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Journal of Clinical Research and Reports
Henry Robayo Amórtegui

Open Access

Research Article

Characterization of Asynchronous Telemedice Consultation for Pulmonology in Colombia

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Received date: February 17, 2020; Accepted date: March 05, 2020; published date: March 18 2020
Citation: Henry Robayo Amórtegui, Alirio Bastidas Goyes, Julián Monroy Tovar, Britt Whitaker (2020) Characterization Of Asynchronous Telemedice Consultation For Pulmonology In Colombia J Clinical Research and Reports, 4(1); **DOI:**10.31579/2690-1919/049

Abstract

Background: Among the modalities of asynchronous telemedicine used in Colombia, there exists the *teleconcepto*, through which a medical response from a specialist is provided within certain time. Currently, there is no data about the characteristics of teleconceptos directed to the pulmonology service.
Methods: A cross-sectional study was carried out to identify the characteristics of teleconceptos aimed at pulmonology. Data was obtained from the clinical record of each teleconcepto, taking into account date and time of the request, vital signs, ICD-10 diagnosis, present illness, and the reason for consultation, as well as date and time of response from pulmonology and type of recommendation, either a diagnosis or a treatment. Subsequently, the frequency and the percentage of the qualitative, quantitative, average and standard deviation variables were described.
Results:766 teleconceptos were studied, the mean age was 60 years. The cities with the highest number of requests were Ibague (7.4%) and Bogotá (7.3%). Mainly reported symptoms in the present illness were dyspnea (47%) and coughing (44.1%); the main preceding condition associated with pulmonary pathology was chronic obstructive pulmonary disease (COPD) (31.6%).
Conclusions: Coughing and dyspnea were the most frequently found symptoms in the patients referred to pulmonology by teleconcepto and COPD was the preceeding condition which was most frequently associated with pulmonary pathology. On the other hand, spirometry and flow-volume curve were the most requested tests by the physician and the pulmonologist. Finally, the average time in hours from the request to the teleconcepto response was 9.1 hours.

Keywords: Pulmonary disease; Pulmonary Telemedicine; Remote consultation; Rural health services; Telemedicine; Telehealth

Introduction

The increase of population worldwide and their allocation in remote areas are two factors which have brought certain difficulties for health services coverage (1). According to data from the World Health Organization (WHO), between 2000 and 2009, in average, there were 13 physicians per 10.000 habitants in the world. Countries which are considered to lead healthcare services worldwide, such as Canada, register an average of 19 physicians per 10.000 habitants. Great Britain and Cuba have 27.03 and 67.23 physicians per 10.000 habitants, respectively. Colombia, specifically, has an average of 14 physicians per 10.000 habitants, with the professionals located mostly in urban areas (2).

On the other hand, there is a lack of specialists in urban and rural areas. Pulmonology solely has a record of 350 Pneumologists in Colombia, having an average is of 0.75 specialized professionals per 100.000 habitants (3,4), making it even more difficult to attend to all patients. Furthermore, a greater number of specialists concentrate in the major cities of the country, which leaves many zones uncovered (5).

This situation has proven to be one of the causes of shortfalls and delays in assistance for specialized medicine in the region. However, the use of technology in telemedicine might offer different kinds of solutions to these issues. Among its advantages, telemedicine permits the patient improved accessibility to specialised medical attention. According to Colombia's Ministery of Health and Social Protection, Telemedicine activities are carried through exchange of information of health professionals their patients' health status. Modalities are in-person, synchronous or asynchronous. According to regulations, providers have been classified as *centros de referencia* providers (referring centers), that is, those institutions who can offer support to both primary and complex attention. Another type of providers are *prestadores remisores* (referring providers), which are the institutions that have certain limitations in their service coverage in terms of technology or accessibility to obtain a patient's diagnosis (6).

Colombia has 282 sites as referring centers and 443 telemedicine referring telemedicine providers, which are scattered in cities and townships. Using this resource also shortens the waiting time for answers regarding a specialized medical opinion, the average waiting time being 41.58 hours for an appointment in telemedicine for referring centers and 23,95 hours for referring providers (6).

Additionally, telemedicine is profitable in terms of cost saving: expenses for a patient who is served through telemedicine are 313 US, whilst expenses for a patient who attends an appointment in person are 585 US (7). There is also a saving on an additional expense about keeping a medical specialization in healthcare service centers, which is estimated to cost about 1166 US per patient (8).

Among the modalities of telemedicine used in Colombia, there exists the teleconcepto, a resource from asynchronous telemedicine (time measured in hours, starting from initial medical inquiry to specialized medical response) (1). We define it as an activity carried out remotely to request formal medical specialized opinion, having previously exchanged valid information (digital clinical record). The exchange is done between a physician in charge of primary care and a specialist, throughout the use of information and communication technologies, in order to improve a patient's medical condition. In October 2010, French health authorities decreed 5 different types of medical procedures which are part of the concept of telemedicine, teleexpertise being a similar option as the one implemented in Colombia (9).

The method of teleconcepto is carried out throughout easy-access technological elements, such as desk computers or laptops, or mobile devices and tablets, in order to establish contact between the expert and the physician who is attending the patient. That way, it is possible to offer more tools for diagnosis, treatment and forecasting of certain types of pathologies. Currently, there is no data regarding the characteristics of teleconcepto consultation to pneumology requested by primary medical attention. This paper has set the objective of describing teleconceptos for pneumology service through healthcare service providing institutions (HSPI) in Colombia.

Method

A cross-sectional study was carried out to identify the characteristics of pneumology-related teleconceptos. Data was obtained from the database of a Colombian HSPI which is specialized in telemedicine and offers the service of teleconcepto nationwide. The requests are referred to their office in Bogota throughout a program specialized in clinical records. On the other hand, the referring centers are placed nationwide in institutions of first and second level of medical attention. Most of them are run by primary attention physicians. They start their query for a teleconcepto to pneumology by writing a new medical record in a computer.

Data collection was made by analyzing each of the teleconceptos directed to pulmonology from February 1st to April 30th in 2016. After that, to-be analyzed characteristics were selected; in order to minimize any typing errors, the research team verified the data twice. Any kind of teleconcepto directed to pneumology was included, patients were required to be older than 15. Teleconceptos directed to any other specialization were discarded, as well as those required by mistake.

A Pneumologist gives an opinion based on the data reported by the clinical record, the physical examination, para-clinical tests and any other tests from the physician in charge of the patient. To provide an answer for the teleconcepto, the specialist must write their opinion, which should be no more than 500 words, according to the regulations for clinical records. For this reason, said response must include clear indications on the procedures for the patients.

The factors that were evaluated were personal information, date and time of the teleconcepto requirement, vital signs, CIE-10 diagnosis, current disease and reason for requesting a teleconcepto. In terms of the request as such, the evaluated variables were the following: general request (purpose of inquire is not determined), treatment, diagnostic approach, radiological findings, abnormal para-clinical tests, proceedings and prognosis. Finally, in terms of the reaction from pneumology, the following factors were studied: follow-up, diagnosis test, treatment, para-clinical tests request, diagnostic imaging, in-person pneumology assessment, referral to emergency, proceedings, and the date and time of the teleconcepto response from the specialty.

Calculations for the size of the sample

The calculations to obtain the sample size were made with Epidat, Pan American Health Organization's free program. Through the formulas, a confidence interval was estimated for a 5% of absolute precision and a maximum estimated proportion of 50%. Thus, at least 462 teleconceptos were needed. A convenience sampling was carried out and it included all teleconceptos obtained during February, March and April of 2016.

Data management and statistical analysis

A description of the variables was carried out firstly, to acknowledge and exclude those variables with a loss of information 20% higher than the data. Then, the description covered frequency and percentage of qualitative factors, as well as measures of central tendency and dispersion for quantitative data. If their distribution was normal or median, only mean o and standard deviation were included. If their distribution did not meet normality criteria, interquartile rank was included as well. An estimation on the proportion and confidence interval were made about the ten most frequent diseases that required a teleconcepto. Data was managed and analyzed with the use of the program SPSS v23.

Results

Data entry and healthcare centers that requested a teleconcepto

Figure 1 describes entry of the reported teleconceptos in a period of three months. 820 teleconceptos in total were revised, out of which 54 were excluded, most of them, due to being considered as redirected to other specialties, since there were no respiratory pathologies. Two of the teleconceptos were for patients under 15 years old, thus, a pediatric assessment was demanded. In total, 766 teleconceptos were chosen for the final analysis.

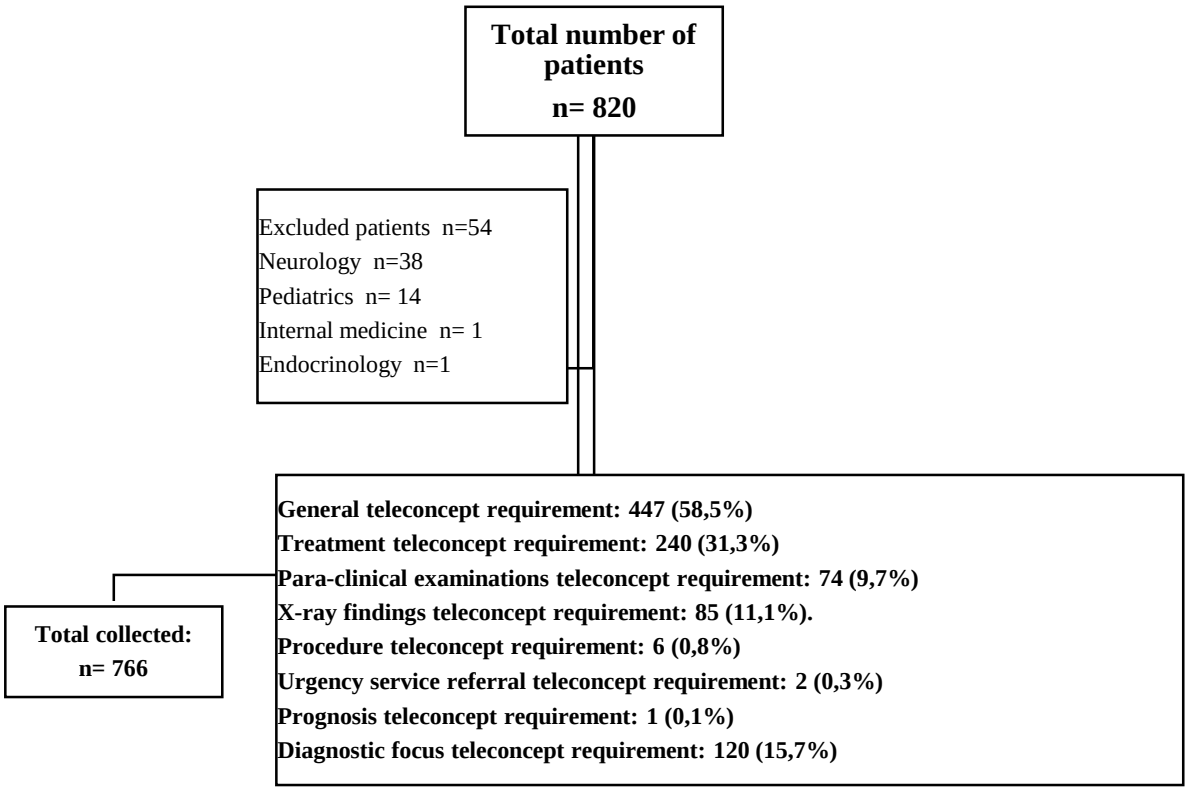

Figure 1: Design of the study

Referral centers were found nationwide in both urban and rural areas (Figure 2). Teleconceptos coming from 140 townships and the capital district in Colombia were demanded. The rate of requirements, as defined per city, were: Ibague (7.4%), Bogota (7.3%), Cucuta (5.7%), Tunja (4.6%), Medellin (3.7%), and Pereira (3.7%). On the other hand, the highest frequency of requirements was held in Dosquebradas (3.3%) (Located in Risaralda) and Chinchina (2.7) (Located in Caldas).

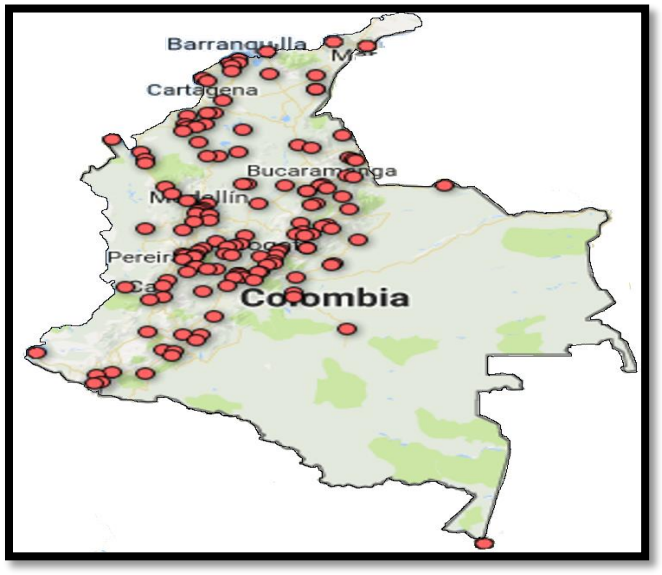

Figure 2: Nationwide locations of the referring centers for teleconceptos

Characteristics of the population

Mean age was 60 years old, the minimum being 15 and the maximum 98 (IQR:24). Out of all the assessed teleconceptos, 425 patients were women (55.5%). The record of participation in any assistance program for chronical pathologies was 80%. Cardiac frequency was reported in 92.5% of the cases, as well as systolic pressure. Diastolic arterial pressure was taken in 95.3% of the cases, respiratory frequency in 93.1% of them, temperature in 82% of them, and oximetry in 5% of the cases. Pulmonary auscultation was reported in 19.5% of the cases (149 patients), out of which 76% had some abnormality.

The physicians who wrote the clinical record described the reason for consultation in 0.5% of the cases. Symptoms during consultation were mainly dyspnea (47%), coughing (44.1%), fever (23%), chest pain (11.4%) and asthenia (5%). On the other hand, symptoms that appeared less frequently (in less than 5% of the cases) were intense headache, symptoms related to sleep apnea (apnea, snoring, insomnia and daytime hyperinsomnia), wheezing, loss weight, runny nose, dysphonia, hemoptysis, odynophagia, and others. Table 1 describes the general characteristics of the population.

Characteristics of the population and referring site of the teleconcepto

Characteristics	**Population n = 766**
Age M(IQR)	60 (24)
Feminine sex n(%)	425 (55.5)
Chronical disease program n(%)	

Main cities where teleconcepto was requested Ibague n (%) Bogotá n (%) Cucuta n (%) Tunja n (%) Medellin n (%)	
Signos vitales M(RIQ)	
Cardiac frequency heartbeat x min	614 (80.2)
Systolic arterial pressure mmHg	57 (7.4)
Diastolic arterial pressure mmHg	56 (7.3)
Respiratory frequency breathing x min	44 (5.7)
Temperature in ºC.	35 (4.6)
	28 (3.7)
Symptoms of current condition	
Dyspnea	**M(RIQ)–Frecuencia en%**
Coughing	
Fever	78 lpm (8) – 95.2%
Chest pain	120mmHg (10)- 95.2%
Asthenia	76,5 mmHg (10) – 95.3%
Physical examination	18 rpm (2) – 93.1%
Pulmonary auscultation n (%)	36°C (1) - 82%
Abnormal auscultation n (%)	47 %
	44.10 %
Personal preceeding conditions n(%)	27 %
HBP	11.4%
COPD	5.5 %
Smoking	19.5%
Asthma	76%
Obstructive Sleep Apnea	31.7 %
Tuberculosis	31.6 %
Diabetes Mellitus	15.9 %
Pulmonary Hypertension	11.4 %
Obesity	8.2 %
Pneumonia	7.4 %
Gastritis	7.3%
	5.6 %
	5.2 %
	5.2%
	5%

Table 1: Characteristics of the population and referring site of the teleconcepto

Most of the reported preceding conditions related to pulmonary disease were chronic obstructive pulmonary disease (COPD) with a rate of 31.6%, followed by smoking (15.9%), asthma (11.4%), obstructive sleep apnea (8.2%), tuberculosis (7.4%), pulmonary hypertension (5.6%) and pneumonia. On the other hand, one preceding condition unrelated to pulmonary disease was high blood pressure (HBP) in 31. 7% of the population (Table 1).

Diagnosis related to CIE-10 which were more frequently reported to pulmonary pathology were COPD (19.1%), asthma (6.9%), sleep apnea (6%) and coughing (2.5%). The most frequent of non-pulmonary pathologies are cardiovascular diseases (cardiopathies, systemic arterial hypertension, and others) in a 11.9%.

Requested para-clinical exams before and after the teleconcepto

Paraclínicos requested by the doctor before establishing a teleconcepto were mainly the following: Chest X-ray (46.5%), followed by spirometry test (31.5%), blood test (21.1%), microscopy (17.4%), echocardiogram (13.6%), arterial blood gas analysis (8.7%) and polysomnography (8.5%). In terms of pneumology, suggested testing was for: spirometry (61.4%), arterial blood gas analysis (33.8%), blood test (31.7%), chest computerized axial tomography (22.5%), chest X-ray (19.6%), transthoracic echocardiogram (18.61%), microscopy (16.7%), immunoglobulin E test (9.7%) and polysomnography (7.8%). Para-clinical tests required per specialty are summarized in Table 2.

Examinations requested before the teleconcepto	
Chest X-ray n (%)	46.5%
Spirometry n (%)	31.5%
Complete blood count n (%)	21.1%
Mycroscopy n (%)	17.4%
Ecocardiography n (%)	13.6%
Arterial gas n (%)	8.7%
Polysomnography n (%)	8.5%
Polymerase chain reaction n (%)	2.2%
Fibreoptic bronchoscopy n (%)	2.2%
Immunoglobulin E n (%)	1.8%
Upper GI endoscopy n (%)	1.8%
Sinuses X-ray n (%)	1.3%
Chest axial tomography n (%)	0.8%

Para-clinical examination requested during the teleconcepto	
Chest X-ray n (%)	19.6%
Spirometry n (%)	61.4 %
Complete blood count n (%)	31.7%
Mycroscopy n (%)	16.7%
Echocardiography TT n (%)	18.1%
Arterial gas n (%)	33.8%
Polysomnography n (%)	7.8%
Fibreoptic bronchoscopy n (%)	4.6%
Immunoglobulin E n (%)	9.7%
Upper GI endoscopy n (%)	6%
Sinuses X-ray n (%)	5.9%
Chest axial tomography	22.5%
CT angiography (%)	1.3%
Ventilation and perfusion scan n (%)	0.1%

Table 2: Characteristics of para-clinical examinations of the teleconcepto

Reason for requesting a teleconcepto, response time and type of answer from pneumology

General inquiry refers to a request to the specialty about guidance for diagnosis, treatment and follow-up. Out of all the requests for teleconcepto, 58.5% was for a general inquiry. 31.3% was for treatment; 15.7% was for diagnostic focus; 11.1 was for X-ray findings; 9.7% was for abnormal findings in para-clinical examinations, 0.8% was to establish any additional procedures (such as fibreoptic bronchoscopy); and 0.1% was for prognosis.

Reason for requesting	
General request n (%)	58.5%
Treatment request n (%)	31.3%
Diagnostic focus request n (%)	15.7%
X-ray findings request n (%)	11.1%
Para-clinical examinations request n (%)	9.7%
Procedure request n (%)	0.8%
Emergency services referral request n (%)	0.3%
Prognosis request n (%)	0.1%

Table 3: Characteristics of the reason for requesting a teleconcepto

Month, day, year and time of request are reported in the clinical record of a teleconcepto. Date and time of the response from the pneumologist are also included. According to the analyzed data, the average of answering time for the teleconcepto was 9,1 hours. The indications provided by the response were: patient follow-up with a new assessment (78,5%), diagnostic test (72,8%), treatment (59,7%), extra pulmonary para-clinical examinations (59,4%), X-rays (46,9%), in-person assessment by a pneumologist, and surgical or non-surgical procedure (8,4%). The following table (Table 4) contains indications once the answer is provided from the specialty.

Characteristics of indications in teleconcepto	
Indication	**Population** n = 766
Follow-up n (%)	78.5%
Diagnostic test n (%)	72.8%
Treatment n (%)	59.7%
Para-clinical examinations n (%)	59.4%
X-rays n (%)	46.9%
In-person assessment by Pneumology n (%)	31.5%
Procedure n (%)	8.4%

Table 4: Characteristics of indications in teleconcepto

Discussion

The present study carries out the first nationwide description of the main characteristics of the request for specialized guidance to pneumology by using the method of asynchronous teleconcepto. Findings reveal that the main preceding condition for assistance in primary care was COPD, smoking, asthma, sleep apnea and tuberculosis. These pulmonary diseases are the main cause of medical consultation for respiratory pathologies in consultation in Colombia (3, 10, 11).

Elderly people (plus 60 years) are the ones who most frequently undergo specialized consultation. The mainly reported symptoms were coughing and dyspnea, which matches the first report from Colombia's National Health Watch that assures respiratory diseases, specially COPD, have a higher prevalence and mortality rate in those older than 60 years old (11). Coughing and dyspnea are the most frequently reported symptoms by the general population. Dyspnea's frequency being about 8,9% in general population; the percentage might even raise to 35% in people older than 65 years (12, 13). According to data from America, coughing is found in 18% of the population (14).

Smoking is still one of the main previous conditions found in those patients with respiratory abnormalities in our environment. Well known and reported, this situation associates cigarettes with a risk for developing COPD (RR:4.01), asthma (RR:1.61), sleep apnea (RR:1.97) and tuberculosis (RR:1.57) (15). The latter, which has the fifth place in our results, is similarly reported by the WHO in 2015 as part of Colombia being one of the countries with a high incidence of tuberculosis (16). The relevance of knowing about the behavior of these diseases lies in the fact that respiratory diseases in Colombia are ranked as the third cause of mortality (17). For this reason, it is necessary to keep on researching new ways for having an accurate and early reaction to them.

Our research evaluated teleconceptos sent around the whole country (Figure 1). The study of locations found the most frequent city to ask for teleconceptos to be Ibague (7.4%), followed in second place by Bogota (7.3%). Nonetheless, summed percentages of the capital cities represent only 33% of the total number of requests. Indeed, 67% of the requests come from small cities and townships with rural areas. It was expected to obtain such results, since this method might have a higher demand from the outskirts from the country, where there is not enough access to specialized consultation, although the prevalence of respiratory diseases remains important.

Figure 1 portrays also the differences between certain regions of the country in terms of their requirement for a teleconcepto. Northern, Western and Central regions are where teleconcepto is more frequently summoned. On the contrary, Southern and Eastern regions have a very low rate of requirements for teleconcepto, almost none in the latter. This situation could be related to the availability of this resource, which depends on the health service institution that actually provide said service. Other factors considered are the easiness or difficulties implied in access to information technology (IT) and the internet access (6).

Ibague and Bogota were the main cities that required concepts from pneumology, possibly due to various factors, such as having better accessibility to IT and communication technologies and a higher population density, which translates into a higher number of patients with complex pathologies, and possibly factors like smoking and pollution. Resarch by the WHO about pollution in Bogota reveal that the city is considered one of the cities with the highest level of pollution in South America. The mean concentration of particulate matter from less than 10 ug (PM_{10}) was 52 ug/m3, the expected measure was 32 ug/m3. The concentration in 2,5 ug ($PM_{2,5}$) was 24 ug/m3, although the expected measure for this kind was less than 10 ug/m3 (18, 19). Said findings suggest that Bogota fails to comply with the recommendations for protection of the population, given that pollution is a decisive factor for the development of respiratory diseases and an additional reason to receive a higher number of requirements for teleconceptos for pneumology.

Pulmonary auscultation was only reported in 19% of the teleconceptos, and it was found to be abnormal in 76% of the cases. This data shows that the physician who requests for a teleconcepto must emphasize in a better detailed report of the physical examination, since it can offer more information to indicate a better diagnosis and treatment for the patient.

The most frequently reported para-clinical examination by the physician are chest X-ray (46.5%), spirometry and flow-volume curve (31.5%), complete blood count (21.1%), arterial gas (8.7%) and polysomnography (8.5%). The high frequency in chest X-ray requirements might be

connected to the easiness to access it in primary care. However, other examinations would be suggested as well for a diagnostic focus on respiratory pathologies, and they are not seen as frequently in the clinical records of a doctor who required teleconcepto. This might represent the limitations regarding the requests for para-clinical examinations in our healthcare service (availability in facilities or approval from the institutions) and the lack of knowledge in terms of approach for certain diseases and their symptoms.

Para-clinical testing required by the pneumology service are spirometry and flow-volume curve (61.3%), arterial gas (33.8%), blood count (31.7%), chest CT scan (22.5%), chest X-ray (19.6%) and transthoracic echocardiography (18.1%). The reason why spirometry is the most frequently requested examination by the speciality might be related to the fact that it has been reported as subtilized in primary care in patients suspected to have pulmonary disease (20). CT scan is frequently employed for a specialized approach on treating parenchymatous pulmonary diseases. Transthoracic echocardiography is used for diagnosing cardiac diseases which might be related to respiratory conditions or symptoms.

Regarding the teleconcepto requirement itself, most of the general physicians do not ask a specific question, but they ask for a general assessment of their patient. Then the pneumologist provides a general answer to the teleconcepto, usually making an emphasis in follow-up and diagnostic testing in 70% of the cases, and in treatment in 60% of the cases. In-person assessment was requested in 31% of the cases, and this number reflects that not all the pneumology cases can be resolved through the method of teleconcepto.

Guidance might be provided through teleconcepto to any physician, in order to carry out supported follow-up in patients with chronical pathology, and to suggest in-person specialized assessment when needed. Mean answering time of teleconcepto is 9.1 hours. According to data obtained in a Colombian context for telemedicine, the average response time is 41.58 hours for referring centers and 23.96 hours for referring healthcare service providers. Thus, the method of teleconcepto allows the physician to quickly obtain a concept from a specialist.

The present research could not carry out an analysis of cost-effectiveness or satisfaction level from the patients assessed by telemedicine. Even though it might offer certain benefits, current research does not demonstrate significant statistical data about life quality, an improvement on mortality rates or cost-effectiveness for the main chronical diseases (8). Nonetheless, since specialized literature holds few studies about this topic, it is indeed necessary to have a higher amount of them in terms of the three characteristics.

One of the advantages of telemedicine has been being able to reduce geographical distances, as well as the waiting time for patients who are under different circumstances which impedes them to promptly access medical healthcare services (1). However, utilizing this resource may bring other benefits, such as obtaining information about the conditions or diseases which may need more support or guidance from specialized physicians to those giving primary care.

Conclusion

Telemedicine in Colombia might be presented as a solution to the lack of specialists in areas that are difficult to reach. Thanks to teleconcepto, it is possible to obtain a veredict from specialized medicine in a timely manner; the average time between request and answer is 9,1 hours, according to our analysis.

Pulmonary pathologies have a high prevalence worldwide, since they account for high morbility and mortality rates. For this reason, when physicians get more orientation on their medical focus, it is possible to achieve efficient medical healthcare access for patients who have difficulties in attending in-person consultation. High levels of ambient air pollution in urban areas is also associates to a higher prevalence of pulmonary pathologies.

Ethical responsibilities

People and animal protection: The authors declare that the present study did not involve experiments with human beings or animals.

Data privacy: The authors declare they have followed all the protocols about patient data management provided by their work centers.

Funding: The authors were completely responsible for the funding of this research.

Conflict of interest: The authors report no conflict of interest.

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DOI: 10.31579/2690-1919/049