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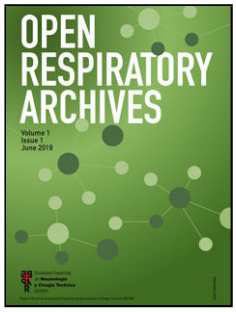


# "Artificial Intelligence-Based Interventions in Pulmonology: What Factors Influence Patient Participation in This Type of Study?"

C Amezcua Sánchez M.G Hurtado Gañán A Valido Morales T.M Guerrero García R Ayerbe García V Almadana Pacheco

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*Short communication*

# "Artificial Intelligence-Based Interventions in Pulmonology: What Factors Influence Patient Participation in This Type of Study?"

# Intervenciones basadas en inteligencia artificial en neumología: ¿qué factores influyen en la participación de los pacientes en este tipo de estudios?"

Amezcua Sánchez C.[1], Hurtado Gañán M. G[1], Valido Morales A.[1,2], Guerrero García T. M[a], Ayerbe García R.[1], Almadana Pacheco V[1].

[1] Pulmonology Department, Hospital Universitario Virgen Macarena
[2] Head of the Pulmonology Department at Virgen Macarena University Hospital

Corresponding author: Carmen Amezcua Sánchez,

Hospital Universitario Virgen Macarena
Avenida Dr. Fedriani 3, 41009, Sevilla
Correo electrónico: carmenamezcuas@gmail.com

*Abstract*

This study evaluated the differential characteristics between Chronic Obstructive Pulmonary Disease (COPD) exacerbator patients who accepted or declined participation in a telemonitoring program based on the virtual assistant "Lola" at Virgen Macarena University Hospital (HUVM). Between october 2023 and november 2024, 82 patients were invited to participate, and clinical as well as sociodemographic variables were collected through electronic health record review and telephone interview. Of these, 59.8% agreed to participate, whereas 40.2% refused. Refusal was significantly associated with lower sociocultural level, fewer electronic devices, higher anxiety and depression scores (HADS-A, HADS-D), and lower adherence to inhaled therapy (TAI). These findings suggest that sociotechnological barriers play a determining role in program acceptance and may inform patient selection strategies and implementation approaches aimed at improving adherence and optimizing the effectiveness of telemonitoring interventions.

Keywords: Telemonitoring; COPD; Exacerbators.

Este estudio evaluó las características de pacientes con enfermedad pulmonar obstructiva crónica (EPOC) que aceptaron o rechazaron participar en un programa de telemonitorización basado en la asistente virtual "Lola" en el

Hospital Universitario Virgen Macarena (HUVM). Entre octubre de 2023 y noviembre de 2024, se invitó a 82 pacientes y se recopilaron variables clínicas y sociodemográficas mediante revisión de historias electrónicas y entrevista telefónica. El 59,8 % aceptó participar y el 40,2 % rechazó. La negativa se asoció con menor nivel sociocultural, menos dispositivos electrónicos, puntuaciones más altas de ansiedad y depresión (HADS-A, HADS-D) y menor adherencia a la terapia inhalada (TAI). Estos hallazgos sugieren que las barreras sociotecnológicas influyen en la aceptación del programa y pueden guiar estrategias de selección e implementación para mejorar la adherencia y la efectividad de la telemonitorización.

Palabras clave: Telemonitorización; EPOC; Exacerbadores.

COPD is the third leading cause of death worldwide (1), with exacerbations increasing morbidity and mortality. Early detection is essential to reduce hospitalizations and disease progression. Telemedicine has emerged as a useful strategy, and since the COVID-19 pandemic, programs incorporate artificial intelligence (AI) to improve prevention, diagnosis, monitoring, and management. Most AI models are unimodal, such as the “TUCUVI” program, which uses the virtual assistant “Lola” to automate calls and enable early, personalized interventions. However, patient adherence is crucial for program effectiveness and remains underexplored in frequent COPD exacerbators. This study aimed to compare the clinical and social characteristics of COPD patients with the exacerbator phenotype who accept participation in a telemonitoring program versus those who decline.

A descriptive, observational, prospective cohort study was conducted at the COPD outpatient clinic of HUVM. The study was approved by the Ethics Committee (approval number 1132-N-23), and all patients provided written informed consent. Patients were invited to participate in the telemonitoring program “TUCUVI” using the virtual assistant “Lola” during routine in-person visits from october 2023 to november 2024, following STROBE guidelines. No evaluation of digital technology use was required, as the program only required access to a mobile or landline. Inclusion criteria required patients with confirmed COPD (post-bronchodilator FEV1/FVC ratio <70 on spirometry and a smoking history of more than 10 pack-years) according to the GOLD (1), classified within group E or as frequent exacerbators (≥2 moderate exacerbations per year or ≥1 requiring hospitalization) (1). Patients with psychiatric pathology or cognitive impairment interfering with adherence were excluded. The program consists of weekly follow-up calls by the virtual assistant Lola, scheduled at the same time each week. During these calls, 23 questions were asked to detect potential exacerbations. When an alert was identified, a notification was sent to the liaison nurse, who contacted the patient. If still unresolved, the attending physician was notified. Clinical data including age, sex, COPD severity, dyspnea grade according to the mMRC scale (2), BODE index (3), exacerbation history, and therapy use, were collected from digital records. Sociodemographic variables, HADS-D A and HADS-D scales (4), and TAI questionnaires (5) were obtained via telephone interview.

Descriptive analyses compared participants and non-participants across epidemiological, clinical, sociodemographic, and questionnaire variables. Quantitative data were summarized as mean or median with standard deviation, and qualitative data as frequencies and percentages. Group differences were assessed using the Mann-Whitney U and Chi-square tests, with $p \leq 0.05$ considered significant. Analyses were performed using SPSS version 25. Of 95 potential candidates for the TUCUVI program, 13 were excluded, leaving 82 patients, of whom 47 participated and 31 declined; two from each group were excluded due to incomplete interviews. Both groups were predominantly male and of advanced age, as detailed in Table 1. Refusal to participate was significantly associated with lower sociocultural level and possession of one or fewer electronic devices. Clinically, non-participants exhibited higher anxiety and depression levels and lower adherence to inhaled therapies, as shown in Table 2. No other significant differences were observed.

These findings suggests that COPD exacerbators who join telemedicine programs typically have higher sociocultural status, better internet access, and more electronic devices. Conversely, those who decline participation exhibit greater anxiety, depression, and poorer adherence to inhaled therapy. These findings help delineate the patient profile most likely to benefit from telemonitoring programs, providing an opportunity to improve adherence and the clinical impact of such interventions. Among the 82 patients invited, most were men, reflecting the higher prevalence of COPD in men despite increasing diagnoses in women. Sex did not appear to influence participation, contrasting with the 2021 Cochrane Review by Janjua (6), which reported 60–80% male participation in digital COPD interventions. The mean age of participants (70.8 ± 9.49 years) was similar to Janjua's findings (6) (69 ± 9), and no significant age differences were observed between participants and non-participants (70.4 ± 9.3 vs. 72.2 ± 9.5 years). Regarding household characteristics, most patients in both groups lived with a spouse or partner (71.7%), higher than the 44.8% reported in the TELBIL study on telemonitoring patients with COPD and heart failure (7). Living alone was more frequent among participants (23.4%), although this difference was not statistically significant, similar to TELBIL findings (7) (intervention group: 14.3% vs. control group: 6.7%). This may reflect that patients living alone seek social interaction through the virtual assistant. Educational level also influenced participation: 64.1% of patients had only completed basic education. Among those who declined participation, 83.8% had basic education, whereas nearly half of the participants (48.9%) held higher education or university degrees, a statistically significant difference. This contrasts with a Tele-COPD study in rural areas by Dayna et al. (8), where most participants had only primary education, suggesting that higher education may facilitate familiarity with technology and willingness to engage in AI-based programs. Technology use further distinguished participants: only 37.2% of patients reported knowing how to use the internet, with 72% of these participating, and 24.3% owned more than one electronic device, of whom 84.2% participated, a statistically significant association. Familiarity with technology influenced participation; these differ from Martinez et al. (9) in the U.S., where 61% of COPD patients reported regular internet use, reflecting population differences.

The severity of disease in our cohort was high, with over 50% of patients in both groups having FEV1 between 30% and 50%, comparable to the findings reported in Soriano et al.'s (10) multicenter telemedicine trial (mean FEV1 34.2 ± 9.1 in the telehealth group vs. 32.2 ± 8.8 in the in-person consultation group).Treatment patterns were similar between groups, with 91.5% receiving fixed triple therapy, 39.7% having at least one hospitalization in the past year, and comparable use of long-term oxygen therapy (39.7%) and home non-invasive ventilation (14.1%), consistent with TELBIL study findings (7) which also reported no differences in therapy use between intervention and control groups (63.6% vs. 65%). Psychologically, patients in our study exhibited higher anxiety and depression than reported by Soriano et al. (10). Non-participants had HADS-A and HADS-D scores of 9.65 and 10.48, respectively, compared with 6.72 and 6.79 in participants, while Soriano et al. reported much lower values (HADS-A: 1.5–1.8; HADS-D: 2.5–2.9). These results suggest that higher levels of anxiety and depression may have contributed to non-participants' lower engagement with the telemonitoring program. Similarly, in the TAI questionnaire, the control group scored lower (42.76 vs. 46.6), contrasting with the study by Dogan et al. (11), where adherence was lower in the group selected to participate in the study (16.7% vs. 21.2%). These findings support that patients with lower adherence are more reluctant to engage in follow-up programs.

Despite these findings, the study presents limitations including the sample size and the fact that it was conducted in a very specific population of functionally advanced, exacerbator COPD patients, making it difficult to extrapolate the data to other populations. Overall, this study may help identify the most suitable candidates to be included in telemonitoring programs within a selected group of exacerbator COPD patients. It provides valuable information to identify those best suited for inclusion in a telemedicine program, highlighting lower sociocultural status and limited access to electronic devices as predictors of refusal, while also emphasizing the importance of considering factors such as sociocultural level and anxiety/depression levels.

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Informed consent

The work involved patients or human subjects, and informed consent was obtained from all participants.

Conflicts of interest
The authors declare not to have any conflicts of interest that may be considered to influence directly or indirectly the content of the manuscript.

Author´s contribution

All authors actively participated in the collection of data for this study. They have read and approved the final manuscript.
I participated in all stages of the study, including conceptualization, study design, data collection, data analysis, drafting of the manuscript, critical revision, and final approval of the submitted version.

Artificial intelligence involvement

This manuscript was originally written in Spanish and translated into English using ChatGPT (version GPT-4.5, developed by OpenAI), with subsequent manual revision to ensure scientific accuracy and clarity.

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| | Participates in TUCUVI N=47 | Refuses to participate in TUCUVI N=31 | Statistical significance * p |
|---|---|---|---|
| Men | 38(80,80%) | 25(80,60%) | 0,46 |
| Mean age | 70,4 +/- 9,3 | 72,2 +/- 9,5 | 0,82 |
| Retired | 41 (80,23%) | 26 (55,31%) | 0,14 |
| Leaves the home | 42 (89,36%) | 24 (77,41%) | 0,20 |
| Lives alone | 11 (23,40%) | 4 (12,90%) | 0,26 |
| Lives with others | 36 (76,60%) | 27 (87,10%) | 0,26 |
| Low sociocultural level | 24 (51,07%) | 26 (83,87%) | 0,01* |
| High school diploma or higher | 23 (48,93%) | 5 (16,13%) | 0,01* |
| Do not know how to use the internet | 26 (55,32%) | 23 (74,19%) | 0,10 |
| Know how to use the internet | 21 (44,68%) | 8 (25,81%) | 0,10 |
| None/one electronic device | 31 (65,95%) | 28 (90,32%) | 0,04* |
| Two or more electronic devices | 16 (34,05%) | 3 (9,68%) | 0,04* |

Table 1. Sociodemographic variables.

Data are expressed as absolute frequencies and percentages for qualitative variables, or as mean and standard deviation for quantitative variables. *Statistical significance set at $p<0.05$.

| | Participates in TUCUVI N=47 | Refuses to participate in TUCUVI N=31 | Statistical significance * p |
|---|---|---|---|
| Active smoker | 6 (12,76%) | 6 (19,35%) | 0,55 |
| GOLD 3 | 26 (55,31%) | 21 (67,74%) | 0,90 |
| GOLD 4 | 8 (17,02%) | 4 (12,90%) | 0,90 |
| BODE | 3,51 +/- 0,23 | 3,70 +/- 0,40 | 0,85 |
| Triple therapy | 44 (93,61%) | 31 (100%) | 0,69 |
| LTOT | 19 (40,42%) | 12 (38,70%) | 0,50 |
| HNIV | 7 (14,89%) | 4 (12,90%) | 0,52 |
| One or more hospitalizations | 18 (38,29%) | 13 (41,93%) | 0,82 |
| Dyspnea MRC | 2,12 +/- 0,11 | 2,03 +/- 0,17 | 0,98 |
| HADS-A | 6,72 +/- 6,65 | 9,65 +/- 6 | 0,041* |
| HADS-D | 6,79 +/- 6,87 | 10,48 +/- 6,28 | 0,009* |
| TAI | 46,6 +/- 5,86 | 42,76 +/- 9,11 | 0,032* |

Table 2. Underlying Disease Variables.

Abbreviations:

GOLD: Global Initiative for Chronic Obstructive Lung Disease

BODE: Body max index, air flow Obstruction, Dyspnea and Exercise

LTOT: Long-Term Oxygen Therapy

HNIV: Home Non-Invasive Ventilation

HADS-A, HADS-D: Hospital Anxiety and Depression Scale

TAI: Test of Adherence to Inhalers

Data are expressed as absolute frequencies and percentages for qualitative variables, or as mean and standard deviation for quantitative variables. *Statistical significance set at $p<0.05$.