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RESEARCH/Systematic review

A systematic review of telemedicine projects in Colombia

Carlos Rey Moreno[1], Javier Simó Reigadas[2], Estrella Everss Villalba[2], Juan Jose Vinagre[2] and Andrés Martínez Fernández[2]

1 Fundación EHAS, Madrid, Spain
2 Departamento de Teoría de la Señal y Comunicaciones, Universidad Rey Juan Carlos, Madrid, Spain

Correspondence:
Professor Andrés Martínez Fernández,
Departamento de Teoría de la Señal y Comunicaciones,
Despacho 123. Edificio de Decanato,
Campus de la Fuenlabrada de la Universidad Rey Juan Carlos,
Camino del Molino S/N 28943,
Fuenlabrada,
Madrid,
Spain
(Fax: +34 91 488 7500; Email: andres.martinez@urjc.es)

Running head: Telemedicine in Colombia

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Summary
A systematic review of telemedicine projects in Colombia is presented, aiming to be able to make recommendations from past experiences. Our study consisted on retrieving projects through an exhaustive search strategy, and then classifying and assessing their evaluations. Results show a country with a lot of institutions, both private and public, including the government, working for the development of the telemedicine in Colombia through more than 45 projects. Health care services have mostly been provided on a telemedicine basis to, at least, 550 000 patients, and they have connected more than 650 health care institutions, mainly in deprived areas of the country. Unfortunately, none of these projects has been rigorously evaluated, and no recommendations can be made with a minimum degree of evidence for their support. The proposed methodology is suitable for similar studies about telemedicine evaluation in other developing countries.

Introduction

Telemedicine projects in Colombia were reviewed in studies conducted in 2001 [2] and in 2003.[7] However, these previous compilations were not systematic reviews, and projects were listed without further analysis. We have therefore updated the previous work. The aim was to identify all the projects carried out in Colombia which provided services via telemedicine. This information may be helpful in future telemedicine work in developing countries.

Methods

The search strategy of the systematic review comprised four steps. In Step 1, relevant articles were identified from the following databases: MEDLINE, LILACS, Cochrane Library, Current Contents, CINAHL, CUIDEN, Telemedicine Information Exchange (TIE) and IEEExplore. Given the lack of articles from developing countries in indexed publications,[8] other documents were examined, such as references within retrieved articles, and other databases, such as the Centre for Reviews and Dissemination (CRD), the Scientific Electronic Library Online (Scielo), the Royal College of General Practitioners (RCGP), the Association of Telehealth Service Providers (ATSP), the American Telemedicine Association (ATA), and the International Society for Telemedicine (ISFT). The keywords used, in English and Spanish, were Colombia and Colombian and each of the following words: telemedicine, telehealth, ehealth and e-health. When a project was found, it was added to the list together with the contact information of the project manager, or of an alternate person if the project manager could not be identified.

In Step 2, Internet search engines were used to retrieve more projects. The search engine Google was used with the keyword combination, and its translation into Spanish, shown in Table 1, following its order of appearance. When using any combination, the following basic rules were followed.

(1) for each combination of keywords, the first 10 hits were examined. When surfing any of them, no more than four levels of navigation were considered;
(2) when a project was found, it was added to the list together with its contact information. In addition, two new keywords were added to the list, the first one containing the current combination but filtering the name of the project found, using the option "-" (in Google, to exclude pages where the current project was present in

order to broaden the scope of our search) and the second one composed by the name of the found project and Colombia (for acquiring specific information of each project prior to the interview);
(3) if after one search, less than 10 pages were retrieved and it was impossible to retrieve any new telemedicine project from them, then the next combination was used.

In Step 3, each project manager was contacted by telephone to identify and discard projects which had not actually been carried out. In a second contact, an interview was undertaken to request information about:

(1) the active projects that he or she was managing, including any available evaluations;
(2) other telemedicine projects in the country;
(3) telemedicine experts in Colombia.

If new projects were identified, Step 2.2 was conducted again.

In Step 4, an expert identified by the interviewees was contacted for confirmation about each project. An expert was somebody who was mentioned more times in Step 3.3. If new projects were identified through the expert, then Step 2 was conducted again.

In order to classify the projects, a previously published method [9] was adapted. The information retrieved from projects was classified according to feasibility and impact indicators[10] (see Table 2). The level of evidence for each indicator was rated according to the nine-level categorization[11] shown in Table 3, and recommendations were made by using previously suggested[12] criteria. That is, for levels 1 to 3, high scientific evidence for recommendation existed; for levels 4 to 7, sufficient evidence for recommendation existed; and for levels 8 or 9, the evidence was insufficient.[OK as re-worded?]

Results

The search process identified 45 different projects. In Step 1, 20 scientific papers were obtained. After reading them, 15 telemedicine projects were identified, and information about Colombian legislation on telemedicine services was also obtained.[13,14]

Step 2 provided information about 16 additional projects, and also provided contact information for the ones that had already been identified. Step 3 allowed us to identify 13 more projects, and to discard 2 (ARCAL 007 [15] and Ecopetrol [2,7]), because they were never carried out. Finally, in Step 4, a list of 42 projects was provided to an expert (an officer from the Communication Office), who confirmed each one and also added a new one, namely the telemedicine activities carried out by ITMS.[16,17]

The 43 resulting projects were classified into two groups: telemedicine research initiatives and projects for providing health care services via telemedicine. The first group included research projects involving the development of hardware and software (such as signal and image processing, telesurgery systems and telemonitoring equipment) for telemedicine projects, which had not yet been validated in patients. The second group consisted of projects in which patients had been managed via telemedicine. A third category was the project from the Colombian Association for Medicine, Informatics and Telehealth itself,[54] which aimed to create a forum where all those involved in telemedicine development in Colombia could exchange ideas and progress.

Telemedicine research projects

The search algorithm provided information about 10 research projects. Strictly speaking, they were not projects, but research groups devoted to specific telemedicine activities. Therefore, they were included on a descriptive basis, but they were not considered in the analysis. The 10 research groups were:

(1) the Telemedicine Centre from Universidad Nacional de Colombia (UNC) that began its work in 1996 with Teleamazon[18], a research project to identify those processes within the public health care system in the Amazonas Department that could be improved using telemedicine;
(2) the R & D in New Telecommunication Technologies Group from Universidad del Cauca that carried out in 1999 a project that laid the foundations for other telemedicine projects in the department of Cauca[19];
(3) the Bioengineering Group from UNC that mainly conducts research in medical image processing (compression and pattern recognition)[20-22];
(4) the Bioengineering Research Group (Grupo de Investigación en Bioingeniería – GIB) from Universidad EAFIT[23] that worked on a project for interchanging medical images using Renata (the national broadband network for academic purposes) infrastructure;
(5) the Colombian Telemedicine Centre (CTC) that conducts research jointly with Universidad Javeriana, mainly related to the development of a virtual platform for surgery[24-32] with educational purposes;
(6) the Clinical Engineering Research Group of the Hospital Universitario La Samaritana, which was carrying out a project for adapting of the PACS and HIS of different Colombian hospitals[15];
(7) the Biomedical Engineering Group (Grupo de Investigación Biomédica-GIB) from the Universidad de los Andes,[33] which was working together with Fundación Santa Fe de Bogotá (FSFB), to propose a methodology for evaluating procedures for digitizing radiology images, and researching on hospital information systems;
(8) the FSFB [34] that was researching about cost-effective methods for teleconsulting regarding suicide risk and sexually transmitted diseases in schools of Bogota;
(9) the Perception and Intelligent Systems Research Group from the Universidad del Valle, which was developing a system to handle second opinions and digital images through the Internet[35];
(10) the Telehealth Research Group from the Universidad de Caldas, that was comparing the efficiency of two methods for teaching the integrated management of childhood illnesses, the conventional one and a virtual course designed by them.[36]

Projects for providing health care services via telemedicine

A total of 32 projects which provided telemedicine services were identified. Out of them, 14 had been finished, 11 remained active, 4 were being implemented and no data were available about the state of the other 3 (see Table 4). Projects were ordered by their current state, and within each group they were ordered chronologically (the most recent first). Table 4 shows whether the indicators referenced in Table 2 had been evaluated or not in each project, and reflects the level of evidence achieved for each of them (in relation to Table 3). Information about medical speciality and telemedicine services provided, patients attended and health care centres connected, was also included; for further information see Rey.[15]

A common feature of all the projects was the lack of studies assessing their performance and

real impact. Most of entries in Table 4 show insufficient level of scientific evidence, because they came from either descriptive articles (e.g. P8[43] or P15 and P16[46]) or from anecdotes that were mentioned in the interviews. The only two studies reporting sufficient evidence for recommendation consisted of a comparison of technical effectiveness (I1) between tele-ECG devices (developed by institutions 3 and 18, respectively) and traditional ECG. They were carried out in P4[17] and P30[54], and both concluded that their devices had the same diagnostic accuracy as the conventional comparators. Some private companies, such as institutions 2, 4 and 18 (see Table 4), mentioned that they had conducted cost-benefit evaluations of their services, but they could not be published for reasons of commercial confidentiality.

The most commonly assessed indicator was I10 (16 projects), showing that many projects in Colombia aimed at improving the accessibility to the health care system for those who live in deprived areas. Also I8 and I4 had been highly considered. Eight projects showed the reduction produced by telemedicine in the time a patient has to wait for being attended, and 12 projects showed that telemedicine services have a good acceptance, although some telemedicine projects (P3, P9) suffered a lot to be accepted in first stance. It is important to note that despite P18 and P24 reported initial institutional acceptance, projects stopped working once they were transferred to the health care institutions.

Very few studies (5 projects) had analysed the improvement in the diagnostic capacity (I6). In P8, an evaluation showed that second opinion reduced six urgent remissions a year in each health care centre. In P15, the manager stated that in San José de Guaviare Hospital, using the teleconsultation system, 170 remissions were avoided during 12 months of operation. The isolated conditions of the hospital produced savings of more than US$300,000 /year for the state administration. On the other hand, in P16, thousands of dollars were invested and only 0.7% of the diagnoses were changed.

There was a lack of data assessing the effect of telemedicine on the rest of the indicators, and very few conclusions could be drawn. It is remarkable, for instance, that a bad initial evaluation of the existing technologies had led P29 to be within an 8 years implementation period.[do you mean that P29 had remained stuck in the implementation period for 8 years?] In other cases, unforeseen circumstances ruined some projects, such as P22 and P25, whcih were affected by the economic crisis that struck Colombia at the end of the 1990s.

Institutions providing telemedicine services in Colombia were mostly private, however, public institutions, such as the Colombian government, were also involved in these fields. This was the case of P1 and P2, financed by the Health Office and entrusted to institution 5, 6 and 18 (see Table 4), which aim at improving access to the health care system for those departments lacking in key services for emergency attention.

There was a wide variety of services provided by the projects, ranging from those typical in industrialised countries, such as telecardiology or teleradiology, to those specific to developing regions, such as telemicroscopy for malaria or tuberculosis. Most of the services of telecardiology, teledermatology or teleradiology were provided by teleconsultation using software developed by each institution. In addition, in some services, like teleneumology [is this telehealth for respiratory medicine?] in P4, the institution (see Table 4), had developed their own hardware.

Discussion

The present systematic review of telemedicine projects in Colombia allowed us to update and extend earlier studies with new information, hence increasing the number of identified projects from 8 to 45. The search strategy was efficient and it served to find almost all the telemedicine initiatives with patients developed in Colombia up to May 2008. Under Colombian legislation, it is compulsory to report to the government on the start-up of projects which aim at managing patients through telemedicine, and the expert who was selected in the search strategy was the civil servant responsible for the management of those reports. Therefore, we can consider that the results of the search strategy were validated at least for the second group of projects. Thus, the proposed search strategy may be useful for future systematic reviews of telemedicine projects in countries where information is not easily accessible.

The systematic review has drawn a picture of Colombia, with a lot of institutions, both private and public, including the government, working for the development of the telemedicine in the country through several projects. Among these ones, which vary in scope and provided services, health care services have been provided on a telemedicine basis to, at least 550,000 patients, and they have connected more than 650 health care institutions, mainly in deprived areas of the country. Unfortunately, although many projects seem to have had a positive effect, none of them has been rigorously evaluated, and therefore no general recommendations can be made in the absence of scientific evidence. In future, therefore, it would be advisable that financing agencies consider funding only projects which include a well-designed plan for evaluating their feasibility and impact.

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Table 1. Keywords used for web search

1. “telemedicine in Colombia”
2. “telemedicine project” Colombia site:.org OR site:.co
3. “telemedicine project” Colombia
4. telemedicine project Colombia site:.org OR site:.co
5. telemedicine project Colombia
6. “telemedicine congress” Colombia
7. telemedicine congress Colombia site:.org OR site:.co
8. telemedicine congress Colombia
9. “health office” telemedicine Colombia site:.co OR site:.gob
10. medicine office OR health telemedicine Colombia site:.co OR site:.gob
11. “health office” telemedicine Colombia
12. “health office” Colombia
13. “faculty of medicine” telemedicine Colombia
14. university OR faculty telemedicine Colombia site:.org OR site:.co
15. university OR faculty telemedicine Colombia

Table 2. Evaluated feasibility and impact indicators

Indicators	Label	Description
Feasibility		
Technical	I1	Effectiveness. Effectiveness indicates whether the technical features of a telemedicine system were sufficient to provide the health service they were designed for. Articles or data which included comparisons between data obtained through telemedicine systems and those obtained through "traditional" methods **have been recalled**.[what does this mean?]
	I2	Reliability. Reliability refers to robustness and security. Robustness refers to the rate of system breakdown; while security refers to the avoidance of undesired side effects caused by the use of a telemedicine system, such as protection against data loss.
	I3	Ease of use. This refers to the simplicity of handling the telemedicine system and its adaptation to the daily work of the institutions where it has been deployed.
Institutional	I4	Acceptance. Acceptance is based on evidence from patients, health workers and health authorities about their satisfaction with the introduction of the telemedicine system.
Economic	I5	Sustainability: This concerns the financial evidence that a telemedicine system can be maintained by the health institution concerned.
Impact		
Clinical process	I6	Improvement in diagnosis capacity: This indicator is intended to measure whether a relationship exists between using a telemedicine system and improving the quality of diagnosis.
	I7	Changes in organization. This assesses whether a new system always brings changes in the way an institution is organized.
Patient health	I8	Utility: This refers to changes in the patient's mental and emotional welfare, i.e. anything which means an improvement of the patient's quality of life.
Accessibility	I9	Perception of isolation: This considers any reduction in the feeling of isolation experienced by patients and health care workers.
	I10	[what is this one called?] To a higher quality health care system: It considers data showing that new disciplines have been extended to remote areas or the protocol for emergencies has been improved.
Economic	I11	[what is this one called?] On the health care centre. It refers to the cost-benefit analysis of the installation of a telemedicine system.
	I12	[what is this one called?] On the health care national system. It takes into account studies or data referring to the economic impact of improving coverage through telemedicine at a national level.

Table 3. Classification of finding [is this Level the wrong way round? Isn't Level 1 the worst and Level 9 the best in the original paper by Jovell AJ and Navarro-Rubio MD?]

Level of evidence	Strength of evidence	Study design
1	Very good	Meta-analysis
2	Very good	Large sample randomized controlled trials
3	Good	Large sample randomized controlled trials
4	Good	Non-randomized controlled prospective studies (multicentre)
5	Fair	Non-randomized controlled prospective studies
6	Fair	Cohort studies
7	Fair	Case-control studies
8	Poor	Non-controlled clinical series, descriptive studies
9	Poor	Anecdotes or case reports

Table 4. Characteristics of selected studies and evaluated indicators

Project	Evaluation indicators												Inst	Beg	Fin	Medical specialit y	Telemed service	Nª patients	Nª centers
	Feasibility					Impact													
	1	2	3	4	5	6	7	8	9	10	11	12							
P1 Basic services[37, 38]								IX		IX			1	2008	Act	C, N, IM, P, G, U, O, D, I, OR	TC	3026	58
P2 Intermediate services[37, 38]								IX		IX				2008	Act	GM	TM, TEI	245	11
P3 Medical Management[39]		IX		IX			IX	IX					2	2007	Act	ND	TA	ND	2
P4 ITMS-Colombia[16,17]	VI			IX			IX						3	2007	Act	C, PN	TC,TM	30000	135
P5 Doctor Chat[40]				IX				IX		IX			4	2006	Act	GM	TEI	1200	1
P6 Leticia Clinic[41]			IX					IX		IX			5	2005	Act	C, IM, U, O, P, D, R, PA, H	TC	2082	1
P7 Teledermatology[42]			IX	IX	IX			IX		IX			6	2002	Act	D	TC	2727	25
P8 EHAS-Colombia[43]			VIII	VIII		VIII	VIII		VIII	VIII	IX	IX	7	2002	Act	GM	TC, TE, TA, O	ND	31
P9 Telemedicine Salud Coop[44]				IX			IX			IX			8	2002	Act	P,G,GA, C,N,ON, OR,E,PN	TC	21581	22
P10 Teleradiology[2]													6	ND	Act	R	TC	150	25
P11 Virtual Clinics[34]													4	ND	Act	GM	TE, TEI	ND	3
P12 Teledermatolgy[34]				IX									4	2007	2008	D	TC	ND	29

P13 San José del Guaviare (now P1 and P2)[37]				IX				IX		IX		IX	5	2007	2008	C, IM, G, U, O, D, I, R, H	TC	3575	1
P14 Ríohacha[37]										IX				2007	2008	D, R, I	TC	1815	1
P15 T@lemed Guaviare (seed of P10 13 and P11)[45,46]	IX	IX	IX			IX		IX		IX	IX	IX		2005	2007	R,D,G,I	TC	1720	2
P16 T@lemed Costa Pacifica[45,46]	IX				IX	IX				IX			9	2005	2006	I	TC	43IX	3
P17 Teleradiology Medellín[47]	IX												10	2004	2005	R	TC	ND	2
P18 ReTaS[48]		IX		IX									7	2003	2004	I	TC, TEI	ND	8
P19 Bogóta-San Andrés-Providencia[2,7]										IX	IX		5	2000	2006	O,R,C,G, D	TC	ND	2
P20 Bogóta-Apaporis-Leticia[2,7]				IX						IX	IX			2000	2003	O,R,C,G, D	TC	ND	2
P21 Telematics Network[15]										IX			7	2000	2001	ND	TA	ND	1
P22 Teleradiology - VTG[2]													11	1999	2002	R	TC	300000	29
P23 Teleradiology-ISS[49]			IX								VIII			1997	1999	R	TC	173125	10
P24 Cundinamarca Telemedicine Network[15]				IX		IX	IX				IX		12	1995	1996	R	TC	2754	5
P25 Cardiac Telemetric Network[2]				IX		IX							13	1994	2002	C	TC	ND	113
P26 Telemap[15]													14	2008	Imp	P, OR, C	TC, TE, TM, TEI	DNA	DNA
P 27 Health Management[50]													15	2008	Imp	ND	TA	DNA	DNA
P 28 Rehab Land													16	200	Imp	PS, OR	TC, TM,	DNA	DNA

Mines Victims[51, 52]													4			TEI, O		
P29 Antioquía Telemedicine Network Red de telemedicina de Antioquía[53]	I X											17	2000	Imp	GM	TC	DNA	DNA
P30 Galaxia Program[54,55]	V II								IX			18	2004	ND	C,R	TC	ND	50
P31 Telemedicine FCV[38]									IX				ND	ND	C, R	TC, TM	ND	103
P32 Dr. Díaz[56]												19	ND	ND	C, IM, G, O, N ,R	TE, TC	ND	ND

Institutions: Pu (public); Pr (private), (1) Caprecom (Pu); (2) Esoft Ltd (Pr), (3) ITMS-Colombia (Pr), (4) Fundación Santa Fe de Bogotá (Pr), (5) Telemedicine Centre-Universidad Nacional de Colombia(Pu) (6) Telehealth Research Group(GIT)-Universidad de Caldas (Pu), (7) Universidad del Cauca (Pu), (8) SaludCoop (Pr), (9) Universidad de Cali (Pr), (10) Bioengineering Research Group (GIB)-Universidad EAFIT (Pr), (11) Vision Technology Group (Pr), (12) Hospital Universitario La Samaritana (Pr), (13) Cardiobip Ltd (Pr), (14) Medicine Faculty-Universidad de Antioquía (Pu), (15) Telemedicine Research Group (GITEM)- Universidad Francisco José de Caldas (Pu), (16) Colombian Telemedicine Centre (Pr), (17) Interdisciplinary Telemedicine Team (EIT) - Universidad Pontificia Bolivariana (Pr), (18) Fundación CardioVascular de Colombia (Pr), (19) Dr. Díaz (Pr)

Project situation: End: End; Act: Active, Imp: Implementation Process

Medical specialties: C (cardiology); R (radiology); D (dermatology), N (neurology), PS (psychiatry), G (gynaecology); PN (respiratory); U (urology); O (otorhinolaringology); EN (endocrinology); OR (orthopaedics); ON (oncology); GA (gastroenterology); IM (internal medicine); P (paediatrics); GM (general medicine), I (infectious diseases); PA: pathology and H: haematology

Telemedicine services: TC: teleconsultation between medical staff; TM: telemonitoring of vital signs of patients with chronic diseases (at home or in hospital); TEI: teleeducation in health for people/patients; TE: teleeducation (remote training, support to medical students/healthcare staff, continuing education); TA: teleadministration (remote administration process as citation management); O: other telemedicine services (e.g. epidemiology surveillance)

Others: ND: No data; DNA: Did not apply