United Bristol Healthcare NHS
NHS Trust

Bristol Paediatric Cystic Fibrosis Guidelines

Bristol Paediatric Regional CF Service

2007

1st edition

www.bristolpaedresp.org.uk

These guidelines were edited by Tom Hilliard, with individual sections written by the paediatric CF team and other consultants within the Children's Hospital. Contributors include Christine Burren, James Bursell, Liz Crowne, June Dyer, Charlotte Hayward, Jane Heraghty, Tom Hilliard, Laura Hole, David Hopkins, Claire Langton Hewer, Simon Langton Hewer, Kate Lindsay, Helen McGowan, Charlotte Mellor, Yvonne Nicholls, Doreen Russell, Jane Smith, Chris Spray, Huw Thomas, Trina Young, Martin Williams and Kathy Wedlock.

These guidelines are not extensively referenced; this is intentional as their aim is to present our current practice. They are based on the best evidence where it is available. These guidelines may be useful to other centres in the area, but we accept that sometimes there are different ways of doing things and that practice may vary.

If you have any comments or questions regarding these guidelines, please contact me on tom.hilliard@ubht.nhs.uk.

We plan to update these guidelines in 2010.

They are available on line at www.bristolpaedresp.org.uk where you can also find further information about our service.

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2. The Paediatric CF Service

2.1 Clinics

Our aim at out-patient review is to provide access for our patients and their families to the whole CF team in as efficient manner as possible. Our main clinic is held on Thursday mornings. We run a segregated clinic in which patients come into a room and stay there until they have been seen by all the relevant members of the team. In November 2007 we moved to having slots of one hour appointments until 12pm, followed by emergency slots. We have two separate clinic streams: the 'blue' clinic is for patients with chronic *Pseudomonas aeruginosa* infection and the 'red' clinic is for those children without chronic *Pseudomonas aeruginosa* infection, as per the criteria below. Clinic status should be considered at each clinic review and at annual review.

Blue clinic: chronic *Pseudomonas aeruginosa* infection, i.e. 2 or more isolates in the previous 6 months, separated by at least one month and despite appropriate treatment, or a significantly raised Pseudomonas antibody titre in a child who does not produce reliable sputum cultures.

Red clinic: intermittent *Pseudomonas aeruginosa* infection (less than 2 isolates in previous 6 months), or previous *Pseudomonas aeruginosa* infection, or no prior *Pseudomonas aeruginosa* infection.

Moving from Blue to Red: no isolation of *Pseudomonas aeruginosa* for 2 years, normal Pseudomonas antibody titres and no longer on inhaled Colomycin.

After booking in at the main desk patients are allocated an individual clinic room where they remain for the duration of the visit. Each team member will carry out their review in the individual patient rooms. When the patient has completed their visit, the room and equipment will be cleaned and left free for as long as possible before the next patient is allocated the room. Respiratory function testing is performed in a separate area. Single use bacteria filters are used and the equipment should be thoroughly cleaned between each patient. We also see patients who have isolated MRSA or the *Burkholderia cepacia* complex in the Blue clinic, ideally at the 12pm appointment. These patients should use separate equipment in their own room or perform their PFTs at the end of the clinic after the other patients. All staff should wash their hands appropriately and clean any equipment between all patients. We use a clinic proforma (Appendix 12.1) to document the outpatient review. There are in addition two 90 minute appointments for annual review on each Thursday morning. We discuss all patients seen in clinic that week at the Thursday multidisciplinary meeting. We follow our patients up in clinic at approximately 2 monthly intervals.

Nurse Led Clinic

The Nurse-Led clinic on Wednesday afternoons is an alternative to the medical clinic and has been an established part of our service since 2003. Patients are not specifically selected by age or microbiological status but tend to be those whose condition is relatively stable. Once seen in the Nurse-Led clinic, patients are referred back to the medical clinic for their next appointment. All patients will have a consultation with a Senior CF CNS, spirometry and other routine clinic investigations. Patients will also be seen by a CF physiotherapist. Medications are prescribed by a registered non-medical prescriber. Patients may also be seen by a senior CF CNS in the Thursday morning medical CF clinic.

Emergency appointments
We also run a drop-in emergency clinic on Tuesday mornings, where patients are often seen by the specialist registrars, supervised by the respiratory consultant on service that week. Families can make emergency appointments to this clinic by contacting the CF nursing team. There is also an emergency slot at the end of the Thursday clinic, but we also see children if necessary on any day. Out of normal hours, emergency medical cover should be accessed through the Children's Emergency Department.

2.2 Home care nursing

A community service is available to all patients and families who receive their primary care in Bristol. This is provided by a team of CF Nurse Specialists, physiotherapists and the social worker based at the CF centre. The philosophy of the team is to allow families to lead as normal life as possible with minimal interruption to the child's education, family and social life. We aim to reduce hospital attendance and in patient stays whenever possible and safe to do so.

Priority for home visits is given to patients with advanced or complex disease, those receiving home IV therapy and newly diagnosed patients. The team are able to provide a wide range of assessment, clinical, monitoring, investigative, educational and supportive skills in the home. They work closely with agencies such as schools, education authorities and social services as well as Health Visitors, GP's and other community based healthcare professionals to achieve a seamless service.

Referrals can be made directly to the team (see contacts list). The service operates between 9am and 5pm, Monday to Friday, although pre and post school visits can often be accommodated. Week-end and out of hours visits are by strict arrangement with the Lead Nurse and are generally reserved for patients with end-stage disease or palliative care.

2.3 Home intravenous antibiotics

Over half of all IV antibiotics given are carried out at home by parents, carers or the patients themselves. Families clearly benefit from avoiding the disruption that hospital stays incur to social and family life. The child may be able to continue with their education, the parents with employment and siblings with normal family life. Often, children eat and sleep better at home and can have their family and friends around them. A balance must be made between opportunity for normal activity and optimising the treatment with adequate rest, nutrition, physiotherapy and careful monitoring. However not all patients are suitable for home IVABs either for clinical or social reasons and some are unable to cope with the increased burden of care. Carers must not be pressurised into taking on this task either by staff or the child. Family circumstances change and even those who routinely do home IVABs may on occasions prefer inpatient care and support.

In assessing patient suitability for home IVABs the primary aim is for an outcome equivalent or better than that achieved as an in-patient. **Home IVABs must never be sub-optimal management or merely a method of releasing hospital beds**.

Families who wish to learn how to prepare and administer IVABs at home must be referred to the CF Nurse Specialist Team who will have an in-depth knowledge of the family situation and can advise on suitability. Families must have access to a telephone,

transport and be within reasonable travelling distance to the CF Centre or an approved local clinic. They will be required to complete a formal teaching package and demonstrate both competence and confidence in carrying out IVABs safely. Prior to discharge, the CF Nurse Specialists will organise drugs, equipment, written individualised instructions and follow-up monitoring / care. Patients must not be discharged to complete IVABs at home without prior consultation with the CF Nurse Specialist Team. All families' skills are reassessed on a regular basis.

Families who have already completed the teaching package and are familiar with home IVABs may have elective courses booked in advance. These are organised by the CF Nurse Specialists and patients are booked to commence their course on CIU on Tuesday mornings. The first dose of antibiotics is given in the hospital. All patients receiving home IVABs will have the following:

- Port accessed or peripherally inserted central catheter (PICC) inserted
- Port needles and bionnectors changed weekly
- Sputum or cough swab at beginning & end of course
- FBC, LFTs, U&Es, CRP at beginning, middle & end of course as indicated
- Spirometry at beginning, middle & end course
- Weight at beginning, (middle) & end of course
- Aminoglycoside trough levels prior to second dose and weekly thereafter
- Assessment of progress at home by CF Nurse Specialists and physiotherapists
- An individualised plan of care
- Contact numbers for support and advice at any time
- Clinic appointment within 1 month of completion

Families wishing to undertake home IVABs need to complete a package of training with a CF physiotherapist prior to authorising home treatment, including evaluation of symptoms e.g. wheeze, cough, volume and colour of secretions

For patients undertaking home IVABs:

- Patients will be assessed by a physiotherapist when attending CIU at the start of treatment and advised on a daily plan of physiotherapy
- Home visits for treatment and assessment will be scheduled as frequently as required and maybe adjusted in the light of changing clinical condition
- Pulmonary function testing will be performed at the start and end of the course
- SpO_2 will be recorded at the start and end of IVABs
- Close liaison with the medical and nursing staff will be maintained in order to discuss progress and amend the treatment regimen as necessary

It is essential that all patients on home IVABs are available for follow-up at home by the nursing and physiotherapy teams.

2.4 Home physiotherapy

All specialist centre patients with CF will automatically fall within the care of the specialist CF physiotherapists. Parents and older children will be encouraged to maintain close contact with the CF physiotherapy team to enable a responsive and proactive service. If parents or patients feel symptoms have deteriorated, they will be encouraged to request a home review. Home review will be available from Monday to Friday, based around time

commitments to clinics. Assessment of respiratory symptoms may include auscultation of the chest, oxygen saturation, pulmonary function tests and collection of sputum samples or cough swabs.

In addition, further assessment of musculoskeletal, postural and incontinence problems are available, with referral on to appropriate services as necessary. Specialist CF physiotherapists have an in-depth knowledge of CF and work closely with all professionals within the CF multidisciplinary team to offer educational information and emotional support. Patients on home IV ABs, on a pseudomonas eradication programme, newly diagnosed, on additional oral antibiotics or with increased sputum production will be prioritised for community review.

On-going development of physiotherapy techniques and the treatment skills required by parents and children will largely be done via home visits. Further assessment and development of skills will be evaluated within hospital and clinics.

Patients who are terminally ill will have every opportunity to have their care at home if they so wish. Physiotherapy will be adapted in accordance with their needs and in respect of their wishes. Out of hours and weekend support can be arranged if required.

2.5 Social work support

The social worker is able to provide non medical support for all patients who attend the centre for their ongoing treatment and healthcare needs. Contact with the Social Work service can be made either independently or as a referral from any member of the CF team.

Appointments can be flexible to fit in with people's commitments and lifestyles. These can be arranged to coincide with either an outpatient visit or during an inpatient stay. Some people prefer to see the social worker in the privacy of their own home.

The social worker can offer practical help and support covering a wide variety of issues. This can include provision of information and advice on health and housing issues. If required the social worker is able to provide a liaison role with housing providers and associated agencies. Similarly, support is available regarding employment and education issues. Help can be given when applying for health related and social benefits and advice on any welfare grants that may be available.

The CF social worker has a working knowledge of the complex system of benefits and allowances. Any benefit applied for is treated on an individual basis as personal circumstances, income or the impact of living with cystic fibrosis is different from person to person. (See Appendix 12.2).

In addition to the practical help and advice on offer the social worker is able to offer time for confidential listening on any aspects of daily living that is affected by cystic fibrosis. This may include family and partner relationships, leaving the family home to live independently, setting up your own home and having children. Coping with changes in health, including deteriorating health is always challenging and having the opportunity to talk to someone in confidence that is not directly involved with the clinical decisions of treatment, may be helpful (see Appendix 12.3 for useful contacts).

2.6 Psychological support

It is well recognised that cystic fibrosis not only has clinical manifestations, but can have an emotional and psychological impact on the whole family. It is important that patients and families receive the support they need through education, listening skills, discussion and counselling. Much of this is addressed from diagnosis onwards through regular support by the CF Nurse Specialists both within the hospital and home settings. In addition, a psychologist was appointed to the team in late 2007 and will be able to give more in depth support to help families with specific needs.
There are often 'key stages' in cystic fibrosis when families feel most in need of emotional and psychological support. These might include:

- Diagnosis
- 'New events' in CF – such as first acquisition of new respiratory bacteria, first hospital stay, intravenous antibiotics
- Key social changes such as starting or moving schools
- Specific fears or anxieties such as needle-phobia
- Deteriorating health
- Balancing health needs with family life, education or social activities

2.7 Patient information

There is a wealth of patient and carer information about the aetiology and treatment of cystic fibrosis. The aim is to ensure that families have all the information they require to understand CF and to make good, informed decisions about any options of care their child may be offered.

CF is a multi system disease, affecting patients to widely varying degrees. Not all patients will experience all aspects or complications of the disease at any one age. Therefore, it is essential that information given is appropriate to the individual and at a level that is relevant and easily understood. Unwanted or irrelevant information can cause undue stress and worry. Information given to a child must be age appropriate. Whenever written information is given, opportunity for discussion with a member of the CF team must also be offered.

Families need to be aware that many of the internet sites offering information are not regulated and information may be inaccurate or biased. Likewise, many books found in libraries are out of date to current practice. Families who collect information or advice from other sources are strongly advised to discuss it with the CF team for accuracy and relevance to their child's disease status.

A range of patient information compiled by the CF team, from the CF Trust and other useful sources can be obtained from the CF office, outpatient department and our departmental web site.

2.8 Annual review

Annual review provides for a complete and holistic review of a patient's progress while giving an opportunity to perform screening investigations. We perform annual reviews during the Thursday morning clinic so that there is access to the whole team, although

some parts of the team may perform their part of the review at other times close to the main review. Annual review appointments are for 90 minutes on Thursday mornings; appointments should be planned well ahead and are often around the patient's birthday. It consists of the following parts:

- Medical review using annual review proforma (Appendix 12.4)
- Discussion of transition when appropriate
- Dietetic review (diet record sent out in advance)
- Physiotherapy review (some children may have an exercise test)
- Nursing review

We perform the following screening investigations:

- Chest X-Ray
- Surveillance culture including culture for non-tuberculous mycobacteria
- Full blood count
- Coagulation screen
- Electrolytes, creatinine, liver function tests (including γGT), CRP
- Random glucose & HbA_1c
- Vitamin A, D & E, Zinc
- Total IgE, RAST to Aspergillus, Aspergillus precipitins
- *Pseudomonas* serology (sent to HPA, Colindale, London)

There are labels for annual review blood tests in outpatients or in the respiratory office (see 4.3 for details of amounts of blood needed).

And in selected patients:

- Hearing test (if intravenous antibiotics in previous year)
- Upper abdominal ultrasound (if hepatomegaly (or splenomegaly) or persistent rise in liver function tests, or on annual basis if previous CF liver disease)
- Oral glucose tolerance test **in those 13 years and above**, and at any age if there is weight loss/poor weight gain, osmotic symptoms, or generally not doing well; however an OGTT should be performed at any time through the year if any of these problems are present
- Home overnight oximetry study

OGTT is performed with 1.75 g/kg of glucose up to a maximum of 75g, diluted in water (200-300mls).
With Lucozade "original" (17.9g per 100mls), use 9.2 ml/kg up to maximum of 394 mls.
With Polycal (66.4g per 100mls), use 2.6ml/kg up to maximum of 113mls.

Data is entered onto our annual review database and the whole review is presented to the team within the next month at the Thursday meeting. A report is generated from the database and this is sent to the family and GP. Suggestions or changes in therapy should be discussed with the family directly after the review meeting or at the next clinic appointment.

2.9 Transition and transfer to adult services

Transition is a relatively new concept which has come about as a result of improved treatments being available to manage previously life-threatening conditions that were once considered the domain of paediatric services. As the life expectancy of these patients is now well into adulthood they require age appropriate services within adult medicine to address their healthcare needs.

Transition is the unique process by which we give our patients the opportunity to prepare for the responsibilities of the adult patient. The process begins in the paediatric clinic and continues well into adult care. Transition should not be confused with transfer which is the actual date of handover from children's to adult services. The process is adapted to meet the individual needs of the patient taking into account their developmental stage and health status. A flexible approach must be taken in relation to timing.

At the age of 13 years all patients will be introduced to the idea of transition (this will occur earlier if we feel appropriate) and will receive a Transition Book. This provides a guide to be used by staff and families to identify the level of understanding the adolescent has in relation to CF, how it affects their health and lifestyle and how to manage it. It aims to encourage open communication and engage patients in decision making, self management and responsibility for their own health. Once the child's knowledge base in each area has been identified then further teaching, education and support can be targeted to their needs. We expect patients and families to bring the document with them to clinics so we can gradually work through all the important aspects.

Increasingly the patient will be encouraged to take over more of the responsibility for their health than has previously been the case. This will be done by offering the patient the opportunity to spend a part of the consultation in clinics without their parents/carers present. The patient will be encouraged to learn the names and dosages of all their treatment as well as the reasons that they are on these treatments. Direct discussion will take place with the CF team about why they are taking the treatment and the reasons for continuing with it, as appropriate.

During transition, patients will receive shared care from the adult and children's nursing, physio and dietetic teams; gradually phasing in new staff and services whilst retaining familiarity with the paediatric team. The year leading to transfer patients will have the opportunity to attend two adolescent clinics set three months apart. This is to finalise the handover between the medical teams. During this process a transfer date will be agreed (when deciding dates for transfer other life events will be considered). We aim for this approach to provide a comfortable and well planned transition into adult care and seamless CF service. The date of transfer of care from Paediatric to Adult Services will be between their 16th birthday and 18th birthday. This date will be made with the individual adolescent once they have been seen in the adolescent clinic, met the key members of the adult team and have been on a guided tour of the adult inpatient and outpatient facility. All other associated issues should be included within a unified transition and transfer, including care of diabetes, gastroenterology, endocrinology etc.

We will ask for feedback during and after transition to allow the individual patient to indicate how successfully it has been undertaken and allow both CF teams (adult and paediatric) to continually improve the process.

2.10 Shared care

Bristol operates as a part of a hub and spoke model of shared care as favoured by the UK Cystic Fibrosis Trust. Within this model, Bristol operates as the hub and is able to offer the full range of CF care to patients. There are approximately 80 children that receive full CF care in Bristol and approximately another 80 that receive their care in Bath, Cheltenham, Gloucester and Taunton. Shared care clinics have been established in each of these clinics, Dr Tom Hilliard performing clinics in Cheltenham (with Dr Alan Day) and Gloucester (with Dr Mike Webb) and Dr Simon Langton Hewer attending clinics in Bath (with Dr Jenny Tyrrell) and Taunton (with Dr Sarah Bridges). Each patient is seen at least once a year by the Bristol team as well as their local team. Complications as they arise will be dealt with by the local team, often in discussion with the Bristol team as necessary (e.g. for consideration of CT scanning or bronchoscopy). Annual reviews are mostly performed in patients' local clinics. All clinics comply with the UK CF Trust Standards of Care 2001 document.

All patients in the South West have data recorded on an annual basis on the South West CF database (held in Bath). From 2008 all patients should also be entered onto the CF Registry (held by the CF Trust) each year.

3. The diagnosis

3.1 Clinical presentation

Neonatal presentation: babies may present within the first few days of life with meconium ileus. This will cause abdominal distension and vomiting and will usually necessitate neonatal fluid resuscitation before transfer to a regional neonatal surgical unit.

Presentation in an infant or young child: suspicion of a possible diagnosis of cystic fibrosis should arise in a young child who presents with failure to thrive especially where this is associated with frequent or recurrent respiratory infections and possible malabsorption. Many infants and young children have cough and wheeze with recurrent viral infections.

Presentation in an older child or adult: it is unusual to make a new diagnosis of CF in an older child or adult, though the features described above may be present. If so, suspicion of CF would be raised even higher if the child also has finger clubbing, liver disease or chest infections with pathogenic bacterial infections known to be associated with cystic fibrosis (e.g. *Staphylococcus aureus* and *Pseudomonas aeruginosa*). Symptoms would include a persistent and fruity cough, particularly present in the mornings and associated with production of (often green) phlegm, breathlessness particularly with exertion, or foul and floaty stools. Unusually young adults have presented with features of recurrent pancreatitis and males under investigation for infertility where the diagnosis has turned out to be CF. These individuals may have little or no history of respiratory or gastro-intestinal symptoms, may have an otherwise normal physical examination.

Making the diagnosis

The diagnosis of CF will be usually made by a sweat test. These are performed in Bristol by Dr Janet Stone or Dr Ann Bowden (extension 2590 or bleep 2598). When a positive sweat test is returned, the parents will usually be asked to return to the hospital for a repeat sweat test. They will usually be asked to come together to the CIU and to be available later the same day to meet the on call respiratory consultant with one of the CF nurse specialists if the positive result is confirmed. The diagnosis will usually be given to both parents by the consultant and nurse specialist. If they have not already been done, consideration should be given to doing the following additional tests:

Blood tests	Full blood count & film; clotting screen; U&Es; liver function tests
	Fat soluble vitamins (A, D and E); Pseudomonas antibodies
	CF mutation analysis
Chest X-ray	
Stool tests	Elastase (to confirm presence of pancreatic insufficiency)
	Fat globules

Sputum or cough swab sample to be sent for culture

3.2 Sweat testing

Sweating is induced locally by iontophoresis of a weak solution of pilocarpine on the flexor surface of the arm (or on the back in small babies) using the EMS sweat test unit. A pad of sufficient thickness must be used between the electrode and the surface of the skin to prevent acid liberated at the electrodes from making contact with the skin of the

patient to prevent any skin burns. The area of skin selected for the sweat test must be free from any lesions.
The site is cleaned with methylated spirits and deionised water leaving the skin slightly moist. A current of 4mA is passed through the skin for 5 minutes. The stimulated area is then washed with deionised water and dried. A piece of preweighed filter paper is placed over the stimulated area using forceps. This is covered with polythene and sealed with waterproof tape. Sweat is collected on to the filter paper for a minimum of 30 minutes. The dressing is then removed and the filter paper transported to the laboratory. The bag containing the filter paper is reweighed as soon as possible after collection. The sweat is eluted from the filter paper and the sodium and chloride content determined.
For information for parents, see Appendix 12.5.

Interpretation of the results
The minimum sweat weight recommended for accurate analysis is 71mg. However sweat weights of > 50mg have been shown to give reproducible results.

Sweat Sodium	< 45 mmol/l	Normal
Sweat Chloride	< 45 mmol/l	Normal
Sweat Sodium	45 - 60 mmol/l	Borderline
Sweat Chloride	45 - 60 mmol/l	Borderline
Sweat Sodium	> 60 mmol/l	Abnormal
Sweat Chloride	> 60 mmol/l	Abnormal

Sweat test results are considered to be abnormal if the following criteria are met:
1. Sweat sodium and chloride are both > 60 mmol/l
2. Sweat chloride > sweat sodium
3. Sweat sodium + sweat chloride > 120
4. If either sweat sodium or sweat chloride ≥ 45 mmol/l results are considered to be equivocal

The sweat test should be repeated in full if :
- the interpretation of the results is equivocal
- the first test results are unequivocally abnormal

References are in the national sweat test guidelines endorsed by the Royal College of Paediatrics in November 2003.

Measurement of nasal potential difference
The active transport of charged ions across electrically tight respiratory epithelia results in a voltage or potential difference. This potential is negative as the principal ion transport of the airway is the absorption of Na^+. In CF there is hyperabsortion of Na^+ and impermeability of Cl^- which leads to a higher negative baseline potential difference than is seen in non-CF respiratory epithelia.

Measurement of the nasal potential difference is a simple procedure which is well tolerated by adolescent and adult patients. A reference electrode is sited on the patients forearm after the removal of epidermal surface at the selected site. The electrode is filled with diluted electrode gel. The measurement electrode is sited in a catheter filled with

diluted electrode gel. The electrodes are connected to a voltmeter and the catheter is passed into the nose. As the catheter is advanced into the nose the potential difference rises, falls and rises again to a maximum value between 15 and 20mm into the nose. In patients with CF the maximum appears to be further back than in normal subjects.

Two measurements are made from each nostril and the mean PD for each nostril calculated.

Reference range:

Normal subjects	nasal PD	-2mV	−	-25mV
CF patients	nasal PD	-30mV	−	-60mV

Measurement of PD may help in confirming or refuting the diagnosis of CF in patients who have otherwise equivocal investigations. We can perform baseline PD only in Bristol. For patients in which there is significant doubt about diagnosis, we would consider referring to Jane Davies at the Royal Brompton Hospital, PD measurement including perfusion protocol.

3.3 Genetic analysis

Cystic fibrosis is a genetic condition following an autosomal recessive pattern of inheritance. Once a positive sweat test has been found blood will usually be sent to the Genetics Laboratory at Southmead Hospital. An initial screen of the 29 commonest genes will be performed and results are usually available within two weeks. It is advisable to contact the laboratory in advance and to avoid sending samples at the weekend. Samples from the parents should also be sent to index the family and particularly if two different gene mutations are present. If the initial screen does not reveal two mutations, consideration should be given to requesting full genotype analysis. This can be performed by the Regional Genetics Laboratory in Exeter (via the Southmead Genetics laboratory). An alternative is Ambry Genetics, a commercial laboratory based in California (http://www.ambrygen.com/). The cost of this test is approximately £600 (2007 prices) and the test takes approximately 4 weeks.

3.4 Sibling and family testing for CF status

Once a child has been diagnosed as having cystic fibrosis, the family will be given counselling and advice concerning the genetic implications to the rest of the family. Siblings of an affected child (and the same parents) have a one in four chance of CF themselves and should be sweat tested to exclude the condition. Even ‘well’ older siblings have been found to have cystic fibrosis on sweat testing. Unaffected siblings also have a 2/3 chance of being carriers. Carrier status is not routinely tested in childhood as it infringes the child’s right to choose in adulthood. It is important that teenage siblings are aware of the implications of being a carrier of the CF gene and that their status can be investigated if they wish when they become of age. Exceptions to this may occur when routine sweat testing is equivocal and genetic analysis may help confirm or exclude diagnosis.

Risk of CF carrier status or having an affected child can be calculated for the extended family and where appropriate, genetic analysis obtained. This should be done by the GP with referral to the department of Clinical Genetics at St Michael’s Hospital.

Parents of a CF child have a 1 in 4 chance of any further children being affected at each pregnancy. Counselling is available through the CF team or by referral to the Genetic Service. Pre-implantation diagnosis involves obtaining sperm and ova from the parents for IVF, testing for CF status and implanting unaffected embryos into the mother. This is only possible where parental genetic mutations are known, is not currently available in Bristol but may be available at the Hammersmith. It is unlikely to be offered as NHS treatment. The procedure is expensive and carries the same traumas and success rate as IVF treatment for infertility.

Parents of a CF child with fully informative gene analysis can be offered CVS testing to determine CF status during subsequent pregnancies. This is usually done at around 11 weeks and can offer the option for termination of an affected foetus if the parents wish. The procedure carries approximately a 2% risk of spontaneous miscarriage which should be taken into account. Pre-natal diagnosis can also be made through amniocentesis, but this procedure is normally not available until 16-18 weeks of pregnancy.

3.5 Newborn screening and diagnosis

Since 2007 the whole of the UK has been participating in a newborn screening programme for CF. This takes the form of testing blood spots from the Guthrie card taken at approximately 5 days of age alongside other screened conditions (currently hypothyroidism, phenylketonuria and haemoglobinopathies, with MCAD deficiency due to be added in 2009). Details of the national screening protocol that is followed for babies born in the South West can be found at the website http://www.newbornscreening-bloodspot.org.uk/. This website gives provides details of the screening algorithm used as well as resources such as information leaflets for parents.

If the Screening Laboratory (based at Southmead for the whole of SW England) finds a positive screening test for a baby living in the area covered by the South West Network, the result will be sent by telephone and fax to the main phone and fax in the Respiratory Office at BCH. The result should be given immediately to the attending respiratory consultant who has the responsibility to confirm to the laboratory that they have seen the result. The attending consultant will then be responsible for coordinating the CF Nurse Specialists in communicating with the GP and Health Visitor of the child and of seeing the child and family, usually the morning after the family are seen by the HV. The HV will explain to the family that CF is a possibility and that both parents (as appropriate) should be seen the following day at BCH at a time a place already arranged with the attending consultant. When the family attend BCH, the diagnosis will be given and explained by the attending consultant with one of the CF Nurse Specialists. The nature of the positive result should be explained, as well as an outline of the implications of the diagnosis. This should cover:

- Positive aspects of picking up the diagnosis before the baby has developed symptoms
- Greater than usual likelihood of developing respiratory infections and that these will be combated by using prophylactic and intermittent antibiotics, usually delivered orally (and on occasion by IV route), and physiotherapy
- Problems with the pancreas that will be countered with enzyme supplements
- That the family will receive help and advice from the CF team including the CF dietician regarding the correct enzyme dose and nutrition

- That the CF team will monitor closely the health of the baby and, later, child to optimise health at all times
- That the baby will grow to be able to attend normal school and activities with minimal restrictions caused by CF
- Giving the family contact names and telephone numbers for the CF team
- Information the CF is an autosomal recessive condition and the implications of this for other children of the parents and of the increased risk of their siblings also being carriers of one of the CF genes.

Whilst remaining truthful at all times, the families' questions need to be addressed in full. A positive attitude to CF should be maintained at all times.

Investigations for children diagnosed by screening

- A sweat test should be organised at some stage within the first 3 months but does not need to be done urgently in a child with two CF mutations
- If both genes have not been identified, consideration should be given to requesting an urgent sweat test and further genetic analysis
- A stool sample should be collected for measurement of faecal elastase to document and confirm pancreatic insufficiency
- A cough swab should be performed and then repeated at least once every 8-9 weeks or whenever the child has increased respiratory symptoms
- Both parents should be offered genetic analysis of their own blood to confirm the gene that each parent carries and should be offered referral to Genetic Counselling (based in Dept of Clinical Genetics, St Michael's Hospital)

Initial treatment in babies diagnosed by screening

- Creon should be started immediately and the family shown the correct way to give Creon and the correct dosage to use
- Over the next few days (and once the family have managed to learn to give Creon) the child should start vitamins and flucloxacillin. All of these should be established within 7 days of the diagnosis being given
- Physiotherapy will be introduced soon after diagnosis. Close support and monitoring will allow development of skills as appropriate

Follow up arrangements of newly diagnosed babies and children

- An unwell child should be admitted to hospital at the time the diagnosis is made
- Over the first few weeks after the diagnosis is made, contact with the family should be made at least once a week by a member of the CF team, either by telephone or home visit. Clinical problems should be discussed with the attending consultant or in the CF team meetings
- Where possible, the next consultant review should be performed in the family home at approximately 6-8 weeks after the diagnosis has been made
- Follow up should then continue in the CF clinic with routine monitoring appointments made approximately every 8-9 weeks

4. Admission to hospital

4.1 Reasons for admission

These can be categorised as follows:

- for in-patient therapy for a pulmonary exacerbation which has not responded to oral antibiotic therapy
- for a severe pulmonary exacerbation requiring urgent admission
- elective regular in-patient therapy
- semi-elective admission for flexible bronchoscopy to look for occult infection
- admission for other procedure, e.g. elective surgery

4.2 Admission process

Admission is either arranged through the clinical site team (bleep 2942) if urgent or through the admissions office. Semi-urgent admissions need to be checked on a daily basis to ensure the patients remain on the admissions list. All patients need a cubicle for admission, ideally en-suite toilets. Prior to the admission as much paperwork should be done as possible in case the admission is outside normal hours (see admission proforma in Appendix 12.6). Antibiotic regimes should be discussed with the attending consultant and microbiology if necessary.

4.3 Clinical measurements and investigations

These are tailored to each child's clinical picture, but the following are routine:
Weight and height (and plotted on growth chart). Weight repeated at least weekly.
Cough swab/Sputum sample with results recorded on the 'microbiology' record. Repeat during admission and ensure results chased, recorded and discussed with the team.
Pulmonary Function Tests (if old enough). PFTs repeated at least weekly.
SpO_2 performed as spot measurement, with overnight oximetry if these are low.
Admission Bloods can be performed when the port is accessed or cannula/long-line inserted. If the child's annual review is due soon you can take the additional bloods at the same time. There are labels for annual review blood tests in outpatients or in the respiratory office. Never use veins in the antecubital fossa taking blood.

Routine tests	**Bottle**	**Volume**
Full blood count	EDTA (purple/red)	0.5ml
Urea and electrolytes Liver function tests (incl γGT) & CRP Total IgE	Yellow	3mls
Annual review bloods		
Full blood count	EDTA (purple/red)	0.5ml
HbA1c	EDTA	0.5ml
Clotting profile	Blue	1.3mls
Urea and electrolytes Liver function tests (incl γGT) & CRP Total IgE	Yellow	3mls
Vitamins A,D & E	Yellow	1ml
Aspergillus RAST & IgG precipitins	Yellow	1ml
Pseudomonas Antibodies	Yellow (separate form)	1ml
Zinc	Trace Elements (navy blue)	1ml
Glucose	Grey	0.5ml

Aminoglycoside levels are usually done before the second dose and at least weekly (see formulary). It may be necessary to arrange this in advance with microbiology if they are required at weekends or Bank Holidays.
Urea, electrolytes & LFTs should be repeated at least weekly; they may need to be done more often depending on the combination of antibiotics administered.

4.4 Process during stay

Peripherally inserted central catheters (PICC or long lines)
You should always consider inserting a long line at the start of the admission as this can usually last the duration of the admission and avoid multiple cannulations. **However they should only be placed under experienced supervision; multiple attempts at long line insertion must be avoided.** Older children may only require Ametop/Emla before long line insertion. Younger children may need oral sedation for line insertion. Sometimes general anaesthesia is required (discuss the availability of theatre slots with the theatre coordinator on Bleep 2025 and the on-call anaesthetist). If a child is to have a GA, consider whether a flexible bronchoscopy and / or physiotherapy under might be useful.

Equipment

- Vygon 3F PICC line (occasionally 2F in infants)
- Sterile gauze swabs
- Sterile gloves
- Non-toothed forceps (plastic disposable type)
- Sterile scissors
- Clear sterile dressing (e.g. large IV 3000)
- 10mls Normal Saline
- 10ml Syringe (second syringe if bloods to be taken)
- Green needle
- Appropriate bung
- Steri-strips
- Bandage
- 2ml of Hepsal (100u/ml)
- Tourniquet (or assistant holding)
- Cleaning solution (e.g. Chlorhexidine 0.5%)

You should ideally apply the local anaesthetic cream after inspecting the veins yourself. The best veins are usually in the antecubital fossa; lines rarely feed from the hand, and the long saphenous vein is not usually appropriate for mobile children. The length of the line required from insertion point to the mid sternum should be measured before starting the procedure.

Prepare all the equipment in advance and flush the line with normal saline. Once the patient is ready, clean the skin, apply the tourniquet and cover the area with the sterile sheet. Once you have placed the introducer in the vein (you can take blood at this point), remove the needle, loosen the tourniquet and insert the catheter to the appropriate length. If obstruction is encountered it may help to stroke the vein at the site of obstruction, or try moving the arm at the shoulder or elbow, or advance the line while flushing it. Once the line is fully in place it should flush easily. Remove the introducer, clean the skin again and place a small section of gauze underneath the wings of the line, securing everything with Steri-strips. Place a large clear adhesive dressing over the insertion point and remaining

line. Put an appropriate bung to the end of the line and finally flush again with Hepsal (write this up for flushing after each antibiotic). Cover the area with a bandage. We don't usually X-ray lines in older children when the lines has been inserted easily, but X-ray young children (e.g. toddlers) to ensure the line has not gone up into the neck, or when there has been any obstruction when the line has been inserted.

Ward rounds and meetings

The respiratory team will see patients each day Monday to Friday, with formal consultant ward rounds on Mondays and Fridays; the consultant on service that week will also see patients on the ward in between as necessary. All cases will be discussed in the multidisciplinary meeting on Mondays (the notes need to be brought to the office on Monday morning); each patient should be presented at this meeting by the juniors with a brief resume of their condition and on going problems. Further discussion may take place at the team meeting at Thursday lunchtime, particularly with respect to microbiological issues.

4.5 Inpatient physiotherapy

Patients admitted for intravenous antibiotic therapy, surgery or other reasons will automatically have a package of physiotherapy as part of their hospital stay, as follows:

- Number and type of treatments offered will depend on age, stage of disease and severity of current symptoms
- Mon-Fri treatment will usually be twice per day - airways clearance techniques and where possible exercise
- Hydrotherapy may be scheduled for the day of needle change
- Assessment of posture, exercise tolerance, orthopaedic or rheumatological will be undertaken if necessary
- Weekend and 'out of hours' physiotherapy treatment plan will be developed in conjunction with the patient, parents and ward staff
- ACT will be reviewed, revised and modified as necessary whilst an in patient
- Initiation of nebulised treatments will require liaison with the physiotherapists to provide necessary equipment
- Families who express a wish to train for administration of home IVs will need to complete a training package with the physiotherapy team
- Patients who are scheduled for bronchoscopy or other theatre procedures may benefit from physiotherapy whilst under GA. The physiotherapist must be informed in advance to schedule treatment in theatre and collection of microbiological samples

4.6 Infection control for inpatients

The potential for cross infection between patients is considered very carefully by the team. Every effort is made to minimise the risk in both the inpatient and outpatient environments.

To minimise the risk of cross infection between patients with CF and those with other susceptible illnesses (e.g. oncology patients) each patient should be allocated a single cubicle. Ideally this should have bathroom facilities, if this is not achievable then bathrooms should not be shared by CF patients. Patients should not enter and spend time in each others cubicles and should not mix in communal areas of the ward. Ward staff

should endeavour to ensure communal areas are shared fairly allowing each patient allocated time if required.

Facilities such as the Playroom, School room and Radio Lollipop are essential resources that allow patients to participate in educational and fun activities. This is particularly important as most treatment courses are for a minimum of two weeks. As with the communal areas on the ward they should not be used by more than one patient at the same time. Staff working in these areas need to ensure time is allocated separately amongst patients who wish to use these facilities.

4.7 Care pathways and patient profiles

Care pathways have been devised to support and guide the medical, nursing and allied health professionals who care for children with cystic fibrosis within the hospital or community settings. These are based on accepted good practice and evidence based care. The purpose is to ensure that all children receive safe, optimal and equitable care.

Care pathways currently in use are:

- Management of intravenous antibiotics
- Management of Port-a-Cath®

These can be found on the wards or are available from the CF Nurse Specialists.

Patient profiles.

All patients have a concise synopsis of their medical history, health status, current medication, nursing, physiotherapy and nutritional needs. Folders with this information are kept on wards 33, 35 and in the CF Office. This can give valuable information as many patients will have several volumes of medical notes.

4.8 Discharge

A clear plan will made prior to discharge between the CF team, the patient and their family. A brief discharge note should be made on the MDI form and any medication that is needed prescribed. Most repeat prescriptions are organised through primary care so it is usually not necessary to prescribe all medication. A follow-up clinic appointment needs to be booked, ensuring that it will be in the correct colour of clinic.

A formal typed discharge letter needs to be completed within one week. This should be either dictated or typed and should be based on the CF discharge template. Please concentrate on the therapies given as an inpatient, any important investigations, and changes to ongoing treatment. Give this to the secretaries for distribution (GP and parents) and addition to the CDS storage system.

5. Respiratory Care

5.1 Physiotherapy

Aims

- Support and work with the patient and family at all stages of the disease
- Mobilise and clear secretions from the respiratory tract
- Teach appropriate Airway Clearance Techniques (ACT)
- Encourage age appropriate physical activities
- Promote long term fitness
- Monitor respiratory progress
- Assess and treat any associated musculoskeletal problems
- Monitor posture and give appropriate advice
- Monitor continence problems
- Collection of microbiological specimens

The CF physiotherapy team provide an inpatient, outpatient and a community service. Individual treatment programmes are developed for each patient. Those on IV antibiotics will be seen and treated either as an inpatient or at home. Techniques are reviewed regularly. Treatment options will be broadened and new techniques developed as age, skill and understanding allow.

Vigorous daily exercise is beneficial and actively encouraged but **does not** replace the need for ACT.

Physiotherapy at diagnosis

- The physiotherapists will be involved as soon as possible following diagnosis
- Patients and parents will be introduced to an appropriate physiotherapy technique and be advised on an individualised initial treatment programme
- The level of intervention will depend on age and degree of respiratory disease
- Close support and regular contact with the physiotherapy team in the initial few months following diagnosis will allow both physiotherapy skills to be developed by the family and development of the treatment regimen to occur

Physiotherapy as an out-patient

- All patients have open access to the CF team physiotherapists Mon - Fri 8.30 -4.00. All families will be provided with contact details
- Patients will have access to a physiotherapy review during the Thursday morning, Wednesday NLC and the Tuesday drop in clinic
- Patients can access advice over the phone from CF team physiotherapists
- Treatment as an outpatient can be arranged with prior notice
- A&E may call on the CF physiotherapists for advice and assessment of CF patients

Airway clearance techniques include

1 Active Cycle of Breathing Techniques (ACBT)
2 Autogenic Drainage (AD)
3 Positive Expiratory Pressure (PEP)– regular, oscillating or 'bubble' PEP using the Mask, Flutter, Acapella or Cornet
4 Percussion and vibrations

5 Postural Drainage
6 Airway suctioning either under anaesthetic or on the ward
7 Non Invasive Ventilation (NIV)

Nebulisers
Taken before physiotherapy
- Bronchodilators (or inhalers) 10-20 minutes before treatment
- DNase - a minimum of 1 hour before treatment (best given early morning for maximum benefit when on IV Abs)
- Normal saline 10-20 minutes before treatment

Taken with physiotherapy
- Hypertonic saline

Taken after physiotherapy
- Nebulised antibiotics

Physiotherapy under general anaesthesia
- Physiotherapy techniques used with saline, bagging and suction are useful to obtain specimens that otherwise cannot be obtained due to age, lack of secretions or dislike of expectoration
- Treatment will also clear secretions from a very productive child or a non-compliant one, particularly if they are likely to be reluctant to cough due to postoperative pain
- The medical staff need to arrange additional time for physiotherapy with the anaesthetist and theatres

Annual review
All patients will have an annual review (AR) of their physiotherapy programme.
This will include: -
- Analysis of the current home ACT programme
- Analysis of respiratory symptoms
- Evaluation of current levels of exercise and activity
- Exercise testing
- Assessment of posture
- Incontinence awareness
- Musculoskeletal review if necessary
- Pulmonary function tests
- Development of skills or changes in the methods of ACT will be planned and followed up following AR
- Additional treatment for postural, musculoskeletal, incontinence or other problems will be developed following AR if necessary

Specimens
Physiotherapists can obtain microbiological specimens such as
- Sputum samples
- Cough swabs
- Nasopharyngeal aspirates
- Induced sputum samples
- Specimens via endotracheal tubes
- Antibiotic blood levels from finger prick

5.2 Respiratory exacerbations

Pulmonary exacerbations are associated with the following symptoms:
increased cough, breathlessness (perhaps on exercise), sputum production (which may change colour to yellow or green), loss of appetite or energy, wheezing, chest pain, fall in lung function (a fall of 10% is significant), and haemoptysis. New signs may be found on examination (e.g. crackles, wheeze, rattle on huff), but an unchanged examination dose not exclude an exacerbation.

CXRs are usually unnecessary and you **must not** routinely perform a CXR to ascertain if a child has an exacerbation. You should have a low threshold for considering a child or young person as having an exacerbation. A cough swab or sputum sample should be obtained and then a treatment course of 2 weeks of oral antibiotics should be prescribed. Increased physiotherapy as per their individualised regimen should also be started. You should not wait for microbiology results before starting antibiotics for a significant exacerbation; similarly negative samples do not obviate the need for antibiotics, or escalation in therapy if a patient does not improve. Previous microbiology results, including sensitivity patterns, should be used to direct antibiotic therapy.

When patients have a significant viral upper respiratory tract infection, then oral antibiotics for 2 weeks should be prescribed to minimise the risk of a subsequent pulmonary exacerbation.
The following treatment courses are suitable:

- 14 days of oral co-amoxiclav (Augmentin)
- 10 days of oral daily azithromycin

An alternative is clarithromycin for 14 days, or an oral cephalosporin. When patients have chronic *P. aeruginosa* infection, then 14 days of oral ciprofloxacin may be appropriate. The combination of oral azithromycin (14 days) and ciprofloxacin has at least theoretical benefit, as azithromycin may have a synergistic effect.

Initial advice may be given over the phone, but children who are less well should usually be seen, either in clinic or at home by one of the CF team. You should also make a plan of follow up in the near future, and always inform the CF team. If a child is not responding to the initial treatment plan, you should look at the microbiology results and consider changing antibiotic therapy. You should discuss with one of the senior members of the CF team. Further therapy may include switching to a different oral antibiotic, but if children are not improving, or are becoming more ill, you should consider intravenous antibiotic therapy. Patients who present very unwell may need inpatient therapy from the outset.

5.3 Policies for specific organisms

5.3a Haemophilus influenza

Isolates of *H. influenza* should usually be should be treated, initially with 2 weeks of co-amoxiclav. Continued isolation, with or without symptoms, may need further or longer courses (e.g. one month) of co-amoxiclav or cefixime. If a child is still symptomatic, they may need IV therapy.
Frequent isolates of *H. influenza* should prompt consideration of specific antibiotic prophylaxis, e.g. co-trimoxaxole or co-amoxiclav (ideally Augmentin Duo if available).

5.3b Staphylococcus aureus

New isolates of *S. aureus* should be treated with a 2 week treatment course of antibiotics, preferably flucloxacillin (*S. aureus* is often resistant to macrolides). If a child is on flucloxacillin prophylaxis, this should be doubled for 2 weeks (use three or four times per day). Continued isolation should initially prompt a longer course of antibiotic, and if ongoing symptoms, consideration of IV therapy. Chronic *S. aureus* infection can however occur, and further isolates, if not associated with increased symptoms, may not necessarily need additional treatment.

5.3c Methicillin Resistant Staphylococcus aureus (MRSA)

The decision to treat MRSA is a clinical one and should be discussed with one of the CF consultants, in conjunction with advice from microbiology. Antibiotic sensitivities may help guide therapy. Initial isolations may be treated with a combination of ***two*** oral agents e.g. trimethoprim and rifampicin. If the patient is unwell, and IV antibiotics are planned, then using agents active against MRSA may be appropriative, e.g. teicoplanin. Again, consult with microbiology. Therapy and preventative measures should also be in conjunction with the Trust-wide policy on MRSA treatment.

In-patients who have isolated MRSA should have strict isolation in their cubicle. Out-patients should be seen in the Blue clinic and ideally at 12pm appointments, going straight into their room from the waiting area. Their lung function should be done on portable spirometry in their room, or at the end of clinic, with appropriate cleaning of equipment afterwards. They can move out of the Blue clinic when they have not isolated MRSA for **12 months**.

5.3d Pseudomonas aeruginosa

For **first** isolates of *P. aeruginosa* when a child is well or only mildly unwell, an initial trial of eradication therapy should be given as follows:

- 21 days of oral ciprofloxacin
- 3 months of nebulised colistin

A repeat sputum sample or cough swab will be taken within 1-2 weeks of finishing ciprofloxacin.

If a child is unwell, then you should consider admission for intravenous antibiotic therapy. We would repeat a culture following stopping ciprofloxacin. Re-isolation of *P. aeruginosa* following stopping ciprofloxacin will lead to consideration of a repeat course of ciprofloxacin (or long term therapy for up to 3 months) or intravenous antibiotics.

If there are no further isolates in the subsequent months of nebulised therapy, then the nebulised colistin may be stopped after 3 months, with careful surveillance cultures following this.

For **subsequent** isolates of *P. aeruginosa*, then further oral courses of ciprofloxacin (14 days) may be given. If there has been no recent isolates and the child has stopped nebulised colistin, then make a further attempt at eradication. Pay attention to the sensitivity profile, as ciprofloxacin resistance can develop; alternative oral therapies are co-trimoxazole, doxycycline or chloramphenicol - however these should only be prescribed after discussion with one of the CF consultants and/or microbiologists. We would consider intravenous antibiotic therapy if there are persistent symptoms, at any

stage for significantly unwell children, for ciprofloxacin resistance and sometimes for repeated isolates. Longer courses of ciprofloxacin (up to 3 months) are sometimes used.

When there have been repeated re-isolations of *P. aeruginosa*, particularly when there has been intermittent use of nebulised colistin, we would suggest continuing nebulised colistin indefinitely. We now recommend twice daily colistin through portable electronic mesh nebulisers (see section 5.8 on nebulisers). For patients who are deteriorating despite otherwise conventional therapy we would recommend a trial (ideally for 6 months) of alternate months of TOBI (with colistin on the other months).

We define **chronic** *P. aeruginosa* infection as two or more isolates in a period of 6 months. However chronic infection can exist with negative cultures (especially on cough swabs). Pseudomonas serology (performed by the HPA in Colindale), is usually only positive after a long period of infection, but occasionally high levels of antibodies can occur in children with no overt infection. This should prompt an aggressive search for infection, including flexible bronchoscopy.

We do not recommend regular intravenous antibiotics as routine in chronic *P. aeruginosa* infection. However, children with significant lung disease may require frequent courses of intravenous antibiotics; in some children regular elective courses are preferable to frequent intermittent unplanned antibiotics. In these children we would suggest starting with a year of elective intravenous antibiotics, and continue if there is an improvement in their clinical course.

5.3e Non-tuberculous mycobacteria (NTM)

Mycobacterial species are classified as either: *M. tuberculosis* (MTB) complex (typical) or MOTT (mycobacteria other than TB, atypical or nontuberculous mycobacterium (NTM). Increasingly, atypical mycobacteria (especially *M. avium* and *M. abscessus*) are being isolated in the sputum from patient with CF, however the clinical significance of these isolates are often unclear. ATS guidelines for diagnosis and treatment of NTM were revised in 2007, but these were not specifically for patients with CF (AJRCCM 2007;175:367-416). Patients should have at least yearly screening for NTM on sputum samples, and NTM should be suspected and evaluated for when there is pulmonary decline not responding to conventional therapy.

ATS criteria for diagnosis of NTM disease are appropriate radiological abnormalities (nodular or cavitatory opacities on CXR or multifocal bronchiectasis and/or multiple small nodules on CT) and

- positive cultures from at least two sputum samples or
- positive culture from at least one bronchial lavage

If there is a clinical picture compatible with NTM disease, including CT abnormalities, particularly with *M. abscessus*, then specific therapy should be considered. With single isolates, patients should be re-screened on alternate clinics for a minimum of 12 months.

Treatment

Treatment of atypical mycobacterial infections should not be instigated without discussion with a consultant microbiologist and one of the CF consultants. Treatment of *M. avium-intracellulare* includes clarythromycin, rifampicin and ethambutol (latter will require

ophthalmic review at baseline). Antibiotics should continue until culture negative for 1 year based on monthly sputum cultures.

Treatment *of M. abscessus* is complicated as it is not susceptible to conventional anti-mycobacterial agents. Isolates of *M. abscessus* are susceptible to clarithromycin (100%), tigecycline, linezolid (50%), clofazimine, amikacin (90%), and cefoxitin (70%) and imipenem (50%). Clofazimine and cefoxitin are not readily available. Treatment of *M. abscessus* should be discussed and agreed with a consultant microbiologist once the sensitivities of the isolate are known. The duration of therapy is usually 18-24 months and relapse rates are high.

Infection Control Considerations
There are no specific infection control measures necessary when dealing with an individual infected or colonised with atypical mycobacteria.

5.3f Other organisms

Aspergillus fumigatus
A. fumigatus is commonly isolated (in up to 50% of patients), and is often of no clinical significance. It is however associated with ABPA (see 5.6a). Without any evidence of ABPA, we would not usually treat isolates. However in some children with repeated isolates it may be associated a decline in pulmonary status, and it may be worth a trial of treatment for 3 months. We would use oral itraconazole, optimising its absorption (see formulary), but we do not routinely perform itraconazole levels. Other anti-fungal agents (e.g. voricanazole) do not appear to provide additional benefit for *A. fumigatus* infection in the absence of ABPA. Invasive aspergillosis is rare in CF.

Stenotrophomonas maltophilia
It is unclear whether isolation of *S. maltophilia* is clinically very significant in CF, however it would appear to be pathogenic in some children. We often treat isolations with 2 weeks of oral co-trimoxazole; other antibiotic choices are very limited.

Burkolderia cepacia complex
It is extremely important to ensure that this is identified and typed correctly, including sending to a national reference centre (e.g. Colindale HPA). There are a number of genomovars within the *B. cepacia* complex, with varying degrees of pathogenicity and transmissibility. Clinical course following isolation varies between no significant change, an acceleration in decline, and a fulminant fatal course (the cepacia syndrome). *B. multivorans* and *B. cenocepacia* are the most commonly isolated. Most isolates have multiple antibiotic resistance, but there may be response to antibiotic combinations. Treatment decisions should be made by senior members of the CF team, in conjunction with senior microbiology advice.
Patients who have isolated the *B. cepacia* complex should have strict isolation in their cubicle when they are in-patients. As out-patients they should be seen in the Blue clinic at the 12pm appointments, going straight into their room from the waiting area, and having strict isolation from other patients. Their lung function should be on portable spirometry in their room or at the end of clinic, with appropriate cleaning of equipment afterwards. They may be able to be moved out of the Blue clinic when they have not isolated *B. cepacia* complex for **12 months**.

Candida
This is commonly isolated on cough swabs and sputum. We do not treat, except when there is an obvious oral infection.

Influenza
We recommend yearly influenza vaccination. We would consider the early use of oseltamivir (Tamiflu) when we suspect influenza.

5.4 Choice of intravenous antibiotics

Our first choice of intravenous antibiotic therapy is ceftazidime and tobramycin. We always use a combination of two agents, with different mechanisms of action, and usually for not less than 14 days. Choice of antibiotics should always be discussed with the CF team, and this may alter in the light of previous isolates, antibiotics resistance patterns, and clinical response to prior courses. A change in antibiotics during a course may be considered if there is little improvement or with isolation of new organisms or altered antibiotic resistance. However, antibiotics do not necessarily need to be changed if there is appropriate clinical improvement but an altered resistance pattern. Choice of agents for patients with multiple strains of organisms or multiple resistance should be discussed with senior members of the team and microbiology.

We usually only stop nebulised colistin if a patient is on intravenous colistin.

5.5 Specific respiratory therapies

5.5a rhDNase (Pulmozyme)
Recombinant human DNase digests DNA released from neutrophils within the airway lumen. It decreases sputum viscosity and aids mucus clearance; in clinical trials there has been a mean increase in FEV_1 of approximately 5%.

Our previous main indication was to start rhDNase in patients when FEV_1 fell below 70%. However we now have more liberal indications for starting rhDNase, and have seen significant improvements in children when used much earlier in the course of disease.

- Any persistent fall in lung function (despite usual therapy and having excluded typical causes)
- Ongoing respiratory symptoms (despite usual therapy, includes those unable to perform lung function)
- Lobar collapse (consider local instillation at flexible bronchoscopy)
- Short-term therapy during an in-patient exacerbation when there is significant mucus production

In children with a chronic indication, rhDNase should be given as a trial of at least 3 months duration. rhDNase should be continued beyond 3 months if there is an improvement in FEV_1 of at least 5% or improvement in symptoms. After 3 months, consider switching to alternate day therapy (one trial has shown that it is equivalent to daily therapy). Voice alteration and rash are the only reported occasional side effects.

We now usually give rhDNase via a vibrating mesh nebuliser (eFlow® or I-neb®). We currently prescribe and dispense the majority of DNase, but this may change in the future with shared care agreements with GPs.

5.5b Long term azithromycin

In addition to its antibiotic effect, azithromycin appears to have some anti-inflammatory properties. In randomised trials in children and adults (including those with or without chronic *P. aeruginosa* infection), long term azithromycin over 6 months had an overall effect of an increase of approximately 5% in FEV_1. Our main indication is a persistent fall in lung function (despite usual therapy and having excluded typical causes).

A trial should be continued for at least 4 months, as any effect may not be seen until after 2 months of therapy. When starting azithromycin, stop flucloxacillin if being used as a prophylactic antibiotic. However, resistance to macrolides is common in isolates of *S. aureus*; be careful to check the resistance patterns of isolates. Regular flucloxacillin may need to be started if there are continued macrolide-resistant isolates. If after 4 months there is no objective or subjective improvement, then azithromycin should be stopped. If continuing azithromycin beyond 4 months, consider reducing to 3 times per week. Nausea, abdominal pain and diarrhoea are reported side effects. If these are experienced, it may be worth a 2nd trial of therapy at a later date.

5.5c Inhaled corticosteroids and bronchodilators

The use of inhaled corticosteroids as an anti-inflammatory agent in CF has not yet been shown to be effective. However some children with CF have an asthma phenotype that may respond to asthma therapies. A trial of inhaled corticosteroids should be started when there are recurrent episodes of wheezing, wheeze or cough on exercise, or persistent night cough, but only after appropriate therapy is given if this may be a pulmonary exacerbation. Reversibility should be tested in those children able to do spirometry. The choice of device should guide the prescribed drug, but the use of metered dose inhaler and a spacer is appropriate for most patients. It may be appropriate to switch to a combination (corticosteroid/long acting bronchodilator) inhaler, e.g. Seretide or Symbicort. If there is no improvement after a trial of therapy (e.g. 3 months), then therapy should be stopped or an alternative agent considered.

Using short-acting bronchodilator therapy is usually not necessary on a regular basis, but some children may benefit from bronchodilators before physiotherapy. It can be used on an intermittent basis for increased wheeze with exercise (pre-medication may be helpful) or with exacerbations.

5.5d Oral steroids

Indications for oral steroid therapy are:

- Allergic bronchopulmonary aspergillosis (see 5.6a)
- Acute episode of wheezing
- Symptomatic small airway disease (see 5.6d)

Although the use of long term oral steroid therapy is associated with less decline in pulmonary function, it has significant adverse effects. The dose of oral steroid should be

as low as possible and ideally on alternate days. An attempt should be made to stop long term steroid therapy unless it has had a clear improvement in pulmonary function, or it is required to keep ABPA in remission. Prednisolone should not be enteric coated. When using high dose oral steroids, daily urinalysis should be performed and blood pressure measured regularly. Patients should be warned of possible glucose intolerance and should look out for any osmotic symptoms. All patients on long term steroid therapy should have DXA scans.

5.5e Other anti-inflammatory therapies

Currently we do not use high dose ibuprofen as an anti-inflammatory agent, despite its apparent effect on delaying decline in pulmonary function. Other agents (see 5.6d) are empirical and are based on small case series at best rather than on better evidence, e.g. intravenous immunoglobulin, methylprednisolone, and methotrexate.

5.6 Respiratory complications

5.6a Allergic bronchopulmonary aspergillosis (ABPA)

ABPA is an IgE and IgG mediated hypersensitivity to *A. fumigatus*. It is relatively common, occurring in up to 10% of patients. It can be difficult to make a clear diagnosis, as some of its manifestations are common in CF patients without ABPA. You should have a low threshold of considering ABPA and pay close attention to screening tests. However when the clinical, radiological and serological picture fits ABPA, the diagnosis should be made promptly and treatment initiated without delay.

Clinical manifestations

Wheezing or increased cough
Pulmonary exacerbation not responding to initial therapy
Sputum with brown or black plugs

Investigations

Pulmonary infiltrates or round shadow on CXR
High total serum IgE: needs to be >500 IU/ml, and usually with at least a recent doubling or four-fold rise
High specific RAST IgE to Aspergillus
Positive IgG Aspergillus precipitins
Eosinophilia (>0.5 x 10^9/l)

A mildly raised total IgE and *A. fumigatus* RAST usually implies only sensitivity to *A. fumigatus*, and in the absence of a compatible clinical picture and other positive investigations, is **not** ABPA. Isolation of *A. fumigatus* on respiratory cultures is in itself common. Skin tests may only indicate sensitivity against *A. fumigatus* and are usually not useful. Similarly, bronchiectasis is common in CF without ABPA and changes on thorax CT does not often give extra diagnostic information for ABPA.

Treatment

i) oral corticosteroids:
Start oral prednisolone (non-enteric coated) 2mg / kg per day (max 40mg) for 2 weeks. Then reduce to 2mg / kg (max 40mg) on alternate days for 2 weeks. Dosage is then

reduced mainly according to clinical response, aided by change in total IgE and radiological improvement. If there is continuing clinical improvement, then prednisolone can be reduced by 5mg every 2 weeks, so that typically steroids would be tapered and then stopped (from 5mg alt days) over approximately 4 months. Send blood for varicella serology to establish chicken pox immunity at the time of starting oral steroids.

Total IgE should be measured after 1 month and then usually at no more frequently than 2 monthly intervals. A CXR could be repeated after 2 months of therapy. If there is reduction in IgE and radiological improvements, this will reinforce the diagnosis of ABPA. However, in the setting of clinical improvement, stability of IgE (e.g. <1000) should not necessarily prevent reduction and withdrawal of oral prednisolone. Although some young people have an ongoing steroid requirement, continuing oral prednisolone over many months should be questioned and an attempt made to withdraw. However a Synacthen test may be necessary if very long term steroid therapy has been used.
You should warn patients and parents of the possible side effects of oral steroid therapy, including glucose intolerance, hypertension, growth impairment, danger of chickenpox infection if not previously infected and adrenal suppression. Urine should be dipped for glucose when on high dose steroid, and blood pressure measurement taken at every review. They should have steroid warning card.
We might consider a trial of pulsed methylprednisolone in very difficult cases, but this has not yet been shown to be effective. Inhaled corticosteroid therapy appears to be ineffective in ABPA.

ii) oral anti-fungals:
We usually treat with oral itraconazole at the same time as oral steroid therapy. Absorption should be optimised, but we do not routinely monitor blood itraconazole levels.
There has been one report of oral voricanazole being used as co-therapy with oral steroids, and its potential as mono-therapy when oral corticosteroids are not suitable. We would consider its use in difficult ABPA and / or when oral steroids are not tolerated or not suitable. It is however expensive and has a significant adverse effect profile. Patients should be warned of possible transient visual side effects, sun hypersensitivity. Liver function tests should be performed at least every 2 months.

5.6b Haemoptysis

Streaky haemoptysis is not uncommon in CF due to chronic infection. Sputum should be cultured and antibiotics considered.

Massive haemoptysis may occur (in about 1% of patients per year) in areas of chronic airway inflammation or due to vessel rupture. The site of bleeding is usually tortuous bronchial arteries. The possibility of pulmonary embolism should be considered if the child has a Port-a-Cath®. There may be a gurgling sensation in the chest and this might suggest which side the blood is coming from.

Management

- Reassure
- Resuscitate – lay patient on side, gurgling side down and apply O_2
- Give blood and correct coagulation defects if necessary
- Start IV antibiotics

- Do the following investigations: FBC, coagulation screen, group & save or Cross-match blood
- Continue with careful regular physiotherapy. Percussion is not advised and should be omitted for 24 hours
- Consider stopping rhDNase
- CXR but it is not usually useful in localising the source of bleeding

If massive bleeding persists or if repeated bleeding occurs over a few days (daily for 7 days with >100mls on 3 days) then consider the following:

- IV Vasopressin: 0.3 units/kg (max 20 units) over 20 minutes then infuse at 0.3 units/kg/hour (max 1 unit/kg/hour). If bleeding stops, continue the infusion at the same rate for 12 hours, then gradually withdraw over 24-48 hours. Maximum duration of treatment 72 hours.
- Tranexamic acid (15-25 mg/kg tds (max 1g/dose))
- Bronchoscopy is usually not useful, but consider urgent rigid bronchoscopy in massive haemoptysis
- Bronchial angiography and selective embolisation. There is an interventional radiologist in Exeter (Tony Watkinson) who performs selective embolisation, and it is worth discussing cases with him. However there are significant major risks and it may not be beneficial in the long term

5.6c Pneumothorax

Pneumothorax should be considered if there is:

- Unexpected and sudden deterioration
- Unexplained chest pain
- Worsening shortness of breath
- Haemoptysis

A chest X-ray (CXR) should be performed if a pneumothorax is suspected, although a CT thorax may be needed. A small, asymptomatic pneumothorax (e.g. less than 20%) may be managed conservatively. If the pneumothorax is large or the patient is decompensating, management should be as follows:

- Monitor SpO_2 and administer oxygen
- IV antibiotics
- Insertion of an intercostal chest drain
- Adequate analgesia

If the lung does not re-expand, or there is continuing air leak, after several days, then discuss with the paediatric surgical team. Pleurodesis or pleurectomy may make future lung transplantation difficult, but they are not absolute contra-indications. However, localised pleurodesis or thoracoscopic stapling may be preferable options. Patients should not fly after a pneumothorax for at least 6 weeks.

5.6d Small airways disease

This clinical picture refers to a relatively small group of patients who have some or all of the following features, and who do not respond to conventional "asthma" therapy.

- frequent wheezing
- poor exercise tolerance
- obstructive spirometry
- little sputum production

Therapy for these children is often difficult and must be discussed with senior members of the team. Consider the following:

- is there evidence of ABPA?
- thorax CT to assess airway structure
- pH study
- flexible bronchoscopy to look for occult infection
- trial of combination inhaled therapy e.g. Seretide or Symbicort
- trial of empirical high dose steroids e.g. 2mg / kg (max 40mg) once a day for 14 days and assess response
- trial of regular azithromycin therapy if not already given
- trial of monthly intravenous immunoglobulin (IVIG). Give 1g/kg on each of two sequential days at first treatment, followed by monthly infusions of 1g/kg. Pre-treat with IV chlorpheneramine and IV hydrocortisone. IVIG infusions can be started in the late afternoon to stop the following morning. Plan for at least 6 months therapy. Measure LFTs and IgG, A, M & E before each treatment. (See Balfour-Lynn, ADC 2004;89:315-9).

Other suggested therapies are even more empirical and include consideration of pulsed methylprednisolone, subcutaneous terbutaline and methotrexate.

5.7 Bronchoscopy

Consider flexible bronchoscopy in the following settings:

- clinical and/or pulmonary function deterioration not responding to conventional therapy
- deterioration without an identified organism
- if NTM is suspected
- lobar collapse not responding to conventional therapy
- investigation of focal change on chest imaging
- if having general anaesthesia for another procedure, e.g. surgical procedure, line insertion

We are currently not bronchoscoping all infants following diagnosis, or our children at regular intervals. There is however some evidence of being able to identify significant pathogens even in asymptomatic infants, so we may adopt this practice in the future.
If bronchoscoping to look for occult infection, ideally this should before starting IV antibiotics. BAL should be performed in the area of greatest disease, or in the right middle lobe if it is widespread. BAL should be pooled and sent for:

- **Microbiology**: M, C & S (mark CF sample) and ?AFB / TB culture
- **Cytology:** Cell differential and staining for fat laden macrophages
- **Virology:** immunofluorescence for respiratory viruses

It may be useful to perform physiotherapy under anaesthesia after bronchoscopy, particularly if there is lobar collapse. However physiotherapy does not need to be routine alongside bronchoscopy. If mucopus is blocking a segmental or larger bronchus, instill rDNase first before attempting to unblock the bronchus (2.5mg of rDNase can be diluted to 10mls with 0.9% saline). It may be useful to instill diluted rDNase down the bronchoscope into a number of areas at the end of bronchoscopy, particularly if physiotherapy is being performed.

5.8 Nebulisers

rDNase

- Patients will be provided with an appropriate nebuliser and a specific set of nebulising equipment for rDNase. This should only be used with this medication to prevent contact with other drugs. Full instruction in use of the equipment will be given, together with written information and instruction on cleaning and sterilization of equipment
- rDNase should be taken once daily and timed so that it is taken 1-2 hours before a planned physiotherapy treatment. We do not recommend taking it before bed-time.
- The first dose of rDNase will be supervised
- Pulmonary function tests and objective assessments will be made to evaluate the efficacy of rDNase for each individual patient. Continued use will be determined in the light of these assessments

Nebulised Antibiotics

- All necessary equipment will be provided together with full instruction on its use and cleaning
- The initial dose will be given under supervision to assess for bronchoconstriction
- If using a bronchodilator this should be taken approximately 15 minutes prior to the nebulised antibiotic
- Nebulised antibiotics should be taken after physiotherapy

Saline and hypertonic saline

- Patients with sticky secretions may benefit from nebulised saline or hypertonic saline
- 6% hypertonic saline solution is available through pharmacy or can be made up with 1ml 30% saline and 4ml water
- The initial dose will be given under supervision to assess for bronchoconstriction
- If using a bronchodilator this should be taken approximately 15 minutes before the saline
- Saline should be nebulised just before physiotherapy

Home visits to support nebulisation will be available.

During 2006 we moved to using to electronic nebulisers with vibrating mesh technology as our nebulisers of choice, rather than the traditional compressor driven nebuliser (e.g. Pari LC Plus). The majority of our patients are now using an eFlow® or an I-neb®. These nebulisers reduce nebulisation time significantly, and are more convenient and portable. Some children and young people however use a compressor nebuliser for particular medications.

Name	Pari Boy	Pari eFlow®	Respironics I-neb®
Age	All ages (mask or mouthpiece)	All ages (mask or mouthpiece)	Need to use a mouthpiece, usually from 3-4 yrs
Drug delivery time	DNase 10-15 minutes Colomycin 10-15 minutes	DNase 2-3 minutes Colomycin 3-4 minutes	DNase 3-6 minutes Promixin 3-6 minutes
Noise	Relatively noisy	Silent	Soft buzz
Technology	Air compressor. Nebulises throughout respiratory cycle	Nebulises throughout respiratory cycle; doesn't need breath activation	Adaptive Aerosol delivery, nebulises only on breath activation
Power	Mains only	Battery or AC	Battery or AC
Cleaning & parts	Straightforward washing in hot water	Requires prompt washing and weekly sterilisation. Needs care with nebuliser plate. Cleaning adaptor available	Requires prompt washing and weekly sterilisation. Needs care with nebuliser plate.
Drugs	Any drug	Any drug (not hypertonic saline)	Colistin, DNase, salbutamol
Filtering	Colistin requires filtering	Colistin requires filtering	Not required
Costs	Inexpensive	Requires funding (~£400)	Nebuliser provided free but have to prescribe Promixin (see table below)
Servicing	Annual service.	No service, but needs replacement parts each year	Provided free
Adherence monitoring	None	None	Can download usage

Drug dose conversion

Conventional Compressor or eFlow®	I-neb®
1MU Colomycin mixed with 3mls saline	0.5MU Promixin (mix 1 MU vial with 2mls saline, draw out 1ml; can use remaining 1ml later in evening)
2MU Colomycin mixed with 3mls saline	1MU Promixin (mix with 1ml saline)
2.5mg DNase (2.5mls)	1ml DNase (residual 1.5mls not required)

5.9 Radiological investigations

CXR

A CXR is usually performed as a part of the annual review. We no longer formally score radiological changes but it is important to look at the CXR on the day of the review. CXRs are usually not needed during a pulmonary exacerbation, but it may be useful if there is an usually severe exacerbation or to look for other complications such as ABPA or pneumothorax.

CT

A chest CT scan gives much greater definition of the architecture of the lungs than a plain CXR but we are currently not performing CT as part of routine evaluation. A CT can be used to assist in the evaluation of bronchiectasis, mucous plugging, small airways disease (suggested by air trapping), ABPA and infection with non-tuberculous mycobacteria (NTM). The decision to request a CT scan should be taken by one of the CF consultants in discussion with a consultant radiologist.
Sinus CT scans should be considered in children with symptoms suggestive of sinusitis that is unresponsive to treatment.

5.10 Totally Implantable Venous Access Devices

Children requiring frequent courses of IV antibiotics or having recurrent difficulty with IV cannulation may benefit from insertion of an implanted venous access device (TIVADS or Port-a-Cath® (Smiths Medical)). This should be considered as a long term procedure. Insertion of ports needs careful consideration if the child has an aversion to needling as the port will require access monthly to renew the heparin solution. However, accessing a port is fast, accurate and pain free if anaesthetic creams are used and many children afraid of needles have found this preferable to the uncertainty and sometimes prolonged attempts at cannulation.

There are several TIVAD systems available in a variety of sizes and materials. Generally, paediatric or low profile ports connected to 4FG catheters are used for children (and adults) although older teenagers with a high BMI may be considered for an adult size port. TIVADS consist of a small portal chamber made of metal and or plastic with a self sealing silicone septum connected to a PVC, polyurethane or silicone catheter. The site of catheter insertion is usually via a subclavian vein into the SVC but other routes are possible. The catheter is tunnelled subcutaneously and attached to the portal chamber, usually buried on the upper chest wall. Siting of the portal chamber should take into account ease of access (away from breast tissue and shoulder joint), comfort (no chafing from arms), and not interfere with chest physiotherapy. Girls are particularly concerned with the cosmetic appearance and every effort should be made to take their wishes into consideration. Where possible the non dominant side should be used (easier for self access and less interference in daily activity). Ultimately the final decision will be left to the surgeon.

Arm ports have been very successfully used for teenagers and adults. However this procedure is not currently available in Bristol and would require referral to another centre. They are not suitable for young children due to size and rapid growth.

Ports are inserted under general anaesthetic for children (see section 5.11 on preparation for surgery). Local anaesthesia may be considered in exceptional circumstances for older

children who present a significant anaesthetic risk. The port should be needled in theatre if immediate use is required as the portal area is likely to be sore and bruised directly afterwards. Generally, dissolvable sutures are used. Physiotherapy and earlier mobilisation are important post operatively. Discharge is usually within 48hours but IV antibiotic cover may be required for longer.

On-going management of the port is carried out by the CF Nurse Specialists who will arrange for monthly flushes with 4-5mls heparin saline (Hepflush 100 units/ml) to prevent the formation of emboli. This may be either in the clinic or the patient's home. All patients are offered local anaesthetic cream (Emla or Ametop) or ethylchloride 'cold spray' prior to needling. Some patients eventually decide they are happy without local anaesthetic.

Accessing the port for flushes or treatment must only be carried out by suitably qualified and trained staff using specific non-coring needles (huber) needles. Care Pathways and guidelines for the use of ports are available on the medical wards and from the CF CNS. Sections on complications such as blockage and general trouble shooting can be found in the guidelines. Details of port training courses are also available from the CF CNS and training department. Some carers and older patients may opt to learn how to access and self-manage their ports. This is under the supervision of the CF CNS

Blood sampling is not always possible from ports, although the port may be perfectly functional for infusions. Aminoglycoside levels must not be taken from the port as this is the site of infusion. Coagulation studies are likely to be contaminated by the heparin in the system and should therefore be taken from a peripheral site and not the port.

Line infection should always be considered if the patient has a persistent fever. This will usually result in removal of the port. Pain or swelling during infusion into the port should be investigated for misplaced needle or possible fracture / disconnection of the catheter. The latter will require CXR and radio opaque contrast (lineogram) to determine the exact problem. If the port is blocked consider instilling 5,000 of Urokinase in 3ml 0.9% saline. Try flushing port gently after 2-3 hours.

5.11 Preparation for surgery

There should be good communication between the CF team and both the surgical and anaesthetic teams prior to planned surgery. Patients should be optimised in terms of respiratory and nutritional status prior to surgery, when possible. For minor procedures, in patients who have minimal respiratory involvement and who are currently well, a course of oral antibiotics starting just a few days before surgery may be of benefit. However other patients, and those undergoing more significant procedures, should start intravenous antibiotics at least 48 hours before surgery. These should continue until there is complete recovery from the procedure and the patient is pain free. The physiotherapy team needs to be closely involved both pre- and post-operatively. Physiotherapy while under general anaesthesia may be useful, but this does not need to be routine.

5.12 Home oxygen

Hypoxia during sleep may occur with advanced lung disease. If a patient does have nocturnal hypoxia, oxygen therapy *may* improve sleep quality and give some daytime improvement. If spot SpO_2s during an admission are not normal, then an overnight

oximetry recording should be performed towards the end of the admission, and repeated at home if necessary. Overnight oximetry should also be performed in those patients with advanced lung disease on a regular basis (e.g. 6 monthly). There is no universally agreed definition of hypoxia in CF, but we would consider nocturnal oxygen therapy if SpO_2 was below 90% for ≥10% of the study.

Oxygen should be ordered through the relevant provider using the forms available in the home oxygen section of the respiratory folder on the shared network drive. You will need to gain written consent for this process, and also please request consent for the CHORD database, using the information sheets and consent forms within the folder.

6. Gastrointestinal care

6.1 Nutrition

The role of nutritional support

Weight loss and poor growth in CF has previously been thought to be an integral part of the disease process. However, aggressive nutritional support has been shown to be linked to good nutritional status and improved survival. With the use of pancreatic enzyme replacement therapy, dietary counselling, high energy food and supplements along with more aggressive forms of nutritional support failure to thrive should not occur in infants and children with CF once diagnosis has been made.

Energy and Protein Requirements

Because of increased energy expenditure and fat malabsorption, infants and children with CF usually have increased energy and protein requirements. It is estimated that 120-150% of the Estimated Average Requirement (EAR) for energy is needed in those with moderate to severe lung disease. However, because of the heterogeneity of patients with CF, with different levels of respiratory function and activity it is difficult to give universal recommendations. Some children will grow well whilst only achieving the EAR whilst others will require far more. The exact requirements for protein in cystic fibrosis are not known but due to malabsorption and losses in the sputum it is recommended that intakes exceed the recommended nutrient intake (RNI).

Nutritional assessment

Anthropometric measurements: throughout infancy and childhood sequential measurements for weight and height should be taken and plotted on a relevant growth chart. During infancy head circumference should also be plotted and monitored at regular intervals if there is cause for concern.

Paediatric Body Mass Indexes can be calculated and the aim is to achieve and maintain a BMI on or above the 50th percentile.

Expected height is calculated taking into account the height attained by both parents, and using the formula for mid-parental height on the growth charts.

Criteria for assessing poor nutritional status:

- A child who is consistently below the 2nd percentile for weight.
- Less than 85% weight for height or with weight 2 percentile bands lower than height.
- "Falling off" the percentile lines previously attained. This equates to a weight loss or a plateau in weight over a 4-month period for children under 5 years or over a 6-month period for a child 5-18 years.

Possible causes of failure to achieve adequate weight are:

- Non-adherence with pancreatic enzyme replacement therapy
- Ongoing malabsorption
- Concomitant coeliac disease
- Gastroesophageal reflux
- Incipient CF associated diabetes mellitus
- Anorexia (may be associated with reflux)

Consider depressive illness as a cause for acute weight loss, which cannot otherwise be explained.

Infant feeding
Starting points: infants should be breast-fed if possible, or be given a whey-dominant cows' milk formula powder, e.g. SMA Gold, Farley's First, Milupa Aptamil or Cow & Gate Premium. Demand feeds are recommended but the aim should be for initial intakes to be 150-180ml/kg/day and this may need to be higher.

Poor weight gain: if weight gain is poor then a change to higher energy formula milk may be necessary to provide more nutrients within the same volume of milk. Alternatively normal formula feeds can be concentrated or have powdered energy supplements added (glucose polymer or glucose polymer/fat mixture). Care needs to be taken when adding these supplements so that the protein:energy ratio of the infant formula is not affected. In rare cases an infant will fail to thrive on a normal or high-energy formula in spite of maximal pancreatic enzyme replacement therapy and the use of ranitidine or a proton pump inhibitor. In these instances a hydrolysate feed, fortified if necessary, may be required to try to optimise absorption.

Meconium ileus: breast milk or normal infant formula should be given in those infants who have had bowel surgery for meconium ileus as the remaining length of small intestine has essentially normal structure and function. However, some may require a hydrolysed formula containing a proportion of fat as medium chain triglyceride to maximise energy absorption and achieve adequate growth.

Weaning: on introducing solids, high-energy foods should be chosen as appropriate. Usual initial weaning foods may be fortified if necessary to improve energy intake.

Feeding the older child
Meals should be fortified with fatty foods (such as cream, butter, oil and full fat milk) so that there is not a heavy reliance on snacks to achieve a good energy intake. Children should be encouraged to choose high energy, high protein snacks. Feeding problems are common in toddlers and children with CF and it is important that snacks do not take the place of meals and that a good main meal routine is followed.

6.2 Pancreatic enzyme replacement therapy (PERT)

About 85% of patients with CF require pancreatic enzyme replacement from diagnosis. Enteric-coated enzyme microspheres are introduced as early as possible, within a few days of birth. Creon micro (granules) is the preparation of choice for babies, whilst Creon 10,000 is used for older children who usually require a higher dose. The starting dose for infants is ¼ to ½ scoop of Creon granules per feed, increasing in increments of ¼ to ½ scoop according to response and tolerance.
Types of enzyme replacement used at BCH are:

- *Creon micro*: 5,000 units of lipase/scoop for infants and some younger children
- *Creon 10,000***:** 10,000 lipase units/capsule. This is now the preparation of choice for most young children
- *Creon 25,000***:** 25,000 lipase units/capsule. Contains 2 ½ times the amount of lipase as Creon 10,000. When changing over from Creon 10,000 to Creon 25,000 start with ~ 1/3 the number of capsules

- *Creon 40,000*: 40,000 lipase units/capsule has four times the lipase activity of a Creon 10,000 capsule
- *Pancrease***:** 5,000 lipase units/capsule

Taking PERT supplements
The granules are mixed with some breast milk, infant formula or fruit puree and offered on a spoon. They are given directly into the mouth, wiping the gums with a clean finger to ensure no granules are left in contact with the mucosa where they may cause ulceration. Granules should not be added to a bottle as this makes the milk curdle and the granules will block the teat. As the child grows Creon in capsular form should be ideally swallowed whole; however they can be opened and the contents sprinkled onto a teaspoon of soft food (pureed fruit is ideal). The starting dose is 1-2 capsules/meal and adjusted according to need, i.e. to normalise stool frequency and appearance, weight gain and faecal fat levels. It should be noted that the activity of the "live" enzymes in the capsules decreases with time and is markedly less at the end of the "shelf life" than when the capsule is first manufactured.
Peri-anal irritation can be prevented and treated with barrier creams, e.g. "Metanium".

If there is ongoing malabsorption, consider the use of either ranitidine or omeprazole to aid PERT efficacy.

6.3 Oral dietary supplements

These may be indicated if there is failure to thrive over a 3-6 month period, a poor appetite, or loss of appetite due to an acute respiratory exacerbation. They should be used in combination with high-energy meals and snacks. It is important that children and parents are advised appropriately so that reliance on supplements does not occur.

Supplements
Energy modules (no protein)
Calogen liquid (long chain fat emulsion) 250ml: 1125kcal per bottle
Duocal powder (fat and carbohydrate) 400g tubs: 492kcal /100g
Liquigen liquid (MCT emulsion) 250ml: 875kcal/250ml
Polycal liquid (glucose) 200ml bottle: 494kcal / bottle*
Polycal powder (glucose) 400g tubs. 380kcal / 100g*

Energy and protein (with some minerals)
Build Up powder + 200ml full fat milk: 375kcal/16g protein
Scandishake powder + 280ml full fat milk: 600kcal/12g protein

Nutritionally complete
Milk based
Ensure Plus (for older children) 220ml carton: 330kcal/13g protein
Fortisip (for older children) 200ml carton: 300kcal/12g protein
Paediasure (for younger children) 200ml carton: 200kcal, 5.6g protein
Paediasure Plus (for younger children) 200ml carton: 300kcal, 8.2g protein
Resource shake 200ml carton: 348kcal, 10.2g protein

Juice based
Enlive 240ml carton: 300kcal/10g

Provide Extra 200ml carton: 250kcal/7.5g

*These supplements do not need enzymes

All of the above are prescribable supplements with the exception of Build Up (available on the wards at BCH). Other supplements may be available via the GP and can be advised upon.

6.4 Enteral feeding

Enteral feeding should be considered, and discussed with the family, in those with poor growth and:

- No weight gain for 6 months despite exclusion of other causes (e.g. diabetes) and despite intensive dietetic input with use of oral supplements
- Severe acute exacerbation with anorexia
- Chronically reduced appetite with inadequate caloric input resulting in weight loss or plateau
- Before major operations if nutritional status is thought to be at risk

It can take the form of:

- **Nasogastric feeding**: either short term in an acute illness or (sometimes) as a long-term option, passing a tube daily-with a fine-bore tube and using a feeding pump. This is usually for overnight feeds only.
- **Gastrostomy feeding**: A percutaneous endoscopically placed gastrostomy (PEG), which may then be converted to a gastrostomy "button". Overnight feeding with a pump is most appropriate although bolus feeds may also be a useful way of topping up energy requirements as long as the timing and volume are such that appetite for meals is unaffected. This mode of feeding can be used long-term. "Buttons" require changing 3-6 monthly and this is may be done by the CF or home enteral feeding nurses. A PEG will usually last 2 years. Both the button and "Freka-Peg" gastrostomies can be used in those who swim frequently.

Type of feed

The type of feed given may be polymeric (whole protein) or elemental (amino acid based with a high proportion of fat as medium chain triglyceride). The polymeric feeds require pancreatic enzyme supplements to be given, usually at the start of the feed and at the end of the night if it is being given as a continuous infusion overnight. Dosage of enzyme to give with the feeds may be calculated out on the basis of the level given in an equivalent amount of energy from a meal. Theoretically the elemental feeds should not require pancreatic enzymes but as they contain a small proportion of long chain fat they may require some enzyme therapy if signs of malabsorption occur once the feed has been commenced. No differences in fat malabsorption or weight gain have been noted between patients fed either polymeric feeds with enzymes or semi-elemental feeds. The level of energy supplementation that is needed to achieve satisfactory weight gain is 40% of the estimated average requirement (EAR).

Suitable feeds available within the hospital that may be given via nasogastric tube or gastrostomy are:

- Paediasure / Paediasure Plus (Abbot Ltd): polymeric feeds used from 1-6 years or if less than 30Kg

- Osmolite or Ensure Plus (Abbot Ltd): polymeric feeds used when over 6 years or >30kg
- Emsogen (SHS Ltd): elemental feed may be used if there are signs that the polymeric feeds are not managing to achieve adequate weight gain or that there is malabsorption that cannot be controlled adequately by altering the pancreatic enzyme dose. This feed can be used in a concentrated form to provide 1.0-2.5 kcal/ml. However they need to be made up from powder and may be more difficult for parents to use. Some other peptide based feeds may be used, some of which have the advantage of being in liquid format but they have the disadvantage of not being able to have their energy density manipulated.

Delivery of feeds and supplies at home
If the patient lives locally delivery and provision of feeds is provided by Fresenius Homecare. If the patient lives out of the Avon area an alternative home enteral feeding company will be used. The Dietitian will arrange for these services to be provided but should be given as much prior notice as possible, with a minimum of 5 days. At least 7 days TTA's must be sent with the patient on discharge.

Follow up
Any patient who is sent home on enteral feeds will receive a telephone review one week after discharge and should be reviewed at each of the next 2 CF outpatient clinic appointments. Thereafter they should be reviewed every 3-4 months (~ every second clinic) until they are established on their feed regimen.

Insulin intolerance (especially if the patient is also on corticosteroids) and precipitation of frank diabetes mellitus is common when starting overnight feeding in older children. It is essential to monitor blood glucose and consider insulin therapy if the glucose tolerance test is abnormal. Children on enteral feeds should have early morning finger-prick tests during inpatient stay.

Contraindications for a nasogastric tube or gastrostomy are:
- **Gastro-oesophageal reflux**: 24-hour pH monitoring should be performed before insertion since reflux may be exacerbated. If reflux is present a fundoplication can be performed at the same time as the gastrostomy placement.
- **Portal hypertension**: varices *may* develop at the site of the gastrostomy.

Cases need to be examined individually and relative risks discussed with the family.

6.5 Vitamin supplements

There is likely to be malabsorption of fat-soluble vitamins particularly if the patient is pancreatic insufficient. Vitamin A levels have been shown to be lower in individuals with cystic fibrosis whether they are pancreatic sufficient or not. Clinical evidence such as night blindness is rare but has been documented. Reduced levels of vitamin D are relatively common and osteoporosis has been seen in children although frank rickets is rare. As vitamin E is an anti oxidant, protecting cell membranes from oxidative damage, it may be beneficial in ameliorating deterioration in cell function. Supplementation with Vitamins A, D & E is usual for most patients who are pancreatic insufficient and vitamin E supplements may help even with pancreatic sufficient patients.

Recommended supplementation levels for fat soluble vitamins:

Age	Vitamin A	Vitamin D	Vitamin E
< 1 year	4000 IU (1,200 mcg)	400 IU (10 mcg)	10-50 mg
> 1 years	4000-10,000 IU	400-800 IU (10-20 mcg)	50-100 mg
Adult	4000-10,000 IU	800-2000 IU (20-50 mcg)	100-200 mg

Standard vitamin supplements
All pancreatic insufficient infants should commence on 0.6ml of Dalivit providing 5000IU of vitamin A and 400IU of vitamin D and 0.5ml of vitamin E suspension providing 50mg per day. Dalivit may need to be increased to 1.2 mls depending on serum vitamin levels.

In October 2007, standard vitamin A&D capsules became unavailable and we switched to using vitamin BPC capsules. The table below shows the conversion to the new vitamin BPC capsules.

Current vitamin A&D caps per day	Daily dose of Vitamin A (IU)	Daily dose of Vitamin D (IU)	**Vitamin BPC caps per day**	Daily dose of Vitamin A (IU)	Daily dose of Vitamin D (IU)
1	4000	400	**2**	5000	600
2	8000	800	**3**	7500	900
3	12000	1200	**4**	10000	1200
4	16000	1600	**6**	15000	1800

When children are able to swallow capsules the 0.6ml of Dalivit can be exchanged for 2 vitamin BPC capsules per day, providing 5000IU of vitamin A and 600IU of vitamin D. The level of vitamin E supplementation can increase after the first year to 1ml of suspension. When children can swallow larger tablets a 100mg vitamin E tablet can replace the suspension.

Monitoring serum vitamin levels
Fat-soluble vitamin levels are checked at annual review and may be checked at other times of the year if ongoing monitoring is required. Supplemental doses are adjusted according to the serum levels (for Vitamin D see also section 7.5).
We are not currently prescribing Vitamin K routinely, apart from those children with significant liver disease (use Menadiol 10mg once per day).

If at annual review, the diet is found to be deficient of some nutrients then supplementation with either Paediatric Seravit (which can be mixed with drinks) or Forceval Junior capsules may help to make the diet adequate. Additional dietary counselling can be given to improve intake of specific nutrients if needed.

6.6 Meconium ileus

Meconium ileus occurs in up to 15% of infants with CF. There may be antenatal suspicion of meconium ileus if there is hyperechoic or dilated fetal bowel on ultrasound, but these are not necessarily specific findings. The typical clinical presentation is with bowel obstruction within 48 hours of birth. There may have been a failure to pass meconium and there may be bile-stained vomit. Some cases may have complex meconium ileus, with intestinal atresia, volvulus and perforation with meconium peritonitis. Infants with suspected meconium ileus should be discussed with the paediatric surgical team and usually transferred to Bristol.

In less complex cases, decompression may be accomplished by a gastrografin enema. However if this fails or in more complex cases, a laparotomy is necessary, with irrigation of the obstructed segment, bowel resection, or a temporary ileostomy. Infants with meconium ileus should be referred to the CF team for appropriate further investigations. (See section 3.5 on newborn diagnosis).

6.7 Constipation and distal intestinal obstructive system (DIOS)

Distal intestinal obstructive syndrome (DIOS), previously known as meconium ileus equivalent, is a common complication of pancreatic insufficient cystic fibrosis affecting up to 10-20 % of patients during their lifetime. It occurs due to the accumulation of viscous mucous and faecal material in the terminal ileum, caecum and ascending colon. The incidence seems to increase with age but can occur at any time after the neonatal period.

The cause is not fully understood but dehydration, rapid increases in enzyme dosage, viscid intestinal secretions, altered gut motility and pH, and poor compliance with enzyme therapy seem to contribute to problems. Patients may have intermittent acute exacerbations or chronic symptoms. In the acute form the patient frequently presents with acute lower abdominal pain, abdominal fullness, diarrhoea or constipation and a tender mass in the right iliac fossa. In the chronic form, DIOS can present in a more indolent fashion with symptoms such as anorexia, colicky abdominal pain, abdominal distension, fatty stools and constipation.

Differential diagnoses include appendicitis, intussusception, volvulus, fibrosing colonopathy, biliary tract or gallbladder disease, acute pancreatitis, inflammatory bowel disease, ovarian cysts and urinary tract infections.

Investigations

- FBC, amylase, LFTs
- Urine analysis and culture; stool culture
- Abdominal X-ray
- Abdominal USS (not often helpful in the diagnosis of DIOS but may help exclude other pathology)
- Contrast enema
- Consider faecal fat study after the episode has resolved

Management of acute DIOS

If there are signs of peritoneal irritation or complete obstruction then surgical review is recommended and the patient should be placed nil by mouth, given intravenous fluids and nasogastric aspiration (drip and suck). Oral treatments cannot be given in the presence of bile-stained vomiting. All patients presenting with acute DIOS should be well hydrated, intravenously if necessary. Therapies can be highly osmotic. Pain relief with non-opioid analgesia is recommended and an antiemetic is often given. Give clear fluids only and avoid solids until obstruction has resolved.

There are variable treatment options and preparations may be administered either orally or via nasogastric tube. These include:

1) High dose oral gastrografin (see dosage in BCH CF formulary) once per day for 2 to 3 days. Gastrografin may also be administered by enema under radiological supervision (e.g. 100 ml diluted 3 to 5 times with water up to twice in 24 hours)

2) Alternatively the intestines can be flushed out using a balanced electrolyte solution such as Klean-Prep, which may need to be given via nasogastric tube. Klean Prep may be administered at 10 ml/kg/hour for the first 30 minutes, followed by 20 ml/kg/hour for 30 minutes, and then increased to 25 ml/kg/hr if well tolerated. Maximum volume over 4 hours is 100 ml/kg or 4 litres. A further 4 hours of treatment may be necessary if the output is not clean. However in practice it is unusual to prescribe more than 4 litres a day. The standard adult dose is 2 litres on two successive days.

3) Oral N-acetylcysteine acts as a mucolytic and can help break up the protein matrix of the inspissate. Either N-acetylcysteine oral sachets or Acetylcysteine injection (200mg/ml) can be used orally (see formulary for doses, the latter has a horrid taste). Dilute the injection solution to a concentration of 50mg/ml (orange or blackcurrant juice or cola drink may be used as a diluent to mask the bitter taste).

In more severe cases, DIOS can be successfully treated using gastrografin directed into the lumen of the ascending colon by means of either an enema or colonoscopy (500 ml of 50% gastrografin. In a few refractory cases, surgical decompression may be required but carries a high post operative mortality. In one case of DIOS resistant to conventional therapy, a modified antegrade continence enema technique, creating a continent stoma proved an effective alternative to more conventional surgery.

Once the acute DIOS has resolved, review chronic management to prevent recurrence.

Management of chronic DIOS

- Dietetic review including enzyme dosage, timing and compliance
- Ensure adequate fluid and fibre intake
- General constipation advice
- Treat with laxatives: lactulose, Movicol or senna

7. Other complications

7.1 Diabetes

CF related diabetes (CFRD) occurs primarily from insulin deficiency following progressive deterioration in pancreatic beta cell function; there may also be variable insulin resistance and an increased insulin clearance. It is different from both type 1 and type 2 diabetes. Prevalence increases with age, particularly during the teenage years. There is a spectrum of impaired glucose metabolism varying from normal to fasting hyperglycaemia to persistently elevated blood glucose. Frank CFRD is associated with a deterioration in overall status, and it is becoming clearer that the pre-diabetic period is also linked to worsening clinical status.

Clinical presentation is usually insidious, and typical features of diabetes may be present only in the minority of patients (e.g. osmotic symptoms such as thirst, polydipsia and polyuria). Ketoacidosis does not usually occur. Random urine glucose testing, HbA_{1c} and fasting blood glucose have very limited value in detecting CFRD. The oral glucose tolerance test (OGTT, see section 2.8 for details) remains the gold standard, although it is time consuming and it may miss episodes of hyperglycaemia in some patients. The WHO criteria are used as follows:

Normal	Fasting glucose < 6.0 mmol/l AND 2 hour post OGTT glucose ≤ 7.7 mmol/l
Diabetic	Random glucose ≥ 11.1 mmol/l OR fasting glucose ≥ 7.0 mmol/l OR 2 hour post OGTT glucose ≥ 11.1 mmol/l
Impaired glucose tolerance	Fasting glucose < 7.0 mmol/l AND 2 hour post OGTT glucose 7.8 - 11.0 mmol/l
Impaired fasting glucose	Fasting glucose 6.1 – 6.9 mmol/l

Glucose tolerance can vary with time and can change with pulmonary exacerbations or with drug therapy, especially corticosteroids. Abnormal OGTT results should be discussed with one of the paediatric endocrinologists. Blood glucose profiling is often recommended, sometimes with continuous glucose monitoring devices.

Screening

All patients **13 years and above** should have a yearly OGTT, usually as part of their annual review. All patients will have random blood glucose and a HBA_{1c} on annual review bloods. An OGTT should be considered at any age and at any time of the year for those patients with osmotic symptoms (polydipsia or polyuria), unexplained weight loss or poor growth, or any unexplained deterioration in pulmonary status.

Treatment

Careful dietetic advice will be given but the priority is usually to maintain calorie intake and not omit snacks. Insulin regimes will be directed by the endocrinology team and will vary from a combination of short-acting (bolus) and long-acting (basal) insulin, to long-acting insulin only. Patients with CFRD will be seen regularly seen by the diabetes team, with regular clinic review, ideally to coincide with their usual CF appointments.

7.2 Growth and puberty

Monitoring growth in children with CF is an integral part of their long term management. They may struggle to gain weight and to maintain normal growth velocity. Final adult height may be reduced and there is often a delay in the onset of puberty and sexual maturation.

The causes of suboptimal growth and delayed puberty are multifactoral including reduced pulmonary function, nutrition, chronic infection and inflammation, psychological morbidity and steroid therapy. If considering a possible endocrinological cause for poor growth and/or delayed puberty in children with CF, it is important to optimise the management of any such contributory factors before investigating further or referring to the endocrinology team.

Consider referral to the endocrinology team if concerns about:
glucose tolerance, HPA axis suppression, poor growth despite attention to above factors, concern about delayed puberty or queries about pubertal induction.

Assessment

- Measure and plot height and weight on a growth chart at every clinic visit (no less than 3 monthly)
- Mid parental height range should be calculated and plotted.
- Assess puberty at least annually. For girls ask whether periods have started and for boys if voice has broken. Although self-reporting is unreliable, ask if pubic hair is present. Perform Tanner staging (see definitions of Tanner stages on the growth charts).
- Growth is poor if
    - Height is crossing centiles
    - Height is significantly below the mid parental height range
- Puberty is delayed if
    - Girls of 13 years do not yet have Tanner breast stage 2
    - Boys of 14 years do not yet have testicular volumes of 4 mls

Intervention
If growth is poor or there is delayed puberty, reassess nutrition, lung function, infection status, glucose tolerance and steroid dose if on long term therapy.
Investigations should include

- a bone age (request a TW2 bone age on an X-ray of the left hand and wrist)
- thyroid function tests (request TSH and fT4)
- coeliac screen
- karyotype

Therapy to induce puberty may be considered (e.g. ethinyloestradiol in girls and testosterone in boys). The role of growth hormone in children with CF who are not growth hormone deficient remains controversial and it is not currently a licensed indication.

7.3 Liver disease

The pathogenesis of cystic fibrosis liver disease (CFLD) is multifactorial. Advances in the management of pulmonary disease have increased the importance of recognising CF related liver disease and its management. One of the greatest challenges is to agree criteria for diagnosing liver involvement. This is because onset of liver disease is subclinical and varies between biochemical liver disease without symptoms, reportedly in 20 – 50% of cases, to cirrhosis and portal hypertension in approximately 2 – 8% of children. Peak incidence of diagnosis appears to be about 10 years of age. Children with significant liver disease who have cirrhosis and portal hypertension may have normal transaminases whilst those with mild liver disease may have transaminitis. Although imaging modalities can detect established nodularity or cirrhosis, they are not good at detecting early changes in CFLD such as hepatic fibrosis. Some abnormalities on ultrasound are of uncertain significance (e.g. hepatic steatosis) but ultrasound can usefully quantify spleen size and portal vein flow as evidence of portal hypertension.

Our current screening protocol is as follows:

- abdominal examination at each clinic attendance
- yearly liver function tests (including γGT)

We request upper abdominal ultrasound if there is either hepatomegaly on clinical examination, or if there is significant abnormality in LFTs (e.g. 2x upper limit of normal). If LFTs are only mildly abnormal, these should be repeated in the next 6 months.

As yet, it is not possible to prevent the onset of liver disease but there is some evidence that the use of ursodeoxycholic acid (UDCA) may prevent the progression of cirrhosis. It has been demonstrated that transaminitis resolves on UDCA therapy and there is improvement in bile flow. There are no significant side effects of UDCA but it can sometimes cause transient diarrhoea which responds to a reduction in dose or settles with time.

Clinical criteria for CFLD - at least 2 of the following:

- Clinical hepatomegaly (liver palpable at least 2 cm below the costal margin)
- Raised transaminases (AST, ALT) and gammaGT (γGT) at least 3 times upper limit of normal on at least 3 occasions in a 12 month period
- Ultrasound evidence of liver disease / cirrhosis +/- portal hypertension
- Liver biopsy evidence of CFLD

If above criteria apply, start UDCA at 10mg/kg twice a day.
Patients with CF are also at increased risk of gall stones/biliary strictures which may respond to UDCA treatment at the above dose. However, if symptomatic they may require surgical intervention.

Nutritional support

Poor weight gain may be a manifestation of deteriorating or significant liver disease. Generally, this is because of fat malabsorption due to the underlying liver disease and if severe also protein loss in addition to pancreatic insufficiency.

- Ensure energy intake is sufficient
- Increasing proportion of fat to 40 – 50% of feed or diet to improve fat absorption and avoid essential fatty acid deficiency

- Protein supplementation to 3g/Kg/day
- Appropriate pancreatic enzyme supplementation to allow absorption of long chain triglycerides and essential fatty acids.
- Ensure fat soluble vitamin supplementation (A,D,E **and K**). Monitor levels in particular vitamin A levels which can be hepatotoxic.

It may be necessary to give supplemental nutrition via naso-gastric tube feeding. Gastrostomy insertion is not recommended in patients with advanced liver disease and portal hypertension because of the risk of developing "stomal" varices.

Consider referral to Birmingham Children's Hospital Liver Transplant Unit for assessment for possible liver transplant (Consultant is Dr Indra Van-Mourik, 0121 333 9999) if:

- Significant and progressive liver disease with deteriorating lung function
- Progressive liver disease may be manifested by increasing spleen span, hypoalbuminaemia, prolonged clotting or jaundice if severely compromised. Difficulty maintaining good weight gain in the presence of liver disease despite optimal support should also be considered as a pointer for referral
- Complications of portal hypertension such as bleeding oesophageal varices would prompt referral to the Liver Unit for management but may not indicate immediate consideration for liver transplant as other treatment modalities are available such as oesophageal banding

7.4 Arthropathy

The usual age of onset of arthopathy in CF is in the second decade, with symptoms often resolving in adulthood. Up to 10% of patients can be affected and symptoms do not appear to correlate with disease severity or nutritional status; however joint exacerbations may occur during pulmonary exacerbations.

Exacerbations usually occur as flares (reactive arthritis) which resolve spontaneously and often affect single joints or form a symmetrical polyarthritis. There may be a local maculopapular rash, or erythema nodosum, and occasionally a vasculitic rash. Symptoms last from one day to several weeks but usually for an average of 5-7 days. The knees are most commonly involved but other joints can also be affected. Reactive arthritis can progress to persistent synovitis with recurrences over many years.

The pathophysiology is unknown but may be related to high levels of immune complexes with bacterial antigens. Joint fluid is sterile, with inflammatory cells but no microcrystals. Synovial biopsies are often normal or show an inflammatory synovitis.

X-Rays are generally unhelpful but can show an effusion. Episodic arthritis usually responds to NSAIDs or aspirin, in addition to paracetamol. Steroids (either oral or intraarticular) may have some benefit. Ciprofloxacin can cause an arthropathy in children and adults; this usually settles within two weeks of stopping the drug.

Differential diagnoses should include septic arthritis, other causes of a reactive arthritis (perform an ASOT), haematological malignancy, non-accidental injury, and various forms of autoimmune connective tissue disease e.g. SLE, dermatomyositis and juvenile chronic arthritis (request rheumatoid factor, ANA etc, and HLA B27 status).

Pulmonary hypertrophic osteoarthropathy (HPOA) tends to occur in adult patients with severe pulmonary disease. There is a symmetrical arthralgia with pain and effusions affecting the larger joints such as the knees, wrists and ankles and long bones. There is often tenderness along the shaft of the bone and the X-ray will show periostitis.

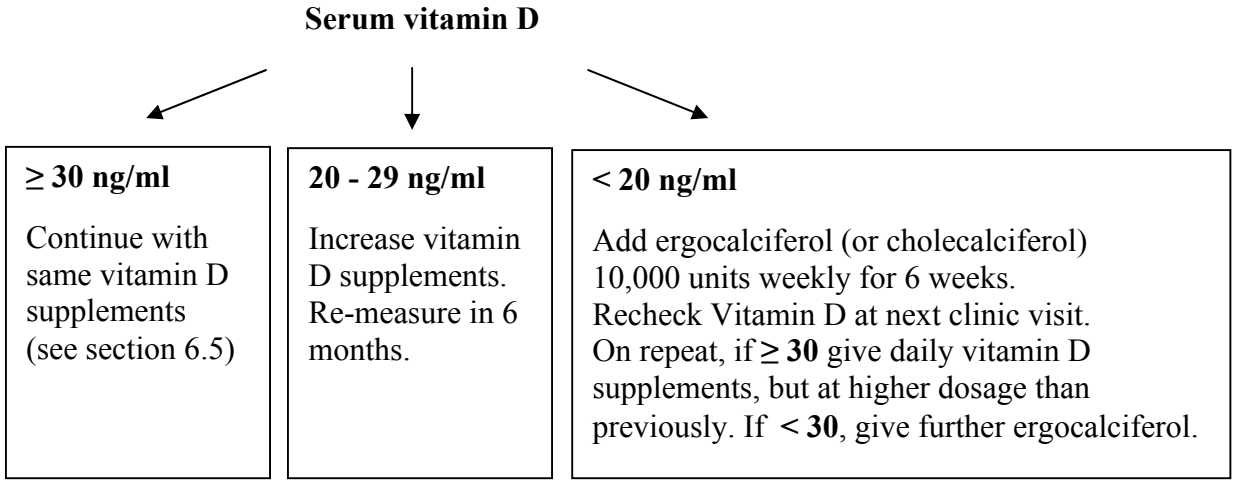
Difficulties in managing joint problems should be discussed with Dr Athimalaipet Ramanan or Dr Jacqui Clinch, Consultant Paediatric Rheumatologists. Patients with arthropathy will be routinely seen by physiotherapy including access to the specialist rheumatology physiotherapist.

7.5 Bone health

Improved survival with CF into adulthood has led to an increased recognition of bone disease in CF adults. Disturbances of normal bone development occur in CF through a myriad of mechanisms. The term 'osteoporosis' is therefore oversimplistic, as osteomalacia is also often present. It is more appropriate to refer to "CF bone disease".

As CF bone disease has a multifactorial aetiology, minimisation of each risk factor through appropriate management is an important component of routine CF management. Emphasis on improving bone health is necessary from the outset, rather than once low bone mineral density is documented on DEXA. Contributory factors identified from several international studies are outlined in the table below:

Risks to Bone Health	**Management Strategy**
Reduced pulmonary function & systemic inflammatory response to infection	General CF pulmonary management
Malnutrition	Optimisation of nutrition
Vitamin D insufficiency	Aim to maintain serum 25(OH) Vitamin D between 30 - 60 ng/ml (see below).
Vitamin K insufficiency	Consider Vitamin K supplements
Calcium deficiency	>8 years: Ca intakes 1300 – 1500mg/day are suggested
Reduced levels of exercise	Encourage exercise and mobility, with specific reference to weight-bearing activity
Glucocorticoid use	Dose and/or duration minimisation if clinically possible
Delayed puberty	Monitor pubertal progression Referral to endocrinology if pubertal delay is present (section 7.2)
CF related liver disease	Section 7.3
CF related diabetes mellitus	Early diagnosis through screening Optimisation of diabetes management (section 7.1)



Screening Tools: DEXA assesses the cross-sectional area of bone to calculate the area (2 dimensional) bone density. It is important to remember that small bones will give an artificially low value. Thus care must be taken in DEXA interpretation in CF children with poor growth. Various methods for body size correction exist, but there is no consensus agreement on validity of one method. In practice, it must be remembered that children with poor growth will appear to have low bone mineral density (BMD).

We suggest **selective DEXA screening** (in line with several international consensus documents) in children **over 12 years of age** with at least one of the following additional risk factors:

- Prolonged oral steroid use
- Poor growth
- Rapidly falling lung function
- Fragility fracture (fracture sustained following minimal trauma)

Requests for DEXA scans should be sent to Dr Christine Burren, Consultant Paediatric Endocrinologist – the form is available on the shared respiratory folder.

Actions following DEXA

DEXA indicates normal BMD:

- repeat scan in approximately 3 years

DEXA indicates low BMD:

- this should heighten the focus on the strategies listed above to minimise progression of CF bone disease. In particular, optimise nutrition and supplementation with Vitamin D, Vitamin K and calcium and encourage weight bearing exercise.
- Bisphosphonates do not have a routine role in CF bone disease, although consideration would be given in cases of progressive bone loss, fragility fractures and pre-transplant workup; such cases should be discussed with Dr Burren.

7.6 Nasal polyps and sinusitis

Nasal polyps are non-neoplastic outgrowths of the lining of the nose and sinuses that are characterized by oedematous mucosa. They occur in about 10% of children and up to 40% of adults with CF. They are uncommon < 5 years and onset is generally between 8-10 years. The aetiology is uncertain but it may be related to infection, allergy, immune factors, altered secretions and abnormal cilia. There is also an association with chronic sinus infection. If the polyps are small, patients are asymptomatic.

Large polyps can result in chronic nasal obstruction that increases airway resistance and may lead to mouth-breathing. Impaired nasal airflow prevents smells reaching the olfactory mucosa situated in the roof of the nose. This results in an impaired sense of smell and taste. Polyps can easily block the narrow channels through which the sinuses drain, resulting in headache and eventually chronic sinus infection. Chronic rhinosinusitis develops which can increase the incidence of pulmonary infections.

Diagnosis is made from the history and examination findings. The nose is easily examined using an auriscope with a 4mm end-piece. The nasal septum (midline wall) and turbinate bones (lateral wall) look pink. Nasal polyps have a grey, glassy appearance and are insensate if probed using a cotton bud.

Initial treatment is with a topical steroid nasal spray such as fluticasone (Flixonase) or mometasone (Nasonex) once daily. Nose drops are a more powerful topical treatment in the form of betamethasone (Betnesol) or fluticasone (Flixonase nasules). Flixonase nasules are preferred as the dose is more accurate and less susceptible to overdose. All nasal preparations should be used either in the head-down forward-roll position or with the head tilted backwards off the side of the bed. A short course of oral prednisolone can give good relief but only 2 courses are recommended per year (e.g. 30mg od for 1 week, then 20mg od for 1 week and 10mg od for the 3rd week). Anti-histamines are of little value.

Surgery is considered for patients who fail to respond to these treatments. HR CT is performed prior to surgery. Radical endoscopic polypectomy is carried out in the first instance. If polyps recur quickly then more extensive FESS (Functional Endoscopic Sinus Surgery) is performed but due to the high recurrence rate (60-90%), multiple procedures may be necessary.

If conservative therapy is failing, refer to Mrs Claire Langton Hewer.

Sinusitis is inflammation of the lining of the nose and sinuses characterised by symptoms of nasal block, facial pain or headache and infected nasal secretions which drip down the front or back of the nose. Although almost all children with CF have chronic paranasal sinusitis, only 1% are symptomatic. X-ray of the sinuses is of little value, as over 92% of all children with CF will have opacification of the maxillary, ethmoid and sphenoid sinuses. Initially, opacity is due to retention of thick secretions but later it may be due to polyposis within the sinuses. The frontal sinuses rarely develop in children with CF, probably due to early onset of sinusitis, which prevents pneumatisation. Chronic sinusitis is commonly associated with nasal polyposis.

Sinusitis may cause headaches and aching of the face, particularly on tilting the head forwards. Other symptoms are related to chronic nasal obstruction (mouth-breathing,

snoring, loss of sense of smell) and purulent drainage (postnasal drip, constant throat-clearing, halitosis).

Diagnosis is based on a history of nasal obstruction, infected nasal discharge and headache. Nasal endoscopy in clinic will reveal inflamed nasal mucosa with or without the presence of nasal polyps. Purulent nasal secretions may lie on the nasal floor or arise from the maxillary or other sinuses. There may be some associated tenderness of the maxillae or forehead. Nasal swabs may grow Staphylococcus aureus or Pseudomonas aeruginosa.

Treatment with long-term oral macrolide antibiotics (6-8 weeks), such as clarithromycin or azithromycin, may be effective. Saline douching with either Sterimar nasal spray or, better still, Sinus Rinse (Neilmed) is helpful in thinning down the infected secretions, but is usually not popular with children. Oral metronidazole may improve halitosis. Use of a sinus nebuliser (SinuNEB) for DNase and/or colistin is available through the CF physiotherapists.

Functional Endoscopic Sinus Surgery (FESS) is sometimes necessary to alleviate symptoms when conservative treatment fails. As with patients with nasal polyps, detailed CT imaging of the sinuses is performed in order to establish detailed bony anatomy and the extent of sinus disease before surgery is undertaken.

7.7 Pseudo-Bartter's syndrome

Pseudo-Bartter's syndrome is an uncommon form of metabolic alkalosis that may occur in CF, and rarely as a presenting feature. There is a **hypochloraemic-hypokalaemic alkalosis** with appropriately low levels of urinary chloride and sodium (<20mmol/l). There is chronic salt depletion and sometimes failure to thrive without dehydration. Treatment is with sodium and/or potassium chloride supplements which should, fairly rapidly, lead to resolution of metabolic abnormalities and then weight gain. These may need to be continued for some months. Pseudo-Bartter's syndrome should be considered as a possible explanation for poor weight gain despite adequate other therapy.

7.8 Infertility

Between 95% and 98% of all CF males are infertile due to absence or obliteration of their vas deferens during foetal development, with resultant azoospermia. It is important that this is discussed with the parents soon after the child's diagnosis. In turn, parents are advised to talk to their child about this important issue as early and simply as possible. Emphasis should be made that infertility is not to be confused with impotence and males will be able to enjoy normal sexual relationships. It is essential that all boys with cystic fibrosis are aware of infertility by the time they reach their teens.

Although it can be assumed that almost all males are infertile, good contraceptive measures should be used by sexually active boys until semen analysis confirms this. The continued use of condoms is highly recommended as a measure against sexually transmitted diseases – we should promote 'safe sex'.

At present, infertile CF males who would like to have children can be referred to the Centre for Reproductive Medicine and opt for microsurgical sperm aspiration and IVF treatment using intracytoplasmic sperm injection (ICSI). At present there is around a 30%

success rate with IVF treatment. However, techniques may develop and have success rates in the future.

Girls with cystic fibrosis have been reported to have slightly more viscid cervical mucus than normal but this does not seem to impair fertility. Sexually active girls should use effective contraception to avoid unwanted pregnancy. Advice regarding suitable contraception is essential as both antibiotic treatment and malabsorption can affect the efficiency of some preparations.

8. Transplant assessment

The primary goal of pulmonary transplantation is to give survival benefit. Expected post transplant survival should therefore outweigh expected survival without transplant. Current median survival after pulmonary transplant in cystic fibrosis patients is approximately 5 years. There is however also often a significant increase in quality of life.

We would consider referral for assessment for pulmonary transplantation in some or all of the following settings. There is usually no single determinant for referral.

- Expected chance of surviving two years is less than 50%
- FEV_1 is dropping to 30% or there is rapid decline in pulmonary function
- Frequent admissions with pulmonary exacerbations, with decreasing response to therapy

We refer patients below 16 years of age for assessment to Great Ormond Street Hospital, and those over 16 to Harefield; we would discuss with one of the transplant consultants before formal referral. An open discussion should take place with the young person and their family before referral is made. Referral to the transplant centre is better to be made early rather than very late if there is major decline in pulmonary status.

There are a number of absolute and relative contraindications; these may vary somewhat between centres and will depend on the individual patient. Particular problems are co-existent liver disease, multi-resistant organisms, and infection with non-tuberculous mycobacteria.

It is important at the outset to be realistic with the family. Referral for assessment will only be for assessment; they may or may not be accepted. Even if accepted for transplant, 50% of patients die before transplant. Being on a transplant waiting list may be a very difficult time for the family. Following transplant, some patients die from early rejection or severe infection. Although transplant survival is slowly improving, and immunosuppressive regimes may improve, episodes of infection are common; obliterative bronchiolitis is the main cause of morbidity and mortality long term, and is difficult to treat.

9. Miscellaneous

9.1 Travel

The majority of CF patients can and should enjoy holidays in both the UK and abroad. However patients and families need to consider how best to manage treatments and care whist away from home. Seeking an outpatient appointment 2-4 weeks before is suggested so the team can advise on aspects of care particularly if travelling abroad. Any recommended treatment can also be established and completed before the holiday commences.

When travelling abroad it is worth remembering that standards of health care can vary widely throughout Europe and the rest of the world. Consideration to the following is advised

- Health insurance - Travellers in Europe should obtain an E111 card (this changed in 2005 from an annual form) entitling the holder to the same level of care as that country's own nationals. See http://www.dh.gov.uk/travellers.This should not be the only cover - private health travel insurance should also be obtained.
- Travel health insurance can be obtained from a wide variety of insurance providers. As a team we encourage patients and their families to contact the Cystic Fibrosis Trust as they keep up to date information on insurers who will provide an adequate level of cover at a competitive cost.
- Advice should be sought from the team if vaccinations or anti-malarial cover are recommended.
- Salt supplements may be needed if travelling to a hot country.
- The CF team should be informed if travel to a long-haul destination (over 4-5hrs flying time) is being considered. Patients with moderate/severe disease may need a 'fitness to fly' assessment (see section 10.2)
- A copy of the patient's last clinic correspondence and most recent annual review is the usual information to have with the family in case medical advice and care is needed. This will provide the medical team with recent information and treatment regimes.
- Adequate supplies of all medication, treatment and equipment should be taken, as it is often very difficult to obtain in foreign destinations. The CF team can provide letters of explanation, particularly in the case of needles and syringes.

9.2 Flying

Patients with severe lung disease (FEV_1 <50%), patients with baseline SpO2 <92%, or those on overnight oxygen should have a hypoxic challenge test (fitness to fly test, see http://www.brit-thoracic.org.uk/c2/uploads/FlightRevision04.pdf). A pressurised cabin during flight has a lower concentration of oxygen than at sea level and therefore supplemental oxygen may be necessary. Particular consideration should be given if flying through time zones, as the need to sleep is greater, increasing the need for supplemental oxygen.

A hypoxic challenge test will simulate cabin oxygen concentration, with recording of base line oxygen saturation then measurements in the simulated conditions. We will then make a recommendation as to fitness to fly and what oxygen provision should be made available

during the flight. Supplemental oxygen is recommended if SpO_2 falls below 90% during the test.

Oxygen when travelling
If oxygen has been recommended in flight then the patient and family will need to check with the airline (preferably before booking) they are travelling with as to whether it is available on the flight. Each airline will vary considerably and there may well be an additional cost to provide this service. If supplemental oxygen is required in the holiday destination then an oxygen concentrator and back up cylinder will need to be organised. An oxygen provider can deliver this direct to the holiday accommodation. There will be cost for this service paid directly to the company organising the service. The CF team has information sources for the most popular European holiday destinations. The CF Trust and the UK oxygen provider should also hold this information.

Patients will need to plan well in advance if complex treatments and equipment are required. Careful consideration and planning will needed for a successful and enjoyable holiday.

9.3 Immunisation

Routine childhood immunisations should be given at the usual times.

Influenza
All children over 6 months of age with cystic fibrosis should receive the influenza vaccination annually between September and early November, through their GP. Children under 13 years receiving the vaccine for the first time should receive a second injection 4-6 weeks after the first. It is contraindicated in children with egg hypersensitivity.

Pneumococcal vaccination
The conjugate vaccine is now incorporated into the routine immunisation program. We do not recommend vaccination with the polysaccharide vaccine in older children with CF, unless there are other risk factors for pneumococcal disease.

BCG
BCG vaccination is no longer routine for the general population but neonatal vaccination is given in targeted populations and individuals at particular risk. We do not otherwise recommend BCG vaccination in children with CF.

RSV
We do not currently recommend passive immunisation with the monoclonal antibody Palivizumab (Synagis) in infants with CF.

9.4 Chickenpox

Varicella-zoster infection may lead to infective pulmonary exacerbations and early treatment with acyclovir may be of benefit. It is important to ascertain whether the child is taking oral steroid therapy.

Children who are not on oral steroids:
If it is early in the course of the illness, and the child is unwell, then we would recommend a one week course of oral acyclovir. However if it is several days into the illness and they are well, then we would not recommend aciclovir.

Children who are (or have been) taking oral steroids
If children have not had chicken pox previously, and are exposed to chicken pox, then they should receive Varicella-Zoster Immunoglobulin (VZIG) if they are **currently taking oral steroids**, or in the last **3 months** have had the equivalent of 2mg/kg/day prednisolone for 1 week, or the equivalent of 1mg/kg/day prednisolone for 4 weeks. A second dose should be given if further exposure occurs more than 3 weeks after the first dose.

Varicella-susceptible children on oral steroids that have come in contact with chicken pox should be reviewed. If a rash develops, treat with IV acyclovir.

10. End stage disease

Although the majority of patients with cystic fibrosis will live well into adulthood, death can still occur in childhood or adolescence within the paediatric setting. The role of the CF team at this time is to support the child and family, ensure good symptom control and facilitate choice, whenever possible acknowledging the wishes of the young person and family.

At an early stage a key worker should be identified to coordinate care – this is often one of the CF Clinical Nurse Specialists who will know the family well. An honest and open approach is encouraged to avoid confusion, allow discussion and informed sound decision making. This should include the young person whenever possible. The basis of good palliative care is symptom management. Distressing symptoms must be prevented whenever possible and if not, identified and managed quickly. Medications that are more burdensome than helpful should be discontinued and this should be decided by the child and family. A lifetime of medication is not always easy to let go of and therefore sensitivity should be used when suggesting any withdrawal of treatment. Investigations and observations such as blood samples or oxygen levels should be discontinued as they are unlikely to alter management. Often treatments such as physiotherapy can be changed to massage, helping the child relax and soothing general discomfort. Aggressive nutrition should no longer be employed. The young person should decide what they would like to eat although fluids should be encouraged to maintain hydration. Families must be made aware of any likely events such as haemoptysis so that they are prepared should they occur.

The option of non invasive-ventilation should be discussed, as it may help with symptom control (although also used as a 'bridge' to transplant). Children who are awaiting transplant should still receive palliative symptom management. This may well sit 'hand in hand' with IV antibiotics or other treatment. The transplant centre must be kept informed of all events and may advise whether the child should be removed from the list.

Intubation and ventilation is generally futile for CF patients in end stage, as severely damaged lungs are unlikely to recover. This results in the child spending their last days in PICU and the ventilator being switched off causing extreme distress to the family. This should be gently explained to the family at the beginning of the palliative phase. Do not resuscitate orders (DNR) should also be discussed with the parents and older children and be clearly documented as per Trust policy.

Home care

Children and their families often prefer to be at home during the end of life. Palliative care is offered by the CF CNS and the CF Specialist Physiotherapists who can visit daily if required. The CF CNS will visit the family doctor and keep him or her up to date with events. The GP may wish to be involved in the young person's care or prefer for the CF team to manage this. In any case the GP will be able to provide support to the wider family. The CF CNS will work in partnership with the family, CF Team and community services to assess needs and coordinate care. A 24 hour on call service is offered at the terminal stages. All appropriate medication including opiates and syringe drivers is prescribed and kept in the house to be available to the CF CNS or medical staff to administer as necessary for effective symptom control.

Practical aspects of care must be discussed sensitively. Parents may need to take time off work and their may be financial hardships. The CF Social Worker can be invaluable in addressing these aspects. The family will need to know what to expect and what to do at the time of death. The young person may well have questions (and viewpoints) of their own and these must not be avoided. Many older children want to bequeath their possessions to friends and family and to choose funeral arrangements.

The family will need specific support as coping mechanisms vary widely. Special attention must be given to siblings, in particular those that also have cystic fibrosis. The team also offer bereavement follow-up to the family.

Symptom control should take into consideration the following:

- Pain
- Dyspnoea
- Excess or difficult respiratory secretions
- Anxiety
- Restlessness or confusion
- General discomfort – musculoskeletal aches & pains
- Abdominal discomfort & constipation
- Nausea or vomiting
- Hydration
- Possibility of haemoptysis or haemetemesis

General care must include:

- Hydration
- Appropriate attention to nutrition
- Toileting
- Mobility & pressure area care
- Mouth care
- Review of usual medication and treatment needs
- Emotional support for the whole family
- Bereavement follow up

11. Formulary

Acetylcysteine	Oral	<2 yrs: 0.4-3 grams single dose 2-7 yrs: 2-3 grams single dose >7 yrs: 4-6 grams single dose	For treatment of DIOS. Use oral granules.
Amikacin (A*minoglycoside*)	IV	30 mg/kg od (max 1.5 grams od) Infusion over 20-30 mins.	Level at 22-24 hours after 1st dose must be <3 mg/l. Repeat day 9.
Amoxycillin	Oral	<1 yr: 125 mg tds 1-7 yrs: 250 mg tds >7 yrs: 500 mg tds	Give at least 2 weeks.
Amphotericin	Nebulised	<10 yrs: 5 mg bd >10 yrs: 10 mg bd	
Amphotericin (liposomal)	IV	Start at 1 mg/kg od & increase in daily steps of 1mg/kg to 3mg/kg od	Give test dose of 100 mcg/kg (max 1 mg) over 10-15 mins. Check renal function 3 times per week; be careful if on other nephrotoxics.
Azithromycin *Treatment course*	Oral	10 mg/kg od (max 500 mg od)	Usually give for 7-10 days.
Azithromycin *Regular treatment*	Oral	15-40 kg: 250 mg od >40kg: 500 mg od	Alternative is 3 times per week.
Aztreonam *(Beta-lactam*)	IV	50 mg/kg tds Can use qds (max 2 grams qds)	
Cephradine	Oral	<12 yrs: 25 mg/kg bd >12 yrs: 1 gram bd	Give at least 2 weeks.
Cefixime	Oral	<10 yrs: 8 mg/kg od (max 400mg) >10 yrs: 200-400 mg od	Give at least 2 weeks.
Ceftazidime (*Cephalosporin*)	IV	50 mg/kg tds (max 3 grams tds)	Alternative is 75 mg/kg bd (max 4.5 grams bd).
Ceftazidime	Nebulised	Up to 1 gram bd	
Cefuroxime (*Cephalosporin*)	IV	50 mg/kg tds (max 1.5 grams tds)	
Chloramphenicol	Oral	12.5 mg/kg qds (max 1 gram qds)	Smallest dose is 250 mg (capsule). Needs microbiology approval. Monitor FBC weekly.
Ciprofloxacin	Oral	<5 yrs: 15 mg/kg bd >5 yrs: 20 mg/kg bd (max 750 mg bd)	Warn of photosensitivity – need to take precautions.
Clarithromycin	Oral	<8 kg: 7.5 mg/kg bd 8-11 kg: 62.5 mg bd 12-19 kg: 125 mg bd 20-29 kg: 187.5 mg bd 30-40 kg: 250 mg bd >12 yrs: 250-500 mg bd	
Clindamycin	Oral	5-7 mg/kg (max 600 mg) qds	Capsules are 250 mg.
Co-amoxiclav (Augmentin®) *Treatment course*	Oral	<6 yrs: 0.5 ml/kg of 125/31 tds 6-12 yrs: 0.3ml/kg up to 10 ml of 250/62 tds 12-18 yrs: 1 tablet 500/125 tds	Give at least 2 weeks.
Co-amoxiclav (Augmentin®) *Prophylactic therapy*	Oral	<6 yrs: 0.25 ml/kg of 125/31 bd 6-12 yrs: 5 mL of 250/62 bd >12 yrs: Augmentin oral tabs (250/125) 1 tab bd	Can use if flucloxacillin not tolerated or if regular *H. influenzae*. May discolour teeth. Septrin is alternative. Augmentin-Duo® may be an option.

Colistin (Colomycin®)	Nebulised	<1yr: 500,000 units bd 1-7 yrs: 1,000,000 units bd >8 yrs: 2,000,000 units bd	Can also use od. Be careful of bronchospasm; give first dose in hospital. Give after physio.
Colistin (*Polymyxin*)	IV	25,000 units/kg tds (max 2,000,000 units tds)	Need to monitor renal function at least once per week. Avoid using with IV aminoglycosides and amphotericin.
Co-trimoxazole (Septrin®)	Oral	<6 months: 120 mg bd 6 months – 6 years: 240 mg bd 6 -12 yrs: 480 mg bd >12 yrs: 960 mg bd	
Dalivit	Oral	0.6 ml od	Dose guided by serum levels of vitamin A and D.
rDNase (Pulmozyme®)	Nebulised	2.5 mg od	At least 1 hour pre-physio. Occasionally use twice daily. Can consider using alternate days after 3 months.
Domperidone	Oral	<12 yrs: 0.2-0.4 mg/kg (max 20mg) bd, tds, or qds >12 yrs: 10-20 mg bd, tds or qds	
Doxycycline	Oral	>12 yrs: 200 mg od on 1st day; then 100 mg od (can increase to 200mg od)	Over 12 yrs only. Warn of possible photosensitivity. Take standing or sitting upright with water.
Erythromycin	Oral	<2 yrs: 250 mg bd 2-8 yrs: 500 mg bd >8 yrs: 500 mg - 1 gram bd	
Flucloxacillin *Treatment course*	Oral	25 mg/kg qds (max 1 gram qds)	Can use total daily dose in 2 or 3 doses to aid adherence.
Flucloxacillin *Prophylactic therapy*	Oral	25 mg/kg bd	
Forceval Junior	Oral	>5 yrs: 2 tablets od	May be given as an adjunct to A & D capsules if vit D levels are low.
Forceval	Oral	12-18 yrs: 1 capsule od	As for Forceval Junior.
Gastrograffin	Oral	<10 kg: 25 ml with 100 ml flavoured juice / water 10-25 kg: 50 ml with 200 ml flavoured juice / water >25 kg: 100 ml with 400ml flavoured juice / water	Highly osmotic; need careful hydration. Do not give if there is bile stained vomiting.
Gentamicin (nebulised)	Nebulised	<2 yrs: 40 mg bd 2-8 yrs: 80 mg bd >8 yrs: 160 mg bd	Be careful of bronchospasm; give first dose in hospital. Give after physio.
Gentamicin (*Aminoglycoside*)	IV	10 mg/kg od (max 600mg od) Infusion over 20-30 mins.	Level taken 22-24 hours after 1st dose must be <1 mg/l. Repeat on day 9.
Hypertonic saline	Nebulised	2-4 mls of 7% solution	Up to twice per day 30 mins before physio.
Itraconazole	Oral	2.5 mg/kg bd (Can also use 5 mg/kg od)	Take with cola or other acidic liquid. Stop antacids if possible, or give 1 hour later. Consider monitoring LFTs. Consider monitoring levels (ideal trough serum level is 0.5-1 mg/l).

Lactulose	Oral	<1 yr: 2.5ml bd 1-5 yrs: 5 ml bd 5-10 yrs: 10 ml bd >10 yrs: 15ml bd	Adjust according to response.
Linezolid	Oral	<12 yrs:10 mg/kg tds (max 600 mg tds) >12 yrs: 600 mg bd	Needs microbiology approval. Last line antibiotic against MRSA or *S aureus*. Monitor FBC weekly.
Meropenem (*Carbapenem*)	IV	40 mg/kg tds (max 2 grams tds)	
Ketovite liquid	Oral	5 mls od	Rarely given as vit A content is low. May be useful if serum vit A is high.
Ranitidine	Oral	<6 months: 1 mg/kg tds >6 months: 2-4 mg/kg bd (max 150mg bd)	
Rifampicin	Oral	<1 yr: 5-10 mg/kg bd >1 yr: 10 mg/kg bd (max 600 mg bd)	
Sodium fusidate	Oral	<1 yr: 15 mg/kg tds 1-5 yrs: 250 mg tds 5-12 yrs: 500 mg tds >12 yrs: 750 mg tds	
Tazocin® (*ureidopenicllin & beta-lactamase inhibitor*)	IV	90 mg/kg qds (max 4.5 grams qds)	Piperacillin / tazobactam.
Teicoplanin (*Glycopeptide*)	IV	10 mg/kg (max 400 mg) every 12 hours for 3 doses; then 10 mg/kg od (max 400 mg od)	
Timentin® (*Carboxypenicillin)*	IV	80 mg/kg qds (max 3.2 grams qds)	Ticarcillin / clavulanic acid.
Tobramycin (*Aminoglycoside*)	IV	10 mg/kg od (max 600mg od) Infusion over 20-30 mins.	Level taken 22-24 hours after 1st dose must be <1 mg/l. Repeat on day 9.
Tobramycin (IV solution)	Nebulised	<2 yrs: 40 mg bd 2-8 yrs: 80 mg bd >8 yrs: 160 mg bd	Be careful of bronchospasm; give first dose in hospital. Give after physio.
Tobi®	Nebulised	300mg bd	Use on alternate months.
Trimethoprim *(Prophylaxis)*	Oral	<12 yrs: 2 mg/kg nocte (max 100 mg) >12 yrs: 100mg nocte	
Urokinase	IV	5000 – 10 000 units in 0.9% saline (2mls)	For occluded ports. Leave for 2-4 hours and then aspirate the lysate; then flush with heparinised saline.
Ursodeoxycholic acid	Oral	10 mg/kg bd	
Vancomycin (*Glycopeptide*)	IV	15 mg/kg tds (max 660 mg tds)	Trough level should be 5-10mg/l.
Vitamin A+D	Oral	1-2 capsules od	These became unavailable from November 2007
Vitamin BPC capsule	Oral	Usually start at 2 capsules od	
Vitamin E suspension	Oral	Infants: 0.5 ml od >1 yr: 0.5 - 1ml	May give up to 2ml od depending on serum levels. 1ml = 100mg.

Vitamin E tablets (Ephynal) 100mg	Oral	>1 yr: 100 mg od (1 tablet)	May increase to 200mg; dose guided by serum levels.
Vitamin K (Menadiol)	Oral	10 mg od	Use in liver disease. Supplementation may also be important in bone mineralisation in other children with CF.
Voriconazole	Oral	<12 yrs: 6 mg/kg bd (max 200 mg) for 1 day, then 4 mg/kg bd (max 100 mg) >12 yrs (<40 kg): 200 mg bd for 1 day, then 100 mg bd >12 yrs: (>40 kg) 400 mg bd for 1 day, then 200 mg bd	Warn of photosensitivity and temporary visual problems Monitor LFTs.
Zinc (Solvazinc)	Oral	½ tablet od (22.5 mg)	Given if serum levels are low. Additional dietary advice given to try to improve intake.

12. Appendices

12.1 Clinic proforma

Name **Hospital number**

(or label)

Weight **Height**

Centile Centile

Date of this review

Respiratory symptoms (cough, wheeze, sputum, dyspnoea, exercise)

Gastrointestinal (weight gain, appetite, pain, stools, reflux symptoms)

Other symptoms / problems

Current medications or recent changes

Recent additional antibiotics?

Examination

Clubbing Y/N
Nasal polyps Right: Y/N Left: Y/N
Chest examination

FEV_1	**L;**	**%**
FVC	**L;**	**%**
SpO_2		

Abdominal examination

Hepatomegaly Y/N Size Splenomegaly Y/N Size
Faecal masses Y/N
Other examination:

Dietician review

Physiotherapy review

Nursing review

Plan

Next clinic:
Red / Blue / NLC

No of weeks ☐

Signed: **Date:**

Positive microbiology from this clinic visit and treatment changes

Date Sample: cough swab / sputum

Organism:

Sensitivities:

Treatment:

Signed:

12.2 Social security benefits

Entitlement to benefits depends on personal circumstances such as employment status, national insurance record or savings. Having dependants and any income can also be taken into account for some benefits.

Benefits are divided into two groups: **means tested** and **non-means tested** benefits. All benefit rates are reviewed each year in April.

This is a general overview; it is always best to seek advice to gain accurate information for individual entitlement, as it is possible to fall into more than one category or entitlement to one benefit which will open a gateway to additional benefits.

Means Tested Benefits, Tax Credits and The Social Fund

- **Income Support** - designed to provide a 'safety net' for certain people whose income falls below a legally set level.
- **Jobseekers Allowance** (income based) - designed to provide a 'safety net' for unemployed people whose income falls below a legally set level.
- **Child Tax Credit** - payable to those responsible for one or more children. Entitlement is calculated on an annual basis and is based upon factors including income, age of children and if a child is disabled. It is a separate and additional to child benefit. This benefit is payable to both those in work (combined with working tax credit) and people who are not working.
- **Working Tax Credit** - replaced working families tax credit and disabled person's tax credit in 2003. Entitlement is calculated on an annual basis and is based upon factors including disability, number of hours worked, income and childcare costs.
- **Housing Benefit** - To assist with the payment of rent and similar housing costs for people with a low income.
- **Council Tax Benefits** - To assist with the payment of council tax for people with a low income. A reduction in council tax of 25% is awarded if there is a sole adult occupant or an award is made under each local authority's council tax reduction scheme re: disability element.
- **Social Fund** - Provides one-off payments to meet special needs, all payments are discretionary and funds are limited.

Non-Means Tested Benefits (there are conditions with these regarding entitlement)

- **Statutory Sick Pay** - Legally set minimum level of sick pay, payable by employers, this is therefore not a state benefit.
- **Incapacity Benefit (1)** (based on National Insurance Contributions) - Earnings replacement for people who are sick and unable to work.
- **Incapacity Benefit (2)** (based on incapacity in youth) - Earnings replacement for people who are sick and unable to work and do not qualify for the National Insurance route. At date of claim aged at least 16 - 20 (16 - 25 if in education or training 3 months prior to 20th birthday) for at least 28 weeks commencing prior to 20th birthday. Incapable of working continually for at least 28 weeks commencing prior to 20th (or 25th) birthday.
- **Job Seekers Allowance** - Earnings replacement for unemployed people.
- **Disability Living Allowance (DLA) -** This is a benefit awarded to children or adults who are severely disabled or chronically ill. Payments are made to assist with extra expenses relating to personal care needs and/or mobility problems. A diagnosis of CF does not automatically qualify for entitlement to DLA. This

depends on individual situations and how day to day living is affected by CF. DLA is divided into two components of Personal Care and Mobility which are then divided into varying rates.

Personal Care (Three rates)

Low Rate: awarded if a person can provide evidence to show they need help with personal care needs for a significant portion of each day.

Middle Rate: awarded if a person can provide evidence to show they need help with personal care needs at frequent intervals throughout each day or for periods of time throughout the night. The need for supervision by day or night is also a factor that is considered to achieve this rate.

High Rate: awarded if a person can provide evidence to show care and/or supervision is needed both day and night.

Mobility (Two rates)

Low Rate: awarded from aged 5+, able to walk but needs guidance/supervision in unfamiliar places.

High Rate: awarded from aged 3+ if mobility severely limited due to physical health. Several factors are taken into consideration including severe discomfort, distance, time and manner of walking on level ground out doors.

- **Carers Allowance -** Earnings replacement for people who provide full time care for a person who has been awarded middle or high rate of the personal component of D.L.A. This benefit is granted subject to other conditions regarding entitlement.
- **Child Benefit -** Paid to people responsible for one or more children. This benefit can continue to be paid whilst a child/adolescent is in receipt of full time education up to the age of 19.

Benefits whilst in Hospital

Most benefits are no longer affected by a stay in hospital. However, Disability Living Allowance is affected; adult entitlement to benefit is suspended if a hospital stay exceeds 28 days and for a child under 16 years if a stay exceeds 84 days. (Two separate stays in hospital that are less than 28 days apart (84 days for children) are linked together. This means if there is a return to hospital in that time DLA benefit may be affected sooner).
It is the responsibility of the individual to contact the DWP office to ensure they are informed of admission and discharge dates - the hospital(s) have no legal duty to do this.

Travel costs for visitors - There is limited help available for visitors travel/parking expenses via a Community Care Grant from the social fund. This is a discretionary payment based on each local offices associated funds - there is no guarantee of payment.

12.3 Useful telephone numbers

The Comfort Fund 0117 949 6603
PO Box 32
Bristol BS99 1PT

This charitable fund considers requests for financial assistance from anyone with Cystic Fibrosis who attends the Bristol Centers, i.e. driving lessons, useful items, complementary therapies etc.

The Cystic Fibrosis Trust www.cftrust.org.uk
Helpline 0845 859 1000

Benefits Advice Helpline 0845 8591010
Welfare Grants Helpline 0845 8591020

Provides information, advice and support on any aspect of Cystic Fibrosis
Applications considered for Grants
'Start-up' Independent Living Grant
1st annual Prescription Certificates

Disability Living Allowance inquiries for all new and existing claims
Blackpool Office 08457 123456
Bristol Office 0117 971 8311 (Southwest area)

Working Tax Credits Helpline 0845 3003900
Orderline for Tax Credit Application forms 0845 3667820.

Carers Allowance Helpline 01253 856123
To request application forms

Welfare Benefits Advice Centers
Welfare Benefits Inquiries and Disability Living Allowance Inquiries
North Bristol, BS32 areas of South Glos 0117 951 5751
Bristol City Residents 0117 377 2877
East Bristol Advice Center 0117 378 9200
West Swindon 0179 387 1303

www.entitledto.co.uk
Provides free calculators to help you work out your entitlement to benefits and tax credits.

www.jobcentreplus.gov.uk
Find your local Job Centers/Benefit Office in the area where you live to access the Disability Officer for advice and information regarding employment and/or Benefits.

www.connexionsdirect.com
Information and advice service for young people, including careers, work, housing, health, travel etc.

Pre-payment Prescription Certificates 0845 8500030
www.ppa.org.uk

Purchase of Certificates for those who are not exempt from prescription charges, available as annual or four-monthly certificates.

Further Education in Bristol
University West of England (UWE)

Disability Information Center Inquiries	0117 328 3930
Student Counselling Service	0117 328 2558
University of Bristol	
Student Counselling Service	0117 954 6655
Disabled Student Access Unit Inquiries	0117 954 5724
Student Finance Office	0117 954 5886
City of Bristol College – College Green	0117 312 500x
Disabled Student Support/Learning Needs	0117 312 5491

DVLA Swansea

Medical Inquiries	0870 600 0301
Driving License inquiries	0870 240 009x

Motability Scheme 0845 456 4566
www.motability.co.uk

Inquiry and Application Request Line about the car leasing scheme for those in receipt of high rate mobility component of DLA. Disabled Young Drivers Scheme, aged 16 to 24 years – financial help with driving lessons.

BRI Cashier, Level 2, Queen's Building 0117 928 2286
Open 9am – 4pm daily (Monday – Friday)
All inquiries for re-imbursement of travel expenses subject to current benefit entitlement. Proof of entitlement needed to make claim.

Counselling Services in Bristol
'The Harbour' Mon-Fri 9.30am– 5.30pm 0117 9259348
This is a free Counselling Service for people who have a chronic or serious health condition. They also extend their service to partners or family members. Self Referral.

Off the Record Mon 9.30am – 6pm 0117 927 9120
Tues/Wed 11.30am – 8pm
Free and confidential specialist Counselling/Support Service for young people up to the age of 25 years. Self Referral.

Travel Insurance 0870 7743760
www.freedominsure.co.uk

Specialist Insurance Company who provide travel/holiday insurance for those with pre-existing medical conditions.

European Health Insurance Card (EHIC) formally E111
EHIC Application Line 0845 6062030
www.dh.gov.uk/travellers

Paper applications available from any Post Office. From 1st January 2006 the E111 has been replaced by EHIC for UK residents. It is valid for three to five years and issued on an individual basis regardless of age.

Willow Foundation 01707 259777
www.willowfoundation.org.uk

A Charity that supports seriously ill young adults between the ages of 16 and 40 years by making possible a 'special day'. Any application needs to be endorsed by member of CF Team.

Legal Advice

Avon and Bristol Law Centre Inquiry Line	01179248662
Monday – Friday 9am – 5pm	
Employment/Discrimination Advice	0117 9167727
Tues & Thurs 10am – 12noon	
Benefits/Appeals Advice	0117 9167722

12.4 Annual review proforma

Name Hospital number
(or label)

Date of AR: Lead reviewer:

Problem list Cystic fibrosis Clinic: Red/Blue/Red+NLC/Blue+NLC
Pancreatic insufficient? Yes/No
P aeruginosa status……..
……..
……..
……..
……..
……..

Medications PERT ……..
Antibiotic prophylaxis ……..
Nebulised antibiotics ……..
Vitamins ……..
Inhaled therapy ……..
Others ……..
…… .....……...
…… .....……...
…… .....……...

Weight: kg centile Height cm centile

Symptoms

Respiratory (cough, wheeze, sputum, dyspnoea, exercise, no of exacerbations)
Gastrointestinal (weight gain, appetite, pain, stools, reflux symptoms)
ENT (snoring, obstruction, rhinorrhoea)
Other symptoms (joints, rashes, diabetes)

Treatments over last year

Admissions

When	reason	treatment	duration

Home treatments

When	reason	treatment	duration

No of courses of IV antibiotics: Hospital: Home:
Total number of days IVs Hospital: Home: On elective Rx Y/N

No of courses of **oral antibiotics**: Details:

Courses of **inhaled antibiotic therapy**:

Examination

Clubbing Y/N
Nasal polyps Right Y/N Left Y/N
Chest examination BP:

Abdominal examination

Hepatomegaly Y/N Size Splenomegaly Y/N Size
Faecal masses Y/N
Pubertal: Tanner staging

Other examination:

Lung function

Range of FEV_1 over last year % - %
Change in FEV_1 since previous year

Current FEV_1 L (%) FVC L (%) SaO_2

Microbiology

Date	Organism	Date	Organism

Radiology

Report of CXR; change since previous year

Physiotherapy review: see separate document

Nutrition review: separate document

Social / nursing review

Benefits DLA: High/Med/Low Mobility: Yes/No Carer's: Yes/No
Other benefit:

Name of school:
Number of days off school:
School year:
Career aspirations:
Lives with: mum & dad/mum/dad/between mum & dad
Details of siblings:
CF status of siblings:

IV training: Yes/No Date Port training: Yes/No Date

Awareness of cross infection:

Fertility / contraception issues:

Transition process:

Bloods done: Yes / No / Incomplete
Plan if incomplete:

Other investigations:

Abdo U/S	Yes/No	?Booked:
Hearing test	Yes/No	?Booked:
OGTT	Yes/No	?Booked:

Overall summary of status

Suggested changes

1.
2.
3.
4.

Signed:

12.5 Questions and answers about sweat testing

What is a Sweat Test?
A sweat test measures the amount of salt (sodium and chloride) that is in the sweat.

Why does this need to be carried out?
The test is carried out on children or adults who are having recurrent chest infections, those that have frequent and unexplained pale stools, those that are having problems gaining weight or growing properly, or as part of a screening programme.
There are other rarer indications for a sweat test.

Who does this test?
The test is carried out by specially trained staff from the laboratory. For outpatients the test is usually done in the Clinical Investigations Unit level 5 in the Children's Hospital.
For inpatients the test is carried out at the bedside.
Adult outpatients are usually seen in the Respiratory Department level 2 BRI.

Does the test hurt?
Some patients experience a tingling sensation on the arm where the sweat glands are being stimulated. No needles are involved in the test.

How is the test carried out?
A small area of skin – usually on the lower arm is cleaned with methylated spirits and then water. Special pads soaked in a chemical called pilocarpine are placed on the skin and a small current is passed through the arm from a battery box. The current is passed through the arm for 5 minutes and draws the chemical into the sweat glands in the skin.
The test is not painful but a tingling sensation may occur when the current is being passed through the skin.
The pads are then removed and the skin is carefully washed with pure water and dried.
There should be a red mark where the pilocarpine has stimulated the skin and this will fade within a few hours. There are no side effects from the test and the patient will not feel ill during or after the test.
A dry absorbent paper disc is applied to the stimulated area, covered with a plastic film and secured with plaster or bandage.
You will then be asked to wait for about 30 minutes for the sweat to be absorbed into the filter paper.
During that time you and your child are free to read, play, eat and drink. Salty foods such as crisps should be avoided to minimise any risk of contamination.
The filter paper is then removed and taken to the laboratory for analysis.

What happens to the sample in the laboratory?
The filter paper containing the sweat is weighed so that the weight of sweat that has been collected can be calculated.
A known volume of liquid is then added to the bag containing the filter paper. The salt contained on the filter paper dissolves in the liquid and the liquid can then be tested to determine the sodium and chloride content of the sweat. By taking into account the weight of sweat collected and the volume of liquid added to the bag, the concentration of salt in the sweat is then calculated.

What do the results show?
In most cases the results will clearly show either a normal or a high (abnormal) level of salt in the sweat.
If the results are borderline the test will need to be repeated.
In a few cases the test may need to be repeated for technical reasons e.g. insufficient sweat collected for accurate analysis.
An abnormally high result is always confirmed with a second sweat test.

How long will it take to get the results?
The results will normally be available for your doctor within a few days after having the test.

Who will inform me of the results?
Your doctor will discuss the results with you at your next appointment.

Further questions
If you have any questions about the process of doing the sweat test, please contact Dr Janet Stone Principal Paediatric Clinical Scientist tel. 0117 928 2590.

If you have any further questions regarding the need for your child, please speak to the doctor who has referred you for this test as they can give you further information.

12.6 Admission proforma

ADMISSION SHEET FOR PATIENTS WITH CYSTIC FIBROSIS

Name: …….. Hospital number: ……..

Date of Birth: ……..

(Please affix a label)

Date: ……

Problem list

1. ……
2. ……
3. ……
4. ……
5. ……
6. ……
7. ……
8. ……

Reasons for this Admission

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……

Current History

……..

……..

……..

Regular Medication

1. ……
2. ……
3. ……
4. ……
5. ……
6. ……
7. ……
8. ……

Allergies

1. …… 2. ……

Examination

Clubbing Y/N General:

Chest examination:

Abdominal examination:

Hepatomegaly Y/N Size Splenomegaly Y/N Size
Faecal masses Y/N

Other examination:

Plan

1. Bloods: FBC, U&Es, LFTs (incl γGT), CRP, total IgE, coag screen (check if there any outstanding annual review bloods)
2. Update microbiology Sheet
3. Drug chart (using BCH CF formulary) & check timing with family
4. Prescribe IV antibiotics (D/W team); remember to box drug chart for levels
5. Pulmonary function tests

Other:

Signed: **Date:**