)	The cost of telephone consultation was lower than that of the face-to-face consultation (£ 10.03 versus £ 12.74, mean difference £ 2.71, 95% CI = 1.92 to 3.50, P <0.001) ; usual care costs were £ 11.85 per review achieved	Usual treatment = 5.27 (1.16) Telemedicine = 5.29 (1.21) Face to face consultation only = 5.31 (1.24) Difference Telemedicine x Face-to--face consultation (0.02; CI: (–0.21 to 0.24; P= 0.87) Difference Usual treatment x Face to face consultation (0.04; CI: (–0.18 to 0.26; p= 0.72)	Usual treatment = 1.24 (0.97) Telemedicine = 1.20 (1.00) Face to face consultation only = 1.33 (1.13) Difference Telemedicine x Face-to--face consultation (0.12; CI: –0.06 to 0.31; P= 0.19) Difference Usual treatment x Face to face consultation (0.09; CI: –0.09 to 0.27; p=0.32)	Asthma morbidity was similar in all three groups Confidence in asthma care and self management was higher in the telephone option group
Pinnock et al, 2005(11)	Telephone review consultation with content that was in accordance with the clinical needs of the patient	Total costs per patient were similar (telephone = £ 64,49 [SD = 73,33] versus face-to--face consultation = £ 59,48 [SD = 66,02], P = 0,55). The total costs were also similar (telephone = 725,84 £ versus face-to-face consultation = 755,70 £), but the average cost per query reached was lower in the phone (telephone = 7,19 £ [SD = 2,49] versus face-to-face consultation = £ 11,11 [DP = 3,50]; mean difference = - £ 3,92 [confidence interval of 95% = - £ 4,84 to £ 3,01], P <0,001)			

Ostojic et al, 2005(12)	Each patient had a 1-hour asthma education session with a specialist. Patients in the intervention group were instructed to send their PEF results daily via SMS and also received weekly SMS about asthma management from specialists	Per patient, per week, the additional cost of follow-up per SMS was € 1.67 (equivalent to approximately US $ 1.30 per 1 Euro), compared to the usual treatment.	-	-	-
Gruffydd--Jones et al, 2005(13)	Patients were contacted by telephone every 6 months, for follow-up of symptoms, hospitalization needs and advice on use of action plan	Costs of £ 210 per patient per year in the group followed by telephone compared to £ 334 in the usual treatment group (P=0,071)	The median change in the mini AQLQ was +0.07 (interquartile range = 1.27) in the clinical group and +0.23 (interquartile range = 0.87) in the telephone group (P = 0,028)	Similar in the usual treatment and in the group that received telephone calls: mean change in ACQ = -0,11 (IC95% = -0,32 a 0,11) versus -0,18 (CI 95% = -0,38 para 0,02).	-

*Source: own authorship. * PEF: peak expiratory flow*

when considering aspects such as confidence in the practice of asthma care, in the self--management skills of the patients and in evidence of greater capacity[9,10,13].

As far as asthma control is concerned, the results obtained show that follow-up through telephone calls presents similar results to those obtained with usual follow-up, with no significant differences[10,13]. However, patients who received telephone calls revealed that they have developed more confidence in the management of asthma with this telemedicine resource[10], which may be a factor in improving care with the disease. In the study conducted by Ostojic et al.[12], general asthma control, considered from the reduction of PEF variability, showed a slight improvement in forced expiratory volume in the first second (FEV1) and symptom profile, was better controlled in the SMS group to the detriment of the control group. These authors attributed this difference in asthma control parameters to adjustment in medications and to counseling transported to these patients via SMS.

Only one of the studies analyzed investigated the effect of telemedicine on hospitalizations caused by asthma[10]. Morbidity was similar across the three study groups, but confidence in asthma care and self management was greater in the telephone consultation group.

DISCUSSION

Telemedicine is defined by the World Health Organization (WHO) as a provision of services through the use of communication technologies for the exchange of health information, aiming at improving the quality of life of individuals and communities[14]. The application of telemedicine is particularly

useful when it comes to individuals who have difficulty accessing multiprofessional services; however, it has become quite popular, even in cases where face-to-face visits are feasible, given their convenience and their potential low cost[15].

Brazil is a country with a vast territory, and access to health is difficult for people living in cities far from the capital, especially in places without many resources. In this way, telemedicine can be a feasible alternative for these localities, facilitating the attendance of the various professionals at a distance. In addition, this technology has the ability to send patients biometric data to the professional who is performing the service remotely[16,17].

Nevertheless, there is a shortage of studies on telemedicine and its application for patient education in our country. Telehealth Brasil Redes, for example, was created in 2007 and is a program of the Ministry of Health that provides tele-consulting, second opinion training, tele-education and national telediagnostic offer only for professionals and workers of the Unified Health System, not contemplating strategies directed to the users[18].

Telemedicine programs began several decades ago and are experiencing rapid growth today. However, the analysis of the economic impacts of these programs is not common, and there is a gap in the literature when it comes to reliable and comparative economic data to support political and administrative decisions[19].

In this study, only five scientific productions published in the last 13 years addressed the cost-effectiveness of telemedicine programs in the management of asthma, corroborating this information. These studies demonstrated that telemedicine can be used as a strategy to improve adherence and control of asthma, with impact on clinical outcome and with similar or even slightly lower costs compared to usual treatments[9-13].

Despite the lack of experimental studies on this subject, there is evidence of its potential in improving access to health services and the quality of care provided, as well as facilitating clinical management, reducing the number of hospitalizations and emergency visits, and improving quality of life of patients with chronic diseases[2,6,7,20].

In a retrospective two-year study conducted in primary care clinics in Italy, Belgium and Germany, involving 112 adult patients, the follow-up was evaluated via a telemedicine program in an allergy/immunology hospital clinic. In this study, the authors estimated that when comparing clinical outcomes and indirect cost savings between telemedicine and traditional consultations, telemedicine use saved 200 days of work or school, a value of $ 58,000 in travel-related costs and 80,000 km in displacement of patients. This has evidenced the potential in cost reduction afforded by telemedicine[21].

A prospective study conducted by Liu et al.[19], with the objective of investigating whether a telemedicine intervention would achieve a better asthma control, showed that in the intervention group, when compared to the control group, there was an improvement in PEF parameters and FEV1, improvement in quality of life and fewer episodes of exacerbation and unscheduled emergency visits. These authors conclude that the telemedicine intervention provided a convenient and practical self-monitoring and management of asthma with improved disease control.

In this perspective, review studies[23,24] suggest that there is a beneficial effect of telemedicine strategies in the control of asthma and other respiratory diseases, especially in the acceptance and satisfaction of patients un-

dergoing these interventions. They also stress the importance of evaluating the long-term performance of such strategies to provide information on installation and operation costs, since cost-effectiveness is a crucial factor for the sustainability of telemedicine[25].

It is important to highlight that the articles analyzed in this review used different modalities of telemedicine – telephone consultations[10,11,13], sending of SMS with clinical data and health education[12], and an internet self-management program[9]. The use of SMS was considered as a new means of telemedicine in the monitoring of PEF[12].

A wide variety of telemedicine systems are available for clinical application such as interactive services, remote monitoring, clinical data transmission and diagnostic imaging. The choice of modality for telemedicine intervention should include the various stakeholders, such as patients, health professionals, health institution, and the government. In addition, the type of intervention can directly influence costs, since more sophisticated programs and equipment denote greater financial investment[25].

All the studies analyzed were carried out in developed countries and with advanced economies, more specifically European countries. The use of telemedicine in developing countries, especially in rural areas or outlying cities, has the potential to increase access to health care and new technologies, as well as to facilitate the transfer of knowledge among local professionals, which would make health care more affordable, particularly for the poorest populations[19].

In a broad review of the circumstances in which telemedicine would be appropriate for developing countries, it was concluded that this modality in health would be valued in those countries, with the main advantage of improving access to health care that is characterized by continuous difficulties[26]. However, these authors draw attention to the cautious use of telemedicine in these countries, using cost-effectiveness as guiding, since the loss of resources has a profound impact in this context.

With regard to the health professional responsible for performing telemedicine intervention in the studies that were part of this sample, the nurse played a relevant role in the five studies, and in four of them she was the professional responsible for the intervention. The fact that the nursing professional integrates the studies as responsible for the intervention evidences that the way of caring in nursing has been modified to meet the needs of care emerging in the contemporary world, using various forms of communication, such as portable systems, electronic medical record systems or even performing care through telephone or video camera[27,28].

CONCLUSION

The use of telemedicine-based interventions in the follow-up of asthmatic patients may be an alternative with similar or slightly lower costs compared to usual treatments, and may even affect clinical parameters such as asthma control, quality of life and hospitalizations.

Attempts to Reduce the Economic Burden of Asthma, such as telemedicine, should advance in both developed and developing countries to better manage this disease, because its control imposes less economic burden than the costs of uncontrolled asthma. However, it is perceived that this tool is still little used in developing countries, possibly due to the lack of skilled professionals and in-

vestments by public agencies and, when used, is rarely evaluated as to its cost-effectiveness.

The use of telemedicine by health professionals still lags behind its real potential. Although nursing already has a relevant participation in this strategy of health care (in four of the five articles used in this review the intervention was carried out by nursing), it is believed that to increase the autonomy of the nurse in the planning of telemedicine strategies and in the attendance to the asthma can result in improved quality of care and reduced costs in asthma.

This study contributes to the understanding of the need for the training of professionals, especially nursing professionals, regarding the use of a tool such as telemedicine for asthmatic care, in this growing scenario of people with this chronic health condition. Further studies should be developed so that a deep understanding of the cost-effectiveness of telemedicine can be obtained in the care of asthmatic patients.

The main limitation of this study was the number of studies that discussed cost-effectiveness with regard to secondary outcomes considered: quality of life, asthma control and number of hospitalizations. Regarding the methodological limitations, different methodologies were observed in the studies, with different periods of follow-up of the telemedicine interventions and the heterogeneity of the types of interventions performed. Another limitation to be observed is the lack of more specific data on the classification and severity of asthma in the individuals included in the studies, which may directly influence the analyzed outcomes.

The homogeneity of the statistical analyzes was not observed in the included studies, since it is a systematic review of the literature without meta-analysis. The use of specific questionnaires for the evaluation of the methodological quality of the studies was considered unnecessary, since it would mean a relevant restriction in the selection of already scarce studies in the literature and the articles evaluated reflect the current reality of the publications in the studied subject.

REFERENCES

1. Pérez-Manchón D. Telemedicina, una red social médica de ayuda humanitaria entre España y Camerún. Gac Sanit [Internet]. 2015 Feb; 29 (1): 59-61. Disponible en: http://www.gacetasanitaria.org/es-linkresolver-telemedicina--una-red-social-medica-S021391111400209X
2. Mariani AW, Pêgo-Fernandes PM. Telemedicine: a technological revolution. Sao Paulo Med. J. [Internet]. 2012; 130 (5): 277-278. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1516--31802012000500001&lng=en.
3. To T, Stanojevic S, Moores G, Gershon AS, Bateman ED, Cruz AA, Boulet LP. Global asthma prevalence in adults: findings from the cross-sectional world health survey. BMC Public Health. 2012 Mar 19; 12:204. doi: 10.1186/1471-2458-12-204. Available from: https://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-12-204
4. The Global Asthma Report 2018. Auckland, New Zealand: Global Asthma Network, 2018.
5. Global Initiative for Asthma. Global Strategy for Asthma Management and Prevention, 2018. Available from: www.ginasthma.org.
6. Koufopoulos JT, Conner MT, Gardner PH, Kellar I. A Web-Based and Mobile Health Social Support Intervention to Promote Adherence to Inhaled Asthma Medications: Randomized Controlled Trial. J Med Internet Res. 2016 Jun 13;18(6):e122. doi: 10.2196/jmir.4963. Available from: https://www.jmir.org/2016/6/e122/
7. Licskai C, Sands TW, Ferrone M. Development and pilot testing of a mobile health solution for asthma self-management: asthma action

plan smartphone application pilot study. Can Respir J. 2013 Jul-Aug; 20(4): 301-6. Available from: https://www.hindawi.com/journals/crj/2013/906710/abs/

8. Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med. 2009 Jul 21;6(7):e1000097. doi: 10.1371/journal.pmed.1000097. Epub 2009 Jul 21. Available from: https://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1000097
9. van der Meer V, van den Hout WB, Bakker MJ, Rabe KF, Sterk PJ, Assendelft WJ, Kievit J, Sont JK; SMASHING (Self-Management in Asthma Supported by Hospitals, ICT, Nurses and General Practitioners) Study Group. Cost-effectiveness of Internet-based self-management compared with usual care in asthma. PLoS One. 2011;6(11):e27108. Available from: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0027108 [included in the review].
10. Pinnock H, Adlem L, Gaskin S, Harris J, Snellgrove C, Sheikh A. Accessibility, clinical effectiveness, and practice costs of providing a telephone option for routine asthma reviews: phase IV controlled implementation study. Br J Gen Pract. 2007 Sep;57(542):714-22. Available from: https://bjgp.org/content/57/542/714.long [included in the review].
11. Pinnock H, McKenzie L, Price D, Sheikh A. Cost-effectiveness of telephone or surgery asthma reviews: economic analysis of a randomised controlled trial. Br J Gen Pract. 2005 Feb;55(511):119-24. Available from: https://bjgp.org/content/55/511/119.long [included in the review].
12. Ostojic V, Cvoriscec B, Ostojic SB, Reznikoff D, Stipic-Markovic A, Tudjman Z. Improving asthma control through telemedicine: a study of short-message service. Telemed J E Health. 2005 Feb;11(1):28-35. Available from: https://www.liebertpub.com/doi/abs/10.1089/tmj.2005.11.28?url_ver=Z39.88-2003&rfr_id=ori%3Arid%3Acrossref.org&rfr_dat=cr_pub%3Dpubmed& [included in the review].
13. Gruffydd-Jones K, Hollinghurst S, Ward S, Taylor G. Targeted routine asthma care in general practice using telephone triage. Br J Gen Pract. 2005 Dec;55(521):918-23. Available from: https://bjgp.org/content/55/521/918.long [included in the review].
14. World Health Organization. Preparing a health care work force for the 21st century: the challenge of chronic conditions. Available from: http://www.who.int/chp/knowledge/publications/workforce_report/en/
15. Shih J, Portnoy J. Tips for Seeing Patients via Telemedicine. Curr Allergy Asthma Rep. 2018 Aug 15;18(10):50. Available from: https://link.springer.com/article/10.1007%2Fs11882-018-0807-5
16. Maldonado, J. M. S. DE V. Marques, A. B. Cruz, A. Telemedicine: challenges to dissemination in Brazil. Cadernos de Saúde Pública, v. 32, n. suppl 2, e00155615, 2016. Available from: http://www.scielo.br/pdf/csp/v32s2/1678-4464-csp-32-s2-e00155615.pdf
17. Machado, F. S. N. et al. Utilização da telemedicina como estratégia de promoção de saúde em comunidades ribeirinhas da Amazônia: experiência de trabalho interdisciplinar, integrando as diretrizes do SUS. Ciência & Saúde Coletiva, v. 15, n. 1, p. 247–254, jan. 2010. Available from: http://www.scielo.br/pdf/csc/v15n1/a30v15n1.pdf
18. Taveira ZZ, Scherer MDA, Diehl EEl. Implantação da telessaúde na atenção à saúde indígena no Brasil. Cad. Saúde Pública, Rio de Janeiro, 30(8):1793-1797, ago, 2014. Available from: http://www.scielo.br/pdf/csp/v30n8/0102-311X-csp-30-8-1793.pdf
19. Dávalos ME, French MT, Burdick AE, Simmons SC. Economic evaluation of telemedicine: review of the literature and research guidelines for benefit-cost analysis. Telemed J E Health. 2009 Dec;15(10):933-48. Available from: https://www.liebertpub.com/doi/abs/10.1089/tmj.2009.0067?url_ver=Z39.88--2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed
20. Waller M, Stotler C. Telemedicine: a Primer. Curr Allergy Asthma Rep. 2018 Aug 25;18(10):54.

Available from: https://link.springer.com/article/10.1007%2Fs11882-018-0808-4
21. Waibel KH. Synchronous telehealth for outpatient allergy consultations: A 2-year regional experience. Ann Allergy Asthma Immunol. 2016 Jun;116(6):571-575.e1. Available from: https://www.annallergy.org/article/S1081-1206(16)30089-8/fulltext
22. Liu WT, Huang CD, Wang CH, Lee KY, Lin SM, Kuo HP. A mobile telephone-based interactive self-care system improves asthma control. Eur Respir J. 2011 Feb;37(2):310-7. Available from: http://erj.ersjournals.com/content/37/2/310.long
23. Bonini M. Electronic health (e-Health): emerging role in asthma. Curr Opin Pulm Med. 2017 Jan;23(1):21-26. Available from: https://insights.ovid.com/pubmed?pmid=27763999
24. Ambrosino N, Fracchia C. The role of tele-medicine in patients with respiratory diseases. Expert Rev Respir Med. 2017 Nov;11(11):893-900. Available from: https://www.tandfonline.com/doi/abs/10.1080/17476348.2017.1383898?journalCode=ierx20
25. Hernandez C1, Mallow J2, Narsavage GL3. Delivering telemedicine interventions in chronic respiratory disease. Breathe (Sheff). 2014 Sep;10(3):198-212. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4734754/
26. Wootton R, Vladzymyrskyy A, Zolfo M, Bonnardot L. Experience with low-cost telemedicine in three different settings. Recommendations based on a proposed framework for network performance evaluation. Global Health Action 2011, 4: 7214. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3234078/
27. Wootton R, Bonnardot L. In what circumstances is telemedicine appropriate in the developing world? JRSM Short Rep. 2010 Oct 1;1(5):37. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2984368/
28. Barbosa IA, Silva MJP. Cuidado de enfermagem por telessaúde: qual a influência da distância na comunicação? Rev Bras Enferm. 2017;70(5):978-84. Disponível em: http://www.scielo.br/pdf/reben/v70n5/pt_0034-7167--reben-70-05-0928.pdf

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