Airway clearance treatments in bronchiectasis: Feasibility of linking survey results to Registry data and a survey of patients' and physiotherapists' practices.

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Airway clearance treatments in bronchiectasis: Feasibility of linking survey results to Registry data and a survey of patients' and physiotherapists' practices

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Abstract

Background and objective: There are limited data on airway clearance treatment (ACT) practices. This study aimed (i) to assess the feasibility of collecting online surveys on ACTs from patients and physiotherapists and linking the patient survey data to outcome data in the Bronch-UK/EMBARC Registry; (ii) to assess the association between ACT practices and outcome data and (iii) to ascertain the factors affecting physiotherapist ACT practices.

Methods: Survey methodology was used to collect data from (i) patients with bronchiectasis and (ii) physiotherapists in Northern Ireland (NI). Associations between patient survey data and linked Bronch-UK/EMBARC Registry patient outcome data were explored.

Results: It was feasible to conduct an online survey with patients with bronchiectasis and link the data to Bronch-UK/EMBARC Registry. 13% of patients did not perform ACTs. ACTs were used more often by patients who were symptomatic/ had more severe disease compared to those with milder symptoms/disease. Patients used ACTs when they were symptomatic rather than as a preventative management strategy. Physiotherapists generally followed the bronchiectasis guidelines, using the stepwise approach to management.

Conclusion: Our survey provided information about the feasibility of linking online survey and patient registry data. This study provides up to date information on ACT practice throughout the course of the disease trajectory, as well as insight into the implementation of bronchiectasis guidelines by physiotherapists. Future work should explore how to optimise ACT data collection to maximise the use of real world ACT data in bronchiectasis research, and inform priority ACT research questions.

Take home message:

This study provides up to date information on ACT practice and the implementation of bronchiectasis guidelines by physiotherapists. Future work should explore how to optimise ACT data collection to maximise the use of real world ACT data in bronchiectasis research.

Key words: airway clearance treatments, bronchiectasis, physiotherapy

Introduction

It is recognised that airway clearance treatments (ACT) in the form of pharmacological and non-pharmacological treatments are central to facilitate early management of bronchiectasis and have increasing importance over the disease trajectory.[1] ACTs aim to facilitate sputum expectoration, to improve ventilation and reduce cough and breathlessness. In the long-term, ACTs reduce further airway damage through limiting the vicious cycle of bacterial colonization, thus reducing inflammation, number of exacerbations and hospital admissions and improving health-related quality of life (HRQoL).[2–5] Published guidelines recommend that people with bronchiectasis should be made aware of the different ACT available to them, techniques should be as independent as possible and preference and adherence should be taken into account when choosing the technique.[2–5] Experts advocate a stepwise approach to treatment appropriate to the stage and severity of disease, underpinned by clinical judgement[1] with a personalisation of ACT based on established physiological principles.[6]

Given the limitations of traditional research methodologies in ACT research to date (a limited number of clinical trials, most of which are single treatment studies), exploration of the relationships and patterns in real world longitudinal data may generate important evidence and provide direction on future ACT research.

The Bronchiectasis Observational Cohort and Biobank UK (Bronch-UK); and EMBARC (the European Multicentre Bronchiectasis Audit and Research Collaboration)) registries collect baseline and follow up data (including some basic ACT data) on patients with bronchiectasis throughout UK and Europe. At time of our study initiation, there were limited surveys on ACT practices[7,8] and UK ACT practices have not been explored for 20 years.[8]

The aims of the current study were (i) to assess the feasibility of collecting online survey data relating to ACTs from patients and physiotherapists and linking the patient survey data

to their outcome data in the Bronch-UK/EMBARC Registry; (ii) to assess the association between the patients' reported ACT practices and their outcome data and (iii) to ascertain the factors affecting physiotherapists' decision making, related to their patients' ACT practices.

Methods

Participants

Patients from each of the participating sites in Northern Ireland (NI) (Belfast City Hospital; Antrim Area Hospital, Craigavon Hospital, and Altnagelvin Hospital) with prior agreement to be re-contacted for future studies, were identified from the Bronch-UK/EMBARC Registry. Only patients on the Bronch-UK/EMBARC Registry were eligible. All patients had a clinical history consistent with bronchiectasis and computed tomography (CT) demonstrating bronchiectasis. Patients with bronchiectasis due to known cystic fibrosis were excluded. Eligibility criteria for the Bronch-UK/EMBARC Registry are described in full elsewhere.[9,10]

Physiotherapists

Physiotherapists who were currently treating people with bronchiectasis were identified by a senior physiotherapist at each NI hospital providing respiratory care to people with bronchiectasis.

Survey design and content

The research team conducted patient and physiotherapist focus groups, semi-structured interviews[11] and obtained feedback from patient representatives from the European Lung Foundation and Belfast City Hospital to inform the content and format of the final patient and physiotherapist surveys.

The online survey was delivered using Survey Monkey. Invitations featured a hyperlink and quick access code, distributed via post or email. Agreeable patients completed the consent form and survey online. Patients could call the study team to complete the survey over the phone or to complete a paper version and post back. Reminders were sent at 1,3 and 6

months. Consenting patients were contacted 9-12 months after the completion of the first survey, to complete a second survey. To facilitate linkage of the survey data to the registry data, patients entered their Bronch-UK/EMBARC Registry unique study ID to retain anonymity and confidentiality of the patient's personal data.

Registry data accessed for this study included demographics, lung function, total exacerbations in the preceding year, mMRC dyspnoea, sputum, Pseudomonas aeruginosa status, bronchiectasis severity index (BSI) and HRQoL.

The purpose of the online patient surveys was to ask patients about their experience using ACTs and their current practices when they felt well and unwell (increase in symptoms or unwell with a chest infection). In the patient information sheet, ACTs were defined as chest physiotherapy/ exercises that help to remove mucus from the lungs and cough it out.

Invitations to the physiotherapist survey featured a hyperlink and quick access code were distributed via email. Reminders were sent at 1, 3 and 6 months.

The purpose of the online physiotherapist survey was to explore current ACT practice and respiratory physiotherapy services for bronchiectasis in NI.

Statistical analysis

Data were analysed descriptively using RStudio 4.1.0. Appropriate descriptive statistics were used. The categorised variables for frequency and duration of ACT were combined to achieve a dose of ACT. High dose included patients who performed ACT at a high duration (>10 minutes) by high frequency (daily); medium dose included patients who performed ACT at a high duration (>10 minutes) by low frequency (monthly), high duration (>10 minutes) by medium frequency (1-3 times weekly), and low duration (<10 minutes) by high frequency (daily). Low dose included patients who performed ACT at a low duration (<10 minutes) by low frequency (monthly) and low duration (<10 minutes) by medium frequency (1-3 times weekly). Additionally, data was categories and analysed according to use of non-pharmacological ACT adjunct (i.e. using a device) vs. ACTs non-adjuncts (i.e. not using a

device) status; as well as the use of mucoactives (pharmacological ACTs) vs. no mucoactives. Associations between patient reported ACT usage and clinical outcomes (main comparisons made when registry data was available within 6 months) were assessed using appropriate parametric and non-parametric statistics. Simple logistic and multiple regression were used to assess the effects of outcomes on the probability of a patient using ACTs and using mucoactives.

Ethics

Full ethical approval (REC Reference: 19/SC/0528) and research governance permissions from each participating Health and Social Care (HSC) Trust were in place at the respective sites. Informed consent was provided by all participants.

Results

Feasibility of data collection using online surveys

The first patient survey was distributed to 398 patients with bronchiectasis from the Bronch-UK/EMBARC Registry and the survey was completed by 205 (52%) individuals between October 2020 and October 2021. Some questions were only completed by patients who were taught ACTs (n=188) or who performed ACTs (n=177).The second patient survey was distributed to all 205 patients who completed the first survey and was completed by 96 (47%) individuals. The physiotherapist survey was distributed to 100 physiotherapists reported to provide a bronchiectasis service and was completed by 48 (48%) individuals between January 2020 and January 2021. The number of responses varied for each question within the surveys, therefore the total number of responses to each question is included in this manuscript and missing responses were excluded.

The majority of patients (55%, n=113/205) self-administered the first survey online, 33% (67/205) completed over the phone with the researcher, 11% (25/205) completed a paper version. The majority of patients (94%, n=90/96) self-administered the second survey online,

whilst 6% (6/96) completed over the phone with the researcher. All physiotherapists (n=48) self-administered independently online.

Feasibility of linking survey data to patient outcome data in the registry

Patient outcome data from the Bronch-UK/EMBARC Registry were available for 86% (n=176/205) of patients who completed the first survey. Only 53% (n=108/205) of patients had a registry review visit within six months of completing the first survey and this data is presented as the main analysis. Their demographics and outcome data are presented in Supplementary Table 1 and there were no differences between the cohort with registry data and those without. Only 27% (n=30/108) who completed the second survey had a registry review within six months of the second survey.

Patients' ACT practices

Use of ACTs

At the time of survey completion, the majority of patients performed ACTs (86%, 177/205), however, 14% (28/205) did not perform ACTs.

The linked outcome data from the Bronch-UK/EMBARC Registry for the 108 patients (93 performed ACTs, 15 did not perform ACTs) who completed the survey who had a Registry review within six months are presented in Table 1. Demographics and lung function parameters were similar in patients' who did and did not perform ACTs. Whilst limited by small numbers in subgroups, patients who performed ACTs were more likely to have: had a higher total number of exacerbations in the preceding year (p=0.03) and had a worse QoL according to QoL-B treatment burden domain (p=0.04), compared to those who did not perform ACTs. There were no differences in the other outcome data. Simple logistic regression modelling did not demonstrate significance in the effect of patient outcome data on the probability of using ACTs (Supplementary Table 2.1).

The linked outcome data from the Bronch-UK/EMBARC Registry for the 176 patients showed similar results and are presented in Supplementary Table 3.

In the survey, the majority of patients (68%, 140/205) reported being first taught about ACTs by a physiotherapist at an outpatient appointment at a hospital clinic; 8% (17/205) said they had never been taught ACTs (Supplementary Figure 1).

Most patients ranked seeing a physiotherapist who was a specialist in bronchiectasis as important for their first ACT visit (Supplementary Figure 2). The most important factors considered by patients to be included in their first visit with a physiotherapist were: being taught how to perform ACTs, receiving a chest assessment and receiving information on the importance of ACTs (Supplementary Figure 2 & 3). Of patients who had been taught ACTs, 73/184 40% of patients reported that they had not been followed up for their ACT by a physiotherapist.

Types of ACTs

In the survey, Active Cycle of Breathing Techniques (ACBT) (64%, 129/201) was the most commonly reported ACT, followed by huffing (41%, 83/201) and exercise and/or physical activity (38%, 76/201). Of the few patients who reported using adjunct ACTs, the Acapella (24%, 49/201), Aerobika (8%, 16/201) and Flutter (4%, 9/201) devices were most common (Figure 1A). The specific use of ACTs in NI is similar to use throughout the UK (Bronch-UK registry data (Figure 1B)) [12].

The linked outcome data from the Bronch-UK/EMBARC Registry for the 108 patients (43 used non-adjuncts alone, 50 used adjuncts, either alone or in combination with non-adjuncts) who had a Registry review within six months are presented in Table 2. Demographics and lung function parameters were similar in patients who used non-adjuncts and adjuncts. There were no differences in the other outcome data.

The linked outcome data from the Bronch-UK/EMBARC Registry for the 176 patients are presented in Supplementary Table 4.

ACT dose

In the survey, 84% (145/173) of patients performed either a medium or high dose of ACTs when well. In the survey, a higher number of patients (91%, 158/173) performed a medium or high dose of ACTs when unwell compared to when well (Figure 2). When unwell, the majority of patients (79%, 136/173) did not change the type of ACT they performed, 12% (21/173) changed their ACT type, 4% (7/173) increased their ACT dose and 5% (9/173) increased pharmacological support (Supplementary Figure 4). When unwell, patients reported that ACT frequency and duration depended on clearing their chest (28%, 48/173), how much sputum they had (25%, 43/173) and their physiotherapist's instructions (24%, 41/173) (Supplementary Figure 5).

The majority of patients found that ACTs helped to prevent chest infections (75%, 131/174) and alleviate sticky (68%, 119/174) or excessive sputum (68%, 118/174 (Supplementary Figure 6).

The linked outcome data from the Bronch-UK/EMBARC Registry for the 108 patients (45 performed a high dose, 32 reported a medium dose and 7 reported a low dose of ACTs when well) who had a Registry review within six months are shown in Supplementary Table 5. Demographics and lung function parameters were similar in patients who performed a high, medium and low dose of ACTs. Compared to those who performed a low dose of ACTs, patients who performed a high or medium dose of ACT had worse QoL than patients who performed a low dose according to QoL-B treatment burden (p=0.04) and respiratory symptoms (p=0.04) domains. There were no differences in the other outcome data.

The linked outcome data from the Bronch-UK/EMBARC Registry for the 176 patients show similar results and are presented in Supplementary Table 6.

Mucoactives and other medications to help ACTs

In the survey, patients reported taking bronchodilators (45%, 89/199), hypertonic saline (35%, 69/199) and carbocisteine (32%, 63/199) (Supplementary Figure 7). Fewer patients reported taking other medications including isotonic saline, DNase, mannitol, antibiotics, and

steroids. The majority of patients report taking their medications before their ACTs, with the exception of carbocisteine; 54% (34/63) of patients said they did not time their carbocisteine around their ACTs (Supplementary Figure 8). 23% (45/199) of patients said they did not take any medications to help with their ACTs.

The linked outcome data from the Bronch-UK/EMBARC Registry for the 108 patients (53 used mucoactives and 55 patients did not use mucoactives) who had a Registry review within six months are presented in Table 3. Lung function parameters and exacerbation rates were similar in patients who did and did not use mucoactives. Compared to those who did not use mucoactives, patients who used mucoactives: were younger (p=0.004); had a lower mMRC grading (p=0.006); had a higher BSI score (p=0.03) and worse QoL across several QoL-B domains: physical functioning (p=0.02); vitality (p=0.001); treatment burden (p=0.0001) and respiratory symptoms (p=0.004). There were no differences in the other outcome data.

The linked outcome data from the Bronch-UK/EMBARC Registry for the 176 patients showed similar results and are presented in Supplementary Table 7.

In simple logistic regression modelling of the probability of using mucoactives, the effect of age, modified MRC, BSI, and QoL-B domains (physical functioning, vitality, respiratory symptoms and treatment burden) were significant. The probability of using a mucoactive diminished by: 4% for every year increase in age; 2% for every 1 point increase in QoL-B physical functioning; 3% for every 1 point increase in QoL-B vitality; 3% for every 1 point increase in QoL-B respiratory symptoms; 4% for every 1 point increase in QoL-B treatment burden. The probability of using a mucoactive increased by: 62% for every 1 unit increase in mMRC and 12% for every 1 unit increase in BSI (Supplementary Table 2.1). In multiple logistic regression modelling, when controlling for all these factors, only age and QoL-B treatment burden remained significant (Supplementary Table 2.2.).

Follow-up survey (9-12 months later)

In the second survey, the majority (78%; 70/90) of patients reported performing the same type of ACT with no change in ACT frequency (72%; 65/90), duration (68%; 61/90) and dose (54%; 49/90) .The majority (80%, 72/90) also used the same mucoactive medications.

Airway clearance practices the physiotherapist's perspective

Physiotherapists' ranked patient symptoms as the most important factor influencing choice of ACTs and ranked performing a physiotherapy chest assessment and providing patients with information on ACTs as the most important factors involved in a first visit for patients with bronchiectasis (Table 4). Patient access to a respiratory physiotherapist, regardless of whether they specialised in bronchiectasis was ranked as most important for patient follow-up (Table 4). Patient symptoms and disease stability were considered most important factors in prioritising patients for follow-up visits (Table 4).

Discussion

In the current study, we used an online survey to collect data on ACT practices from the patients and physiotherapists perspective and linked this data to patient outcome data in the Bronch-UK/EMBARC Registry; this provided an in depth insight into ACT practices in bronchiectasis.

The overall patient and physiotherapist response rate aligned with average response rates reported in a recent systematic reviews of surveys.[13] In the current study, although over half (55%, 113/205) of patients responded online independently, a large proportion (45%, 92/205) requested to complete by other means (including interview mode and via post), indicating that this population still requires support for completing an online survey. Similarly, Meyer et al.[13] reported higher response rates for in person and postal surveys (77% and 68% respectively) compared to online surveys (59%). .

In the BTS guidelines[5] and BTS Quality Standards,[14] it is recommended that ACTs should be taught to all patients with bronchiectasis, however a small number of patients in the current survey reported that they had never been taught ACTs. Data from the EMBARC registry[15]

found that only 48.3% of patients performed ACTs regularly with the primary reason for not doing ACTs being that it was not required in the opinion of the clinicians (67.9%). Data from the US Bronchiectasis Registry[16] found that more than one-half of patients (58%) who used ACTs at baseline did not report the use of ACTs at one-year follow up. In contrast, in the current survey, 78% of patients reported performing the same type of ACT at 9-12 months follow up. One possible reason for the difference may be that the majority of hospitals in NI have designated respiratory physiotherapy services.

Published guidelines[2,4,5] and BTS Quality Standards[14] provide guidance on assessment, treatment and follow-up on ACT. This survey showed the specific use of ACTs in NI is similar to use throughout the UK (Bronch-UK Registry data). Most patients reported using ACBT, huffing and exercise and/or physical activity; previous studies in bronchiectasis have reported similar findings.[7,8,15,17] PEP and OPEP were used less frequently than ACBT in the UK and also used less than in other countries e.g. Australia and New Zealand.[7] This is not surprising as some ACTs have geographical dominance; they tend to be closely related to their country of origin and/or the undergraduate training in the country.[16,18,19]

The subgroup and regression analyses in this study provides a novel insight into ACT practice, with data showing that those who use ACT and indeed those who used a higher dose of ACT, were sicker patients. Those patients who used mucoactives were younger and more likely to have a bigger treatment burden. This may reflect the clinical experience that some older patients can be challenged by polypharmacy/ treatment burdens for their “other” conditions and mucoactives may be less likely to be considered as a result. These results also reflect that patients may be using ACT symptomatically rather than prophylactically and may also reflect instructions and subsequently the preferences of the physiotherapist managing the patients.

In the current study, the results indicate that physiotherapists are generally following the bronchiectasis guidelines and using the stepwise approach to management: patients are using manual ACTs when they are experiencing milder symptoms, and as their symptoms

become more severe, adjunct type ACTs and mucoactives are also being used. Similar results have been shown in the US Bronchiectasis Registry.[16]

Patients and physiotherapists both highlighted that it was important patients were seen by a specialised physiotherapist for ACTs and most patients reported being first taught ACTs by a physiotherapist; this aligns with what is recommended in the guidelines and quality standards. Despite this, the latest National Bronchiectasis Audit (2017)[20] highlighted there was suboptimal assessment of adult patients by a respiratory physiotherapist. Based on our survey results, we suggest the quality statement should expand recommendations to fully capture adherence to guidelines.

The latest Bronchiectasis Audit (2017)[20] collected high level data on physiotherapy input i.e. were patients seen by a respiratory physiotherapist and did they have a self-management plan, however, it did not collect granular detail on ACTs i.e. ACT type, frequency, duration, dose and how these change when well/ unwell. We propose that more detail on ACT is included in future audits to assess the adherence to quality standards. This level of detail would optimise the real world data collected, to enable review and facilitate longitudinal studies of the linkage of ACT and patient clinical status.

Study Limitations

This study was limited to patients enrolled on the EMBARC/Bronch-UK Registry consenting to the survey. We were unable to explore changes in ACTs with patient outcome data over time due to large timeframes between each database review and completion of the surveys. Better co-ordination of registry and future survey initiatives will result in more complete and reliable longitudinal data.

Conclusion

Our survey provided information about the feasibility of conducting an online survey in bronchiectasis patients and linking the data to a patient registry. This study provides information on ACT practice throughout the course of the disease trajectory. Future work

should explore how to optimise ACT data collection to maximise the use of real world ACT data in bronchiectasis research, and inform priority ACT research questions. More in depth information will enable more full utilisation and exploration of real world evidence on ACT effects.

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Contributors

RMCL: Supervision, validation, visualisation, data curation, formal analysis, writing- original draft, writing-review and editing; KON: Conceptualisation, funding acquisition, methodology, investigation/ data collection, project administration, resources/ survey development, supervision, visualisation and formal analysis of preliminary results, writing-review and editing; BON: Conceptualisation, funding acquisition, methodology, resources/ survey development, writing- review and editing; JC: Conceptualisation, funding acquisition, methodology, resources/ survey development, writing- review and editing; JBo:

Conceptualisation, methodology, resources/ survey development, writing- review and editing; RMCC: Validation, visualisation, data curation, formal analysis, writing-original draft, writing-review and editing. MC: Data collection (Bronch-UK/EMBARC Registry), writing-review and editing; ADS: Conceptualisation, funding acquisition, methodology, resources/ survey development, writing-review and editing; JBr: Conceptualisation, funding acquisition, methodology, investigation/ data collection, project administration, resources/ survey development, supervision, validation, visualisation, data curation, formal analysis, writing-original draft, writing- review and editing.

Table 1 Comparison of demographics/outcome data of patients who did vs did not perform airway clearance techniques. Data represents patients who had linked outcome data from the Bronch-UK/EMBARC Registry within six months of survey completion (n=108/205). Data are presented as n (%), mean ± standard deviation or median (25-75% interquartile range).

Variables from Bronch-UK/EMBARC Registry	**Reported in the survey- Performed ACT**				
	Yes		**No**		
Demographics	n		n		***p*-value [95% CI]**
Age (Years)	93	67 (57-73)	15	70 (60-80)	0.1 [-13.00, 1.00]
Gender (Female)	93	57 (61)	15	8 (53)	0.76
Smoking status (Yes)	93	2 (2)	15	2 (2)	0.1
BMI (Kg/M^2)	29	25 (22-29)	3	29 (26-30)	0.37 [-8.60, 5.35]
Lung Function					
FEV_1 (L)	42	2 ± 1	4	2 ± 1	0.42 [-1.35, 0.70]
FEV_1 % predicted	31	88 (56-102)	3	81 (71-97)	0.78 [-62.84, 52.37]
Mild (> 80%)		16 (52)		2 (67)	1
Moderate-Severe (≤ 80%)		15 (48)		1 (33)	
Pulmonary Exacerbations					
Total exacerbations in the preceding year	93	2 (0-3)	15	1 (0-2)	0.03 [0.0000042, 2.00]
No exacerbations		24 (26)		6 (40)	0.04
1-2 exacerbations		31 (33)		8 (53)	
≥ 3 exacerbations		38 (41)		1 (7)	
mMRC					
Overall	93	1 (1-3)	15	1 (1-2)	0.59 [-0.00002, 1.00]
Grade 0-1		13 (14)		2 (13)	1
Grade 2-4		80 (86)		13 (87)	
Sputum					
Produces daily sputum (Yes)	93	82 (88)	15	11 (73)	0.25

Sputum Colour	81		11		
Mucoid		43 (53)		9 (82)	0.16
Mucopurulent		23 (28)		2 (18)	
Purulent/Severely Purulent		15 (19)		0 (0)	
Sputum Volume (ml)	82	18 (6-40)	11	12 (6-38)	0.75 [-6.84, 12.76]
Mild (<10ml)		25 (30)		4 (36)	0.96
Moderate-Severe (≥10ml)		57 (70)		7 (64)	
***Pseudomonas aeruginosa* (Yes)**	93	10 (11)	15	0 (0)	0.39
BSI	92	8 (5-12)	15	6 (4-12)	0.48 [-2.00, 3.00]
QOL-B Domains					
Physical functioning	86	40 (20-67)	10	37 (18-77)	0.92 [-26.60, 20.00]
Role functioning	87	53 (33-70)	11	67 (30-83)	0.38 [-26.70, 13.30]
Vitality	86	44 (22-56)	11	44 (22-61)	0.89 [-11.10, 22.20]
Emotional functioning	86	75 (50-92)	11	75 (62-92)	0.49 [-25.00, 8.30]
Social functioning	87	44 (25-67)	11	67 (46-75)	0.07 [-33.30, 0.00001]
Treatment burden	80	56 (44- 78)	8	78 (64-92)	0.04 [-33.40, -0.00005]
Health perceptions	87	42 (25- 58)	11	50 (21-54)	0.83 [-16.60, 16.70]
Respiratory Symptoms	87	59 (41- 74)	11	59 (51-80)	0.36 [-22.20, 7.40]

BMI: Body mass index; **FEV_1**: Forced expiratory volume in 1 second; **mMRC:** Modified Medical Research Council dyspnoea scale; **BSI:** Bronchiectasis severity index; **QOL-B:** Quality of life – Bronchiectasis.

Table 2 Comparison of demographics/outcome data of patients who reported using non-adjuncts alone vs adjuncts (either alone or in combination with non-adjuncts). Data represents patients who had linked outcome data from the Bronch-UK/EMBARC Registry within six months of survey completion (n=108/205*). Data are presented as n (%), mean ± standard deviation or median (25-75% interquartile range).

Variables from Bronch-UK/EMBARC Registry	**Reported in the survey- Type of ACT performed**				
	Non-adjuncts		**Adjuncts**		
Demographics	n		n		***p*-value [95% CI]**
Age (Years)	43	69 (59-74)	50	64 (55-72)	0.06 [-11.00, 0.00006]
Gender (Female)	43	21 (49)	50	36 (72)	0.04
Smoking status (Yes)	43	0 (0)	50	2 (2)	0.01
BMI (Kg/M^2)	12	26 (24-30)	17	23 (22-27)	0.22 [-5.39, 1.49]
Lung Function					
FEV_1 (L)	16	2 ± 1	26	2 ± 1	0.94 [-0.47, 0.51]
FEV_1 % predicted	13	95 (62-110)	18	73 (54-97)	0.25 [-40.09, 11.07]
Mild (> 80%)		8 (62)		8 (44)	0.57
Moderate-Severe (≤ 80%)		5 (38)		10 (56)	
Pulmonary Exacerbations					
Total exacerbations in the preceding year	43	1 (0-3)	50	2 (1-4)	0.15 [-0.00003, 1.00]
No exacerbations		14 (33)		10 (20)	0.24
1-2 exacerbations		15 (35)		16 (32)	
≥ 3 exacerbations		14 (33)		24 (48)	
mMRC					
Overall	43	1 (1-2)	50	1 (1-3)	0.71 [-0.00007, 1.00]
Grade 0-1		8 (19)		5 (10)	0.37
Grade 2-4		35 (81)		45 (90)	
Sputum					
Produces daily sputum (Yes)	43	37 (86)	50	45 (90)	0.79
Sputum Colour	37		45		
Mucoid		22 (59)		22 (49)	0.24
Mucopurulent		7 (19)		16 (36)	

Purulent/Severely Purulent		8 (22)		7 (16)	
Sputum Volume (ml)	37	18 (6-30)	45	30 (6-40)	0.31 [-0.92, 12.24]
Mild (<10ml)		11 (30)		14 (31)	1
Moderate-Severe (≥10ml)		26 (70)		31 (69)	
***Pseudomonas aeruginosa* (Yes)**	43	4 (9)	50	6 (12)	0.93
BSI	43	7 (5-10)	49	8 (5-12)	0.22 [-1.00, 3.00]
QOL-B Domains					
Physical functioning	39	40 (20-70)	47	40 (20-60)	0.78 [-13.40, 13.30]
Role functioning	40	53 (32-68)	47	47 (33-67)	0.81 [-13.30, 6.70]
Vitality	39	44 (33-56)	47	44 (22-56)	0.61 [-11.10, 11.10]
Emotional functioning	39	75 (54-96)	47	75 (50-83)	0.44 [-16.70, 8.30]
Social functioning	40	46 (24-69)	47	44 (25-67)	0.75 [-16.60, 8.40]
Treatment burden	34	67 (47-86)	46	56 (36-67)	0.15 [-22.20, 0.00003]
Health perceptions	40	42 (25-58)	47	42 (17-58)	0.42 [-16.60, 8.30]
Respiratory Symptoms	40	62 (43-78)	47	56 (39-74)	0.42 [-14.80, 7.40]

*n=15/108 excluded as they reported they did not perform ACTs; **BMI:** Body mass index; **FEV_1**: Forced expiratory volume in 1 second; **mMRC:** Modified Medical Research Council dyspnoea scale; **BSI:** Bronchiectasis severity index; **QOL-B:** Quality of life – Bronchiectasis.

Table 3 Comparison of demographics/ outcome data of patients who reported using or not using mucoactive medications. Data represents patients who had linked outcome data from the Bronch-UK/EMBARC Registry within six months of survey completion (n=108/205). Data are presented as n (%), mean ± standard deviation or median (25-75% interquartile range).

Variables from Bronch-UK/EMBARC Registry	**Reported in the survey- Uses mucoactive medications**				
	Yes		**No**		
Demographics	n		n		***p*-value [95% CI]**
Age (Years)	53	63 (54-71)	55	70 (60-77)	0.004 [-12.00, -2.00]
Gender (Female)	53	37 (70)	55	28 (51)	0.08
Smoking status (Yes)	53	3 (6)	55	1 (2)	0.44
BMI (Kg/M^2)	18	24 (22-32)	14	26 (23-27)	0.78 [-3.80, 4.74]
Lung Function					
FEV_1 (L)	29	2 ± 1	17	2 ± 1	0.52 [-0.55, 0.28]
FEV_1 % predicted	21	76 ± 30	13	87 ± 33	0.33 [-34.26, 12.00]
Mild (> 80%)		11 (52)		7 (54)	1
Moderate-Severe (≤ 80%)		10 (48)		6 (46)	
Pulmonary Exacerbations					
Total exacerbations in the preceding year	53	2 (0-5)	55	1 (0-3)	0.14 [-0.000004, 1.00]
No exacerbations		14 (26)		16 (29)	0.5
1-2 exacerbations		17 (32)		22 (40)	
≥ 3 exacerbations		22 (42)		17 (31)	
mMRC					

Overall	53	1 (1-2)	55	2 (1-3)	0.006 [0.00003, 1.00]
Grade 0-1		4 (8)		11 (20)	0.11
Grade 2-4		49 (92)		44 (80)	
Sputum					
Produces daily sputum (Yes)	53	46 (87)		47 (85)	1
Sputum Colour	46		49		
Mucoid		25 (54)		28 (60)	0.67
Mucopurulent		12 (26)		13 (28)	
Purulent/Severely Purulent		9 (20)		6 (13)	
Sputum Volume (ml)	46	20 (6-4)	47	2 (1-3)	0.67 [-4.08, 10.00]
Mild (<10ml)		15 (33)		14 (30)	0.94
Moderate-Severe (≥10ml)		31 (67)		33 (70)	
***Pseudomonas aeruginosa* (Yes)**	53	7 (13)	55	3 (5)	0.29
BSI	52	9 (5-12)	55	6 (4-10)	0.03 [0.00001, 3.00]
QOL-B Domains					
Physical functioning		33 (15-53)		47 (27-80)	0.02 [-26.70, -0.00004]
Role functioning		47 (22-65)		53 (40-80)	0.14 [-20.00, 0.00007]
Vitality		33 (22-53)		56 (33-67)	0.001 [--22.30, -11.1]
Emotional functioning		67 (50-83)		75 (58-92)	0.08 [-16.70, 0.00003]

Social functioning		42 (18-67)		50 (33-67)	0.14 [-22.30, 0.00003]
Treatment burden		56 (33-67)		78 (56-89)	0.0001 [-33.30, -11.10]
Health perceptions		33 (25-50)		50 (25-58)	0.09 [-16.70, 0.00001]
Respiratory Symptoms		52 (38-69)		67 (44-82)	0.004 [-22.20, -3.70]

BMI: Body mass index; **FEV_1**: Forced expiratory volume in 1 second; **mMRC:** Modified Medical Research Council dyspnoea scale; **BSI:** Bronchiectasis severity index; **QOL-B:** Quality of life – Bronchiectasis.

Table 4 Factors influencing physiotherapists decision making regarding ACTs for patients with bronchiectasis

Factors	
1. Influencing choice of ACTs	**Mean Rank of Importance (1 – Most Important, 10 – Least Important)**
My knowledge and experience of using the ACT	4.8
Availability and access to the ACT	5.8
Co-morbidities of the person with bronchiectasis	6
Understanding and competence of the person with bronchiectasis	3.8
Time allocated to the individual's appointment	8.2
Preferences of the person with bronchiectasis for certain ACTs	4.4
Symptoms of the person with bronchiectasis	2.4
Disease stability of the person with bronchiectasis	5.1
Disease severity of the person with bronchiectasis	5.1
Local tariffs or prescriptions/funding available for equipment	9.5
2. Content for a first visit for ACTs	**Mean Rank of Importance (1 – Most Important, 8 – Least Important)**
Providing information about ACTs and why they are important	2.3
Performing a physiotherapy chest assessment	1.7
Teaching an ACT	3.1
Setting a personal action plan for ACTs with the patient	4.6
Having enough time for the first appointment	4.7
Providing information about other physiotherapy treatments in addition to ACTs	5.5
Providing information about support groups	7.7

Providing contact details and instruction on how to access a physiotherapist in the future	6.3
3. Content for a first follow-up visit	**Mean Rank of Importance (1 – Most Important, 4 – Least Important)**
Patient access to a physiotherapist who is specialised in bronchiectasis	2.2
Patient access to a physiotherapist who works with respiratory patients who is not a specialist	2
Patient visit in a dedicated bronchiectasis clinic	2.8
Patient visit in a location of their choice	3
4. Priorities of a follow-up visit	**Mean Rank of Importance (1 – Most Important, 6 – Least Important)**
Symptoms of the person with bronchiectasis	2
Co-morbidities of the person with bronchiectasis	4.7
Understanding and competence of the person with bronchiectasis with their ACT	3
Disease stability of the person with bronchiectasis	2.2
Disease severity of the person with bronchiectasis	3.3
Local tariffs or prescriptions/funding available for equipment	5.9

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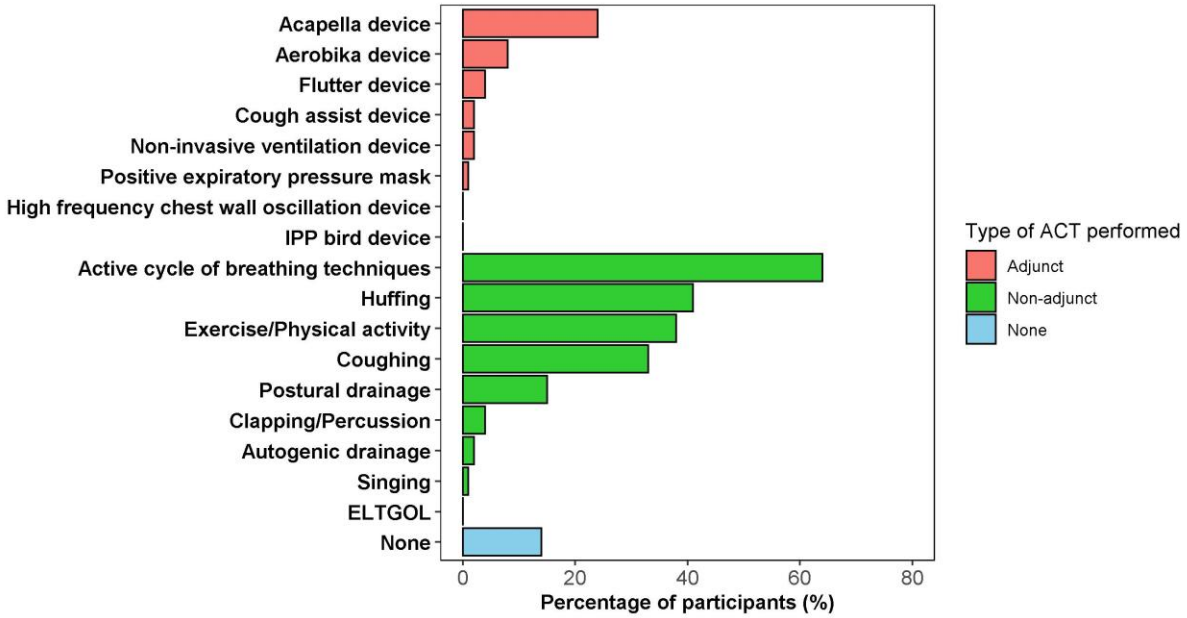

Figure 1A: Types of ACTs used by patients in the ACT-BE survey (n=201)

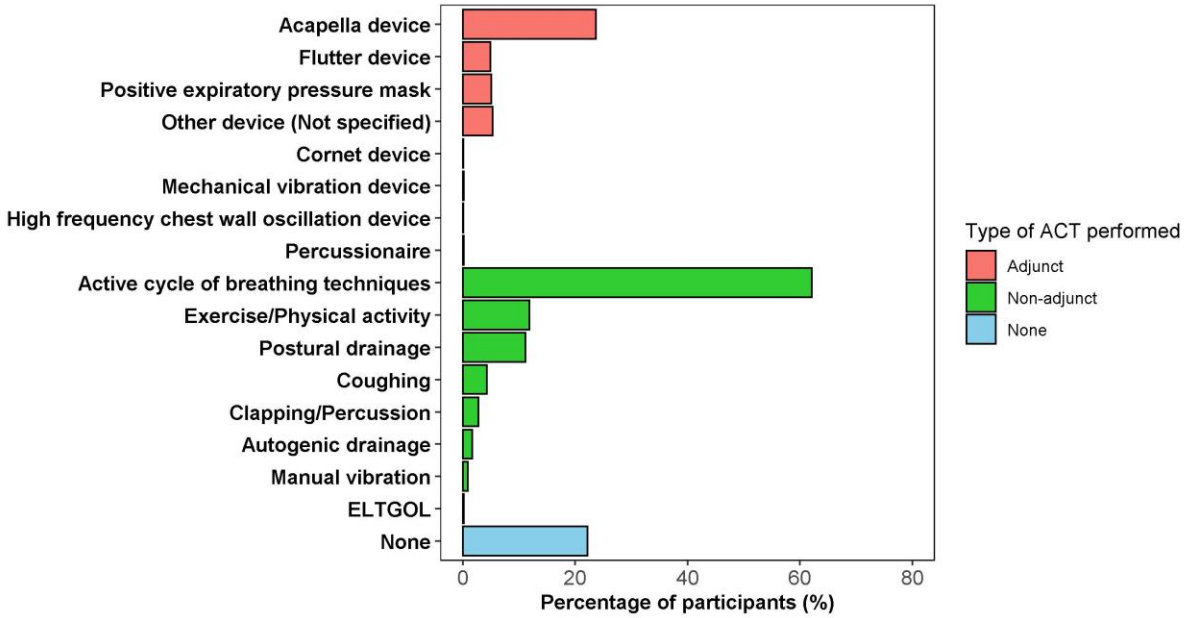

Figure 1B: Types of ACTs used by patients in the Bronch-UK Registry.

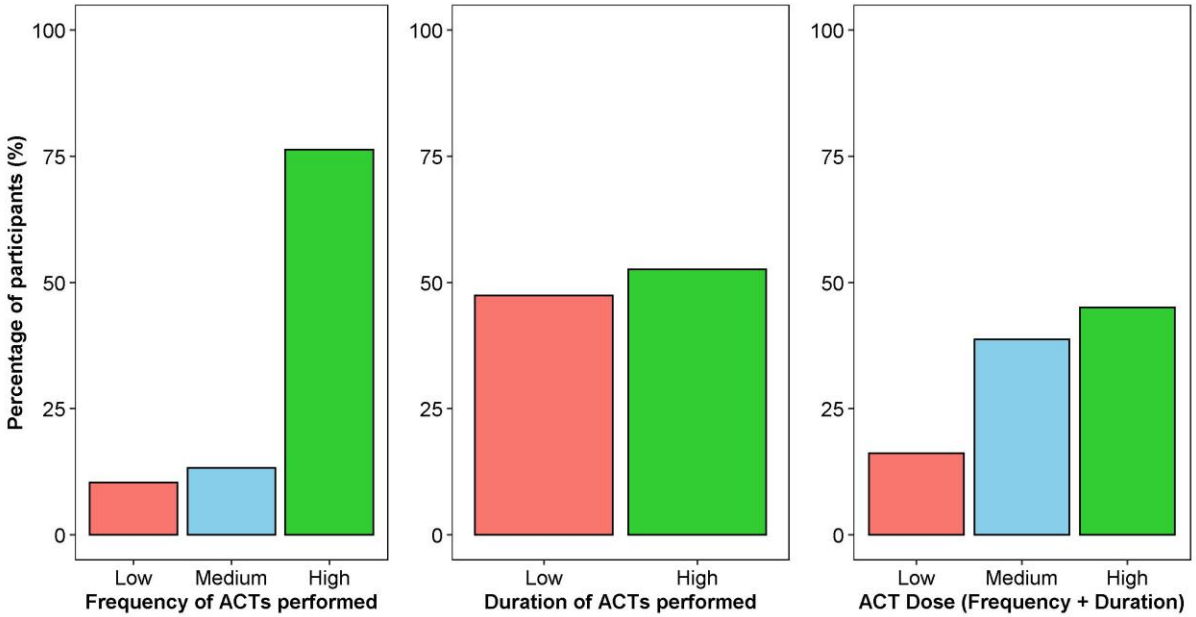

Figure 2A: Frequency, duration and dose of ACTs performed by patients when well (n=177).

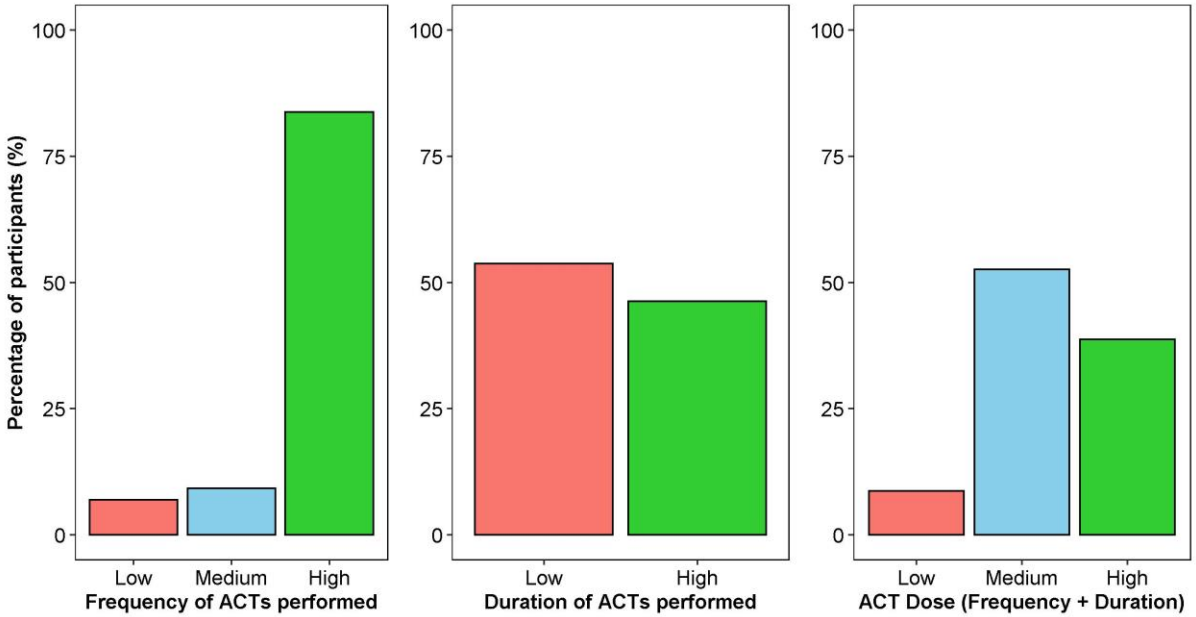

Figure 2B: Frequency, duration and dose of ACTs performed by patients when unwell (n=177).

Airway clearance treatments in bronchiectasis: a survey of patients' and physiotherapists' practices and feasibility of linking survey results to Registry patient outcome data

Supplementary Material

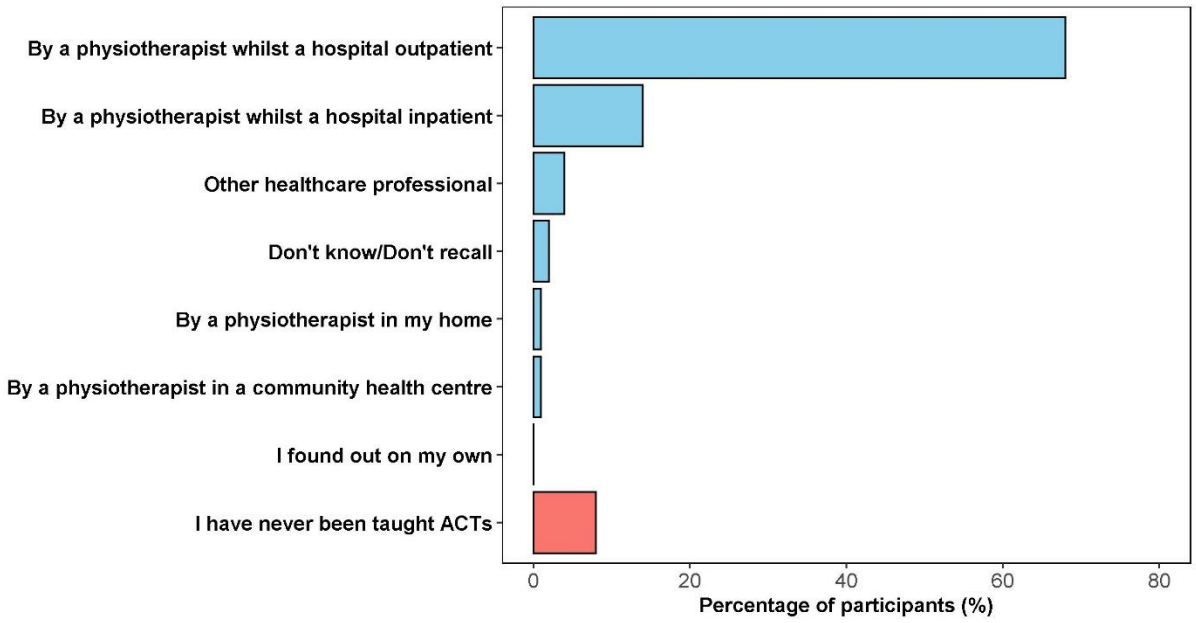

Figure 1. *How patients were first taught about ACTs (n=205))*

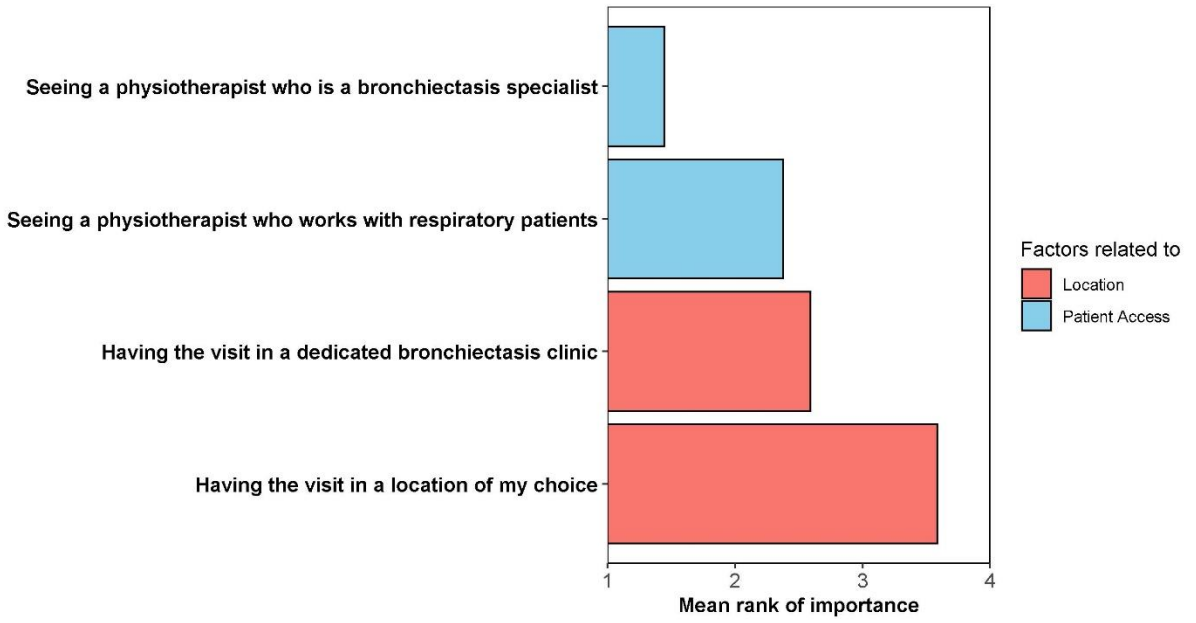

Figure 2. *Factors considered important by patients for their first visit for ACTs (n=186). Mean rank of importance: 1 – Most important, 4 - Least important.*

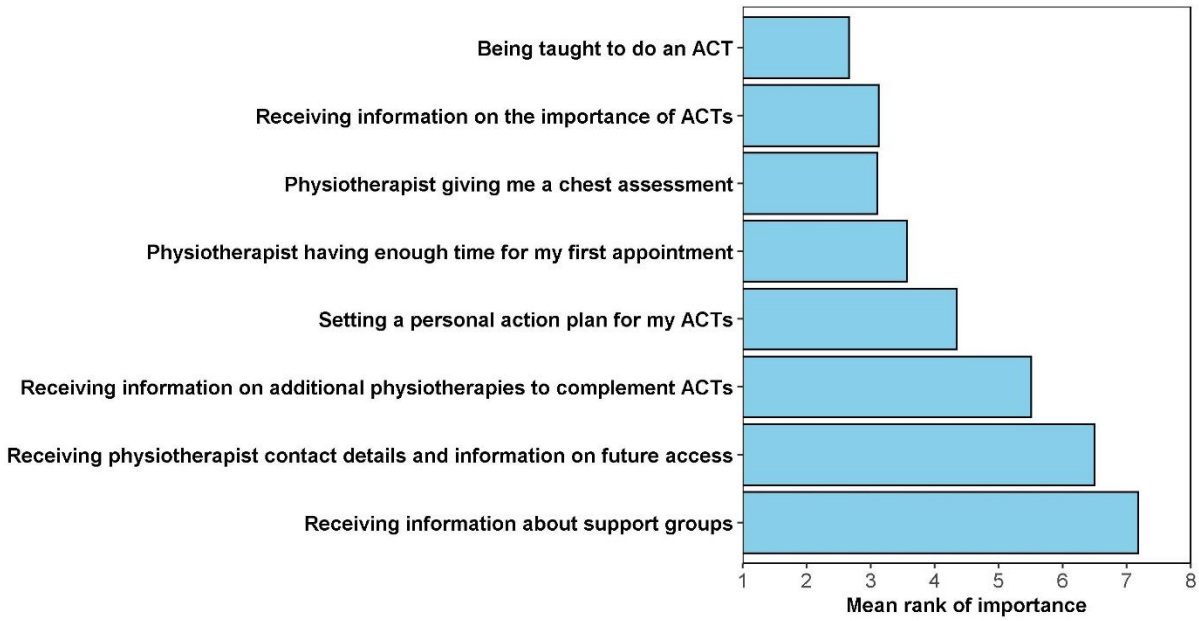

Figure 3. *Content considered important by patients in a first visit with a physiotherapist for ACTs (n=184). Mean rank of importance: 1 - Most important, 8 - Least important.*

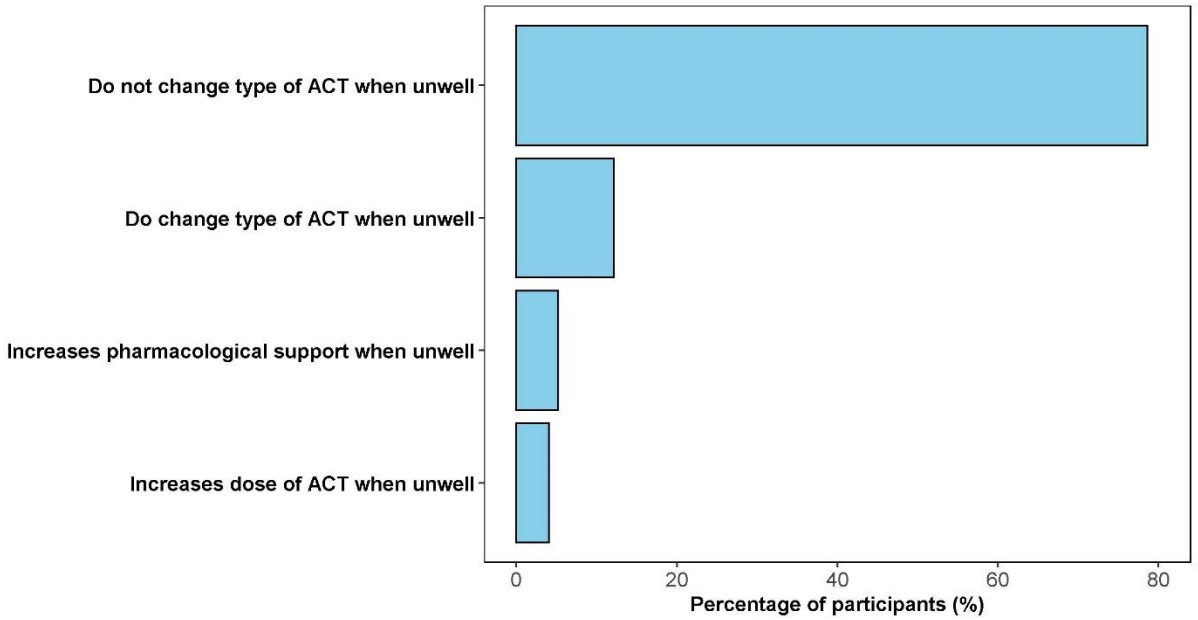

Figure 4. *Type(s) of ACTs used by patients when symptoms increase or they are unwell with a chest infection (n=173)*

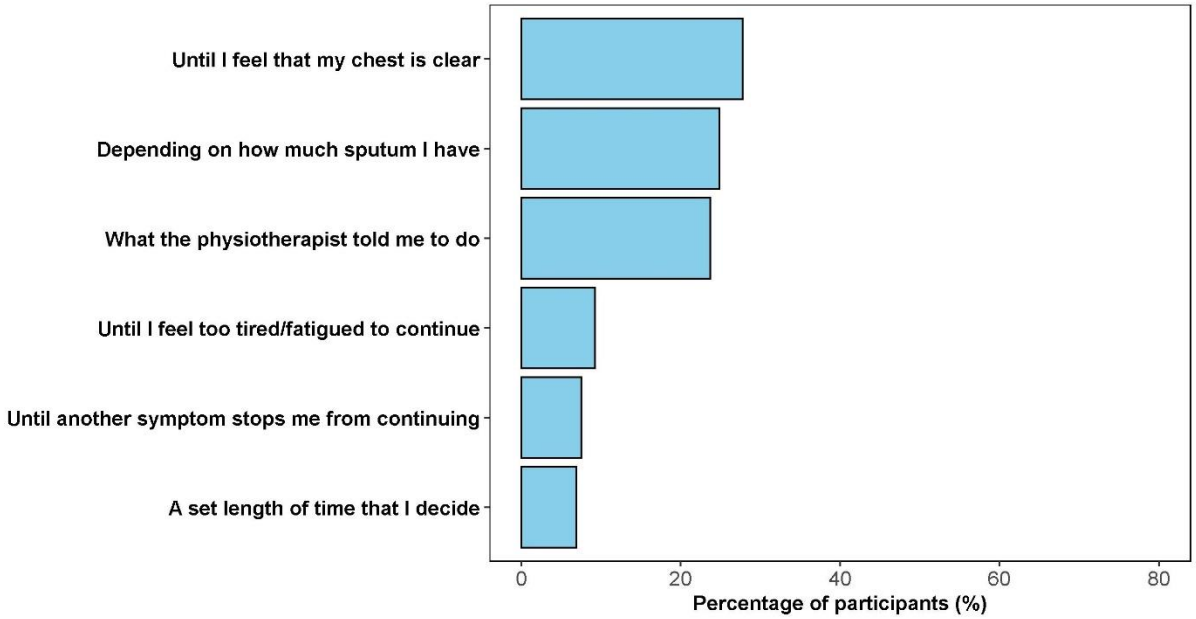

Figure 5. *Factors considered by patients to guide the frequency and duration of their ACT session (n=173).*

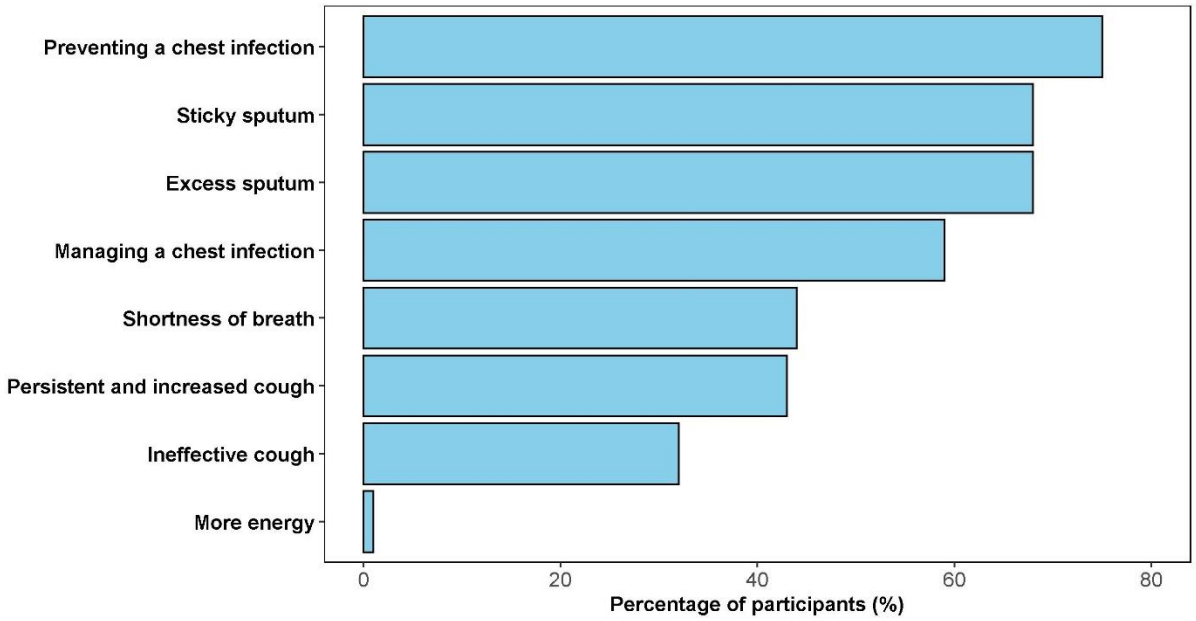

Figure 6. *Aspects of bronchiectasis condition that patients consider are helped with ACTs (n=174).*

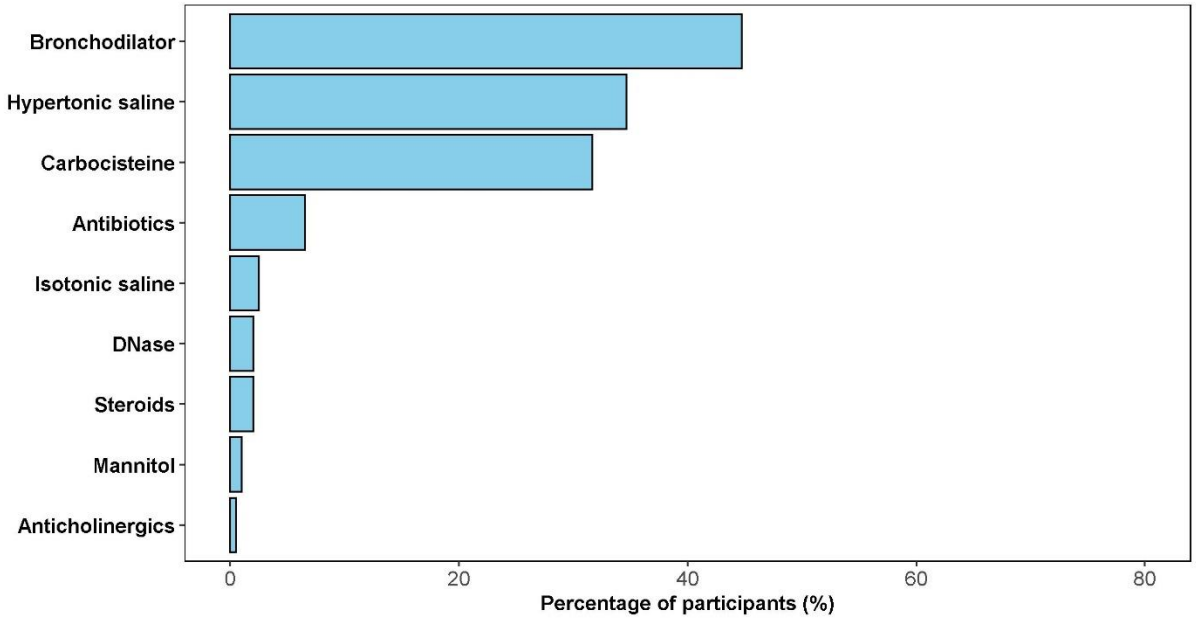

Figure 7. *Medications used by patients to help with ACTs (n=199).*

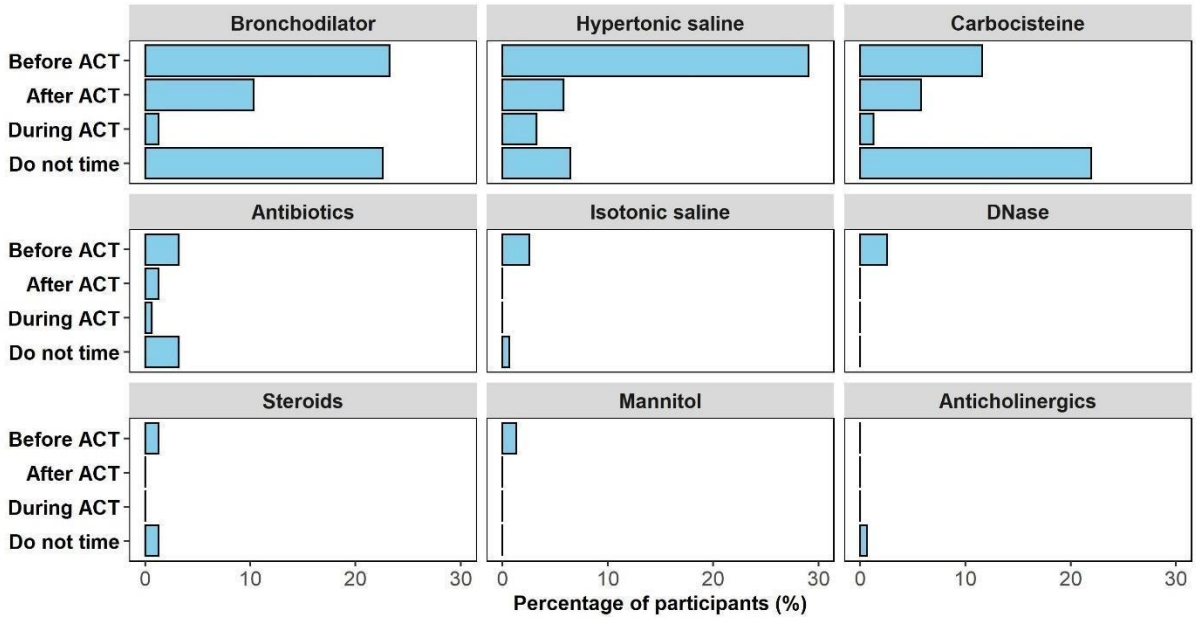

Figure 8. *How patients time their medication with their current ACTs (n=154)*

Table 1 Summary of demographics/ outcome data from the Bronch-UK/EMBARC Registry of patients who completed survey 1 (n= 176) and patients who completed survey 1 within six months of their Registry review (n=108). Data are presented as n (%), mean ± standard deviation or median (25-75% interquartile range)

Variables from Bronch-UK/EMBARC Registry	**n**	**Full cohort (n=176)**	**n**	**Sub cohort (n=108)**
Days between survey completion and review appointment	176	185 (87-737)	108	122 (54-186)
Demographics				
Age (Years)	176	68 (57-74)	108	67 (57-74)
Gender (Female)	176	99 (56)	108	65 (60)
Smoking status (Yes)	176	7 (4)	108	4 (4)
BMI (Kg/M^2)	88	27 (24-31)	32	25 (22-29)
Lung Function				
FEV_1 (L)	104	2 ± 1	46	2 ± 1
FEV_1 % predicted	92	82 ± 26	34	84 (60-102)
Mild (> 80%)		52 (57)		18 (53)
Moderate-Severe (≤ 80%)		40 (43)		16 (47)
Pulmonary Exacerbations				
Total exacerbations in the preceding year	176	1 (0- 3)	108	2 (0-3)
No exacerbations		56 (32)		30 (29)
1-2 exacerbations		61 (35)		39 (36)
≥ 3 exacerbations		59 (33)		39 (36)
mMRC	176		108	
Overall		1 (1-2)		1 (1-2)
Grade 0-1		36 (20)		15 (14)
Grade 2-4		140 (80)		93 (86)
Sputum				
Produces daily sputum (Yes)	176	139 (79)	108	93 (86)
Sputum Colour	141		93	
Mucoid		73 (52)		53 (57)
Mucopurulent		46 (33)		25 (27)
Purulent/Severely Purulent		22 (17)		15 (16)
Sputum Volume (ml)	144	20 (6-40)	93	18 (6-40)
Mild (<10ml)		39 (27)		29 (31)
Moderate-Severe (≥10ml)		105 (73)		64 (69)
***Pseudomonas aeruginosa* (Yes)**	176	11 (6)	108	10 (9)
BSI	174	6 (4-11)	107	7 (5-12)
QOL-B Domains				
Physical functioning	157	40 (20-67)	96	40 (20-67)
Role functioning	161	58 (33-73)	98	53 (33-73)
Vitality	158	44 (22-56)	97	44 (22-56)
Emotional functioning	158	75 (58-92)	97	75 (50-92)
Social functioning	160	50 (33-75)	98	50 (27-67)
Treatment burden	134	67 (44-89)	88	56 (44-78)
Health perceptions	162	42 (23-58)	98	42 (25-58)
Respiratory Symptoms	160	60 (41-74)	98	59 (42-74)

BMI: Body mass index; **FEV_1**: Forced expiratory volume in 1 second; **mMRC:** Modified Medical Research Council dyspnoea scale; **BSI:** Bronchiectasis severity index; **QoL-B:** Quality of life – Bronchiectasis.

Table 2.1 Simple logistic regression of demographics/outcome data for using airway clearance techniques and mucoactive medications. Data represents patients who had linked outcome data from the Bronch-UK/EMBARC Registry within six months of survey completion (n=108/205).

	Model 1 (N = 108)			**Model 2 (N = 108)**		
Simple Logistic Regression	**From the survey- Uses ACTs**			**From the survey- Uses Mucoactives**		
Variables from the Bronch-UK/EMBARC registry	Odd's ratio (95% CI)	Coefficient	*p*-value	Odd's ratio (95% CI)	Coefficient	*p*-value
Age				0.96 (0.93, 0.99)	-0.04	0.008
Total exacerbations in the preceding year	1.42 (1.04, 2.18)	0.36	0.06			
Modified MRC				1.62 (1.15, 2.37)	0.49	0.008
BSI				1.12 (1.02, 1.24)	0.11	0.02
QOL-B Physical functioning				0.98 (0.97, 1)	-0.02	0.02
QOL-B Vitality				0.97 (0.95, 0.99)	-0.03	0.002
QOL-B Respiratory symptoms				0.97 (0.95, 0.99)	-0.03	0.005
QOL-B Treatment burden	0.98 (0.95, 1)	-0.02	0.09	0.96 (0.94, 0.98)	-0.05	0.0002

QOL-B: Quality of life – Bronchiectasis.

Table 2.2 Multiple logistic regression of demographics/outcome data for using mucoactive medications. Data represents patients who had linked outcome data from the Bronch-UK/EMBARC Registry within six months of survey completion (n=108/205).

	Model 1 (N=108)		
	Uses Mucoactives		
Multiple Logistic Regression	Odd's ratio (95% CI)	Coefficient	*p*-value
Age + Modified MRC + BSI + QOL-B Physical function + QOL-B Vitality + QOL-B Respiratory symptoms + QOL-B Treatment burden		5.11	0.008
Age	0.96 (0.92 , 0.99)	-0.04	0.03
Modified MRC	1.6 (0.91, 2.7)	0.08	0.12
BSI	1.1 (0.96, 1.2)	0.4	0.21
QOL-B Physical functioning	1 (0.98, 1)	0.007	0.59
QOL-B Vitality	0.98 (0.95, 1)	0.002	0.12
QOL-B Respiratory symptoms	1 (0.97, 1)	0.0001	1
QOL-B Treatment burden	0.97 (0.95, 1)	-0.003	0.04

QOL-B: Quality of life – Bronchiectasis.

Table 3 Comparison of demographics/outcome data of patients who did vs did not perform airway clearance techniques. Data represents patients who had linked outcome data from the Bronch-UK/EMBARC Registry (n=176/205). Data are presented as n (%), mean ± standard deviation or median (25-75% interquartile range).

Variables from Bronch-UK/EMBARC Registry	**Reported in the survey- Performs ACTs**				
	Yes		**No**		
Demographics	n		n		***p*-value [95% CI]**
Age (Years)	148	67 (57-73)	28	69 (59-79)	0.33 [-8.00, 3.00]
Gender (Female)	148	84 (57)	28	15 (54)	0.92
Smoking status (Yes)	148	5 (3)	28	2 (7)	0.51
BMI (Kg/M^2)	76	27 (23-31)	12	29 (26-30)	0.13 -4.88, 0.74]
Lung Function					
FEV_1 (L)	89	2 ± 1	15	2 ± 1	0.27 [-0.67, 0.19]
FEV_1 % predicted	78	81 ± 27	14	88 ± 20	0.26 [-20.18, 5.76]
Mild (> 80%)		43 (55)		9 (64)	0.73
Moderate-Severe (≤ 80%)		35 (45)		5 (36)	
Pulmonary Exacerbations					
Total exacerbations in the preceding year	148	2 (0-4)	28	0 (0-1)	0.002 [0.00005, 2.00]
No exacerbations		42 (24)		14 (50)	0.004
1-2 exacerbations		49 (33)		12 (43)	
≥ 3 exacerbations		57 (38)		2 (7)	
mMRC					
Overall	148	1 (1-2)	28	1 (1-2)	0.38 [-0.00007, 1.00]
Grade 0-1		30 (20)		6 (21)	1
Grade 2-4		118 (80)		22 (79)	

Sputum					
Produces daily sputum (Yes)	148	122 (82)	28	17 (61)	0.02
Sputum Colour	124		17		
Mucoid		60 (48)		13 (76)	0.16
Mucopurulent		44 (36)		2 (12)	
Purulent/Severely Purulent		20 (16)		2 (12)	
Sputum Volume (ml)	126	20 (6-40)	18	15 (7-39)	0.79 [-6.84, 10.00]
Mild (<10ml)		34 (27)		5 (28)	0.16
Moderate-Severe (≥10ml)		92 (73)		13 (72)	
***Pseudomonas aeruginosa* (Yes)**		11 (7)		0 (0)	1
BSI	148	6 (4-11)	28	5 (3-10)	0.09 [-0.00001, 3.00]
QOL-B Domains					
Physical functioning	136	40 (20-67)	21	40 (20-80)	0.56 [-20, 8.30]
Role functioning	139	53 (33-73)	22	70 (43-85)	0.1 [-26.70, 0.00003]
Vitality	136	44 (22-56)	22	44 (25-56)	0.94 [-11.10, 11.10]
Emotional functioning	136	75 (58-92)	22	92 (69-92)	0.11 [-16.70, 0.00007]
Social functioning	138	50 (33-67)	22	67 (44-81)	0.05 [-25.00, 0.00003]
Treatment burden	121	67 (44-89)	13	78 (56-89)	0.15 [-22.30, 0.00003]
Health perceptions	140	42 (24-58)	22	50 (19-58)	0.74 [-16.60, 8.40]
Respiratory Symptoms	138	59 (41-74)	22	70 (50-82)	0.09 [-18.50, 1.40]

BMI: Body mass index; **FEV_1**: Forced expiratory volume in 1 second; **mMRC:** Modified Medical Research Council dyspnoea scale; **BSI:** Bronchiectasis severity index; **QOL-B:** Quality of life – Bronchiectasis.

Table 4 Comparison of demographics/ outcome data of patients who reported using non-adjuncts alone vs adjuncts (either alone or in combination with non-adjuncts). Data represents patients who had linked outcome data from the Bronch-UK/EMBARC Registry (n=176/205*). Data are presented as n (%), mean ± standard deviation or median (25-75% interquartile range).

Variables from Bronch-UK/EMBARC Registry	**Reported in the survey- Type of ACT performed**				
	Non-adjuncts		**Adjuncts**		
	n		n		***p*-value [95% CI]**
Demographics					
Age (Years)	77	70 (59-74)	71	66 (54-72)	0.01 [-9.00, -1.00]
Gender (Female)	77	38 (49)	71	46 (65)	0.08
Smoking status (Yes)	77	3 (4)	71	2 (3)	0.01
BMI (Kg/M^2)	39	27 (25-31)	37	25 (22-29)	0.05 [-4.72, -0.07]
Lung Function					
FEV_1 (L)	43	2 ± 1	45	2 ± 1	1 [-0.34, 0.34]
FEV_1 % predicted	40	82 ± 29	38	85 ± 25	0.59 [-15.43, 8.89]
Mild (> 80%)		22 (55)		21 (55)	
Moderate-Severe (≤ 80%)		18 (45)		17 (45)	1
Pulmonary Exacerbations					
Total exacerbations in the preceding year	77	1 (0-3)	71	2 (1-4)	0.03 [0.00004, 1.00]
No exacerbations		28 (36)		14 (20)	0.05
1-2 exacerbations		25 (33)		24 (34)	
≥ 3 exacerbations		24 (31)		33 (46)	
mMRC					

Overall	77	1 (1-2)	71	1 (1-3)	0.5 [-0.00002, 0.00002]
Grade 0-1		19 (25)		11 (15)	
Grade 2-4		58 (75)		60 (85)	0.24
Sputum					
Produces daily sputum (Yes)	77	64 (83)	71	58 (82)	0.99
Sputum Colour	64		60		
Mucoid		32 (50)		28 (47)	
Mucopurulent		20 (31)		24 (40)	1
Purulent/Severely Purulent		12 (19)		8 (13)	
Sputum Volume (ml)	64	18 (10-31)	62	20 (6-40)	0.39 [-2.24, 10.00]
Mild (<10ml)		15 (23)		19 (31)	
Moderate-Severe (≥10ml)		49 (71)		43 (69)	0.48
***Pseudomonas aeruginosa* (Yes)**	77	4 (5)	71	7 (10)	0.44
BSI	77	6 (4-9)	69	6 (5-9)	0.06 [-0.00002, 3.00]
QOL-B Domains					
Physical functioning	69	40 (20-73)	67	40 (13-60)	0.47 [-13.40, 6.70]
Role functioning	72	56 (40-80)	67	47 (33-73)	0.33 [-13.40, 6.70]
Vitality	69	44 (33-56)	67	44 (22-56)	0.5 [-11.10, 0.00002]
Emotional functioning	69	75 (58-92)	67	75 (54-92)	0.72

					[-8.30, 8.30]
Social functioning	71	50 (33-71)	67	50 (29-67)	0.67 [-13.90, 8.30]
Treatment burden	56	78 (56-89)	65	56 (44-78)	0.007 [-22.20, -0.000005]
Health perceptions	72	42 (25-60)	68	38 (17-58)	0.13 [-16.60, 0.00007]
Respiratory Symptoms	72	63 (44-75)	66	56 (37-73)	0.12 [-14.80, 0.90]

*n=28/176 excluded as they reported they did not perform ACTs.

BMI: Body mass index; **FEV_1**: Forced expiratory volume in 1 second; **FVC:** Forced vital capacity; **mMRC:** Modified Medical Research Council dyspnoea scale; **BSI:** Bronchiectasis severity index; **QOL-B:** Quality of life – Bronchiectasis.

Table 5 Comparison of demographics/outcome data of patients who performed airway clearance at a high, medium vs low dose. Data represents patients who had linked outcome data from the Bronch-UK/EMBARC Registry within six months of survey completion (n=108/205*). Data are presented as n (%), mean ± standard deviation or median (25-75% interquartile range).

Variables from Bronch-UK/EMBARC Registry	**Reported in the survey- Dose of airway clearance performed**						
	High		**Medium**		**Low**		
Demographics	n		n		n		***p*-value**
Age (Years)	45	63 (56-72)	32	70 (61-74)	7	63 (62-70)	0.18
Gender (Female)	45	27 (60)	32	20 (63)	7	2 (29)	0.24
Smoking status (Yes)	45	1 (2)	32	0	7	1 (14)	0.2
BMI (Kg/M^2)	12	24 (22-34)	11	23 (21-26)	1	27 (27-27)	0.38
Lung Function							
FEV_1 (L)	18	2 ± 1	15	2 ± 0	4	2 ± 1	0.95
FEV_1 % predicted	14	88 (53-102)	11	62 (53-96)	2	85 (74-96)	0.59
Mild (> 80%)		8 (57)		4 (36)		1 (50)	0.59
Moderate-Severe		6 (43)		7 (64)		1 (50)	
Pulmonary Exacerbations							
Total exacerbations in the preceding year	45	2 (1-4)	32	1 (1-4)	7	1 (0-2)	0.4
No exacerbations		9 (20)		8 (25)		3 (42)	0.53
1-2 exacerbations		19 (42)		9 (28)		2 (29)	
≥ 3 exacerbations		17 (38)		15 (47)		2 (29)	
mMRC							
Overall	45	2 (1-3)	32	1 (1-2)	7	1 (1-2)	0.66
Grade 0-1		21 (47)		17 (53)		0	0.79
Grade 2-4		24 (53)		15 (47)		7 (100)	
Sputum							
Produces daily sputum (Yes)	45	40 (87)	32	30 (94)	7	6 (86)	0.7
Sputum Colour	40		32		6		
Mucoid		20 (50)		17 (53)		4 (67)	1
Mucopurulent		11 (28)		7 (22)		2 (33)	
Purulent/Severely Purulent		9 (23)		6 (25)		0	
Sputum Volume (ml)	40	25 (9-40)	32	18 (6-30)	6	22 (3-40)	0.41
Mild (<10ml)		10 (25)		9 (28)		3 (50)	0.45

Moderate-Severe (≥10ml)		30 (75)		21 (72)		3 (50)	
Pseudomonas aeruginosa (Yes)	45	8 (18)	32	0	7	0	0.18
BSI	44	8 (6-12)	32	10 (6-12)	7	5 (4-6)	0.13
QOL-B Domains							
Physical functioning	40	27 (18-60)	31	40 (23-63)	7	53 (30-77)	0.33
Role functioning	41	47 (20-60)	31	47 (37-63)	7	73 (53-93)	0.07
Vitality	40	33 (22-56)	31	56 (33-61)	7	44 (28-61)	0.08
Emotional functioning	40	67 (50-92)	31	75 (67-88)	7	83 (75-100)	0.2
Social functioning	41	33 (17-67)	31	42 (19-58)	7	67 (47-79)	0.08
Treatment burden	39	56 (33-67)	28	56 (53-81)	7	89 (61-94)	0.04
Health perceptions	41	33 (22-50)	31	44 (25-62)	7	42 (42-62)	0.08
Respiratory Symptoms	41	52 (30-70)	31	63 (44-75)	7	70 (61-82)	0.04

*n=15/108 excluded as they reported they did not perform ACTs; n=9/108 excluded as they either reported they performed ACTs on an adhoc basis or they never performed ACTs.

BMI: Body mass index; **FEV_1**: Forced expiratory volume in 1 second; **mMRC:** Modified Medical Research Council dyspnoea scale; **BSI:** Bronchiectasis severity index; **QOL-B:** Quality of life – Bronchiectasis. **High dose:** Daily use for >10min; **Medium dose:** Daily use for <10min, 1-3 times/week for >10min or Monthly usage for >10min; **Low dose:** 1-3 times/week for <10min or monthly usage for <10min.

Table 6 Comparison of demographics/outcome data of patients who performed airway clearance at a high, medium vs low dose. Data represents patients who had linked outcome data from the Bronch-UK/EMBARC Registry (n=176/205*). Data are presented as n (%), mean ± standard deviation or median (25-75% interquartile range).

Variables from Bronch-UK/EMBARC Registry	**Reported in the survey- Dose of airway clearance performed**						
	High		**Medium**		**Low**		
Demographics	n		n		n		***p*-value**
Age (Years)	65	67 (56-72)	56	70 (59-74)	12	62 (58-70)	0.22
Gender (Female)	65	36 (55)	56	31 (55)	12	6 (50)	0.94
Smoking status (Yes)	65	3 (5)	56	1 (2)	12	1 (8)	0.44
BMI (Kg/M^2)	29	25 (24-31)	33	27 (23-31)	6	26 (24-28)	0.96
Lung Function							
FEV_1 (L)	35	2 ± 1	37	2 ± 1	9	2 ± 1	0.4
FEV_1 % predicted	31	84 ± 28	33	73 ± 26	7	88 ± 24	0.56
Mild (> 80%)		21 (68)		12 (37)		5 (71)	0.03
Moderate-Severe (≤ 80%)		10 (32)		21 (63)		2 (29)	
Pulmonary Exacerbations							
Total exacerbations in the preceding year	65	2 (1-4)	56	1 (0-4)	12	0 (0-2)	0.05
No exacerbations		12 (19)		18 (32)		6 (50)	0.13
1-2 exacerbations		27 (42)		16 (29)		3 (25)	
≥ 3 exacerbations		26 (40)		22 (39)		3	
mMRC							
Overall	65	2 (1-3)	56	1 (1-2)	12	1 (1-1)	0.19
Grade 0-1		12 (18)		10 (18)		3 (25)	0.84
Grade 2-4		53 (82)		46 (82)		9 (75)	
Sputum							
Produces daily sputum (Yes)	65	53 (82)	56	47 (84)	12	10 (46)	0.94
Sputum Colour	54		48		10		
Mucoid		25 (46)		23 (48)		6 (60)	1
Mucopurulent		18 (33)		16 (33)		4 (40)	
Purulent/Severely Purulent		11 (20)		9 (19)		0 (0)	
Sputum Volume (ml)	55	20 (8-40)	49	18 (6-40)	10	18 (5-35)	0.59
Mild (<10ml)		14 (81)		13 (27)		3 (30)	0.96
Moderate-Severe (≥10ml)		41 (19)		36 (73)		7 (70)	

***Pseudomonas aeruginosa* (Yes)**	65	8 (12)	56	3 (5)	12	0 (0)	0.21
BSI	63	8 (5-12)	56	7 (4-12)	12	4 (2-6)	0.01
QOL-B Domains							
Physical functioning	57	33 (13-53)	53	40 (13-67)	12	60 (37-82)	0.07
Role functioning	59	47 (22-63)	54	56 (40-78)	12	83 (58-88)	0.002
Vitality	57	33 (22-56)	53	56 (33-56)	12	50 (33-67)	0.02
Emotional functioning	57	75 (50-92)	53	75 (67-92)	12	92 (81-100)	0.01
Social functioning	58	42 (19-67)	54	50 (33-67)	12	67 (56-83)	0.02
Treatment burden	56	56 (33-67)	46	78 (56-89)	10	89 (69-97)	0.0005
Health perceptions	60	33 (17-50)	54	44 (19-65)	12	58 (42-67)	0.004
Respiratory Symptoms	59	48 (31-70)	53	63 (44-74)	12	72 (65-79)	0.003

*n=28/176 excluded as they reported they did not perform ACTs; n=15/176 excluded as they either reported they performed ACTs on an adhoc basis or they never performed ACTs.

BMI: Body mass index; **FEV_1**: Forced expiratory volume in 1 second; **FVC:** Forced vital capacity; **mMRC:** Modified Medical Research Council dyspnoea scale; **BSI:** Bronchiectasis severity index; **QOL-B:** Quality of life – Bronchiectasis. **High dose:** Daily use for >10min; **Medium dose:** Daily use for <10min, 1-3 times/week for >10min or Monthly usage for >10min; **Low dose:** 1-3 times/week for <10min or monthly usage for <10min.

Table 7 Comparison of demographics/ outcome data of patients who reported using or not using mucoactive medications. Data represents patients who had linked outcome data from the Bronch-UK/EMBARC Registry (n=176/205). Data are presented as n (%), mean ± standard deviation or median (25-75% interquartile range).

	Reported in the survey- Uses mucoactive medications				
Variables from Bronch-UK/EMBARC Registry	**Yes**		**No**		
	n		n		***p*-value [95% CI]**
Demographics					
Age (Years)	92	66 (56-72)	84	70 (60-75)	0.005 [-9.00, -1.00]
Gender (Female)	92	58 (63)	84	41 (49)	0.08
Smoking status (Yes)	92	4 (4)	84	0 (0)	0.91
BMI (Kg/M^2)	52	28 (23-30)	36	27 (24-31)	0.7 [-2.75, 1.77]
Lung Function					
FEV_1 (L)	63	2 ± 1	41	2 ± 1	0.93 [-0.32, 0.29]
FEV_1 % predicted	55	81 ± 27	37	84 ± 25	0.58 [-13.95, 7.88]
Mild (> 80%)		31 (56)		21 (57)	1
Moderate-Severe (≤ 80%)		24 (44)		16 (43)	
Pulmonary Exacerbations					
Total exacerbations in the preceding year	92	2 (0-5)	84	1 (0-3)	0.15 [-0.00002, 1.00]
No exacerbations		29 (32)		27 (32)	0.34
1-2 exacerbations		28 (30)		33 (39)	
≥ 3 exacerbations		35 (38)		24 (29)	
mMRC					
Overall	92	2 (1-3)	84	1 (1-2)	0.004 [0.00004, 1.00]
Grade 0-1		16 (17)		20 (24)	0.39
Grade 2-4		76 (83)		64 (76)	

Sputum					
Produces daily sputum (Yes)	92	73 (79)	84	66 (79)	1
Sputum Colour	75		66		
Mucoid		34 (45)		39 (58)	1
Mucopurulent		28 (37)		18 (28)	
Purulent/Severely Purulent		13 (17)		9 (14)	
Sputum Volume (ml)	78	20 (6-40)	66	18 (10-39)	0.81 [-4.08, 7.00]
Mild (<10ml)		23 (30)		16 (24)	0.6
Moderate-Severe (≥10ml)		55 (70)		50 (76)	
***Pseudomonas aeruginosa* (Yes)**	92	7 (8)	84	4 (5)	0.64
BSI	90	7 (4-12)	84	6 (4-9)	0.06 [-0.00009, 2.00]
QOL-B Domains					
Physical functioning	81	33 (13-53)	76	47 (20-80)	0.02 [-26.60, -0.00005]
Role functioning	83	53 (27-73)	78	59 (40-80)	0.18 [-13.40, 0.00002]
Vitality	81	33 (22-56)	77	56 (33-67)	0.003 [-22.20, -0.00002]
Emotional functioning	81	75 (50-92)	77	83 (58-92)	0.22 [-8.40, 0.00002]
Social functioning	82	50 (25-73)	78	58 (42-75)	0.24 [-16.60, 2.70]
Treatment burden	73	56 (33-78)	61	78 (56-89)	<0.0001 [-22.30, -11.10]
Health perceptions	84	38 (17-51)	78	50 (25-67)	0.01 [-16.70, -0.00005]
Respiratory Symptoms	82	55 (41-73)	78	67 (44-82)	0.008 [-17.10, -3.70]

BMI: Body mass index; **FEV_1**: Forced expiratory volume in 1 second; **mMRC:** Modified Medical Research Council dyspnoea scale; **BSI:** Bronchiectasis severity index; **QOL-B:** Quality of life – Bronchiectasis