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Airway clearance techniques by video consultation for patients with bronchiectasis: satisfaction, adherence, effectiveness, and safety. A pilot study

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Abstract

Airway clearance techniques (ACT) should be included as part of the non-pharmacological treatment of patients with bronchiectasis (BE) following international guidelines. This approach in chronic respiratory patients should be maintained despite a pandemic situation, including SARS-CoV-2. The objective of this study is to evaluate the satisfaction, adherence, effectiveness, and safety of telehealth ACT (tACT) *via* video consultation for secretion drainage in patients with stable BE. This is an observational pilot study with prospective recruitment describing a cohort of patients with BE and patients with BE and infection due to non-tuberculous mycobacterial pulmonary disease (NTM-PD) included in a tACT program. Patients received an initial tACT visit (V1), another after one week (V7), and a final visit after one month (V30). Adherence, effectiveness and safety data were recorded. Satisfaction with the intervention was determined using a visual analogue scale (0-10). A total of 40 patients with BE and 17 patients with BE and NTM-PD were included, with a mean age of 63 (13). A total of 48 patients evaluated the telehealth intervention at >8 with the VAS, with a mean VAS score at V7 of 9.0 (1.9) and 8.9 (2) at V30. Self-reported adherence to treatment was high, with an average of 6.5/7 and 25/30 days; 94% of the patients managed to expectorate during V1 (effectiveness of the intervention). No relevant side effects were detected. tACT for managing secretions in patients with BE, whether with or without NTM-PD, has proven to be satisfactory, effective, and safe during a critical pandemic situation. This safety strategy could be included in the future as a complementary tool in the management of chronic respiratory patients.

Key words: airway clearance techniques, non-cystic fibrosis bronchiectasis, non-tuberculous mycobacterial pulmonary disease, telehealth, airway clearance techniques.

Introduction

The SARS-CoV-2 pandemic made it necessary to change protocols and treatments in the field of respiratory medicine to minimise the risk of contagion [1]. Due to the nature of airway clearance techniques (ACT), a detailed protocol must be followed in order to apply respiratory physiotherapy techniques in a safe manner [1-5]. These techniques are used across all healthcare settings, and during the pandemic the demand for physiotherapy treatments increased significantly across all medical care levels, from standard hospital wards to semi-critical and critical care units [5-9]. Since the pandemic began, these procedures required the use of personal protection equipment (PPE) by professionals, and it was recommended that they be performed in negative pressure environments, preferably on an individual basis [3]. If the new normal ACT safety protocols for chronic respiratory patients are extrapolated, even more strict protection measures would need to be implemented [10]. Despite the end of the pandemic, the care and treatment of chronic patients with ACT should be maintained. According to national and international guidelines the gold standard treatment for the management of secretions in patients with bronchiectasis (BE) is ACT [11-13]. It is also known that non-tuberculous mycobacterial pulmonary disease (NTM-PD) can worsen BE [14], so incorporating bronchial hygiene into the management of these patients, along with pharmacological treatment, is essential [15].

Airway clearance techniques employ expiratory flow modulation to move secretions from the bronchial tree. Patients are instructed in producing a low expiratory flow to mobilise distal secretions and a high flow to mobilise proximal secretions [16,17]. Some of these techniques can be self-administered at home under the supervision of a specialized physiotherapist through telehealth services [18,19]. Telehealth has proven crucial during and after the pandemic to guarantee the treatment of chronic respiratory patients as it provides convenient access to routine care without the risk of contagion in hospitals [20-28]. With regards to respiratory rehabilitation programmes prior to the pandemic, there is some published evidence on the use of this strategy, primarily concerning training programmes [29-32]. In order to apply telehealth controls or perform respiratory physiotherapy through telemedicine, it is necessary to demonstrate that it is effective, feasible, and safe [20,25,27]. The main goal of this study was to evaluate the satisfaction, adherence, effectiveness and safety of delivering respiratory physiotherapy via tele-ACT (tACT) during the COVID-pandemic, focusing on patients diagnosed with either BE or BE with NTM-PD.

Materials and Methods

Population

A prospective observational pilot study was performed. Patients with a diagnosis of either BE or BE with an infection due to NTM-PD who had never received ACT were included in a tACT programme. The study commenced in November 2020 and was concluded in April 2021. All referred patients from the Bronchiectasis Functional Unit and the Mycobacteria Unit from the hospital from November 2020 to March 2021 were evaluated consecutively and prospectively. After agreeing to participate and signing the informed consent form, patients were referred to the tACT video consultation service. Patients who had difficulties with using a smartphone were asked to get support from a carer or family member to minimise the technological bias. Finally the included patients were followed up for 30 days from the start of the intervention.

The inclusion criteria were a diagnosis of BE or BE and NTM-PD in a stable state (defined as no exacerbations in the previous month and actively receiving treatment) [33], with or without daily expectoration. Patients or their caregivers were required to own a smartphone to be able to undertake the video consultation. The exclusion criteria were patients under 18 years of age and patients with cystic fibrosis or primary ciliary dyskinesia.

Protocol

Patients were given video call appointments with the telehealth consultation service, which used a software specifically designed by the hospital to guarantee patient confidentiality by using end-to-end encryption (E2EE). Authentication, data integrity and data encryption were upheld as essential to safeguarding patient privacy and ensuring the reliability of medical data exchange. During the first visit (V1), the patient's medical history was recorded, and education was given regarding the inhalation therapy. If necessary, corrections were made. Afterwards, a 30 minute individualised tACT session was performed. Also during this visit, patients were taught how to carry out these techniques on their own to attain the goal of each ACT, namely to drain secretions. Based on previous studies, the selected treatment technique was slow expirations with an open glottis in the lateral decubitus position (ELTGOL), as defined by Postiaux in 1990 [34].

This technique works by leveraging mechanical forces such as gravitational compression, expiratory resistance, and diaphragmatic displacement, while simultaneously preventing airway collapse to enhance mucus clearance. These physiological changes support the mobilisation of mucus from peripheral to central airways, providing an effective method for airway clearance. Patients were instructed on how to perform slow expirations with an open glottis in a lateral decubitus position by themselves or prolonged slow expirations while seated,

depending on their condition and the location of the mucus plugs [18,33,34]. The number of repetitions depended on the effectiveness of the techniques. To complete the drainage, patients were instructed to perform high-flow expiratory manoeuvres and to expectorate secretions through coughing or using the forced expiration technique (FET). Patients were recommended to perform respiratory physiotherapy sessions twice a day for at least 15 minutes [33]. After 7 days, another telehealth visit was performed (V7) so that the physiotherapist could answer questions and doubts about the self-application of these techniques. Satisfaction, adherence, effectiveness and safety of the intervention were evaluated at V7, and again after 1 month (V30) by a different investigator (Figure 1). The present project was accepted by the centre's clinical research ethics committee and patients provided a signed consent form.

Variables

The variables taken at each protocolised visit, V7 and V30, were always recorded electronically whether by email, telephone, or personal interview in a video call. The satisfaction with tACT was measured using a visual analogue scale (VAS) from 0-10 at visits V7 and V30, with 0 being a negative satisfaction evaluation and 10 expressing maximum satisfaction [35]. Adherence to the tACT was monitored through email submission of an image of the expectorated mucus. This was registered as 7/7 (every day during the first week of treatment) and 30/30 (every day after V7 until V30). The effectiveness of the physiotherapy techniques was determined at:

V1: by obtaining a sample during the online session (yes/no).

V7 and V30: with a tACT internal questionnaire to validate the effectiveness in a follow up period.

Patients responded to the following questions through a VAS from 0-10 (0 being the worst possible response and 10 the best):

Do the tACT techniques help you to expectorate?

Do you feel that you can manage to empty your lungs of mucus?

Have you improved clinically with the techniques that you have learnt?

Safety: Possible adverse effects were recorded (dizziness, nausea, irritation, haemoptysis, headache, tachycardia) during and after the application of tACT at V7 and V30 [36].

Inhaled therapy (IT): the administration procedure was revised and errors, if found, were corrected [37].

Statistical analysis

Numerical clinical variables were described as means $\pm$ 1 standard deviation (SD), and dichotomous variables as counts with percentages. Variables were presented descriptively, as were the presence of possible adverse effects of the application of the intervention (percentages). To evaluate changes over time in satisfaction, adherence, effectiveness, and safety (measured by reported side effects), paired statistical tests were applied. The paired Student's t-test was used to compare values between visit 7 (V7, after 7 days) and visit 30 (V30). Additionally, the independent Student's t-test was used to assess differences between disease groups. The chi-squared test was used to compare the categorised variables in the groups studied. Statistical significance was set at $p < 0.05$. The statistical software used was IBM SPSS v.28.

Results

The characteristics of the population, which included fifty-seven patients, 40 of whom had BE and 17 of whom had BE and NTM-PD, are described in Table 1. Fifty-three patients continued the follow-up period until V30. There were essentially no differences between both groups in the items analysed (Table 1).

Furthermore, a total of 68 patients referred from the Bronchiectasis Functional Unit and the Mycobacteria Unit of the hospital between November 2020 and March 2021 were evaluated for inclusion, with a final selection of 57 patients. Several patients who were initially expected to participate in the study were excluded for various reasons: 6 due to network coverage, 2 due to suffering an exacerbation in the first week, 2 because they had already received physiotherapy beforehand, and 1 who finally did not agree to take part in the study for personal reasons (Figure 2).

Satisfaction

Forty-eight patients evaluated the telehealth intervention at >8 with the VAS, with a mean VAS score at V7 of 9.0 (1.9) and 8.9 (2) at V30.

Adherence

There was a statistically significant difference between adherence in both groups at V30, with a mean of 24.3 (7) for BE and 27.7 (4) for BE and NTM-PD ($p < 0.008$). However, the overall self-reported adherence to treatment was high, with an average of 6.5/7 and 25/30 at V7 and V30, respectively.

Effectiveness of the therapy

At V1, 94% (54/57) of patients managed to expectorate. Even though some patients had not referred secretions at the beginning of the telehealth consultation, demonstrating the technique's effectiveness. Regarding the tACT internal questionnaire, 82% (47/57) of patients evaluated the effectiveness of the techniques at V7 and at V30 with a VAS greater than 7 (Table 2).

Safety

Mild adverse effects were detected immediately after the application of techniques by four patients who complained of dizziness, nausea, headache or sore throat at V7. Mild side effects persisted in 1 patient between visits, but this was resolved online at the final appointment (V30).

Inhaled therapy

Thirty-eight out of 45 (84%) of patients under treatment with inhaled therapy, independent of age, administered it incorrectly, irrespective of the device used.

Discussion

The present pilot study demonstrates that the implementation of tACT via video consultation in response to the SARS-CoV-2 pandemic resulted in high satisfaction, adherence, effectiveness, and safety among a cohort of BE with or without NTM-PD who were candidates to undergo ACT daily. Despite the small number of patients reported by Lee in 2022 regarding the perception on telehealth physiotherapy, this new paradigm was accepted as a feasible model of care [27]. The results of the present study, which involved a larger and more homogeneous group of patients with the same chronic respiratory disease (BE) compared to previous studies, show a high level of satisfaction consistent with findings reported by other authors [27,38]. Moreover, telehealth represents an alternative option to face-to-face visits to ensure a continuous service during and after events such as the COVID-19 pandemic, reducing the burden of travel and ensuring treatment, regardless of living in a remote area with limited access to specialised care. In some articles, authors used apps to ensure a good level of adherence. In this protocol, however, this tool was not utilised and instead phone calls were conducted, resulting in a high compliance rate [23,31,39].

In the present cohort, the short-term effectiveness of tACT demonstrates that even in patients with subjective difficulty expectorating, more than 90% of patients achieved this during the video consultation following the physiotherapist's recommendations. This high degree of effectiveness, evaluated through the internal questionnaire created for this purpose, was

maintained after 30 days. Regarding safety, literature indicates that the application of ACT has a low risk of adverse events [36]. In the present protocol, few mild adverse effects were detected in the first visit, and all of these were solved by visit 30.

The published data regarding telehealth and physiotherapy has focused only on exercise, the feasibility of implementing telematic exercise protocols, and their effects on a heterogeneous population of chronic respiratory patients [32,40]. However, the present protocol emphasises a homogeneous and broad population, consisting exclusively of individuals with BE from a specialised referral hospital. A group of patients with BE and NTM-PD was included because many of them (especially those with associated Lady Windermere syndrome) exhibited voluntary suppression of cough, which, combined with anatomical peculiarities, predisposes them to the accumulation of secretions [41,42]. However, among the relevant differences observed between the two groups, only adherence at V30 was higher in the group with BE and NTM-PD. Another aspect to highlight in the current study is that a consistent telematic protocol of specific physiotherapy techniques has been adapted to the patients' needs, unlike other published studies [32,36,43].

Considering the digital divide, this study intentionally avoided the use of a specific mobile application, facilitating the inclusion of patients, especially older individuals or those with limited familiarity with technology. Patients only needed to be able to perform a video call. Only six patients could not participate due to technical issues (poor internet connection). In the present protocol, low expiratory flow techniques were selected due to previous demonstrations by Muñoz G. et al., proving the significant long-term benefits of ELTGOL [33], mainly in reducing exacerbations and improving quality of life. A non-instrumental flow modulation method was chosen to treat patients with BE because the literature supports this option as a treatment, and to date, ELTGOL has not been found to be less effective compared to the use of instrumental techniques based on positive airway pressure, or those involving positive pressure with oscillation [12]. Additionally, Lanza [18] highlighted the reproducibility of ELTGOL, noting that this technique could be self-administered. Recently, Herrero-Cortina [17] emphasised the role of ELTGOL in improving mucociliary clearance and patient adherence to treatment protocols.

Given the current health situation, the study ensured non-pharmacological international standards of care (bronchial hygiene) for patients with chronic lung disease, such as those with BE [17]. Telemedicine is crucial in preventing the spread of infectious diseases by protecting vulnerable patients and preserving personal protective equipment [19]. Direct exposure during face-to-face respiratory physiotherapy increases infection risks for both patients and staff, requiring well-ventilated or negative pressure spaces, use of PPE and thorough disinfection, which leads to delays and longer waiting lists [3,44]. Telehealth eliminates these risks,

allowing continuous and efficient patient care.

The methodological limitations of this study can be largely attributed to the unprecedented global health crisis caused by the COVID-19 pandemic. One limitation of this protocol is the absence of a control group. However, given the pandemic circumstances, physiotherapy services were reorganised for chronic patients and the number of face-to-face visits was limited to prevent infection. Conversely, in the present study, adherence was verified via phone calls, resulting in a high compliance rate according to the patient's response (information bias). In addition, the necessity of telehealth consultations (instead of in-person visits) limited the ability to perform certain diagnostic tests and physical assessments. These real-world constraints inevitably impacted the robustness of the study's methodology, highlighting the need for adaptive and flexible research practices in times of crisis. Another limitation of this study is that no formal sample size calculation was performed prior to data collection. This may affect the statistical power and limits the strength and generalizability of the findings. Therefore, the results should be interpreted with caution.

Despite these challenges, tACT could be considered a complementary tool to integrate into routine care to improve adherence and patients' technical skills. Larger, multicentre trials with longer follow-up periods are needed to confirm the long-term effectiveness and safety of tACT.

Conclusions

Tele airway clearance techniques by video consultation for managing secretions in patients with BE, whether with or without NTM-PD, have proven to be satisfactory and effective in the short term during a pandemic. Such a protocol may be included in the future as a complementary tool within the usual care of chronic respiratory diseases.

References

1. Lew H, Oh-Parck M, Cifu D. The war on COVID-19 pandemic: role of rehabilitation professionals and hospitals. *Am J Phys Med Rehabil* 2020;99:571-2.
2. Sommerstein R, Fux C, Vuichard-Gysin D, et al. Risk of SARS-CoV-2 transmission by aerosols, the rational use of masks, and protection of healthcare workers from COVID-19. *Antimicrob Resist Infect Control* 2020;9:100.
3. Schnitzbauer AA, Kempf VAJ, Hack D, et al. SARS-CoV-2/COVID-19: systematic review of requirements for personal protective equipment in primary patient contact and organization of the operating area. *Chirurg* 2020;91:576-85. [Article in German].
4. Fathizadeh H, Maroufi P, Momen-Heravi M, et al. Protection and disinfection policies against SARS-CoV-2 (COVID-19). *Infez Med* 2020;28:185-91.

5. Vitacca M, Carone M, Clini EM, et al. Joint statement on the role of respiratory rehabilitation in the covid-19 crisis: the Italian position paper. *Respiration* 2020;99:493-9.
6. Dean E, Jones A, Yu HP-M, et al. Translating covid-19 evidence to maximize physical therapists' impact and public health response. *Phys Ther* 2020;100:1458-64.
7. Sheehy LM. Considerations for postacute rehabilitation for survivors of COVID-19. *JMIR Public Heal Surveill* 2020;6:e19462.
8. Iannaccone S, Castellazzi P, Tettamanti A, et al. Role of rehabilitation department for adult individuals with COVID-19: the experience of the San Raffaele hospital of Milan. *Arch Phys Med Rehabil* 2020;101:1656-61.
9. Lazzeri M, Lanza A, Bellini R, et al. Respiratory physiotherapy in patients with COVID-19 infection in acute setting: a position paper of the Italian association of respiratory physiotherapists (ARIR). *Monaldi Arch Chest Dis* 2020;90:1285.
10. Cinesi Gómez C, Peñuelas Rodríguez Ó, Luján Torné M, et al. Recomendaciones de consenso respecto al soporte respiratorio no invasivo en el paciente adulto con insuficiencia respiratoria aguda secundaria a infección por SARS-CoV-2. *Rev Esp Anestesiol Reanim* 2020;67:261-70.
11. Lee E, Kim K, Jeon YH, et al. Evidence-based management guidelines for noncystic fibrosis bronchiectasis in children and adolescents. *Clin Exp Pediatr* 2024;67:418-26.
12. Hill AT, Sullivan AL, Chalmers JD, et al. British Thoracic Society Guideline for bronchiectasis in adults. *Thorax* 2019;74:1-69.
13. Chang AB, Bell SC, Byrnes CA, et al. Thoracic Society of Australia and New Zealand (TSANZ) position statement on chronic suppurative lung disease and bronchiectasis in children, adolescents and adults in Australia and New Zealand. *Respirology* 2023;28:339-49.
14. Honda JR, Knight V, Chan ED. Pathogenesis and risk factors for nontuberculous mycobacterial lung disease. *Clin Chest Med* 2015;36:1-11.
15. Reich JM, Johnson RE. Mycobacterium avium complex pulmonary disease presenting as an isolated lingular or middle lobe pattern. *Chest* 1992;101:1605-9.
16. McIlwaine M, Bradley J, Elborn JS et al. Personalising airway clearance in chronic lung disease. *Eur Respir Rev* 2017;26:160086.
17. Herrero-Cortina B, Lee AL, Oliveira A, et al. European Respiratory Society statement on airway clearance techniques in adults with bronchiectasis. *Eur Respir J* 2023;6:2202053.
18. Lanza FC, Alves CS, dos Santos RL, et al. Expiratory reserve volume during slow expiration with glottis opened in infralateral decubitus position (ELTGOL) in chronic pulmonary disease: technique description and reproducibility. *Respir Care* 2015;60:406-11.
19. Dorsey ER, Okun MS, Bloem BR. Care, convenience, comfort, confidentiality, and contagion: the 5 c's that will shape the future of telemedicine. *J Parkinsons Dis* 2020;10:893-

7.

20. Ambrosino N, Fracchia C. The role of tele-medicine in patients with respiratory diseases. *Expert Rev Respir Med* 2017;11:893-900.
21. Fisk M, Livingstone A, Pit S. Telehealth in the context of COVID-19: Changing perspectives in Australia, the United Kingdom, and the United States. *J Med Internet Res* 2020;22:e19264.
22. Dimer N, do Canto-Soares N, dos Santos-Teixeira L, et al. The COVID-1 pandemic and the implementation of telehealth in speech-language and hearing therapy for patients at home: an experience report. *CoDAS* 2020;32:e20200144
23. Schinköthe T, Rolando Gabri M, Mitterer M, et al. A Web- and app-based connected care solution for COVID-19 in- and outpatient care: qualitative study and application development. *JMIR Public Heal Surveill* 2020;6:e19033.
24. Viganò M, Mantovani L, Cazzolino P, et al. Treat all COVID 19-positive patients, but do not forget those negative with chronic diseases. *Intern Emerg Med* 2020;15:787-90.
25. Grona SL, Bath B, Busch A, et al. Use of videoconferencing for physical therapy in people with musculoskeletal conditions: a systematic review. *J Telemed Telecare* 2018;24:341-55.
26. Phillips J, Lee A, Pope R, Hing W. Physiotherapists' use of airway clearance techniques during an acute exacerbation of bronchiectasis: a survey study. *Arch Physiother* 2021;11:3.
27. Lee AL, Tilley L, Baenziger S, et al. The perceptions of telehealth physiotherapy for people with bronchiectasis during a global pandemic - a qualitative study. *J Clin Med* 2022;11:1315.
28. Seligman KL, Liming BJ, Smith RJH. Pediatric tracheostomy decannulation: 11-year experience. *Otolaryngol Head Neck Surg* 2019;161:499-506.
29. Selzler AM, Wald J, Seden M, et al. Telehealth pulmonary rehabilitation: A review of the literature and an example of a nationwide initiative to improve the accessibility of pulmonary rehabilitation. *Chron Respir Dis* 2018;15:41-7.
30. Miozzo AP, Camponogara Righi N, Yumi Shizukuishi ML, et al. A telerehabilitation programme for maintaining functional capacity in patients with chronic lung diseases during a period of COVID-19 social isolation: quasi- experimental retrospective study. *JMIR Rehabil Assist Technol* 2022;9:e40094.
31. Reyckler G, Piraux E, Beaumont M, et al. Telerehabilitation as a form of pulmonary rehabilitation in chronic lung disease: a systematic review. *Healthc* 2022;10:1795.
32. Ben Bowhay, Latour JM, Tomlinson OW. A systematic review to explore how exercise-based physiotherapy via telemedicine can promote health related benefits for people with cystic fibrosis. *PLOS Digit Heal* 2023;2:e0000201.

33. Muñoz G, de Gracia J, Buxó M, et al. Long-term benefits of airway clearance in bronchiectasis: a randomised placebo-controlled trial. *Eur Respir J* 2018;51:1701926.
34. Postiaux G, Lens E, Alsteens G, et al. Efficacité de l'expiration lente totale glotte ouverte en décubitus latéral (ELTGOL) : sur la toilette en périphérie de l'arbre trachéobronchique. *Ann Kinésithér* 1990;17:87-99.
35. Sousa-Pinto B, Louis R, Anto JM, et al. Adherence to inhaled corticosteroids and long-acting β_2 -agonists in asthma: a MASK-air study. *Pulmonology* 2023;3:130-7.
36. Heinz KD, Walsh A, Southern KW, et al. Exercise versus airway clearance techniques for people with cystic fibrosis. *Cochrane Database Syst Rev* 2022;6:CD013285.
37. Topal E, Arga M, Özmen AH, et al. The pharmacists' ability to use pressurized metered-dose inhalers with a spacer device and factors affecting it. *J Asthma* 2021;58:659-64.
38. Wickerson L, Helm D, Gottesman C, et al. Telerehabilitation for lung transplant candidates and recipients during the COVID-19 pandemic: program evaluation. *JMIR MHealth UHealth* 2021;9:e28708.
39. Fraile Olivero CA, Jarabo Sarceda JR, Fernández Martín E, et al. The use of fissios app© as a complement to a face-to-face respiratory physiotherapy program versus an attendance-only face-to-face physiotherapy program in patients scheduled for thoracic surgical procedures reduces the risk of developing postoperative pulmonary complications—a quasi-Experimental study. *J Clin Med* 2023;12:6774-85.
40. de la Plaza San Frutos M, Abuín Porras V, Blanco Morales M, et al. Telemedicine in pulmonary rehabilitation – benefits of a telerehabilitation program in post-COVID-19 patients: a controlled quasi-experimental study. *Ther Adv Respir Dis* 2023;17:17534666231167354.
41. Balañá Corberó A, Domínguez-Álvarez M, Barreiro E. Respiratory physiotherapy in Lady Windermere syndrome: the missing link? *Arch Bronconeumol* 2020;56:619-20.
42. Gomes DS, Cravo J. Lady Windermere syndrome. *J Bras Pneumol* 2023;49:e20230285.
43. Welsh EJ, Evans DJ, Fowler SJ, Spencer S. Interventions for bronchiectasis: an overview of Cochrane systematic reviews. *Cochrane Database Syst Rev* 2015;7:CD010337.
44. Storer TW, Latham NK, Bhasin S. Maximizing participant and staff safety during assessment of physical function in the COVID-19 era. *J Am Geriatr Soc* 2021;69:12-7.

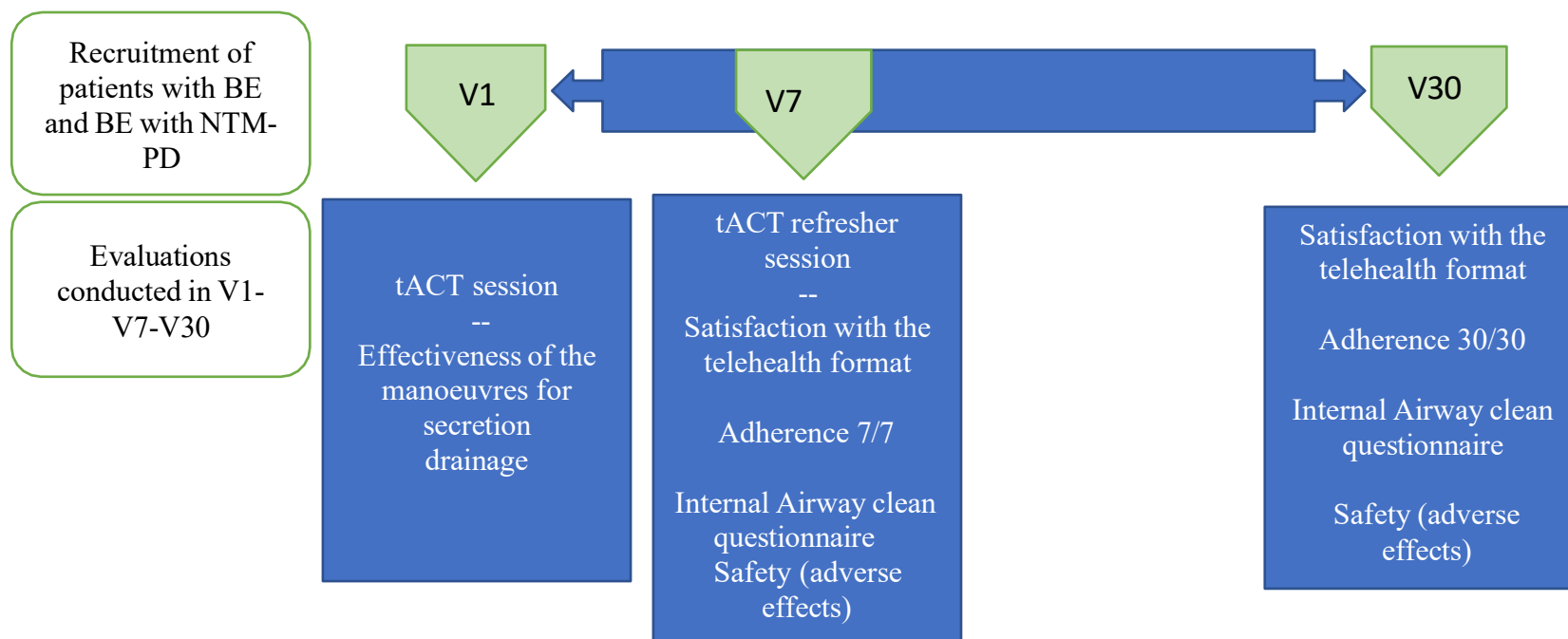


Figure 1. Methodology of the telematic airway clearance techniques for bronchiectasis patients by video consultation. BE, bronchiectasis; NTM-PD, non-tuberculous mycobacteria; V1, first online consultation; V7, control visit one week after beginning treatment; V30, control visit one month after beginning treatment; tACT, telehealth airway clearance techniques.

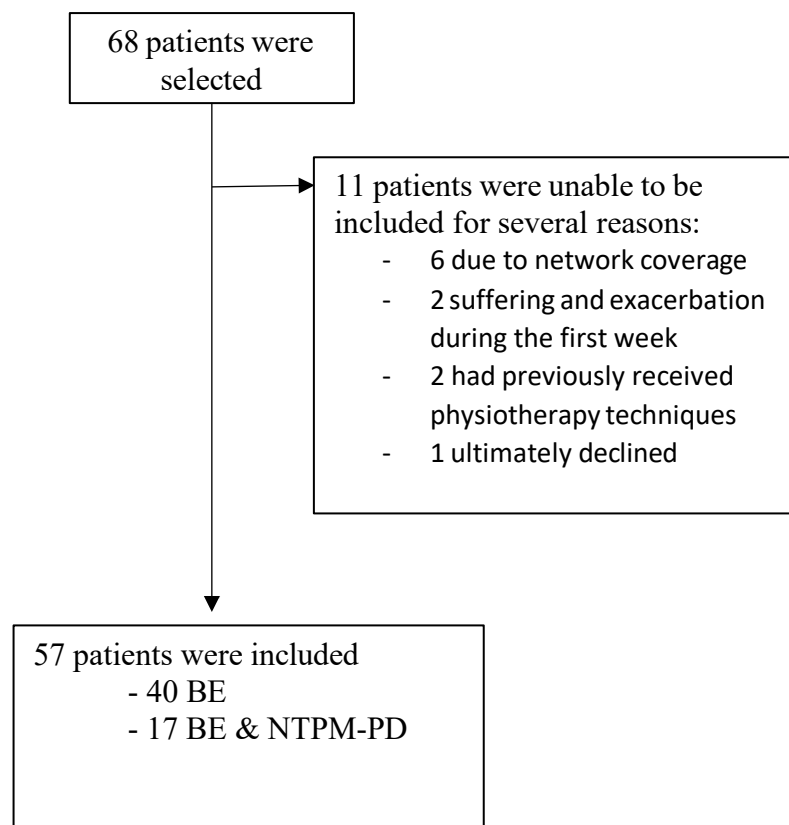


Figure 2. Study flow. BE, bronchiectasis; NTM-PD, non-tuberculous mycobacterial pulmonary disease.

Table 1. Functional characteristics of the patients by diagnosis bronchiectasis (BE) or BE and non-tuberculous mycobacterial pulmonary disease (NTM-PD).

	BE		BE & NTM-PD		p-value
	31 (%)	9 (%)	12 (%)	5 (%)	
	Mean (SD)		Mean (SD)		
Age, years	64 (15)		63 (8)		0.06
Weight, kg	67.8 (14)		61.8 (7)		0.02
Height, cm	161 (9.3)		165 (10)		0.15
BMI cm/Kg ²	26 (5)		23 (4)		0.03
ppFEV1	73.8 (22)		68 (20)		0.45
ppFVC	82 (19)		85 (16)		0.89
%FEV1 /FVC	68 (8)		62 (12)		0.059

Values are reported as mean ($\pm$ SD) or counts (%). BE: bronchiectasis; NTM-PD: non-tuberculous mycobacterial pulmonary disease; BMI: body mass index; ppFEV1 and ppFVC, both expressed in relation to the values of reference (%ref) %FEV1/FVC: coefficient between the forced expiratory volume in 1 second and the forced vital capacity. The reference equations used were Quanjer 2012 (GLI).

Table 2. Level of effectiveness measured by the VAS of the internal *Airway clean* questionnaire at V7 and V30.

	Visit 7	Visit 30	p-value
Do the RP techniques help you to expectorate?	8 (1.7)	8.1 (1.9)	0.79
Do you feel that you can manage to empty your lungs of mucus?	7.4 (2.3)	7.8 (1.9)	0.36
Have you improved clinically with the techniques that you have learnt?	7.8 (1.8)	7.9 (1.7)	0.78