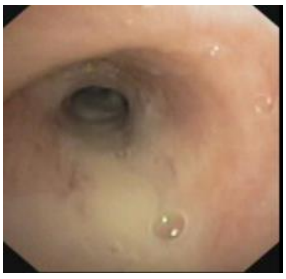
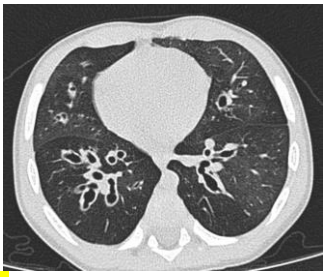
ERS pocket guidelines

From the ERS task force on the management of children and adolescents with bronchiectasis

European Respiratory Society guidelines for the management of children and adolescents with bronchiectasis





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ERS TASK FORCE ON THE MANAGEMENT OF CHILDREN AND ADOLESCENTS WITH BRONCHIECTASIS

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Introduction

The European Respiratory Society (ERS) Task Force for the management of paediatric bronchiectasis sought to identify evidence-based management (investigation and treatment) strategies. It used the ERS standardised process that included a systematic review of the literature and application of the GRADE approach to define the quality of the evidence and level of recommendations.

A multidisciplinary team of specialists in paediatric and adult respiratory medicine, infectious disease, physiotherapy, primary care, nursing, radiology, immunology, methodology, patient advocacy and parents of children/adolescents with bronchiectasis considered the most relevant clinical questions (for both clinicians and patients) related to managing paediatric bronchiectasis. Fourteen key clinical questions (7 "Patient, Intervention, Comparison, Outcome" [PICO] and 7 narrative) were generated. The outcomes for each PICO were decided by voting by the panel and parent advisory group.

Question #1: In children/adolescents suspected of bronchiectasis: (a) Should multidetector chest computed tomography (MDCT) scans with high-resolution CT (HRCT) be used instead of conventional HRCT alone for diagnosing bronchiectasis? (b) What CT criteria for broncho-arterial dilatation (BAR) should be used?

In children/adolescents suspected of bronchiectasis, we suggest that MDCT-scans with HRCT is used instead of conventional HRCT to diagnose bronchiectasis in children/adolescents	• **Conditional recommendation** (Very low-quality of evidence)
In children/adolescents suspected of bronchiectasis, we suggest that paediatric derived BAR (defined by the ratio of the inner diameter of the airway to the outer diameter of the adjacent artery) >0.8 is used to define abnormality instead of the adult cut-off of >1-1.5	• **Conditional recommendation** (Very low-quality of evidence stemming from narrative review of the evidence)

Evidence on benefits and harms

- The key benefits relate to early diagnosis (leading to appropriate treatment) and hence achieving cure.
- The side effects of radiation are more marked in young children. However, modern CT-scanners require much lower radiation doses.
- Young children may need general anaesthesia with its own possible adverse events.

Rationale of recommendation

MDCT scan with HRCT is more sensitive in detecting bronchiectasis than conventional HRCT alone. Paediatric studies found that the mean BAR is significantly lower in children than in adults. BAR correlates with age and increases as bronchiectasis becomes more severe (from

cylindrical to varicose to cystic). To diagnose bronchiectasis earlier thus requires using an appropriate BAR cut-off to define abnormality.

Implementation considerations

We need to develop strategies to improve (i) availability and access to high-quality scanners that reduce radiation exposure and (ii) interpretation of paediatric chest CT-scans. Using the suggested paediatric-defined threshold of BAR 0.8 may result in more radiographic-based diagnoses of bronchiectasis in children with chronic wet cough, and reduce problems of drug reimbursement in some countries. However, as there are false positives with diagnosing bronchiectasis based purely on BAR, the panel advocated that BAR alone should not be used to diagnose bronchiectasis i.e. it is best based on the presence of clinical features consistent with this diagnosis and confirmed radiographically.

Question #2: In children/adolescents with suspected or confirmed bronchiectasis, what standard tests that impact on clinical outcomes should be undertaken when managing this group of patients?

In children/adolescents with suspected or confirmed bronchiectasis, we suggest they have a minimum panel of tests undertaken, as done currently by most experts in the field. The minimum panel of tests are: (i) chest CT-scan (to diagnose bronchiectasis), (ii) sweat test, (iii) lung function tests (in children/adolescents who can perform spirometry), (iv) full blood count, (v) immunological tests (total IgG, IgA, IgM, IgE, specific antibodies to vaccine antigens) and (vi) lower airway bacteriology.	• **Conditional recommendation** (Very low-quality of evidence stemming from narrative review of the evidence)
In selected children/adolescents with bronchiectasis, we suggest additional tests are considered based on their clinical presentation. These include additional in-depth immunological assessments (in consultation with a paediatric immunologist), diagnostic bronchoscopy with bronchoalveolar lavage (BAL) analysis (microbiology), tests for airway aspiration, primary ciliary dyskenisa and gastro-oesophageal reflux disease (GORD). **Remarks**: In settings where tuberculosis or human immunodeficiency virus (HIV) have a high prevalence and/or there is a history of close contact with tuberculosis, assessment for tuberculosis infection/disease or HIV respectively is also undertaken as part of the minimum panel of tests.	• **Conditional recommendation** (Very low-quality of evidence stemming from narrative review of the evidence)

Evidence on benefits and harms

- Determination of a standard set of investigations will help screen major causes of bronchiectasis that are common or critical, e.g. immunodeficiency, infection, or cystic fibrosis. Identifying these early impacts on treatment.
- No evidence of harm but costs of the tests may be an issue in some settings.

Rationale of recommendation

Identifying the aetiology has management implications (e.g. specific treatment for immunodeficiency, genetic causes for future family planning, etc). Recommendation was based on the large desirable effect and likely trivial undesirable effects of setting a standard

set of investigations as well as the risk and harm of not managing common or critical conditions related to bronchiectasis. Although lung function and respiratory cultures they do not identify the cause, these tests help assess severity and guide antibiotic choices, thus optimising treatment.

Implementation considerations

Health services should increase accessibility to centres practising standard of care management for children/adolescents with bronchiectasis that includes undertaking the recommended minimum panel of tests.

Question #3: In children/adolescents with bronchiectasis, what criteria should be used to define an exacerbation?

For clinical purposes:

In children/adolescents with bronchiectasis, we suggest that a respiratory exacerbation is considered present when a child/adolescent has increased respiratory symptoms (predominantly increased cough +/- increased sputum quantity and/or purulence) for ≥3-days.

Remarks: Other important, but less common respiratory symptoms like haemoptysis, chest pain, breathlessness and wheeze, may not be present. Clinicians should not rely on changes in chest auscultation findings and chest x-rays to diagnose an exacerbation as, although important, these findings are not always present. Systemic symptoms (fever, fatigue, malaise, change in child's behaviour, appetite) may also herald onset of an exacerbation, but are non-specific. Blood markers (e.g. elevated C-reactive protein, neutrophilia and interleukin-6) provide supportive evidence of the presence of an exacerbation. However, these indices are less important in defining exacerbations, but are likely useful for research purposes. Also, markers like IL-6 are not standard clinical tests.

- **Conditional recommendation** (Very low-quality of evidence stemming from narrative review of the evidence)

In children/adolescents with bronchiectasis, we recommend that the presence of dyspnoea (increased work of breathing) and/or hypoxia should be considered a severe exacerbation, irrespective of duration.

- **Strong recommendation** (Very low-quality of evidence stemming from narrative review of the evidence)

Advantages and limitations

- Defining exacerbations leading to better recognition (both parents' and doctors' perspectives) is important as its management is a key component of bronchiectasis care.
- Limited evidence on optimal duration of symptoms before being considered an exacerbation that require treatment

Rationale of recommendation

Exacerbations are particularly important clinically as they are associated with increased respiratory symptoms and psychological stress, impaired QoL, accelerated lung function decline. The recommendation was based on current evidence that parents' value recognising and treating respiratory exacerbations early. We considered that at least 3-days of increased symptoms is required for the definition, except when immune-deficiency or hypoxia/dyspnoea are present. For those with immunodeficiency, a lower threshold is suggested (as commencing treatment earlier may be required). No timeframe is required for those with hypoxia/dyspnoea as immediate treatment is mandated as there is a risk of acute deterioration and death.

Implementation considerations

Increase patient, parent/carer and health professional education in recognising exacerbations and commencing additional treatments.

Children/adolescents with neurodevelopmental conditions may have subtle and/or individually recognised symptoms of an exacerbation, whereby earlier treatment may be necessary.

Question #4: In children/adolescents with bronchiectasis, should regular airway clearance techniques (ACT) (compared to no ACT) be undertaken?

In children/adolescents with bronchiectasis, we recommend they are taught and receive regular ACT or manoeuvres.

Remarks: Individualised ACT that is development- and age-appropriate is best taught by a paediatric-trained chest physiotherapist (see Figure-2). The frequency of ACT is best individualised. As children/adolescents mature, techniques may need to be changed and thus, the ACT type and frequency is best reviewed at least biannually by physiotherapists with expertise in paediatric respiratory care During acute exacerbations of bronchiectasis, children/adolescents should receive ACT more frequently.

- **Strong recommendation** (Very low-quality of evidence)

Evidence on benefits and harms

- Short-term effects by increasing mucus transport have been shown but while no conclusions concerning long-term effects can be drawn, ACT is standard therapy in children and adults with bronchiectasis.
- Significant fall in lung function can occur when halting ACT.
- There was no direct evidence of harm but the burden of treatment may not be considered trivial from the patients' and parents' perspective.

Rationale of recommendation

Recommendation was based on moderate desirable and trivial, but time-consuming undesirable effects for undertaking ACT and the risk of harm if not undertaken. Where data exist, results are consistent and favour ACT compared with controls. ACT is universally advocated for children/adolescents with bronchiectasis. Exacerbations increase airway secretions and enhancing their clearance would be beneficial.

Implementation considerations

Individualised ACT that are development- and age-appropriate are best taught by paediatric-trained chest physiotherapists (figure in guideline) and reviewed at least biannually. The frequency and best ACT method(s) remain uncertain. Adjustment to the type of ACT during exacerbations may be necessary (eg. exercise may not be feasible).

Question #5: In children/adolescents with bronchiectasis, should mucoactive agents (compared to no mucoactive agents) be used routinely?

In children/adolescents with bronchiectasis, we recommend against the routine use of recombinant-human DNAse.	• **Strong recommendation** (Very low-quality of evidence)
In children/adolescents with bronchiectasis, we recommend against the routine use of bromhexine.	• **Conditional recommendation** (Very low-quality of evidence)
In children/adolescents with bronchiectasis, we suggest that neither inhaled mannitol nor hypertonic saline (HS) are used routinely. **Remarks**: Inhaled mannitol or 6-7% HS may be considered in selected patients e.g. those with high daily symptoms, frequent exacerbations, difficulty in expectoration and/or poor quality of life (QoL). If well tolerated, the use of HS or mannitol could improve the QoL and facilitate expectoration.	• **Conditional recommendation** (Very low-quality of evidence

Evidence on benefits and harms

- Regular use of rhDNase was associated with increased hospitalisation and faster lung function decline.
- Regular use of bromhexine was associated with increased adverse effects with minimal potential benefits.
- Studies using HS and mannitol significantly improved some QoL sub-domains, prolonged time-to-next exacerbation and sputum volume. In the subgroup with a high symptom burden, HS and/or mannitol are likely beneficial.
- There is a risk of bronchospasm when using HS and mannitol.

Rationale of recommendation

The balance of the evidence favours not using rhDNAse and bromhexine routinely, based on patient/parents' values, the substantial adverse effects described above and the lack of efficacy of these treatments.

The balance favours administering HS and mannitol in some but not all patients; e.g. mannitol (c.f. controls) was beneficial (significantly fewer exacerbations, prolonged time-to-next exacerbation and symptomatic improvement) in adults with a high symptom burden.

Implementation considerations

Health professionals should be warned of the potential harmful effects of rhDNAse. For HS and mannitol, children should be old enough to tolerate these interventions and short-acting B_2 agonist (SABA) used prior to inhaling either HS or mannitol. The first should be administered under medical supervision and education on its use and equipment care provided. The substantially higher cost of mannitol compared with HS should be considered.

Question #6: In children/adolescents with bronchiectasis, should systemic courses of antibiotics (compared to no antibiotics) be used to treat an acute respiratory exacerbation?

In children/adolescents with bronchiectais and an acute respiratory exacerbation, we recommend a systemic course of an appropriate antibiotic is used for 14-days.

Remarks: The empiric antibiotic of choice is amoxicillin-clavulanate, but type of antibiotics chosen should be based on the patient's airway cultures (e.g. those with *Pseudomonas aeruginosa* require different treatment regimens to those without) and history of antibiotic hypersensitivity reactions. When the exacerbation is severe (e.g. child/adolescent is hypoxic) and/or when the child/adolescent does not respond to oral antibiotics, intravenous antibiotics will be needed

- **Strong recommendation** (Moderate quality of evidence)

Evidence on benefits and harms

- Using amoxicillin-clavulanate significantly increases resolution of exacerbations after 14-days of treatment and shortens the exacerbation duration (c.f. placebo)
- Azithromycin also showed a similar benefit (vs placebo), but this just failed to reach pre-set statistical significance.
- No significant increase in adverse events when either antibiotic or pooled results for amoxicillin-clavulanate and azithromycin were compared to placebo. However, known adverse events associated with antibiotic use include diarrhoea and induction of antibiotic-resistance in upper airway bacterial pathogens.

Rationale of recommendation

Antibiotic treatment for acute exacerbations of bronchiectasis are considered standard of care and this practice is supported by a high-quality RCT.

Implementation considerations

Patients should have access to appropriate antibiotics for the recommended duration of treatment.

Question #7: In children/adolescents with bronchiectasis and recurrent exacerbations, should long-term (≥2-months) antibiotics (compared to no antibiotics) be used to reduce exacerbations?

In children/adolescents and adolescents with bronchiectasis and recurrent exacerbations, we recommend treatment with long-term macrolide antibiotics to reduce exacerbations.

Remarks: We suggest long-term macrolide antibiotics only in those who have had >1 hospitalised or ≥3 non-hospitalised exacerbations in the previous 12-months. Such a course should be for at least 6-months with regular reassessment to determine whether the antibiotic continues to provide a clinical benefit.

Children/adolescents receiving longer treatment courses (>24-months) should continue to be evaluated for risk versus benefit. This suggestion is in the context of lacking data concerning when long-term azithromycin should be initiated and the need for caution because of increasing antibiotic resistance amongst bacterial pathogens within patients and the community. While non-tuberculous mycobacteria (NTM) are very rarely detected in children/adolescents with bronchiectasis, we suggest a lower airway specimen is obtained (when possible) to exclude their presence before commencing long-term macrolide antibiotics. We encourage strategies to ensure adherence to the macrolide regimen as ≥70% adherence improves efficacy and reduces antibiotic resistance.

- **Strong recommendation** (Low quality of evidence)

Evidence on benefits and harms

- Using regular macrolides reduced the number of children/adolescents experiencing any exacerbations.
- Significant increase in macrolide-resistant bacteria in the upper airways (nasopharynx) in those receiving long-term azithromycin but the total use of antibiotics for non-respiratory infections were lower, compared to placebo.
- Emergence of antibiotic resistance is a major concern for global health.

Rationale of recommendation

The efficacy of macrolides at reducing exacerbations is consistent across studies. The importance and impact of exacerbations on children and families were crucial considerations for the strong recommendation.

Implementation considerations

Azithromycin should not be used in children/adolescents with contraindications to macrolides (e.g. those with an abnormal electrocardiogram, liver function abnormality and azithromycin hypersensitivity). While an electrocardiogram is not necessary before commencing macrolides, a family history of prolonged QT syndrome, arrhythmias and acute cardiac events should be obtained and, when appropriate, an electrocardiogram ordered. Adherence ≥70% is important for efficacy as well as reducing antibiotic resistance.

Question #8: In children/adolescents with bronchiectasis, should eradication treatment be used (irrespective of symptoms) when there is a new isolate of a potentially pathogenic microorganism (compared to no eradication treatment)?

IIn children/adolescents with bronchiectasis, we suggest eradication therapy following an initial or new detection of *Pseudomonas aeruginosa*. **Remarks**: We suggest that eradication therapy should commence promptly after confirming *P. aeruginosa* is present. Due to lack of evidence, we are unable to comment on eradication treatment for pathogens other than *P. aeruginosa*, which is informed on a case by case basis according to the clinical status of the child and the pathogen type.	• **Conditional recommendation** (Very low quality of evidence)

Evidence on benefits and harms

- Eradicating *P. aeruginosa* likely improves clinical outcomes (reduction of exacerbations and slower lung function decline).
- Potential undesirable effects include drug reactions/toxicity and inducing antibiotic resistance. Requiring 2 weeks of intravenous antibiotics expose an individual to risks associated with intravenous catheterisation (e.g. line-site infections).

Rationale of recommendation

It is likely that virtually all physicians with specific expertise in paediatric bronchiectasis would undertake interventions to eradicate initial or new isolates of *P. aeruginosa* given the established association between pathogenic microorganisms and deteriorating clinical status and lung function. This recommendation above places a higher value on the theoretical benefits of eradication and patient/carer values and preferences, and a lower value on possible treatment-related adverse effects.

Implementation considerations

Eradication therapy should employ a targeted antibiotic strategy for the minimum time necessary and measures should be instituted to support full adherence to the prescribed regimen. Figure-3 (in guideline) illustrates commonly used approaches in children/adolescents by experts in the field. Antibiotic treatment should be made available in every setting where children/adolescents with bronchiectasis are managed.

Question #9: In children/adolescents with bronchiectasis, should asthma-type treatments (inhaled corticosteroids [ICS], short-acting beta$_2$-agonists [SABA], long-acting beta$_2$-agonists [LABA]), compared to no asthma-type treatment, be used routinely?

In children/adolescents with bronchiectasis, we suggest not using ICS with or without LABAs routinely in either the short or long-term, irrespective of stability or exacerbation.

Remarks: ICS maybe beneficial in those with eosinophilic airway inflammation. We suggest an objective evaluation is undertaken if asthma-type medications are considered. For some, SABAs may be beneficial as pre-airway clearance therapies.

- **Conditional recommendation** (Very low-quality of evidence stemming from narrative review of the evidence)

Evidence on benefits and harms

- Unless an asthma phenotype is concurrent, ICS with or without LABAs are not beneficial.
- Observational study evidence of increased risk of NTM infection and pneumonia in adults with bronchiectasis and other chronic respiratory diseases who received ICS.

Rationale of recommendation

Limited evidence shows a lack of efficacy for these medications. Based on the overall weight of the literature, examining the efficacy and safety of ICS in adults and in other conditions, most clinicians would be concerned about potential adverse events from ICS, alone and in combination with LABA. Data on important adverse events is supported by systematic reviews in other chronic respiratory diseases.

Implementation considerations

If treatment with ICS or ICS/LABA is contemplated, every effort should be made to document acute bronchodilator sensitivity (spirometric response to SABA), atopy (skin prick tests, specific IgE) and airway eosinophilia (peripheral blood eosinophil count, sputum eosinophils, exhaled nitric oxide). If a blind trial of ICS or ICS/LABA is contemplated, because the above tests are equivocal or unavailable, objective evidence of benefit should be obtained if the medications are continued.

Question #10: In children/adolescents with bronchiectasis, what factors should be taken into account when considering surgical removal of the diseased lung?

In children/adolescents with bronchiectasis, we recommend when considering surgery, factors to be taken into account include age, symptoms and disease burden, localisation of the bronchiectatic areas on chest CT-scans, the underlying aetiology (influencing recurrence of disease), facility where surgery is undertaken (surgical expertise and availability of pre- and post-surgical care), and optimisation of the child's clinical state.	• **Srong recommendation** (Very low-quality of evidence stemming from narrative review of the evidence)

Evidence on benefits and harms

- This was a 'usual practice statement' with no harm from careful assessment and considerations prior to undertaking surgical removal of lobes.

Rationale of recommendation

The benefits from surgery are higher in those with localised disease where complete resection can be done and when the disease is not recurrent (i.e. absence of underlying aetiology such as immunodeficiency). Careful preoperative evaluation as well as rehabilitation post-surgery improves outcome. Ideally, bronchoscopy and BAL are performed prior to surgery to exclude a foreign body and obtain microbiological samples. A ventilation-perfusion scan to delineate non-ventilated areas confirming the localised disease to plan for the surgery is likely beneficial. Optimisation of the child/adolescent's clinical state, including using appropriately targeted antibiotics, ACT and improving nutritional status pre and post-surgery is also necessary.

Usual practice statement: It is important to emphasise that surgery is rarely undertaken in the panel's experience, although we are aware that it is not uncommon in some settings. Surgery is only considered after maximal medical therapies (e.g. ACT, long-term antibiotics, etc.) have failed and the child/adolescent's QoL remains significantly impaired. When contemplated, a multidisciplinary approach is essential, and the decision should be based on the individual's clinical state and local surgical expertise.

Implementation considerations

Increasing accessibility to a multidisciplinary team with expertise in optimal preoperative evaluation and careful patient selection is recommended. Video-assisted thoracoscopic surgery, compared to open thoracotomy, is associated with fewer complications and shorter postoperative hospital stay.

Question #11: In children/adolescents with bronchiectasis, should attention be paid to other paediatric systematic care issues (nutrition, aerobic and non-aerobic exercise, psychological support, equipment care, vaccinations, etc)?

In children/adolescents with bronchiectasis, we suggest that nutrition is optimised, including Vitamin D status. **Remarks**: There is no evidence upon which to recommend additional nutritional supplements.	• **Conditional recommendation** (Very low-quality of evidence stemming from narrative review of the evidence)
IIn children/adolescents with bronchiectasis we suggest that exercise is encouraged on an ongoing basis; short periods of exercise training are unlikely to have a long-term effect. **Remarks**: There is insufficient evidence to make a recommendation for establishing formal exercise and rehabilitation programmes.	• **Conditional recommendation** (Very low-quality of evidence stemming from narrative review of the evidence)
In children/adolescents with bronchiectasis, we suggest they are fully immunised according to their national immunisation programmes, including pneumococcal and annual seasonal influenza vaccines if these are not part of this programme.	• **Conditional recommendation** (Very low-quality of evidence stemming from narrative review of the evidence)
In children/adolescents with bronchiectasis, we suggest they receive psychological support and education on equipment use and care.	• **Conditional recommendation** (Very low-quality of evidence stemming from narrative review of the evidence)

Evidence on benefits and harms

- The desirable effects of routine immunisation, exercise and physical activity, and good nutrition are undeniable, but their magnitude is uncertain.
- The positive effects of psychological support and teaching appropriate equipment use and care for children/adolescents with chronic illness are also highly desirable, but there are no data on type, duration or intensity of support or how to assist with maintaining equipment.
- Data relevant for vitamin D were limited to adult-based studies.

Rationale of recommendation

Recommendations are based upon placing a higher value on low-moderate quality of evidence for clinical improvement over a low value for concerns over uncertainty of magnitude and duration of benefit.

Implementation considerations

Increase the accessibility of children/adolescents to centres practising standard of care.

Question #12: When monitoring children/adolescents with bronchiectasis, how should cross-infection be minimised?

In children/adolescents with bronchiectasis, we suggest that they and their family are counselled on cough and hand hygiene. Wherever possible, they should also avoid those with symptoms of viral respiratory infections. Children/adolescents managed within a CF clinic must follow their infection control policies.

- **Conditional recommendation**
- Very low-quality of evidence stemming from narrative review of the evidence

Advantages and limitations

- Reducing cross-infection reduces acquisition of pathogenic microorganisms
- Limited data on magnitude of effect.

Rationale of recommendation

Recommendation were based on current standard of care in specialist settings. Also, the panel and PAG advocated for advice on avoiding cross-infection.

Implementation considerations

Standard infection control procedures should be discussed with patients/families and hand and cough hygiene measures followed. Post-writing the guidelines, the onset of the COVID-19 pandemic led local health authorities to introduce additional non-pharmacologic public health measures to interrupt virus transmission.

Question #13: In the monitoring of children with bronchiectasis, (a) how frequently should patients be seen in outpatient clinics? (b) How often should airway microbiology testing be conducted in outpatients? (c) Are there any routine tests that should be undertaken to detect complications when attending outpatient clinics?

(a) In children/adolescents with bronchiectasis, we suggest they are reviewed every 3-6 months in outpatient clinics to monitor their general wellbeing, respiratory status, including lung function when age appropriate, and to detect any complications	• **Conditional recommendation** • Very low-quality of evidence stemming from narrative review of the evidence
(b) In children/adolescents with bronchiectasis, we suggest in those able to expectorate that routine spontaneous or induced sputum samples is collected every 6-12 months as a means of identifying new pathogens, specifically *P. aeruginosa,* and to help guide initial empiric antibiotic therapy for future exacerbations.	• **Conditional recommendation** • Very low-quality of evidence stemming from narrative review of the evidence
(c) In children/adolescents with bronchiectasis, we suggest the following routine tests are undertaken to detect complications when attending outpatient clinics: (a) lung function (spirometry for FEV_1 and FVC) when age-appropriate, (b) sputum when they can expectorate and (c) pulse oximetry.	• **Conditional recommendation** • Very low-quality of evidence stemming from narrative review of the evidence

Advantages and limitations

- Current standard of care in specialist settings where optimised management leads to improved lung function post-diagnosis.
- There are no high-quality studies examining this question.

Rationale of recommendation

The benefits are based on good clinical outcomes observed in studies with outpatient clinic reviews every 3-6 months. Outpatient sputum culture surveillance every 6-12 months is based on expert opinion. The panel and PAG advocated for regular clinical care and monitoring by specialists.

Implementation considerations

The desirable frequency of outpatient clinic attendance and airway microbiology surveillance is dependent upon patient factors (e.g. age, underlying aetiology, illness severity, co-

morbidities and ability to reliably expectorate spontaneous or induced sputum) and circumstances (e.g. traveling long distances for clinic attendance).

Increase accessibility of children/adolescents to centres practising standards of care. Educate clinicians, families and patients on the role of surveillance sputum cultures in those with clinically stable bronchiectasis. As upper airway swabs are unreliable at predicting lower airway pathogens, spontaneous or induced sputum samples in children/adolescents able to expectorate are recommended for surveillance cultures. BAL is reserved for treatment failures, especially if sputum cultures are negative, and/or unusual pathogens are suspected

Question #14: In gradually deteriorating (i.e. non-acute) patients, what investigations should be undertaken?

In children/adolescents with bronchiectasis whose clinical status is gradually deteriorating, we suggest they are assessed for new infections (sputum or lower airway microbiology) and possible co-morbidities (e.g. asthma, GORD, nutritional deficiencies, dental or sleep disorders).

Remarks: These children/adolescents often require hospitalisation for intravenous antibiotics and airway clearance therapy.

- **Conditional recommendation** (Very low-quality of evidence stemming from narrative review of the evidence)

Advantages and limitations

- Indirect evidence for investigations required for gradually deteriorating patients
- The desirable interventions are patient (e.g. age, illness severity, costs of tests) and circumstance (e.g. underlying disease, patients travelling long distances) specific. Thus, desirable effects vary.

Rationale of recommendation

In standard care among paediatric respiratory clinics, when deterioration occurs, the evidence supports assessing and investigating for the treatable traits listed above. Recommendation based upon indirect evidence that the current standard of care in specialist settings leads to improved lung function post-diagnosis. Also, the panel and PAG advocated for standardised clinical care, especially in primary care settings.

Implementation considerations

Increase accessibility of children/adolescents to centres practising the recommended standard of care.

Question #15: When should repeat chest CT-scans be undertaken

In children/adolescents with bronchiectasis, we suggest the decision to repeat chest CT-scans is individualised based on the clinical status and setting. Remarks: Repeat chest CT-scans should be considered to answer a question which will change management	• **Conditional recommendation** (Very low-quality of evidence stemming from narrative review of the evidence)

Advantages and limitations

- Repeating CT scan provide more sensitive modality of assessing severity
- As CT involves radiation, harm from repeated radiation must be taken into account.

Rationale of recommendation

Specialists in tertiary paediatric respiratory clinics individualise the need to repeat the chest CT-scans.

Implementation considerations

Obtaining additional CT-scans needs to be balanced against the reported increased lifetime cancer risk, which is age and dose-dependent.

Question #16: In children/adolescents, is bronchiectasis (a) reversible and/or (b) preventable?

Good practice statement

In children/adolescents with bronchiectasis, we suggest wherever possible, interventions that reverse and/or prevent bronchiectasis are undertaken. However, these measures are context and patient specific.

Rationale

In some children/adolescents, their bronchiectasis is reversible and/or preventable. Factors important for reversibility and/or prevention of bronchiectasis include early identification and treatment of inhaled foreign bodies, preventing early and severe pneumonia, preventing recurrent protracted bacterial bronchitis (PBB), treating primary immunodeficiency disorders causing bronchiectasis, promoting breastfeeding and immunisation, and avoiding tobacco smoke and other pollutants.

Implementation considerations

Access and strategies to improve early diagnosis and interventions to prevent and/or reverse bronchiectasis are required.