

What kind of information and communication technologies do patients with COPD prefer to use? A cross-sectional study in Latin America

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Abstract

The aim of the present study was to assess the frequency of uses and preferences of information and communication technologies (ICTs) among Latin American chronic obstructive pulmonary disease (COPD) patients. We conducted an anonymous cross-sectional survey study on Latin American COPD patients. The adapted version of the Michigan questionnaire was employed in eligible outpatients in different cities of Latin America. We categorized age and educational levels into three groups. The time passed since COPD diagnosis was categorized as ≤ 5 years and > 5 years. χ^2 and crude and adjusted logistic regressions were performed. A total of 256 patients were enrolled with a mean age of 68.7 years old. The most recurrently used ICTs were short message service (SMS; 47.1%) and WhatsApp (30.7%) for receiving COPD information. Moreover, SMS (85.8%) and Facebook (36.1%) were rated as useful for asking physicians information about COPD. Regression analysis showed that the best predictor for patients using ICTs, for any purpose, was higher education (undergraduate or graduate school). Understanding the preferences of ICTs among COPD patients could help improve patient's outcomes through developing applications in response to specific requirements of each patient.

Keywords

Information and communication technology, social media, Mhealth, SMS, electronic media, chronic obstructive pulmonary disease, Web 2.0.

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Introduction

The prevalence of patients with noncommunicable chronic diseases increases each year, and it is more frequent in developing countries.¹ Chronic obstructive pulmonary disease (COPD) is now the third-leading cause of death in the United States.² PLATINO study examined the prevalence of COPD in five major Latin American cities and found that the overall prevalence of COPD varied from 7.8% in Mexico City to 19.7% in Montevideo.³ In Latin America, 14.3% of the population has COPD⁴ and

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this prevalence is expected to increase because of the ongoing exposure to risk factors and aging of the global population.⁵ Self-management education (SME) used in COPD population has usually recommended pharmacological and non-pharmacological treatment strategies for COPD management.⁶

A recent meta-analysis has shown that SME can be a useful strategy to reduce respiratory-related hospital admissions and emergency room visits in patients with COPD. SME may play a promising role in improving COPD patients' health outcomes.⁷ By developing an understanding of how to increase COPD self-management, we could improve COPD outcomes, such as increased physical activity, decreased exacerbation, better adherence to medication, and so on.

Information and communication technologies (ICTs) are broadly defined as technologies used to communicate, manipulate, and store data by electronic means. This includes e-mail, short message service (SMS) text messaging, video chat (i.e. Skype or Hangouts), and online social media (i.e. Facebook or Twitter) as well as all the different computing and mobile-type devices (smartphones and tablets) that perform a wide range of communication and information functions.⁸ When compared to face-to-face communication, the use of ICTs reduces the challenges associated with cultural diversity and decision-making. Therefore, it is possible that the selection and implementation of particular ICTs could facilitate global virtual communication and decision-making.⁹

Therefore, some research suggests the potential of mobile phones plus COPD-specific software to improve incremental shuttle walk test distances, walking endurance, compliance with home-based exercise programs, inspiratory capacity, quality of life scores, exercise time, physical functioning, and self-efficacy in managing dyspnea while at the same time reducing the number of unscheduled visits to physician offices and the number and length of hospital stays due to the exacerbations of disease.¹⁰

Recent publications using information and communication technologies' exercise programs have demonstrated increases in daily physical activity in patients with COPD using a smartphone.^{11,12} Furthermore, one pilot study has suggested that Internet-based support can promote self-management in COPD patients.¹⁰ For this reason, ICTs offer an easier way to reach out to patients and, at the same time, broadening their knowledge and understanding of COPD. Accordingly, patients are increasingly seeking information about their diseases and its self-management using different

ICTs; there are new opportunities for using applied ICTs on the Internet to increase patient's education. Studies in developed countries have identified the proportion of Internet and ICTs use in self-management programs.¹³ However, a literature review found there are insufficient data to analyze a real benefit of ICTs as a COPD support tool.¹⁴

The aim of the present study was to assess the frequency and preferences of ICTs use among Latin American COPD patients. Also, we are trying to determine differences among age, gender, education level, country, and years since the diagnosis of COPD. The results should assist us in developing new electronic media applications in order to use these technological tools as effective support to treatment and management practices.

Methods

Study design and population

We conducted an anonymous cross-sectional survey, in which 295 COPD patients from Latin America rated their frequency of ICTs usage. Eligible outpatients from either public or private practice in Guayaquil, Ecuador, and Buenos Aires; Argentina were surveyed using the Spanish adapted version of the Michigan questionnaire.¹⁵ The survey included 18 items and collected information about demographics, use of cell phones, the interest of patients in using ICTs to receive information about COPD, and the interest of patients in using ICTs to communicate with health care providers about COPD.

The inclusion criteria employed in this survey stated that patients had to be more than 40 years old and had received a COPD diagnosis at least 1 year prior to the carrying-out of the survey. We excluded patients with psychiatric diseases, language impairment, or who found it difficult to visualize the survey.

Ethical considerations

This study was approved by the Ethics Committee of Hospital Luis Vernaza, Ecuador. We obtained informed consent of all the participants in the survey. We guaranteed that the identity of the patient would not be revealed.

Procedures

Participants were approached using a consecutive sample. Patients were informed of the purpose of the study and their role in it. During the survey, patients

completed their questionnaires, either by themselves or with the help of a previously trained person (e.g. physician, nurse, or intern).

We adopted a rigorous method to translate it into a Spanish version of the Michigan questionnaire.¹⁶ An expert panel of pulmonologists checked the translated version. They also considered additional potential questionnaire items in order to include all necessary questions. This questionnaire assesses the frequency of use of ICTs by patients and their preferences for receiving disease-related information.

Participants were asked to quantify their use of each technology (text messaging, Facebook, Twitter, e-mail, LinkedIn, YouTube, Skype, and the Internet) using a scale: daily, at least once a week, at least once a month, less than once a month, or never. They were also asked which ICT (Internet, Facebook, Twitter, YouTube, and e-mail) they use to obtain information by themselves about COPD. Notice that the term Internet represents the networking communications systems used by the patient for the health-related purposes we analyze. The use of Internet might be from any type of hardware that uses any online platform, excluding Facebook, Twitter, YouTube, and e-mail. For instance, a Web browser, any social media not included in the categories and so on.

Participants were also asked to quantify their interest in receiving information about factors that could affect COPD control (e.g. exacerbation factors, ozone levels, medication reminders, and COPD tips) through ICTs (text messaging, Facebook, Twitter, LinkedIn, and e-mail). Level of interest was quantified as high, somewhat, low, or no interest. Using the same scale, participants were asked to quantify their interest in asking questions to their doctors or other health care providers using each of the ICT forms (text messaging, Facebook, Twitter, LinkedIn, and e-mail). Free text entries were asked to determine what kind of information would participants most like to receive via these technologies, the reasons they might not be interested in using such technologies for communication, and any other comments about the use of these methods for COPD patients. Furthermore, patients were asked if they had access to Internet and cell phones. Patients were also asked if they owned a smartphone.

We incorporated two new questions into the survey related to patients' interest in using WhatsApp for health issues. This question was included, because it was highly relevant to our study, but it was not included in the original questionnaire. We asked

participants whether they were interested in seeking and receiving information about COPD using WhatsApp. The dichotomized answer was yes or no.

Also, we collected demographic information about each patient, including age, gender, education, and race/ethnicity together with information about the patient's time lapse since diagnosis and the use of COPD medication.

Statistical analysis

For each electronic media type, frequency of use responses was dichotomized into categories of "at least once a week" and "less than once a week." Age, gender, education level, and years since COPD diagnosis were used as independent variables on each analysis. Age was categorized into under 60 years old, 61–75 years old, and over 75 years old. Gender was either male or female. Education level was categorized into none or elementary school, secondary school, and undergraduate or graduate school. The time since COPD diagnosis was categorized as ≤ 5 years and >5 years.

We performed a χ^2 test to assess the association among Internet access or owning a cell phone or smartphone and age, gender, education level, years since diagnosis, and country. We employed the same test to determine the association between the same independent variables and the frequency of use of each ICT type (SMS, Facebook, Twitter, YouTube, e-mail, Internet, LinkedIn, and Skype). We used the same analysis to determine if there was an association between these independent variables and using each ICT to obtain information.

We performed similar analyses on the association between the described independent variables and the degree of interest (dichotomized into "high or some interest" and "little or no interest") in receiving information through each ICT type and having high or some interest in communicating (asking physician) through an ICT media type.

We undertook adjusted logistic regression analyses between the set of independent variables and use ("at least once a week" and "less than once a week") and interest in receiving information and communicating through each ICT. Analysis was adjusted for age, gender, education level, and years since diagnosis. Reference categories were >75 years old, male, no education/primary school, and ≤ 5 years since diagnosis. Finally, we performed separated non-adjusted logistic regression analysis between frequency of use

of ICTs and the fact of owning a mobile device (cell-phone/smartphone) and interest in receiving information and communicating with a physician through those same ICTs.

All the data were analyzed using SPSS, version 24.0 software (SPSS Inc., Chicago, Illinois, USA). We performed Fisher's exact test where deemed necessary. A p -value of less than 0.05 was considered

Results

A total of 295 patients were enrolled in this study. Mean sample age was 68.7 years old (standard deviation (SD), 9.9) and average time diagnosed with COPD of 7.7 years (SD, 10.3; Table 1).

Most patients were male (65.3%). Around half of the participants were from Ecuador (48.5%). Most of the participants reported having only primary education (41.7%). Most participants were White (52.6%) and Hispanic (45.0%; Table 2).

Internet access, owning cell phone, or smartphone. Of the participants, 77.5% reported they owned a cell phone (either regular or smartphone; Table 3); this was more common in groups aged <75 years (Online Supplemental, Table S1). Internet access was reported by 38.1% (Table 3). The percentage of patients with access to Internet was higher in Argentina compared to Ecuador (44.7% and 30.2%, respectively; Table 3). Out of 77.5% of cell phone owners, 31.5% had smartphones while the remainder had a regular mobile phone.

Use of ICTs at least once a week. SMS was the most used ICT (47.1%), followed by the Internet (35.3%) and e-mail (29.3%). There were no significant differences among age-groups (Online Supplemental, Table S1). Regarding education level, less educated patients reported the lowest use of all ICTs (Online Supplemental, Table S3).

Use of ICTs for seeking COPD information. The Internet was used by 25.5% of patients to obtain information about COPD. Other ICTs were not used frequently for this purpose (Table 3).

High interest in receiving disease information using ICTs. SMS (44.7%) was the most rated ICT for patients to receive information about their disease. WhatsApp (30.7%) and e-mail (28.9%) were also rated as beneficial media for receiving information. However, only SMS and e-mail were statistically significant ($p < 0.01$; see Table 3 and Figure 1).

Table 1. Mean age and years since diagnosis of surveyed population.

Characteristics	Mean (SD)
Age (years)	68.7 (9.9)
Years with COPD	7.7 (10.3)

COPD: chronic obstructive pulmonary disease; SD: standard deviation.

Table 2. Demographic information of surveyed population.

Characteristics (n = 295)	n (%)
Country	
Ecuador	143 (48.5)
Argentina	152 (51.5)
Age (years)	
≤60 years old	56 (19.0)
61–75 years old	171 (58.0)
>75 years old	68 (23.1)
Gender	
Male	192 (65.3)
Female	102 (34.7)
Race	
White	153 (52.6)
Native	1 (0.3)
Hispanic/Mestizo	131 (45.0)
Black	5 (1.7)
Other	1 (0.3)
Education level	
None	13 (4.4)
Primary school	123 (41.7)
Secondary school	95 (32.2)
Undergraduate school	51 (17.3)
Graduate school	13 (4.4)
Years with COPD	
≤5	174 (59.4)
>5	116 (40.6)

COPD: chronic obstructive pulmonary disease.

High interest in asking physician's information using ICT. SMS and Facebook were rated as useful when it came to asking physicians for information about COPD (85.8% and 36.1%, respectively; Table 3 and Figure 2). SMS was the most commonly reported ICT by patients of all age-groups, especially participants older than 75 years (Online Supplemental, Table S1). Twitter also appeared as a utilized ICT (10.7%), though it was not statistically significant ($p > 0.05$; Online Supplemental, Table S1).

Regarding education level, the most frequently used ICTs in all categories, when requesting information from a physician, were SMS and Facebook

Table 3. Use, obtain information, interest in receiving information, and interest in asking a physician through ICT types by country.^a

	Ecuador (n = 143)	Argentina (n = 152)	χ^2 p-value	Total (n = 295)
Internet access	30.2%	44.7%	0.013	38.1%
Owning				
Cellphone	68.0%	85.5%	0.000	77.5%
Smartphone	28.9%	32.9%	0.530	31.5%
Use of ICT type (at least once a week)				
SMS	52.4%	43.4%	0.157	47.1%
Facebook	24.1%	29.6%	0.363	27.6%
Twitter	5.0%	5.3%	1.000 ^b	5.2%
YouTube	10.0%	9.2%	0.845	9.5%
E-mail	38.3%	23.7%	0.014	29.3%
Internet	38.2%	33.6%	0.466	35.3%
LinkedIn	3.6%	0.7%	0.177 ^b	1.4%
Skype	7.0%	2.6%	0.218 ^b	3.8%
Uses ICT to obtain information about disease				
Internet	27.2%	24.3%	0.609	25.5%
Facebook	7.9%	4.6%	0.296	5.8%
Twitter	2.4%	0.7%	0.293 ^b	1.3%
YouTube	2.4%	3.3%	1.000 ^b	3.0%
E-mail	13.6%	3.3%	0.003	7.1%
Interest in receiving information through electronic media type (high/some interest)				
SMS	55.4%	37.5%	0.005	44.7%
Facebook	13.8%	22.4%	0.115	19.4%
Twitter	2.6%	2.0%	1.00 ^b	2.2%
LinkedIn	0.0%	0.0%	N/A	0.0%
E-mail	38.9%	23.0%	0.009	28.9%
Interest in asking physician through ICT type (high/some interest)				
SMS	100.0%	72.4%	0.000	85.8%
Facebook	52.0%	25.7%	0.000	36.1%
Twitter	13.4%	9.2%	0.321	10.7%
LinkedIn	0.0%	2.6%	0.303 ^b	1.7%
E-mail	1.4%	5.3%	0.277 ^b	4.0%
Interest in receiving information through WhatsApp (Yes/No)				
Interested	25.5%	34.4%	0.120	30.7%
Interest in asking physician about disease through WhatsApp (Yes/No)				
Interested	33.7%	38.2%	0.501	36.6%

ICT: information and communication technology; SMS: short message service; N/A: not applicable.

^aAll data are presented as percentages. Differences in values between the two country groups are significant at 0.05 significance level.

^bFisher exact test performed.

(85.1 and 36.1%, respectively), though only Facebook was statistical significant ($p < 0.02$; Online Supplemental, Table S3).

Logistic regression analysis

Adjusted analysis reveals that patients 60 years old or younger as well as those aged between 61 and 75 are less likely to be interested in asking physicians information about COPD (odds ratios (ORs), 0.08 and

0.06, respectively) than those older than 75 years old (reference category; Table 4).

Moreover, patients with secondary schooling or higher educational level presented a greater likelihood of being interested in asking doctors for information about their disease (ORs, 2.28 and 2.81, respectively) than those with no education or elementary schooling (reference category; Table 4). Also, responders with the highest educational level were more interested in both receiving information (OR,

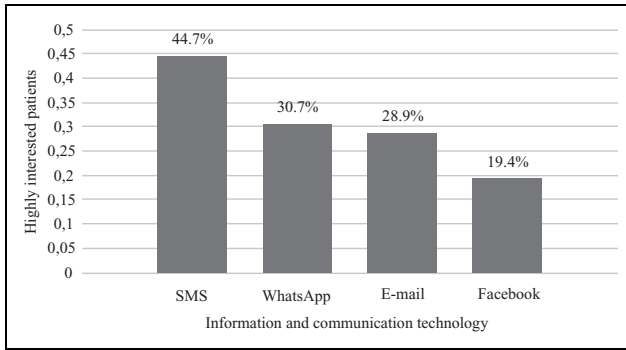


Figure 1. Proportion of patients being highly interested in receiving information about COPD through each ICT type. COPD: chronic obstructive pulmonary disease; ICT: information and communication technology.

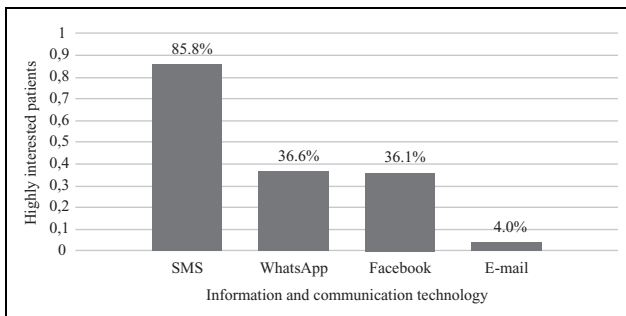


Figure 2. Proportion of patients being highly interested in seeking information about COPD with their physicians through each ICT type. COPD: chronic obstructive pulmonary disease; ICT: information and communication technology.

4.37) and asking their physicians (OR, 3.06) using WhatsApp than patients with the lowest educational level (Table 5).

We did not find statistically significant results for independent variables of gender and years since COPD diagnosis.

Finally, for non-adjusted regressions, we found that individuals that used SMS, Facebook, and e-mail at least once a week were associated with greater odds of being highly interested in receiving and asking physicians about COPD through these same ICTs, when compared to those responders using the ICT less than once a week (reference category; Table 4). Also, we identified differences between mobile devices owners and patients that did not have any type of device. Overall, having a mobile device (cellphone/smartphone) was associated with a greater chance of being highly interested to either receiving information or communicating with physicians than those individuals that did not own a mobile device (Table 4).

If a responder indicated no interest in using an ICT to receive information or communicate with his/her physician, we included open-ended questions to explain his/her reasons why; 26.8% ($n = 79$) patients were not interested in receiving information through any type of ICT, while 11.5% ($n = 34$) were not interested in asking physicians about COPD. Most of the patients did not give a reason why they were not interested in using ICTs for these purposes ($\approx 90\%$). Regarding patients that shared their opinion, approximately 6% referred that they did not have accounts on these ICTs or that they did not know how to use them. Finally, a few subjects ($\approx 4\%$) preferred to communicate directly with their physician either through phone calls or face to face.

Discussion

Recent publications found that COPD self-management programs are associated with better quality of life and improved physical activity.^{11,12} The rapid diffusion, low cost, and general availability of ICTs make them an attractive platform for managing care, communication, and interventions in chronic diseases as part of SME. However, in the present study, we found that 61.8% of patients have no access to the Internet and 68.5% have no smartphone; the proportion differed by country. These groups miss out on the opportunity to have any kind of health-related interventions through ICTs.

It has been reported that Latinos living in California make greater use of SMS, e-mail, and Facebook than any other ICTs.^{17,18} In a previous study of Latin American asthmatic patients, we found that both SMS and e-mail are useful tools for communicating (i.e. receiving and asking to physicians for information).¹⁹ In the same way, among the COPD patients in the present study, the most frequently used ICTs were SMS, Internet, and e-mail. The second rated ICTs for receiving information was e-mail and Facebook for asking information to physicians.

A meta-analysis recently concluded that mobile phone text messaging had the capacity to double the likelihood of medication adherence.²⁰ Our present results suggest that SMS and e-mail are useful tools for receiving COPD information by all patients, regardless of age, and only SMS is used for asking physicians. There are several practical reasons for using SMS. It costs less than voice messaging, and it can reach people whose phones are switched off. Furthermore, SMS messaging is silent, which means

Table 4. Characteristics of frequent users of selected electronic media type ($\geq 1 \times/\text{week}$) showing high/some interest in receiving information and asking physicians about COPD.^a

ICT type	Interest in receiving information through ICT type OR (95% CI)	Interest in asking physicians through ICT type OR (95% CI)
SMS (<i>n</i> = 121)		
Age ^b		
≤ 60 years old	1.35 (0.59–3.13)	0.08 (0.01–0.64)
61–75 years old	0.56 (0.28–1.13)	0.06 (0.01–0.44)
Weekly SMS use ^c	7.5 (4.23–13.20)	2.57 (1.25–5.28)
Owning a cellphone ^d	3.83 (1.52–9.66)	0.78 (0.34–1.79)
Owning a smartphone ^e	3.35 (1.85–6.08)	1.37 (0.65–2.89)
Facebook (<i>n</i> = 66)		
Education level ^f		
Secondary school	1.76 (0.78–3.97)	2.28 (1.20–4.32)
Undergraduate/graduate school	1.86 (0.77–4.50)	2.81 (1.41–5.62)
Weekly Facebook use	38.25 (15.29–95.64)	3.42 (1.86–6.28)
Owning a cellphone	10.52 (1.40–79.11)	8.82 (2.05–37.92)
Owning a smartphone	12.89 (5.85–28.11)	4.43 (2.42–8.11)
E-mail (<i>n</i> = 72)		
Education level		
Secondary school	3.12 (1.38–7.07)	3.49 (0.33–36.60)
Undergraduate/graduate school	12.97 (5.59–30.06)	10.29 (1.13–93.56)
Weekly e-mail use	63.64 (27.07–149.62)	12.99 (2.61–64.69)
Owning a cellphone	2.42 (0.96–6.12)	N/A
Owning a smartphone	6.76 (3.56–12.81)	9.77 (1.97–48.53)

COPD: chronic obstructive pulmonary disease; ICT: information and communication technology; SMS: short message service; OR: odds ratio; CI: confidence interval; N/A: not applicable.

^aLogistic regression analysis was adjusted for variables such as age, gender, education level, and years with COPD. Logistic regression analysis using weekly ICT type, owning a cellphone and smartphone were performed separately (non-adjusted). Bolded values are significant at 0.05 significance level.

^bReference age category is >75 years old.

^cReference ICT use category is “less than once a week.”

^dReference “owning a cell phone” is no.

^eReference “owning a smartphone” is no.

^fReference educational level category is no education/primary school.

that it can be used in places where it may be impractical to hold a conversation.²¹

WhatsApp is a cross-platform instant messaging application that allows smartphone users to exchange text, image, video, and audio messages for free. In Latin America, around two-third of Internet users are now “whatsapping” in contrast with North Americans who have a somewhat lesser frequency of use of WhatsApp.²² Our results suggest that WhatsApp could be appropriate for patients in the age category of <60 years old, because they are twice as likely to receive information through WhatsApp than other sources. Owing to the various categories of interest used in analysis for WhatsApp and other electronic networks, they cannot be directly compared. However, we found that respondents were willing to

employ WhatsApp to receive information and ask a physician about COPD.

Currently, in Latin America, some mobile operators offer different plans that include unlimited data usage exclusively for WhatsApp and Facebook services. This is probably one of the reasons why Latin America has a high social media penetration rate compared with other global regions.²² We found a tendency among participants under 60 years old to use Facebook as a second option for asking physicians. Usage of social networking sites by older Americans has been steadily increasing in recent years, among older adults who use the Internet so much so that about 46% of them use social networking sites such as Facebook.²³

There are different Facebook support groups, where patients can share their stories, learn from

Table 5. Characteristics of WhatsApp users showing interest in receiving information and asking physicians about COPD through this ICT.^a

	Interest in receiving information through WhatsApp OR (95% CI)	Interest in asking physicians through WhatsApp OR (95% CI)
Education level ^b		
Secondary school	1.62 (0.81–3.24)	1.38 (0.71–2.67)
Undergraduate/graduate school	4.37 (2.16–8.86)	3.06 (1.52–6.18)

COPD: chronic obstructive pulmonary disease; ICT: information and communication technology; OR: odds ratio; CI: confidence interval.

^aLogistic regression analysis was adjusted for variables such as age, gender, education level, and years with COPD. Bolded values are significant at 0.05 significance level.

^bReference education level category is no education/primary school.

others, increase their knowledge, and buildup hope. That could account for the increased use of Facebook among patients that we found. In a systematic review, examining the benefits of social media in chronic diseases, 45% of studies identified a positive impact with respect to support (via blogs) and disease modification (via Facebook).²⁴ In our study, female patients were twice as likely to use Facebook at least once a week than other media as a general use.

Health professionals have the responsibility to ensure the quality of information, and comments are reliable.²⁵ Thus, it is necessary to ascertain which ICTs patients prefer to use when physicians want to recommend them to look for information or patient education about COPD.

Individuals with the highest educational degrees reported the highest rates of using all ICTs.²⁶ Our data showed that patients with a higher level of education reported four times more probabilities of interest in receiving information by ICTs. Also, they have three times more chance of using ICTs for asking a physician about their disease.

Our results have important implications for designing interventions using ICTs to improve patient education and communication between health care professionals and patients: e-mail and SMS were used by people of all ages. However, other social media, such as WhatsApp, Facebook, and Twitter, are becoming increasingly popular among patients. There is a significant difference in utilization of different forms of health information technology tools between rural and urban citizens.²⁷ In Latin America, there is a recent research paper published about which appropriate technologies provide the best communication.²⁸ Our study presents data that could be used to develop new ICT applications toward improving

COPD outcomes in Latin America. For instance, in Ecuador, patients do not have access to rehabilitation programs outside the hospital due to lack of availability or adequate transportation to isolated places, and only 3.1% of patients with COPD were receiving rehabilitation, in contrast with 30.1% in Argentina.²⁹

New technologies may help with difficult-to-reach patients, such as those living in inner cities or rural areas and those with poor COPD outcomes. The appropriate use of ICTs could confer notable benefits such as support from health care professionals.

Our study has some limitations. First, it was not conducted in all Latin American countries, and the preferred use of ICTs in other countries could differ from that in Argentina and Ecuador. Second, we do not know if the use of ICTs differed according to disease severity. Our participants knew the purpose of the study, which may have affected the answers which some of them gave. Finally, our survey has not been validated and our results could lead to biased or inaccurate conclusions. However, one strength of this study is that it covered a reasonably large sample size ($n = 295$) of COPD patients. The sample included participants of different age, gender, and education levels, and to the best of our knowledge, our study is the first to explore the use and preference of ICTs in Latin America.

New research is needed to confirm our findings and assess the real use of ICTs' tools as an appropriate development of mobile health applications. Randomized trials will, of course, be necessary to determine the efficacy and cost effectiveness of all new ICTs' tools in promoting better outcomes among COPD patients. Furthermore, it is necessary to examine whether available information may be biased toward certain areas, with a predominance of information

about medications and less emphasis on other aspects of care, such as pulmonary rehabilitation or smoking cessation. However, the widespread use of ICTs opens new possibilities to the relationship between physicians and patients. It may also be possible to develop applications in response to the specific requirements of each patient. Any technological-driven application that aims to be a useful resource on this endeavor must be accompanied by a distribution strategy to increase patient acceptance and use of health care-related applications.

Conclusion

ICTs are revolutionizing health care and becoming mainstream tools for assisting patients in self-monitoring and decision-making. SMS and e-mail are useful for developing future strategies to improve COPD outcomes. Most recent social media, such as Facebook and WhatsApp, would be useful for younger COPD patients. Moreover, patients with higher education levels tend to be more interested in using all ICTs.

Future studies should investigate how to develop and promote social media-based resources more effectively to engage COPD patients in self-management. The widespread use of ICTs opens new possibilities to the relationship between physicians and patients, improving channels of communication that go in both directions.

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