
Cystic Fibrosis Standards of Care, Australia

2008

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Executive Summary

The Cystic Fibrosis (CF) Standards of Care project was proposed by the Cystic Fibrosis Centre Directors Committee, and supported by Cystic Fibrosis Australia and the Thoracic Society of Australia and New Zealand (TSANZ). This document represents the first comprehensive analysis of the requirements for health care and its delivery for people with CF in Australia. Cystic fibrosis is the most common lethal genetic condition affecting Australians with currently ~3000 people living with CF in Australia.

The project scope included assessment of need for CF guideline development, particularly focussing on the requirements for facilities, staffing and services to provide CF care with specific reference to health care delivery and systems, population demographics and climate in Australia. A multidisciplinary Steering Committee which included representatives from clinical care teams, lay organisations and adults with CF from Australia was established to oversee the overall development of the project, including review of published guidelines for CF. Regular teleconferences, meetings and extensive consultation with health care professionals involved in CF care delivery in Australia were undertaken. The Standards of Care have been submitted to the Royal Australasian College of Physicians, the TSANZ and Cystic Fibrosis Australia who have each endorsed the document.

Specific areas covered by the Standards include:

- i Facilities, staffing and services required at CF centres and CF clinics;
- ii Newly-diagnosed children with CF;
- iii Newly-diagnosed adolescent and adult with CF;
- iv Outpatient care;
- v Inpatient care;
- vi Home therapy;
- vii Transition Care;
- viii Outreach Services and Clinics;
- ix End of Life Care and Transplantation;
- x Role of Cystic Fibrosis Organisations.

Each chapter provides a comprehensive literature review and outlines guidelines for clinical care by taking into account requirements for facilities, staffing and services. This document is based on current evidence and best practice, and outlines the ideal situation for the management of people with CF in Australia. Whilst CF centres may not achieve all standards at present, CF services should aspire to, and ideally, have resources available, to support this care.

Foreword

Purpose and Scope

The writing of Cystic Fibrosis (CF) Standards of Care was proposed by the Australian Cystic Fibrosis Centre Directors Committee, and supported by Cystic Fibrosis Australia and the Cystic Fibrosis Special Interest Group of the Thoracic Society of Australia and New Zealand (TSANZ). Following the Sixth Australian Cystic Fibrosis Conference held in Adelaide in August 2006, a multidisciplinary Steering Committee was established to co-ordinate the overall development of the Standards of Cystic Fibrosis Care Project, including review of current published guidelines for CF. Terms of reference were agreed upon and members of the Steering Committee have worked with other interested parties and stakeholders throughout the development of these guidelines.

The scope of this project included:

1. Assessment of areas of need for CF guideline development and included:-

- a What constitutes a cystic fibrosis centre and cystic fibrosis clinic;
- b Assessment of the requirements for facilities, staffing and services to provide CF care;
- c Assessment of the requirements for outpatient care, including home intravenous therapy, outreach services, regional centre care and access to allied health specialist services;
- d Assessment of the requirements for the delivery of inpatient care;
- e Assessment of the requirements for the assessment and education of newly diagnosed patients with CF.

2. Guidelines were to be written with specific reference to health care delivery and systems, population demographics and climate in Australia.

The membership of the Steering Committee included representatives from clinical care teams, lay organisations and adults with CF from Australia (details of committee membership provided below). Each section includes the Section Leaders and all Steering Committee members had input into each of the Section Drafts throughout the project.

Writing groups led by Medical and Nursing specialists in the following areas were established:

- i Introduction, including facilities, staffing and services required at CF centres and CF clinics;
- ii Inpatient care;
- iii Outpatient care;
- iv Newly-diagnosed child with CF;
- v Newly-diagnosed adolescent and adult with CF;
- vi Transition;
- vii Outreach/Shared Care;
- viii End of Life (including Transplantation);
- ix Home therapies;
- x Role of Cystic Fibrosis Organisations.

Consultation Process

The initial meeting of the Steering Committee was held by Teleconference in February 2006. Monthly teleconferences were held throughout 2006, and a face-to-face meeting of Steering Committee members, facilitated by Professor Craig Mellis from the University of Sydney, was held in November 2006. During this one-day meeting, Draft Guidelines for each of the sections were reviewed and modifications of the sections were made accordingly.

In April 2007, Dr Dominic Fitzgerald from the Children's Hospital at Westmead was invited to act as Medical Editor of the Draft Guidelines. Written feedback and suggestions for modifications to the Draft Guidelines was provided, and writing groups further modified the chapters. A further review of the Guidelines was performed by Dr Fitzgerald in July 2007.

Copies of the Draft Guidelines were provided to the CF community, including CF centres and clinics, Lung Transplant Units, CF Organisations, the TSANZ and the Royal Australasian College of Physicians. During Australian Cystic Fibrosis Conference in August 2007, there was an opportunity for conference delegates from the CF community to provide comment to Steering Committee members. A presentation regarding the progress of the Standards of Cystic Fibrosis Care Project was given at the Australian CF conference. Final comments were received following the conference and appropriate modifications made on the basis of the feedback in October 2007. A final review of the Guidelines was performed by Dr Fitzgerald in November 2007. The final document was have been reviewed by Cystic Fibrosis Australia, the TSANZ and the Royal Australasian College of Physicians for endorsement.

This project, along with the recently published Australasian Clinical Practice Guidelines for Nutrition in Cystic Fibrosis, the Infection Control Guidelines and Australian Clinical Practice Guidelines for Physiotherapy in Cystic Fibrosis represent the first comprehensive descriptions of CF care guidelines to be prepared in Australia. The Steering committee believe these projects constitute a beginning and further Guidelines should be considered, including the Management of specific CF related complications (eg. Management of Pulmonary Disease in CF and Management of Endocrine Complications in CF) and Treatment strategies for health maintenance of people with CF.

The following guidelines represent the ideal characteristics (staffing, facilities and services) for the management of people with CF in Australia. Whilst CF centres may not reach all standards at present, CF services should aspire to, and ideally have resources available, to support this care.

This document is based on current best practice.

Review Process

An evaluation of the guidelines will be undertaken across all CF centres in Australia. Prior to 2012, this document will be reviewed and updated. Updates of the guidelines will incorporate the findings of the evaluation as well as new evidence from the scientific literature.

We are grateful for the expertise and enthusiasm from all the health care professionals involved in CF care delivery in Australia who have participated in the Project.

Steering Committee

The membership of the Steering Committee included:

Scott Bell, The Prince Charles Hospital, Brisbane (Co-Chair) - Physician

Philip Robinson, Royal Children's Hospital, Melbourne (Co-Chair) - Paediatrician

Brenda Button, The Alfred Hospital, Melbourne – Physiotherapist

Peter Bye, Royal Prince Alfred Hospital, Sydney - Physician

Clare Collins, John Hunter Hospital, Newcastle - Dietitian

Conrad Guerra, Cystic Fibrosis Australia, Adelaide – CF organisation representative

Colleen Jackson, The Alfred Hospital, Melbourne – Dietitian

Lisa Martin, CF Adult, New South Wales- Adult with CF

Kerry Mordaunt[¶], Cystic Fibrosis WA, Perth – CF organisation representative

Carmel Moriarty, Royal Prince Alfred Hospital, Sydney – Registered Nurse

Christopher O'Connor[¶], Cystic Fibrosis SA, Adelaide – CF organisation representative

David Reid, Royal Hobart Hospital, Hobart - Physician

Pamela Rowell, Royal Hobart Hospital, Hobart–Registered Nurse

Gerard Ryan, Sir Charles Gairdner Hospital, Perth - Physician

Esta-Lee Tannenbaum, Royal Children's Hospital, Melbourne – Physiotherapist

Claire Wainwright, Royal Children's Hospital, Brisbane - Paediatrician

Bruce Whitehead, John Hunter Children's Hospital, Newcastle - Paediatrician

[¶]During 2007, participation in the Steering Committee continued despite leaving organisation

The committee acknowledges the expertise of Associate Professor Peter Middleton, Westmead Hospital, Sydney; Dr Maxine Braithwaite, The Alfred Hospital, Melbourne and Professor Susan Sawyer, Centre for Adolescent Health, Royal Children's Hospital, Melbourne for their input in the writing of these guidelines. Many other CF Specialist Health Care Professionals have provided feedback and suggestions through the drafting of these guidelines. The Steering Committee is very grateful to each of them for sharing their expertise.

Disclosure Statement

Development of the guidelines was funded with financial support from Cystic Fibrosis Australia. This included travel and accommodation to the Steering Committee meeting held in Sydney in November 2006 and regular teleconferences held in 2006 and 2007. A grant from Cystic Fibrosis Australia supported the editorial role of Dr Dominic Fitzgerald. Potential conflicts of interest by membership of the Steering Committee are listed in Appendix 2.

Scott BELL

Philip ROBINSON

Glossary of Terms

BiPAP	Bi-level positive airway pressure
BMI	Body mass index
CF	Cystic Fibrosis
CFA	Cystic Fibrosis Australia
CFRD	Cystic fibrosis-related diabetes
CFTR	Cystic fibrosis transmembrane conductance regulator protein
CT scan	Computerised tomography scan
CXR	Chest radiograph or Chest X-ray
CVC	Central venous catheter
DEXA scan	Dual energy x-ray absorptiometry scan
DIOS	Distal intestinal obstruction syndrome
ENT	Ear nose and throat
FEV ₁	Forced expiratory volume in one second
ICU	Intensive care unit
IV	Intravenous
IVAD	Intravenous access device
LFT	Liver function tests
MRI	Magnetic resonance imaging
MRSA	Methicillin resistant Staphylococcus aureus
NIV	Non-invasive ventilation
OPD	Outpatient department
PICC	Peripherally inserted central catheter
PERT	Pancreatic enzyme replacement therapy
RACP	Royal Australasian College of Physicians
RCT	Randomised controlled trial
RMO	Resident medical officer
RTE	Respiratory tract exacerbation
TSANZ	Thoracic Society of Australia and New Zealand
US	Ultrasound

Methods

Search Strategies and Levels of Evidence

Methods

Search Strategies

At the commencement of the project in 2006 our literature searches for this document were conducted using MEDLINE, using the terms relevant for each of the sections. The electronic searches were performed by Mr Chris Parker (Medical Librarian at The Prince Charles Hospital) and Dr Scott Bell. Manual search of reference lists was undertaken and more appropriate proceedings of conferences were reviewed by the lead authors of each of the sections. Searches were limited to articles in English. Literature up to and including 1/12/2006 was included. Given the limited evidence available for many areas of Cystic Fibrosis practice, both randomised control trials and research conducted with less robust design were included.

Abstracts were reviewed with descriptions of the care of patients with CF relevant to each

specific section. Reference lists for each of the selected published papers were also reviewed for reports not identified in the MEDLINE search. More randomised control trials or formal clinical trials were identified, with each reviewed in detail by the section authors. Published clinical guidelines and associated reference lists were also reviewed, their relevance assessed and included where appropriate.

Levels of Evidence

Levels of evidence described through this document highlight, where available, the studies which have provided evidence which have contributed to the development of these Guidelines, based on the NHMRC guide for the development, implementation and evaluation of clinical practice guidelines (Table A). In Sections where there is no level I, II, III or IV evidence available, consensus of the Steering Committee (expert opinion) is provided [this is the case unless stated otherwise].

I	Evidence obtained from a systematic review of all relevant randomised controlled trials
II	Evidence obtained from at least one properly designed randomised controlled trial
III-1	Evidence obtained from well-designed pseudo-randomised controlled trials (alternate allocation or some other method)
III-2	Evidence obtained from comparative studies with concurrent controls and allocation not randomised (cohort studies), case-control studies, or interrupted time series with a control group
III-3	Evidence obtained from comparative studies with historical control, two or more single-arm studies, or interrupted time series without a parallel control group
IV	Evidence obtained from case series, either post-test or pre-test and post-test

Table A. Designation of Levels of Evidence National Health and Medical Research Council

1. Introduction

(Scott Bell and Philip Robinson)

1.1. Overview

Cystic fibrosis (CF) is a genetic disorder caused by mutations in the cystic fibrosis transmembrane conductance regulator protein (CFTR) gene (Ratjen and Doring 2003). This results in abnormal regulation of chloride and sodium transport at epithelial cell surfaces. This ion transport abnormality results in a complex multi-system disease (Table 1.1.).

Death from CF as a child is now an unusual occurrence and median survival, currently in the mid-thirties, is predicted to approach 50 years in the next decade with survival in males generally longer (Elborn, Shale et al. 1991; Dodge and Lewis 2005; Dodge, Lewis et al. 2007). Ninety percent of mortality and the majority of morbidity is related to lung disease resulting from chronic pulmonary infection (Ratjen and Doring 2003).

Factors which are thought to have contributed to improvements in survival from CF include: improved management of the neonatal complication meconium ileus, advances in pancreatic enzyme replacement therapy [PERT] and nutritional support, development of improved techniques in airway clearance, the availability of bacteria-specific antibiotics and CF-specific centre-based care (British Paediatric Association Working Party on Cystic Fibrosis Cystic fibrosis in the United Kingdom 1977-85: an improving picture 1998; Mahadeva, Webb et al. 1998; Noone and Knowles 1999; Yankaskas and Fernald 1999; Cystic Fibrosis Foundation Patient Registry Annual Data Report 2003). With increased survival, increasing emphasis has been placed on the area of CF-related diabetes

mellitus [CFRD], osteoporosis, transition to adult care, and sexual and reproductive health related issues.

In Australia, CF has an incidence of approximately 1 in 2800 live births and about 1 in 25 people are asymptomatic carriers of a CF gene mutation (Australian Cystic Fibrosis Data Registry 2003). The Australian Cystic Fibrosis Data Registry was established in 1998 to estimate the prevalence and clinical characteristics of all people with CF in Australia (Australian Cystic Fibrosis Data Registry 2003).

Data from 2003, the latest of the Data Registry report annual surveys, demonstrate there were about 2700 people with CF (53.5% males and 46.5 % females) with a median age of 15.2 years living in Australia (Australian Cystic Fibrosis Data Registry 2003). The proportion who were adults was 41%, and 13.6% were older than 30 years. The proportion of the CF population residing in each state and territory follows the general population numbers (NSW 31%, Victoria 22%, Qld 21%, WA 11%, SA 10%, Tasmania 3.3%, ACT 0.3%, NT 0.2%). In 2003, 65 patients were diagnosed with CF with >80% being in the first two months of life. Ten patients [10%] were diagnosed after the first year of life (including six as adolescents or adults).

Lung function decreases with increasing age in people with CF. The mean FEV₁% predicted for children (6-11 years) is 89%, for adolescents (12-17 years) is 82% and for adults (18 years or more) is 68%. Outpatient consultations at a CF clinic are frequent with an average of five OPD medical

reviews per year. About 50% of the CF population were hospitalised at least once in 2003 with more than 80% of admissions for treatment of respiratory complications of CF.

1.2. Provision of Specialist Cystic Fibrosis Care

Co-ordinated programs for the care of children with CF were initiated in the early 1960s in the UK, USA and Australia. The improvement in survival has led to an increase in the number of adults living with CF, generating the establishment of adult care centres. It is now agreed that a dedicated centre with a multidisciplinary team provides the best outcomes for people with CF. Studies have reported advantages in terms of survival, better preservation in pulmonary function and nutritional status for people with CF managed at specialist CF centres (Mahadeva, Webb et al. 1998; Spencer and Bilton 1999). Specialty bodies in the UK have recognised the need for CF specialist centres and guidelines for CF care have been published in the USA, Canada, UK and Europe providing details of optimal care delivery for people with CF in their countries (Clinical Practice Guidelines for Cystic Fibrosis 1997; Cystic Fibrosis Standards of Care 1998; Spencer and Bilton 1999; Standards for the Clinical Care of Children and Adults with Cystic Fibrosis in the UK 2001; Yankaskas, Marshall et al. 2004; Kerem, Conway et al. 2005). The majority of adults with CF and parents of children with CF are in favour of CF specialist care (Walters, Britton et al. 1994).

In Australia, CF services have developed at larger tertiary referral hospitals, which have led to a concentration in expertise and experience of CF care. Over many years, there have been lengthy endeavours to develop the staff, services and facilities required to obtain the best outcomes for people with CF. These centres aim to increase survival, improve quality of life and maintain independence.

Equity of access is an issue in Australia for people in rural and remote areas. In addition, an important contribution to CF care is through patient support groups, such as Cystic Fibrosis Australia as well as state based CF Associations. These organisations provide support, access to loan equipment and

resources within the community and lobbying which are very important to the care of the person with CF and their families.

1.3. Definition of Levels of Cystic Fibrosis Care

1.3.1. Cystic Fibrosis Specialist Centre

Cystic Fibrosis Specialist Centre is defined as a clinical service within a large teaching / tertiary referral hospital which has access to staff and facilities capable of managing all of the common complications of CF. Typically, a centre would provide the care for a minimum of 50 patients and include multidisciplinary staff experienced in CF care. These staff should meet regularly to discuss the care of patients attending the centre. The CF centre should have access to additional specialist services to support the management of complications of CF as outlined in Table 1.2. Ready access to a referral centre for lung transplant services is an important aspect of the role of the specialist centre. The CF specialist centre should have an active research and audit program which allows both the evaluation of the effectiveness of current care and of new therapies.

1.3.2. Cystic Fibrosis Clinic

Cystic Fibrosis Clinic is defined as a service which provides care for patients with CF at a hospital which is close to the geographical location (home) of the patient and where the patients are also seen periodically by members of the CF specialist centre. Typically, a CF clinic will provide care to less than 50 patients. The CF clinic will include a specific outpatient clinic for CF patients and access to allied health and nursing staff with some expertise in CF care. The essential requirements for both outpatient and inpatient care of the patients are equivalent to that available at the CF specialist centre. Many patients attending a CF clinic will receive some of their care (outpatient and or inpatient) at the CF specialist centre.

1.4. Purpose of CF Care Guidelines

This consensus document aims

- a. To define standards for evaluation, monitoring and therapy for people with CF in Australia, which will work towards ensuring all people

- with CF have equitable access to effective and safe health care.
- b. To provide evidence-based health care principles for health care professionals, people with CF and their families and for health care administrators.
 - c. To provide guidelines which are appropriate for health care provision within Australia (allowing for differences between and within States and territories).
 - d. To provide a basis for audit and quality assurance of health care delivery for people with CF in Australia.

1.5. Facilities, Staffing and Services at a Specialist Centre

1.5.1. Facilities

Patients should be able to receive all aspects of care in a timely fashion, taking into account adherence to infection control principles, the age of the patient and other special needs for a person living with CF. It is important to consider that the characteristics and needs of people with CF differ from most other patients at a hospital. Access to accommodation or funding for accommodation for families during periods of assessment at a CF centre for rural and regional patients is required.

Specific facilities required are detailed in each of the Sections to follow (see Section 4, Outpatient Care and Section 5, Inpatient Care)).

1.5.2. Staffing

- a. CF specialist team should include:
 - i. Centre Director
 - ii. Specialist / Consultant Physician
 - iii. Specialist Nurse / Centre Coordinator
 - iv. Specialist Physiotherapist
 - v. Specialist Dietitian
 - vi. Social Worker
 - vii. Psychologist
 - viii. Clinical Pharmacist
 - ix. Clinical Microbiologist
 - x. Administration Support Officer
 - xi. Audit, Research and Data Registry Co-ordinator
- b. Adequate training and registration by local regulatory authorities (eg. Specialist

- Registration Health Boards such as the Nursing Registration Board and Medical Board) should be a prerequisite for permanent employment in the CF specialist centre.
- c. CF specialist centre should act as a resource for training, education, development and support of others involved in CF care in local hospitals (eg CF clinics, share care, outreach).
 - d. Regular multidisciplinary team meetings should be held to plan care for all patients.
 - e. There should be an opportunity for role development, adequate leave planning and relief as well as succession planning for all staff at the CF specialist centre.
 - f. Roles of specific team members include:

Centre Director

Role includes leadership of the multidisciplinary team including staff recruitment and retention, leadership of team meetings, establishment of networks for support and training of staff involved in CF care within the centre and allied hospitals participating in CF care of centre's patients.

The centre director should also be responsible for advocacy for the centre and its patients, which should include provision of adequate and appropriate resources to provide evidence-based care for the present patient population and anticipated growth of the service.

The centre director ensures audit of centres outcomes, facilitates participation in the national database and coordinates research activity at the centre.

Specialist(s) / Consultant(s)

The CF specialist will share clinical responsibilities with the Director, be able to provide support for the Director and participate in CF research at the centre. The CF specialist will have received training in CF, be up-to-date in current treatment practices and been involved in CF care for at least one third of his/her working time.

Usually CF Specialists are respiratory trained physicians / paediatricians or general physicians / paediatricians with extensive expertise in managing patients with CF. Access to gastroenterology and endocrinology expertise is required.

Specialist Nurse

The CF nurse specialist is involved in all aspects of the overall management of the patients, including advocacy, clinical management, support and advice, education of the patients (and their families and carers) and of staff involved in the management of patients with CF. In several cases in Australia, the CF nurse specialist is appointed as a Nurse Practitioner, increasing their scope of practice.

The nurse specialist should participate in decision making and monitoring of a patient's care, including offer day to day advice to ward staff for patients receiving inpatient therapy, facilitate outpatient assessment and review of patients, and provide a link between community based nurses and allied health professionals who are seeing patients in an outpatient or community setting.

The nurse specialist provides an important link between the CF team, the patients and their families. Education of patients and other health care professionals is an important role.

In addition the CF specialist nurse will have specific roles at certain critical times such as at diagnosis, onset of terminal care and changes in clinical status, such as onset of *Pseudomonas* infection or the diagnosis of CF-related diabetes.

Specialist Physiotherapist

The CF specialist physiotherapist will regularly assess each patient's respiratory status, monitoring breathing rate and pattern, volume, colour and consistency of sputum expectorated and degree of dyspnoea at rest and during physical activity.

A regular appraisal of airway clearance therapy and adjunctive inhalation therapy will be undertaken. Ongoing education and training in the optimal use of individually chosen airway clearance techniques and devices, together with instruction on cleaning and maintenance of all equipment will be provided.

Exercise capacity, tolerance and participation will be reviewed and assessed using oximetry at rest and during peak exercise. Attention will be paid to postural alignment, chest mobility, muscle strength and endurance and injury prevention. Musculoskeletal problems will be addressed as they arise.

Ongoing education of the patient/carers relating to appropriate dosage and order of physiotherapy including airway clearance therapy, adjunctive inhalation therapy and regular exercise will be provided.

The CF physiotherapist will communicate on physiotherapy issues with the CF team will ensure continuity of care, and conduct research when possible.

Specialist Dietitian

The CF specialist dietitian will determine each patient's individual energy, salt and fluid needs, based on factors such as lung function, pancreatic function and physical activity, and assist them to meet these needs for optimal growth, weight and body composition.

Dietary advice will also be provided to assist in the management of other factors associated with CF, including pancreatic insufficiency, fat soluble vitamin deficiency, altered gastric motility, impaired glucose tolerance / diabetes, and reduced bone mineral density

Individualised advice will need to be tailored to the patient, considering psychosocial barriers to optimal intake. Additional nutritional guidance at various life stages such as during pregnancy and lung transplantation will be necessary.

The CF dietitian will communicate nutrition issues with the CF team, will ensure continuity of care, and conduct nutritional surveillance and research when possible.

Social Worker

The social work role involves the provision of a range of practical and emotional support services to patients and their families. Regular patient review enables the identification of psychosocial issues such as emotional and relationship problems, financial stress, substance abuse problems, and educational and employment issues.

Specialised knowledge of key support services is required to enable advocacy on issues such as income support and concession card eligibility, reinstatement of cancelled income support payments, and access to travel and accommodation subsidies associated with travel to the CF centre.

A key role is to provide emotional support to patients whose health is deteriorating and assist them to evaluate their short and long term options in terms of both the patient and their family reducing their working hours or stopping work and applying for income support and other benefits.

Clinical Psychologist

The clinical psychologist's role includes the psychological assessment and provision of individualised therapy for patients and their families.

The multidisciplinary team will be advised on psychological issues including the provision of information and education on general, or a patient's specific psychological issues.

Due to the chronic nature of CF, a specific appointment is advantageous rather than referral to a general hospital-based or community mental health service.

Clinical Pharmacist

The clinical pharmacist's role includes the assessment of pharmaceutical aspects of therapy of patients attending the CF centre by providing input at the point of prescribing.

Regular assessment includes examination for potential drug interactions, allergic phenomena and adverse drug reactions. The pharmacist provides education of patients and CF team members of pharmaceutical aspects of therapy. Given that therapies for patients with CF are usually complex the monitoring of adherence and difficulties with access to therapy is also important.

Clinical Microbiologist

The clinical microbiologist role includes supervision of all laboratory aspects of microbiology at the CF centre, participation in the clinical service by the provision of a consultative service.

Advice on infection control issues should also be available. Regular communication between the Microbiology service and the CF team is important, including discussion about individual patients, diagnostic and therapeutic difficulties with the CF centre.

Clinical Geneticist (or Genetic Counsellor)

The clinical geneticist (or genetic counsellor) role includes consultation with the patient and their family including assistance with diagnostic difficulties, counselling families who have had a child with CF or relatives of a person with CF who are considering having a family.

Ideally the clinical geneticist (or genetic counsellor) should have formal and regular contact with the CF specialist team.

Administration Support Officer

The Administration Support Officer role includes support of the multidisciplinary team including coordination of the medical records and communication between the CF team and other health care professionals.

Audit, Research and Data Registry Co-ordinator

The research support officer provides coordination of audit activity and data entry for the National Data Registry at the CF specialist centre. This position may also coordinate research activity at the centre.

1.5.3. Staffing Numbers

Several international CF resources have published recommendations for appropriate staffing for CF treatment centres. While staffing numbers are influenced by local or national health practices, recently the Research and Education Committee of the CF Trust (UK) and CF Centre Directors in the UK have recommended staffing levels. The nature of CF care delivery is similar in Australia and the UK, and at present these guidelines provide a reasonable basis for staffing levels at Adult CF specialist centres [Table 1.3.], Paediatric CF Specialist centres [Table 1.4.] and CF clinics in Australia.

1.5.4. Specialist Services

Access to specialist services is important and includes multiple medical, surgical, subspecialty and allied health disciplines as outlined in Table 1.2. Specifically, the following are key aspects of the service delivery in CF specialist centres:

- a. *Laboratory services* with adequate expertise to support management of CF such as microbiology, infectious diseases consultation,

- genetics and sweat electrolytes,
- b. *Specialist radiology* support including high resolution CT, vascular access support, ultrasound services and interventional radiology such as bronchial arteriography and embolisation.
 - c. *Respiratory function laboratory* including complex lung function testing (generally above the age of six years) and hypoxia altitude simulation testing.
 - d. *Pharmacy department* which is efficient and readily available for advice to members of the CF centre team and patients with CF.

1.6. Facilities, Staffing and Services at a CF Clinic

The principles of care in a CF clinic are shared with those at a CF specialist centre. Access to experienced multidisciplinary team members is important and should include a Physician/Paediatrician, CF Nurse, CF physiotherapist, and CF Dietitian.

Complex complications may require consultation and support from the CF specialists centre and excellent communication between the CF clinic and CF specialist centres is vital. Regular multidisciplinary team meetings are important. A point of contact with the CF clinic should be established for patients and their families.

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Respiratory	Chronic suppurative lung disease with airflow obstruction and chronic airway infection
	Pneumothorax
	Haemoptysis
	Allergic bronchopulmonary aspergillosis
	Respiratory failure and pulmonary hypertension / cor pulmonale
	Chronic rhinosinusitis and nasal polyposis
	Digital Clubbing
Gastrointestinal	Meconium ileus
	Rectal prolapse
	Steatorrhoea and azotorrhea
	Fat soluble vitamin deficiency (including vitamins A, D, E and K)
	Pancreatic insufficiency / Recurrent acute pancreatitis
	Focal biliary or multilobar cirrhosis complicated by portal hypertension
	Cholelithiasis
	Failure to thrive and under nutrition
	Recurrent distal intestinal obstruction syndrome
	Constipation
	Gastro-oesophageal reflux
	Impaired motility and gastric emptying
	Intussusception
Inflammatory bowel disease	
Endocrine complications	Diabetes
	Bone disease (including osteoporosis)
	Functional hypogonadism
Metabolic complications	Acute salt depletion
	Chronic metabolic alkalosis
Infertility	Male – Congenital bilateral absence of the vas deferens
	Female – Urinary incontinence
	Vaginal yeast infections
	Oligomenorrhoea
Vasculitic complications	Arthropathy / Hypertrophic pulmonary osteoarthropathy
	Skin eruptions
Renal complications	Nephrolithiasis (oxalate stones)
	Nephrotoxicity (eg. aminoglycoside, CFRD related)
Other complications of Cystic Fibrosis and or its treatment	Allergic reactions
	Drug toxicity
	Depression / Anxiety
	Venous access devices and their complications
	Gastrointestinal Cancer

Table 1.1. Clinical manifestations of cystic fibrosis

Health Problem	Specialist Services	Facilities
Diagnosis Biochemical Genetic	Laboratory – biochemist, Molecular biologist Clinical Geneticist (or Genetic Counsellor) Education/nursing	Sweat testing Genetic testing Genetic Counselling Reading/websites
Respiratory Bronchiectasis Lung Function Infection Hemoptysis Pneumothorax ABPA Respiratory Failure	Respiratory Physician Thoracic Surgeon Clinical Microbiologist Physiotherapist Radiologist Dietitian Nurse Lung Transplant Team Palliative care	Outpatient and inpatient facilities with infection control. Imaging Lung Function Lab including access to Sleep/Respiratory failure laboratory Microbiology lab Bronchial Artery Embolisation Non invasive ventilation Lung transplant (not necessarily on the same site)
Gastroenterology Pancreatic insufficiency Pancreatitis Meconium ileus Distal intestinal obstruction Constipation Gastroesophageal reflux Gall stones	Gastroenterologist Dietitian Surgeon	Faecal fat/ elastase/chymotrypsin/ Biochemistry lab (Fat soluble vitamin assays) Endoscopy
Liver Cirrhosis Portal hypertension	Hepatologist Liver Transplant Team Liver surgeon	Medical Imaging (US, CT, MRI) Endoscopy Liver transplant facilities
Endocrine Diabetes Osteoporosis Functional hypogonadism	Endocrinologist Dietitian Diabetes Educator	Biochemical testing DEXA, Bone density scan
Renal Nephrolithiasis Renal insufficiency	Renal Physician	Ultrasonography
ENT Sinusitis Polyps Nasal obstruction	ENT surgeon	Medical Imaging ENT surgery
Intravenous access PICC lines [temporary] Implantable vascular access devices	IV service Anaesthetist Interventional Radiologist Surgeon	Medical Imaging
Psychological Depression/anxiety Adherence/Behaviour issues Needle phobia Maladaptive behaviour End of Life Issues	Psychologist Psychiatrist Social work Occupational therapist Nurse	Cognitive behavioural therapy Counselling Pharmacotherapy
Financial/ Social/School/ Work issues	Social work Hospital school	Counselling Educational support
Other Vasculitis Musculoskeletal complications Renal stones Renal impairment Drug allergy/toxicity Fertility	Rheumatology Endocrine Immunology Fertility Services Urology Cardiology Renal Audiology/ENT	Bone density, Antibiotic Desensitising and Skin Prick Tests

Table 1.2. Cystic Fibrosis Specialist Centre Specialist Services and Facilities

	50-75 Patients	75-150 Patients	>150 Patients
Consultant 1**	0.5	1	1
Consultant 2**	0.3	0.5	1
Consultant 3**	---	---	0.5
Clinical Fellow/Advanced Trainee	0.5	1	1
Registrar/RMO	0.4	0.8	1
Specialist Nurse	2	3	6
Physiotherapist	2	4	6
Dietitian	0.5	1	2
Social Worker	0.75	1	2
Psychologist ***	0.4	1	1.5
Secretary	0.5	1	2
Data Clerk	0.4	0.8	1
Pharmacist	0.5	1	1

Table 1.3. Recommended Staffing levels at Adult CF Centres in terms of Full-time Equivalent positions providing CF Care*

	50-75 Patients	75-150 Patients	>150 Patients
Consultant 1**	0.5	1	1
Consultant 2**	0.3	0.5	1
Consultant 3**	---	---	---
Clinical Fellow/Advanced Trainee	0.5	1	1
Registrar/RMO	0.3	0.5	1
Specialist Nurse	2	3	4
Physiotherapist	2	3	4
Dietitian	0.5	1	2
Social Worker	0.75	1	2
Psychologist ***	0.4	1	1.5
Secretary	0.5	1	2
Data Clerk	0.4	0.8	1
Pharmacist	0.5	1	1

Table 1.4. Recommended Staffing levels at Paediatric CF Centres in terms of Full-time Equivalent positions providing CF Care*

* Adapted from the recently updated Standards of CF Care (UK) in press.

** The number represents full-time equivalent positions for CF care. In many centres a greater number of consultants will be involved in CF care but will have additional roles (eg. general respiratory medicine, gastroenterology, endocrinology).

***In some centres an experienced counsellor and an occupational therapist may undertake some of the functions of a psychologist.

2. Newly Diagnosed Children with Cystic Fibrosis

(Philip Robinson and Pamela Rowell)

- Standard 1** Infants diagnosed through newborn screening should have prompt access to experienced medical and allied health CF personnel.
- Standard 2** Following diagnosis, infants should be assessed for pancreatic insufficiency and enzyme therapy commenced when indicated.
- Standard 3** Families should have access to up to date educational material regarding CF from the time of diagnosis.
- Standard 4** Families of infants diagnosed with CF by newborn screening should have access to genetic counselling services.
- Standard 5** Salt, electrolyte and vitamin replacement therapy should be considered in all infants at diagnosis; particularly in those geographical areas where hot and humid conditions prevail.

2.1. Background

2.1.1. The process of newborn screening

All children born in Australia are screened at birth for CF through a heel prick blood test performed usually between 48 and 72 hours of age. Samples are analysed in state based screening laboratories with an initial test quantifying immunoreactive trypsin. Samples with an elevated immunoreactive trypsin level are tested for mutation(s) in the cystic fibrosis transmembrane conductance regulator (CFTR) gene. Patients homozygous for a severe mutation, or compound heterozygotes, are assumed to have CF and are referred to a CF centre (but will need a sweat test for confirmation). Patients with only one detected CFTR mutation may have CF or may simply be carriers, and will need a sweat test for diagnosis.

2.1.2. Evidence

Clear evidence exists about the benefits of newborn screening for CF on the nutritional status of patients, up to and including adolescence (Farrell, Kosorok et al. 1997) [Level II]. No long term benefit on pulmonary function or long term survival has as yet been identified. As several studies have identified the benefits of centre-based care for patients with CF, newborn screening programs should be closely associated with major CF care centres [Level III]. Newborn screening for CF is available in all States of Australia and results in over 90% of paediatric diagnoses of CF being made in the first six weeks of life. While many children may be asymptomatic at that time, the introduction of the diagnosis to a family will involve both a clinical assessment of the child for CF co-morbidities, initial education for the family and enhance information about reproductive options for future pregnancies.

2.2. Guidelines

The following represent consensus views of the authors [Expert opinion]:

2.2.1. Newly diagnosed patients should ideally be transferred to a paediatric tertiary CF treatment centre for initial assessment and parental education.

- a. Care of the child with CF identified by newborn screening re-enforces the position that CF care

is best provided by a multi-disciplinary team including medical, nursing, and allied health persons. In addition, age specific experience is important.

- b. Paediatric trained and experienced staff members should be involved in the initial management of infants diagnosed with CF by newborn screening.
- c. It is important to minimise the time from the diagnosis of CF being made to the initial contact with an experienced CF care team (Sawyer and Glazner 2004).

2.2.2. Patients identified as being homozygous for a single CF mutation, or heterozygous for two mutations in those states with multiple mutation screening is undertaken (see Table 2.1.), should be contacted by a person experienced in genetic counselling and who have knowledge of CF.

- a. This person should work in close liaison with a CF treatment team. Once the initial diagnosis has been identified, a prompt referral to the CF treatment team is important.
- b. A period of education and clinical assessment following diagnosis will be necessary. During that time clinical assessment will include, but not necessarily be limited to:
 - i. History and examination
 - ii. Radiological assessment of lungs – usually a Chest X-radiograph [CXR]
 - iii. Blood levels for fat-soluble vitamins (vitamins A, D and E), liver function tests [LFTs] and blood chemistry
 - iv. Faecal analysis of pancreatic function – random stool analysis for fat globules, 3-day faecal fat balance or 3-day repeat acid steatocrit, faecal chymotrypsin level or faecal elastase level.
 - v. Confirmatory sweat test.

2.2.3. Patients diagnosed after identification of heterozygous CF genotype and a positive sweat test.

- a. Patients identified as being homozygous for a single CF mutation, or heterozygous for two mutations in those states where multiple mutation screening is undertaken (see Table 2.1.), should be contacted by a person

- experienced in genetic counselling and who has knowledge of CF.
- b. Sweat tests should be conducted by a laboratory experienced in performing sweat tests. The laboratory should have satisfied Australian national standards for laboratory accreditation for sweat testing. The consensus view is that such laboratories perform a minimum of 50 sweat tests per year (Massie and Clements 2005).
 - c. This two stage diagnostic process will involve the parents being aware of the test and the reason for the study and therefore may involve considerable parental anxiety until the test results are available.
 - d. Support for the family through this time by an experienced genetic counsellor should be available. Results of the sweat test should be delivered either by a genetic counsellor or a member of the CF specialist team.
 - e. Subsequent assessment of the child is as set out above for homozygous infants but additionally may include extended mutation analysis.

2.2.4. Patients diagnosed after meconium ileus

- a. The majority of infants born with meconium ileus will subsequently be diagnosed with CF. Approximately 15% of infants with cystic fibrosis will be born with meconium ileus (Waters, Dorney et al. 1990).
- b. Care should be taken to ensure that even in those ill infants new born screening tests are conducted, as diagnosis by sweat testing may be difficult due to technical reasons, including the inability to obtain sufficient sweat from such small infants and the risk of burning the skin.
- c. Sweat testing is deferred until clinical recovery in the newborn and has been demonstrated to be safely conducted in experienced laboratories after the first two weeks of life in term infants (Massie and Clements 2005).
- d. In clinical practice, genotyping results will usually confirm the diagnosis of CF and obviate the need for urgent sweat testing.
- e. Close follow-up of these infants should be ensured.
- f. Once the diagnosis of CF is confirmed

education and institution of therapy should be commenced while the infant is still in hospital following the treatment of the meconium ileus.

2.2.5. Initial Education

- a. Once the diagnosis of CF has been made, ample time should be allocated for the family to meet with all members of the care team, ie, physicians, physiotherapists, dietitians, social workers, counsellors and nurses on a one on one basis as required. This may require more than one session by members of the CF team. Additional time should be spent with genetic counsellors to discuss issues including family planning, and cascade testing of relatives.
- b. During this time medical assessment of the infant should be completed.
- c. Where CF Centres have access to community agencies such as local CF Associations, additional support and reinforcement will be available.

2.2.6. Follow-up

- a. Regular follow-up after diagnosis is important to review any therapeutic interventions that have been initiated, such as pancreatic enzyme replacement therapy, vitamin supplementation, nutrition support, antibiotic treatment or chest physiotherapy (Feranchak, Sontag et al. 1999; Sawyer and Glazner 2004).
- b. Regular outpatient appointments for review by the CF Care Team at the hospital should also be made prior to the family going home.
- c. A list of contact numbers of members of the CF care team should be provided to the family on completion of the medical assessment and family education.
- d. It is desirable that families are provided with educational material, either in a printed or audiovisual format, to reinforce aspects of the family education.
- e. Parents should be provided with addresses to allow access to any of the useful online resources from CF Internet sites including those from;

www.cysticfibrosis.org.au
www.cfwww.org
www.ecfsoc.org, and
www.cff.org

State	Mutations screened
New South Wales + ACT	p.F508
Victoria + Tasmania	p.F508, del,c.489+1G>T, c.1585-1G>A, c.3718-2477C>T, p.1507del, p.W1282X, p.R553X, p.R560T, p.N1303K, p.G542X, p.G551D, p.V520F
Queensland + Northern Territory*	p.F508, p.I507, p.G551D, p.G542X, c.621+1G>T, p.R553X, p.N1303K, p.R117H
South Australia + Northern Territory*	p.F508, p.I507, p.G551D, p.G542X, p.R553X
Western Australia	p.F508, p.G551D, p.G542X, c.621+1G>T

Table 2.1. Mutations included in state based newborn screening programs in Australia

*In the Northern Territory, Darwin, Gove and Katherine Hospitals send Neonatal screening tests to Brisbane and receive the same gene testing as Queensland whereas Tennant Creek and Alice Springs Hospitals send Neonatal screening tests to Adelaide and receive the same South Australia based gene testing.

2.3. References

- Farrell, P. M., M. R. Kosorok, et al. (1997). "Nutritional benefits of neonatal screening for cystic fibrosis. Wisconsin Cystic Fibrosis Neonatal Screening Study Group." *N Engl J Med* 337(14): 963-9.
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- Sawyer, S. M. and J. A. Glazner (2004). "What follows newborn screening? An evaluation of a residential education program for parents of infants with newly diagnosed cystic fibrosis." *Pediatrics* 114(2): 411-6.
- Waters, D. L., S. F. Dorney, et al. (1990). "Pancreatic function in infants identified as having cystic fibrosis in a neonatal screening program." *N Engl J Med* 322(5): 303-8.

3. Newly Diagnosed Adolescent or Adult with Cystic Fibrosis

(Peter Bye, Carmel Moriarty and Peter Middleton)

- Standard 1** Investigations such as a sweat test (sweat chloride >60mmol/L) and standard CFTR mutation testing may not be confirmatory in many cases of “atypical” CF.
- Standard 2** For those patients with sinopulmonary symptoms, careful clinical assessment for extra-pulmonary symptoms and medical imaging of the sinuses and lungs is required (CT scan of the sinuses and high resolution CT chest).
- Standard 3** After a diagnosis of “atypical” CF has been made, it is recommended that the patient receive medical follow-up by a physician expert in the management of patients with CF.

3.1. Background

In Australia, the vast majority of patients with CF are diagnosed by neonatal screening. However, up to 10% of CF cases are diagnosed beyond infancy with presentations in childhood, adolescence or adulthood. A number of studies have reported that CF patients diagnosed in adolescence or adulthood have phenotypic characteristics which are distinct from those who are diagnosed early in childhood and include:

- a. Better nutritional status,
- b. Pancreatic sufficiency (which may be complicated by recurrent acute pancreatitis),
- c. Milder lung disease,
- d. Lower rates of chronic *Ps. aeruginosa* infection.

Accordingly, many of the patients diagnosed at an older age have “milder” CF mutations. In a small percentage of people presenting with classical features of CF the diagnosis may not be made until later in life. Some of these people will have been born prior to the advent of neonatal/newborn screening programs or be amongst the small percentage of patients who are not detected on screening.

In contrast, there is a spectrum of diseases associated with some features of the CF phenotype such as patients with isolated obstructive azoospermia and recurrent acute pancreatitis in whom a diagnosis of CF is not appropriate.

A revised classification of “Cystic Fibrosis and Associated Disorders” has been proposed by a joint working group of WHO and International CF organisations and has been presented to the International Classification of Diseases (ICD) (Meeting report 2002).

3.1.1. What is Cystic fibrosis?

An excellent description of characteristic phenotypic features of CF is summarised in Cystic Fibrosis Foundation Consensus report published in 1998 (Rosenstein and Cutting 1998). The recognition of the association between CF gene mutations and conditions such as congenital bilateral absence of the vas deferens (CBAVD), recurrent acute pancreatitis, chronic rhinosinusitis, APBA and bronchiectasis has led to diagnostic uncertainty

in some cases particularly as extended CFTR mutation testing is not routinely available. Recent consensus guidelines (Rosenstein and Cutting 1998; Nick and Rodman 2005; Rodman, Polis et al. 2005) have suggested that a diagnosis should be based on clinical features associated with CF, not merely on the results of genetic testing.

3.2. Guidelines

The following guidelines are based on available evidence and expert consensus (Rosenstein and Cutting 1998; 2002; Nick and Rodman 2005; Rodman, Polis et al. 2005; De Boeck, Wilschanski et al. 2006). Four areas are specifically covered and include:

- a. Diagnostic workup for the diagnosis of CF in an adolescent or adult with features of CF.
- b. Management of an adolescent or adult with atypical CF.
- c. Management of an adolescent or adult who does not meet the diagnostic criteria for CF – e.g., including recurrent acute pancreatitis and CBAVD.
- d. Psychological impact of an adolescent or adult diagnosis.

3.2.1. Diagnostic Workup for the diagnosis of CF in an adolescent or adult

- a. Investigations such as a sweat test (sweat chloride >60mmol/L) and standard CFTR mutation testing may not be confirmatory of “atypical” or “non-classical” CF.
- b. Referral to a clinician with expertise in CF care is important for accurate evaluation of such patients. The presentation of a patient with symptoms suggestive of “atypical” or “non classical” CF can be varied.

3.2.1.1. Sweat electrolytes

- a. Despite their simplicity, sweat electrolytes require considerable technical skill and results are more accurate in laboratories that regularly perform the test.
- b. Sweat electrolytes should be performed in an accredited laboratory with considerable experience in performing sweat tests in adolescents and adults.
- c. Whilst patients with atypical or non classical CF features often have non-diagnostic sweat

electrolytes (Cl⁻<60mmol/l), it is still important to perform the test. The likelihood of a patient with atypical symptoms having CF is higher if the sweat chloride result is in the intermediate (Cl⁻ 40-60mmol/l) range than if the result is completely normal (Cl⁻<20mmol/l).

- d. For indeterminate cases it is important to perform the sweat test on at least three occasions.

3.2.1.2. Genetic screening

- a. Performing extended genetic analysis accounting for ethnic ancestry of the patient is ideal. Specific mutations analysed for the appropriate population can be useful (e.g. examination for specific mutations for those of Jewish descent (W1282X mutation). However, the reality is that full CFTR genetic analysis (sequencing) is not currently available as a routine diagnostic test in Australia.
- b. Negotiation with laboratories overseas (e.g. New Zealand, France and USA) may facilitate extended testing in selected cases, and private laboratories in the USA may offer this analysis at substantial cost (>\$A1500).

3.2.1.3. Other phenotypic tests

- a. There are many other tests that may be of use, depending on the presenting features of the patient.
- b. The presence of significant involvement of other systems eg gastro-intestinal tract, liver, pancreas may be consistent with a mild version of CF.
- c. Fat soluble vitamin levels should be measured and medical imaging of the abdomen (eg. liver and pancreas) performed.

3.2.1.4. Nasal Potential Difference Testing

- a. Nasal potential difference testing is well recognised to provide useful diagnostic information as a “bioassay” of CFTR dysfunction.
- b. The disadvantage of the nasal PD is that the technique is time consuming, not widely available and requires significant patient co-operation.

3.2.1.5. Exclude other causes of bronchiectasis

- a. For those patients with sinopulmonary

symptoms medical imaging of the sinuses and lungs is required (CT scan of the sinuses and high resolution CT chest).

- b. Extensive examination for other causes of bronchiectasis may be helpful and may include: assessment for evidence of primary ciliary dyskinesia (nasal brush biopsy), ABPA (immunological and skin testing), alpha-1-antitrypsin deficiency (blood analysis), gastro-oesophageal reflux (24 hour pH monitoring) and immunodeficiency (immunoglobulin and IgG subclass levels).
- c. Assistance in the diagnosis of “atypical” CF may be provided by semen analysis in men when appropriate, with counselling regarding the potential implications of the result.

3.2.2. Management of the adolescent or adult with atypical CF

- a. After a diagnosis of “atypical” CF has been made, it is recommended that the patient receive follow-up by a physician expert in the management of patients with CF.
- b. Advantages of a CF centre-based approach include an opportunity for the recognition and treatment of other complications associated with CF (eg. specific pulmonary infections), exploration of aspects of infertility and their potential management, genetic counselling for family members.
- c. These advantages need to be balanced with the potential risk of cross-infection and the individual being confronted by the realisation that further complications may occur later in life.

3.2.3. Management of the adolescent or adult with suspected but not proven CF

- a. If a final diagnosis cannot be made, it is preferable to discuss the situation frankly with the patient. One overriding principle to be stressed is that effective clinical treatment is available for most phenotypic presentations such as respiratory, sinus, gastrointestinal tract disease and male infertility, even without a formal diagnosis of CF.
- b. The clinician should be positive, provide hope and support to reassure and lessen concern, and empower the patient. Attention should be focused on individualised and regular

treatment regimens (e.g. physiotherapy and antibiotics for respiratory disease).

- c. At the appropriate time, discussion with parents, partners and other family members, should be considered, in recognition of the potential psychological impact in the uncertainty of the diagnosis.
- d. An education programme about suppurative lung disease (impact and management) should be available to patients, partners and family members. For children with suspected CF, parents must be involved.
- e. If a CF mutation has been found and the phenotypic presentation suggests CF, then the subject and appropriate family members should be referred to genetic counselling services to co-ordinate further testing.
- f. Follow up of individuals who do not fit the diagnostic criteria for CF should generally be by a physician with expertise in the management of suppurative lung disease and preferably CF, who is able to assist in the exclusion / confirmation of the diagnosis of CF.
- g. It may not always be appropriate to follow patients without a definitive CF diagnosis in the CF centre (concerns about the possible psychological impact and/or the patient's wishes). In this circumstance, review in a suitable alternative clinic co-ordinated by an expert physician should be considered. Strategies may vary between clinics and be dependent on logistics and local resources. However access to all the resources and personnel of the CF service should be available.
- h. The opportunity for ongoing follow up is essential and will provide for monitoring new clinical features eg pancreatitis, which may enable a definite diagnosis. This is also important to obtain more information about the natural history of people with a late diagnosis of CF. Recently, there has been considerable interest in the medical literature regarding the clinical presentations and progress of people with a late diagnosis of CF; especially those with the mildest end of the spectrum of CF related diseases. In addition, there are increasing numbers of patients with suspected, but not proven, diagnosis of CF. This raises the question as to what extent of

testing is appropriate.

- i. Recent consensus guidelines (Rosenstein and Cutting 1998; 2002) favour a clinical rather than a solely genetic analysis. Consequently, it is recommended that the patients with milder "atypical" CF have regular treatment for any symptoms and follow surveillance assessments to detect new features, such as complications that would be corresponding to the CF phenotype.

3.2.4. Psychological Impact of adolescent and adult diagnosis

- a. Patients may be relieved when a firm diagnosis of CF is made, especially if they have undergone multiple medical reviews and investigations for ongoing symptoms. Others react with shock, anger and denial (Wideman 2002). Not all such patients embrace the established principles of CF care, and this requires sensitivity in discussion with the patient and their family. Some are desperate for the "instant cure". Some do not want care at an adult centre because of fear of acquisition of infection, allegiance to a previous physician or, reluctance to be labelled / classified as a patient with CF.
- b. Parents and other family members can also suffer considerable psychological distress with the impact of a disease label and concern about the implications for the future, including genetic implications for other family members, and the potential impact applications for life and medical insurance.
- c. It is very important that appropriate counselling, support and education, including approved internet resources are provided to the newly diagnosed patient and that a spirit of optimism and hope is conveyed very strongly by the medical, nursing and allied health staff. This should encourage continued attendance.
- d. It is important to stress to the patient with "atypical CF" that there is evidence that their prognosis is better than the majority of patients who have classical CF (eg. neonatal diagnosis, pancreatic insufficiency).

3.3. References

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4. Outpatient Care

(Peter Bye, Carmel Moriarty, Susan Sawyer and Claire Wainwright)

- Standard 1** Treatment should be coordinated by a multi-disciplinary team in specialised CF centres.
- Standard 2** All patients should be seen at least four times per year (including at least twice by the CF specialist team).
- Standard 3** Access to the specialist CF multidisciplinary team should be available at all clinics.
- Standard 4** An annual review, including appropriate tests, should be undertaken followed by a written report to the general practitioner. This should include assessment of current status and progress.
- Standard 5** Adequate policies, facilities and procedures should be in place to comply with, and promote, infection control guidelines.

4.1. Background

Published guidelines describe details of the requirements for an OPD review, staff involvement, timing and aspects of infection control (Clinical Practice Guidelines for Cystic Fibrosis 1997; Cystic Fibrosis Standards of Care 1998; Standards for the Clinical Care of Children and Adults with Cystic Fibrosis in the UK 2001; Kerem, Conway et al. 2005). In summary, the review of ambulatory patients in an outpatient setting should be undertaken by a multidisciplinary team that consists of a CF specialist physician, nurse, physiotherapist, dietitian and social worker, with access to other specialist services as clinically indicated.

4.1.1. Evidence

There are no controlled trials of specialist centre care for cystic fibrosis. However a study strongly suggested improved outcomes in adult patients who are managed in paediatric specialist centres compared with patients who had not received specialist centre care (Mahadeva, Webb et al. 1998).

4.1.2. Experience in Australia

There are 23 CF centres and CF clinics in Australia (Australian Cystic Fibrosis Data Registry 2003). The median OPD reviews of Australian patients with CF in 2003 were five OPD reviews (25th-75th quartiles 3 to 7). The number of OPD reviews was similar across the infant, child, adolescent and adult age groups.

4.2. Guidelines

The following represent consensus views of the authors [Expert Opinion].

4.2.1. General recommendations

- a. Adequate time is required for each patient and family. Time efficient clinics are needed to reduce waiting times and minimise loss of school and work time for patients and families.
- b. The following procedures should be included at each clinic: Routine physical examination including weight, height, head circumference in infants, oximetry in patients with severe lung disease, spirometry from age five years, blood pressure and urine analysis, especially in

patients on oral prednisolone, sputum sample for productive patients and consideration of oropharyngeal specimen from non-productive patients.

- c. Paediatric patients should be reviewed annually by the gastroenterology team. At this time, review should include appropriate investigation of liver disease, assessment of growth, nutritional status and body composition along with assessment of gastroesophageal reflux and non-specific symptoms such as abdominal pain, bowel function abnormalities and regular review of all aspects of drug therapy. Some will require more frequent review.
- d. Continued access to genetic counselling should be available and considered for patients and their families.
- e. At each clinic there should be a detailed review of all medications, their dosage, and methods of administration to determine whether they are appropriate. Any changes in therapy should be discussed.
- f. Careful consideration of preventative strategies should be undertaken at least annually, but also at regular routine visits. This should include appropriate immunisations (Malfrout, Adam et al. 2005). All childhood immunisations are appropriate including annual influenza immunisation for children aged six months and older, Pneumovax 23 every five years for children aged five years and older, and HPV immunisation. Approaches to reducing exposure to environmental tobacco smoke should be discussed. The potential benefits of a Pulmozyme trial, use of hypertonic saline and azithromycin should be regularly considered (Bell and Robinson 2007; Ford and Flume 2007).
- g. A treatment protocol for *P. aeruginosa* eradication/reduction in load should be agreed by treating teams (Ford and Flume 2007).
- h. Infection Control
 - i. Adequate facilities and a clear plan and procedures should be in place within CF outpatients clinics to prevent patient to patient contact and avoid cross infection with viral and bacterial pathogens in the respiratory laboratory, outpatient clinic and hospital precinct. Use of pagers, separate

- clinics etc should be considered (Infection control guidelines for cystic fibrosis patients and carers 2007).
- ii. Specifically, clinics should have measures in place to avoid contact between patients not chronically infected with *Pseudomonas aeruginosa* and chronically infected patients. Patients infected with *Burkholderia cepacia* or MRSA should not be cohorted together, and measures must be put in place to avoid patient to patient contact. Similarly, although there are no suggestions of person to person spread for non tuberculous mycobacteria, it would seem wise to avoid patient to patient contact.
 - iii. Ongoing research may dictate future strategies in regard to clonal and multi-resistant strains of *Pseudomonas aeruginosa*.
 - i. Patients should have a plan for management of acute exacerbations. This should preferably be written for the patient and/or family and communicated to other medical teams involved such as the general practitioner.
 - j. People with cystic fibrosis related diabetes (CFRD) or glucose intolerance should ideally be managed in conjunction with a diabetes specialist, as part of a multidisciplinary care team. Lifestyle and medication management are commonly both necessary. Patients with CFRD usually require insulin treatment, as oral agents in attempt to manage hyperglycaemia are typically ineffective. While the insulin regimen needs to be tailored to the patient, including the blood glucose monitoring data, generally small doses of rapid acting insulin are required. Insulin requirements can transiently increase markedly during for example treatment with supra-physiological doses of glucocorticoids due to respiratory tract infective exacerbations, or during night feeding.
 - k. Patients and families should have daytime telephone access in order to contact the CF Centre if required. The first point of contact is commonly the CF Nurse specialist. Telephone numbers and location of the Emergency Department should be given for access to services after hours.
 - l. A structured clinical report including a summary should be sent within 10 working days of a clinic visit to all relevant colleagues (Rawal, Barnett et al. 1993).
 - m. Strategies should be put into place to identify and contact patients who fail to attend clinic appointments.
 - n. Continuity of care and quality improvement will be facilitated by regular weekly meetings by the multidisciplinary team, at which both individual patients and systems issues are discussed.
 - o. Regular review and servicing of equipment should be conducted at least six monthly by qualified personnel (spirometers, nebulise pumps, respiratory therapy equipment such as PEP masks, etc).
 - p. All CF Specialist Centres should have clear lines of communication with role responsibilities for the multidisciplinary team with strategies in place to ensure appropriate referrals and monitoring are undertaken, and results are assessed in a timely manner. This should include reporting results of newborn screening, genetic education and counselling.

4.2.2. Facilities

These should include:

- a. An outpatient clinic with sufficient single consulting rooms for each member of the CF team, including office space for education and consultation by members of the multidisciplinary team.
- b. Adequate facilities (or systems) for waiting patients and families in order to reduce the risk of cross infection.
- c. Ambulatory care/treatment room for simple procedures such as flushing of central venous access devices, first dose safety observation for inhaled or oral antibiotics.
- d. Lung function laboratory with appropriate policies to reduce the risk of cross infection (Infection control guidelines for cystic fibrosis patients and carers 2007).

4.2.3. Services provided

See Table 1.2.

4.2.4. Annual review should include the following:

- a. Collection of oropharyngeal specimen or

- sputum where appropriate, with the culture using appropriate media selective for detection of *P. aeruginosa*, *Burkholderia cepacia*, *Staphylococcus aureus* and MRSA. Sputum microbiology including AFB should be performed at least annually, especially for patients on regular azithromycin. Culture results should be checked promptly and acted on if required.
- b. CXR and/or chest CT scanning. CT scanning should be performed according to appropriate protocols agreed with the local CF centre that minimise radiation exposure and maximise the information obtained. Expiratory CT images should also be obtained.
 - c. Assessment of dietary intake, PERT usage, use of vitamins, salt replacement therapy and use of nutritional supplements.
 - d. Fat soluble vitamins levels (A, E, D), full blood count, urea, electrolytes and creatinine, liver function tests, random or fasting blood glucose level (BSL), total IgE.
 - e. Blood glucose monitoring should be performed to exclude hyperglycaemia, either by a formal oral glucose tolerance test or fasting and random blood glucose testing on a regular basis. Annual oral glucose tolerance testing for patients aged 10 years or older should be considered and should be performed in patients with symptoms suggestive of glucose intolerance or with unexplained weight loss, growth failure or worsening respiratory status.
 - f. Spirometry should be completed at each visit, with charting and recording of absolute and predicted values.
 - g. Oximetry and/or the measurement of arterial blood gas tensions should be performed in those with moderate to severe respiratory disease. A diagnostic sleep study should be performed in those likely to need supplemental oxygen or non invasive ventilation (eg FEV1 <65% predicted and SaO2 <93%). Consider assessment for portable oxygen therapy in patients with moderate to severe CF-related lung disease.
 - h. Audiology should be considered for patients receiving azithromycin, clarithromycin or frequent courses of intravenous aminoglycosides. Audiology should be requested for patients with tinnitus, balance disorders, vertigo and hearing loss.
 - i. Growth, including pubertal assessment, should be charted. Body composition measurement should be considered especially for malnourished patients (BMI <18.5kg/m²).
 - j. Bone mineral density should be considered in those at risk of osteopenia or osteoporosis, such as patients on prolonged or repeated courses of oral corticosteroids for ABPA, or patients with malnutrition. DEXA scanning may be particularly helpful as data on both body composition and bone density can be obtained using this technique. Ideally, bone mineral density should be measured in all adolescents and adults with CF (baseline), and every one to three years subsequently.
 - k. Assessment of exercise tolerance using tests as appropriate to patient status and clinical standards.
 - l. Musculoskeletal assessment by physiotherapist with appropriate investigations as required. Referral to a specialist musculoskeletal physiotherapist as required.
 - m. Full assessment of respiratory therapy equipment and its use, including cleaning protocols.
 - n. Assessment of urinary and faecal incontinence.
 - o. Enquiry about oral and vaginal candidiasis with referral to a specialist women's health physiotherapist or gynaecologist as required.
 - p. Audit of clinic infection control procedures should be undertaken. Audit of clinical outcomes such as lung function and nutritional parameters compared with other clinics nationally should be undertaken using the National Data Registry.
 - q. Regular quality control initiatives should be undertaken by each clinic.
- 4.2.5. First Visit to the CF Clinic (transfer from another centre)**
- a. Diagnosis is reviewed, a detailed history is taken, correspondence from the referring centre is reviewed, physical examination is performed and the relevant tests are ordered. Policies specific to the centre are discussed including infection control, management of young people and transition to adult care.
 - b. The parents of young adults attending the

adult hospital for the first time, should be invited to attend and to meet all members of the team who will inform them about best practice in the management of adults. Parents are encouraged to discuss any issues or concerns. The clinician should also meet the young adult in a one-to-one consultation, following which the parents should be invited to spend time with the clinician, with or without the young adult.

4.2.6. Management of patients at risk of CF related disease known as “atypical CF” with borderline or normal sweat test.

Patients should be reviewed at least annually at a specialist CF centre. It is preferable that this is done at a time other than at the usual CF clinic visit, but with appropriate access to the CF multidisciplinary approach to care. Further details are found in Chapter 8.

4.2.7. Education

General recommendations.

- a. Regular, developmentally appropriate education of patients and family members should be undertaken.
- b. This should include understanding of cystic fibrosis including pattern of inheritance and availability of genetic counselling, disease monitoring strategies, treatment loans, use of medication, use and cleaning of equipment, infection control measures, promotion of self-management and transition to adult care, and plans for transfer to adult care as appropriate.

Sexual and reproductive health recommendations (Sawyer and Glazner 2004).

- a. Parents should be informed of probable male infertility soon after the diagnosis of CF.
- b. Discussion with parents should be repeated before their sons reach puberty to facilitate parents discussing aspects of sexual and reproductive health with their sons
- c. Health professionals should talk to boys about male infertility no later than mid-adolescence (approximately 14 years). Topics to discuss include infertility (including differentiating infertility from impotence, encouraging safe sex practices and the importance of condoms),

small volume ejaculates, the role of semen analysis and reproductive options.

- d. Semen analysis should be offered to all older adolescents and adult men with CF (Sawyer and Glazner 2004).
- e. Men with CF should have access to assisted reproductive biology units.
- f. Women with CF should be able to access a gynaecologist who is experienced in the sexual and reproductive health aspects of CF.
- g. Contraception should be offered to all sexually active women who do not want to become pregnant.
- h. Inquiry about symptoms of vaginal yeast infection should occur routinely with a prescription of antibiotics, as should concurrent prescription of topical treatment for those women who commonly suffer from vaginal yeast infections.
- i. A strong emphasis needs to be placed on achieving the best possible respiratory and nutritional status prior to conception. Pre-pregnancy and pregnancy counselling should include genetic counselling and carrier screening. Additionally, discussion should focus on the risks to the mother, the risks to the fetus, and the complex short and long term issues surrounding parenthood in CF.
- j. Pregnancy is best managed when it is a planned event and where there is close collaboration between the medical (CF) and obstetric team.
- k. Pregnancy cannot be recommended to those with severe lung disease, especially those with pulmonary hypertension, significant liver disease or poor nutritional state.

4.2.8. Share care arrangements

- a. For some patients from regional centres who do not have ready access to an Outreach clinic, a structured management plan with a general physician/paediatrician should be considered.
- b. It is the responsibility of the CF Centre to provide as much information to local providers as possible.
- c. It is not always possible for a hospital admission to be undertaken or completed at the CF Centre. Whole or part of the admission may be completed under the care of the local physician/paediatrician in a local hospital.
- d. In some remote areas a general physician/

paediatrician may not be available and the family General Practitioner (GP) may manage a hospital admission.

4.2.9. The role of the general practitioner

- a. The involvement of a general practitioner is required for all patients. Their involvement may be of paramount importance if palliation is required in end stage disease.
- b. At all times, general practitioners must be able to access advice from the CF Centre team and good communication between the CF centre and the general practitioner is essential in optimising care. It may be useful for a CF Centre to provide general information on the care of patients with CF to the general practitioner. An example is illustrated in Appendix 1 (pages 102-105).

4.3. References

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5. Inpatient Care

(Carmel Moriarty, Gerard Ryan and Philip Robinson)

- Standard 1** All hospitals should recognise the characteristics and needs of people with CF.
- Standard 2** All hospitals should have available facilities, staff, and services to manage all complications of CF or the ability to arrange early transfer to an appropriate hospital.
- Standard 3** All hospitals should have ward accommodation that meets the needs of people with CF, particularly with regard to optimal infection control.
- Standard 4** All should have plans for emergency assessment and admission.
- Standard 5** When people with CF are admitted to hospital and not under the direct care of the CF team, there should be prompt communication with the CF centre staff to ensure patients have access to the services, staff and facilities needed for optimal care.
- Standard 6** There should be protocols for management of all common complications of CF in hospitals to which people with CF are admitted/treated.

5.1. Background

People with CF frequently require admission to hospital. The most common reason for admission is a respiratory tract exacerbation (RTE). Less frequent reasons include complications of respiratory disease (e.g. pneumothorax, haemoptysis), gastrointestinal disease (eg Distal Intestinal Obstruction Syndrome [DIOS]), liver failure, unstable diabetes, psychosocial problems or peri-operative care.

People with CF may be admitted to hospital for non-CF problems such as trauma or for elective surgery. Therefore, people with CF may be cared for by hospital staff not familiar with their other medical problems or their specific needs, with the potential to lead to errors in management and patient dissatisfaction.

It is important for hospital staff to recognise the characteristics and needs of people with CF. In particular, it is useful to be aware that people with CF:

- a. May have frequent admissions to hospital.
- b. Often find admission to hospital stressful despite frequent admissions.
- c. Adults with CF are usually younger than other patients in an adult setting.
- d. Have a longer average length of stay, typically at least 10 – 14 days.
- e. Are usually not unwell for much of their admission.
- f. Should be given leave for study, work or recreation which is important to help maintain independence, quality of life, adherence to medications and goodwill.
- g. Have specific dietary needs.
- h. Need specific infection control practices.
- i. Have admissions that are usually planned but may be urgent.
- j. Are wary of nurses, doctors and other staff who are not familiar with CF, particularly if staff does not acknowledge the patient's knowledge and ideas on treatment.

5.1.1. Experience in Australia

The proportion of Australian patients with CF admitted to hospital in 2003 varied from 61.2% in infants (0-1 years), 46.1% in young children (2-5 years), 44.9% of older children (5-11 years),

50.1% of adolescents (12-17 years) and 49.7% of adults. For those with an admission, the mean time in hospital for ages 10 – 29 years was about 25 days (Australian Cystic Fibrosis Data Registry 2003). In 2003, patients were admitted to hospital an average of 0.81 episodes per patient (range 0 - 10 admissions). The majority of hospitalisation episodes were as a result of respiratory indications (Australian Cystic Fibrosis Data Registry 2003).

5.2. Guidelines

In general the facilities, staff and services needed to care for people with CF in hospital are those required for a CF centre as defined previously (Standards for the Clinical Care of Children and Adults with Cystic Fibrosis in the UK 2001; Kerem, Conway et al. 2005). People with CF may be admitted to a ward or hospital other than the hospital at which the CF centre is based or the usual CF ward in their usual hospital. Attending staff in these situations have a responsibility to communicate with the CF centre team to ensure the patient has access to the staff, facilities, services and expertise required for an optimal standard of care. The following represent consensus views of the authors [Expert Opinion].

5.2.1. Facilities

- a. Hospital facilities needed to manage complications of CF should be readily available.
- b. Ward accommodation
 - i. Admit to a ward familiar with caring for people with chronic disease, ideally a respiratory medicine ward.
 - ii. Single rooms to optimise infection control are preferred but not always available (Infection control guidelines for cystic fibrosis patients and carers 2007).
 - iii. Space for associated medical equipment; eg BIPAP circuits, gastrostomy feeds, IV antibiotics and physiotherapy equipment.
 - iv. Additional space is required for parents of children or partners and family members of adults with CF.
 - v. Space and equipment to study and / or work.
 - vi. Isolation space for physiotherapy if not in single room.
 - vii. Space and equipment for exercise.

- viii. Space and equipment for food preparation / storage.
- ix. Hospital kitchen able to provide appropriate high energy food.

5.2.2. Staff

- a. CF team and relevant specialists should be readily available.
- b. Attending staff in these situations have a responsibility to communicate with the CF centre team, when care is coordinated by another medical team.

5.2.3. Services

- a. Emergency Centres should have a plan for people with CF to receive urgent care, including admission to hospital. The CF physician should be notified promptly after the emergency department has assessed the patient's condition.
- b. People with CF should, whenever possible, be admitted under the care of a CF physician. If a medical issue arises which is best managed by another specialty, the CF team must be notified and a joint admission considered.
- c. The CF centre should have protocols for admission, investigations, treatment and monitoring of progress. This should include protocols for complications of CF.
- d. Planning and provision of appropriate venous access soon after admission (see below).
- e. Provision protocols for use of all drugs required by people with CF should be available in the hospital (Report of the UK Cystic Fibrosis Trust Antibiotic Group 2002; Gibson, Burns et al. 2003).
- f. Emergency centres should be able to manage all CF related problems, particularly more common emergencies such as haemoptysis, pneumothorax, respiratory failure, bowel obstruction and bleeding oesophageal varices.
- g. Physiotherapy assessment and treatment; with airway clearance performed as indicated by the patients respiratory condition, at least twice daily (see below).
- h. Dietetic therapy assessment and provision of appropriate food and enteral feeding (see below).
- i. Psycho-social assessment and counselling;

specific issues to address are the effect of hospitalisation on work, education and home life.

- j. Nursing care supported by a CF nurse.
- k. Application of an Australian CF specific infection control policy (Infection control guidelines for cystic fibrosis patients and carers 2007).
- l. CF team to use the time to continue education of patients and families; use the time to encourage patients to discuss issues and refer to appropriate CF team members.
- m. Use time in hospital for review of all problems, particularly those that require laboratory investigations and specialist consultations (see Annual Review, Chapter 4).
- n. Link to services for home treatment.
- o. School, vocational and tertiary education should be supported for inpatients. Learning facilities should be available for those who are engaged in educational programs outside the hospital.

5.2.4. Emergency Access and Admission

- a. Key hospital staff (including switch room operators and CF/respiratory ward staff) should be aware of the out-of-hours contact arrangements for people with CF.
- b. The patient's diagnosis of CF should be readily identifiable in the medical records.
- c. The CF centre should inform people with CF and their carers how to access help out of hours.
- d. The admitting medical staff should notify CF team medical staff and CF ward of the presenting medical problem and of the hospital admission.
- e. Admit to a CF ward if appropriate.
- f. Admit to a single room if possible; ideally attempt to not have the CF patient sharing a room with other people with CF.
- g. Check sputum microbiology results for presence of multi-resistant *Staphylococcus aureus* (MRSA) or *Burkholderia cepacia* complex. If these organisms are present, follow infection control guidelines for management in hospital (Infection control guidelines for cystic fibrosis patients and carers 2007).
- h. Initial assessment should include identification of all medical problems, CF and non-CF

complications.

- i. Check history of adverse drug reactions from patient and their medical record.
- j. Initial investigations should be appropriate for presenting problem and for assessment of status of respiratory disease. For the latter patients should have lung function testing when able to be performed (eg FEV1) and oxyhaemoglobin saturations (or arterial blood gases for adults with CF) measured. All should have sputum sent for microbiology. A chest X-ray should be performed when clinically indicated.
- k. Plan venous access. Initially, use an implantable vascular access device (IVAD) if available or peripheral IV line. A peripherally inserted intravenous central catheter (PICC) line or a central venous catheter (CVC) will usually be arranged during working hours. Venous access should be performed only by experienced staff.
- l. Consult physiotherapy service for treatment and collection of a sputum sample for microbiological culture and sensitivities.
- m. Treatment plan should be appropriate for the presenting problems and include usual medications.
- n. In most people with CF admitted to hospital for any reason antibiotic treatment should be commenced without delay.
- o. Antibiotic treatment will depend on usual organisms (usually anti-pseudomonal) and should follow CF centre protocol or guidelines (Report of the UK Cystic Fibrosis Trust Antibiotic Group 2002; Gibson, Burns et al. 2003).

5.2.5. Intravenous Access

- a. Centres should have a plan for IV access for each person based on knowledge of their history of IV access.
- b. Options for IV access should be discussed with patients at each admission.
- c. Needle phobia is an important problem to consider; sedation or general anaesthesia may be needed for children and some adults.
- d. Centres should have staff with expertise in CF and IV access, and facilities to provide a service for insertion of temporary peripheral or central venous lines as well as IVADs.

5.2.6. Drug Treatment

- a. Ask about and have a readily available record of each patient's adverse drug reactions.
- b. Have a protocol for drug treatment of CF related problems causing admission.
- c. The use of IV antibiotics should follow guidelines, with written information on selection of drugs, dose and monitoring of aminoglycoside levels.
- d. Review benefits and harms of all medication.
- e. Education about drugs for CF by medical staff and by a pharmacist experienced with CF pharmacology.
- f. Discuss medication and treatment adherence.
- g. Early planning for treatment on discharge and review of progress particularly if continuing IV antibiotics at home.

5.2.7. Physiotherapy - Assessment and Treatment

- a. Access to physiotherapy services experienced in CF and applied according to the Australian Clinical Practice Guidelines for Physiotherapy in CF (Button, Holland et al 2008).
- b. Physiotherapists must practice according to current CF infection control guidelines.
- c. Patients should be assessed by a physiotherapist within 24 hours of admission, with airway clearance performed as indicated by the patient's respiratory condition.
- d. Physiotherapy services should be available on evenings, week-ends and holidays as needed.
- e. Treatment frequency may vary from one to four times daily (or more), depending on the severity of respiratory symptoms or other influencing factors.
- f. Physiotherapy treatment includes inhalation therapy, airway clearance, musculo-skeletal care, exercise and management of any other co-existing condition (where appropriate).
- g. Treatment is tailored to the individual needs, according to age and clinical status.
- h. Physiotherapy devices to include access to assist devices such as bilevel positive airway pressure [BIPAP] and other forms of Non Invasive Ventilation [NIV].
- i. Facilities should be provided for inpatient exercise assessment and provision.
- j. In hospital care will include discharge planning,

ongoing education and update regarding their home program. If appropriate and available – referral to local/community physiotherapy/rehabilitation services.

5.2.8. Dietetic Therapy - Assessment and Treatment

- a. Access to a dietitian with experience in CF and the Australasian Clinical Practice Guidelines for Nutrition in Cystic Fibrosis (Stapleton, Ash et al. 2006).
- b. Assess the impact of the illness especially RTEs on appetite, hydration, glucose tolerance and energy demands.
- c. Implement a protocol for monitoring of blood sugar appropriate for diagnosis and management of CF related diabetes or impaired glucose tolerance.
- d. Energy dense foods and/or oral supplements may be needed on a more frequent basis to supplement the usual hospital diet. The hospital kitchen should be able to provide appropriate high energy, high protein diets.
- e. Naso-gastric or gastrostomy feeding that is part of individuals usual treatment should be reviewed and continued.
- f. PERT, glucose tolerance, medical progress and alterations in therapy should be reviewed by the CF dietitian during admission. Patients with additional complications (eg. reduced bone mineral density), may require further dietary support and counselling.
- g. Acute admissions provide the opportunity to provide additional education on nutrition and the appropriate approach to dietary modification.

5.2.9. Discharge Planning

- a. Arrangements for follow-up should be discussed with the patient and their family (including time of next appointment). This includes ongoing nebulised and/or oral antibiotics and any changes to medications.

- b. Follow-up should be arranged at a specific outpatient clinic which is appropriate for the patient with respect to local and national infection control policies.
- c. When appropriate, the date of next IVAD flush should be discussed and an appointment made.

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6. Home Therapy

(Scott Bell and Pam Rowell)

- Standard 1** Home therapy may be considered for treatment of respiratory exacerbations for patients with CF.
- Standard 2** Protocols for selection and training of patients, delivery of treatment and monitoring of responses are required.
- Standard 3** The first dose of parenteral antibiotic therapy should be administered in hospital.
- Standard 4** Written information of the treatment plan and emergency contact details at the CF Centre should be provided to patients.

6.1. Background

Home therapy is defined as the delivery of all care, including parenteral antibiotics, for respiratory exacerbations in patients with CF. Home therapy is increasingly used for respiratory exacerbations in adults and children with CF (Bell and Bunting 2005). Concerns have been raised that home treatment may not be as effective as treatment in hospital and that there is uncertainty about the true cost effectiveness (Marco, Asensio et al. 2000). Arguments proposed in favour of home therapy include:

- i. Less disruption to the daily life of patients and their families,
- ii. Reduced risk of hospital acquired infection is reduced,
- iii. Treatment is not delayed as may happen when waiting for a hospital bed,
- iv. Treatment at home saves money.

6.1.1. Evidence

Clearly, the available evidence is inadequate to answer the questions about the relative cost effectiveness of hospital based or home treatment of respiratory exacerbations. However, the published studies highlight relevant points to consider for clinical practice:

- a. In the one RCT (Wolter, Bowler et al. 1997) involving 17 adult patients home-based therapy had similar outcomes as hospital-based therapy. The results suggested that home-based therapy does not do harm and reduces disruption to the life of the patient [Level II].
- b. In a large study (Thornton, Elliott et al. 2004) from the UK, one-year outcomes in patients receiving predominantly home therapy had increased lung function loss and weight reduction compared with those who had predominantly hospital-based therapy and those who had a mixture of home and hospital therapies were intermediate for both clinical variables. Three other studies demonstrated similar results (Donati, Guenette et al. 1987; Bosworth and Nielson 1997; Esmond, Butler et al. 2006) [Level III].
- c. Other non-randomised studies have demonstrated similar benefits in patients treated at home compared with those treated

in the hospital (Winter, George et al. 1984; Strandvik, Hjelte et al. 1992; Graff von der Schulenburg, Greiner et al. 1997; Klettku, Magdorf et al. 1999; Riethmueller, Busch et al. 2002) [Level III].

- d. Four studies have demonstrated the cost of therapy was reduced both for the family and the hospital for home-based therapy (Donati, Guenette et al. 1987; Wolter, Bowler et al. 1997; Elliott, Thornton et al. 2005; Thornton, Elliott et al. 2005) whereas, the study for Utah (Bosworth and Nielson 1997) found that the reduced costs of treatment (hospitalisation days) were offset by longer treatment courses [Level III].

6.1.2. Experience and practice in Australia

A survey of 19 Australian CF centres (eight paediatric, eight adult and three mixed) found 17 offered home IV therapy for respiratory exacerbations (Bell and Bunting 2005). There were variations in methods for providing home treatment in Australia. There is insufficient evidence to decide between these different methods for delivery of home treatment.

6.2. Guidelines

The recommendations for provision of treatment at home are from descriptive studies [Level II and III], consideration of overseas guidelines (Yankaskas, Marshall et al. 2004) and represent a consensus of the group [Expert Opinion].

6.2.1. Patients for home treatment should be selected to ensure best outcome. Contraindications are:-

- a. Clinical instability which requires regular monitoring (eg, patients with hypoxemia, acute hypercapnia, recent major haemoptysis or pneumothorax).
- b. History of poor adherence, or limited clinical response or inadequate social support that may reduce the likelihood of success of home therapy.
- c. History of severe allergic reactions which have not been successfully controlled by desensitisation.
- d. Poor venous access.
- e. Remote geographical location or difficulty returning for review.

- f. Limited parental understanding of the CF child's condition and treatment needs.

Relative contraindications are:-

- a. Remote geographical location or difficulty returning for review.
- b. Very young children.

6.2.2. A program for starting each person's home treatment should be established in each centre. This should include:-

- a. Stable venous access which will usually (but not exclusively) involve a PICC line, midline catheter placed in the upper arm or IVAD (eg. Port-a-cath®).
- b. First dose of antibiotics should be administered in a hospital.
- c. Antibiotics, delivery devices and disposables should be provided by the CF centre.
- d. An education program for the patients (and their family where appropriate). This is usually co-ordinated by the CF team staff. Education of the first episode of home-based therapy should be undertaken during inpatient care. Patients should be reassessed periodically for their ability to perform home-based therapy.
- e. A written protocol is to be provided to the patients (and their family) at the initiation of each episode of home-based therapy, including details of contact arrangements with the CF team, both during work hours and after hours.
- f. Provision of allergy treatment packs as determined by local CF Centre policy.

6.2.3. Monitoring of patients for treatment benefits and complications should be similar to the guidelines for treatment in hospital. This includes:-

- a. Monitoring of clinical response to home therapy is required and this would commonly involve a weekly visit by the CF team nurse or another health care worker with expertise in IV therapy and/or CF care. This may be undertaken at the hospital or at the patient's home but would typically entail access to spirometry and other clinical assessment equipment.
- b. Intravenous antibiotics are usually initiated in hospital and, when appropriate, the course

may be completed at home. This allows for the monitoring of clinical status, drug levels and possible side-effects early in the treatment course whilst inpatient care is received.

- c. Modification of therapy is considered based on clinical response and current microbiology results as per CF centre protocol.
- d. Monitoring for toxicity of therapy is required (eg, aminoglycoside levels as per CF centre protocol).
- e. Monitoring venous access including changes of lines and dressings of lines or IVAD as per CF centre protocol.

6.2.4. Patients receiving home-based therapy should have other aspects of CF care provided, including:

- a. Easy access for help. Details of 24 hour a day contact point (person with a direct telephone number or that of the hospital ward) in case of a complication during home therapy. Membership of an ambulance fund is encouraged in the event of need for urgent medical treatment.
- b. Adequate physiotherapy and nutritional support are required during treatment of respiratory exacerbations. This may be able to be delivered by the patient, family, CF team or a community service provider, including the local CF organisation. Close communication is required between the CF team and contracted service providers.
- c. State-based Cystic Fibrosis Associations are often able to provide support to the patient and their family during home therapy which can include funding and provision of physiotherapy and nursing support at home.
- d. If a patient is not improving clinically or is unable to adhere to home-based therapy, the patient should be admitted for care.
- e. Access to antibiotic delivery devices is determined by local policy. Protocols for drugs, dosing and frequency are determined by the local CF centre policy.

6.2.5. Monitoring home therapy activity and audit:

- a. The CF centre should have a system for monitoring its home-based therapy program including objective evidence of clinical

response, adverse events, complications and costs.

- b. Home-based therapy activity and outcomes should be audited regularly by the CF team.

6.3. References

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7. Cystic Fibrosis: Transition from Paediatric to Adult Care

(David Reid, Bruce Whitehead and Gerard Ryan)

- Standard 1** Transition from paediatric to adult care involves a process of close cooperation between paediatric and adult specialist care teams.
- Standard 2** All CF Centres should have a transition programme incorporating active education on adult issues, i.e. fertility, and the process should engage the young person with CF and their family in a positive way.
- Standard 3** The concept of transition should be raised soon after diagnosis with more active discussions commencing around secondary school entry (12 years) and the process finishing with transfer to adult care around school leaving age (18 years).
- Standard 4** Paediatric and adult specialist care teams should meet regularly to discuss individuals in transition.
- Standard 5** The adult co-ordinator should meet individuals during the year before transfer, and the adolescent should have the opportunity to visit the adult CF Centre at this time.
- Standard 6** A comprehensive summary of medical and social issues should be available to the adult team well in advance of transfer. The local CF Association can be involved to help facilitate the process.

7.1. Background

Transition is defined as the process of preparing for the transfer from paediatric to adult care systems. The transfer must facilitate chronically ill children beginning a productive life and achieving social integration as independent adults in society (Schidlow 2002; Sawyer and Glazner 2004). The objective of an integrated CF service is to develop a local programme for transition that addresses the young person's concerns and considers the factors affecting their health at the time of transition (Craig, Towns et al. 2007).

In describing the optimal aspects of transition from paediatric to adult care, the authors conducted a standard literature search as previously outlined. There were no controlled trials of interventions related to transition in CF. From an initial total of 80 potentially relevant papers, there were a number of studies that described concerns, needs, and experiences of patients, families and staff using cross-sectional or before and after surveys (Cappelli, MacDonald et al. 1989; Nasr, Campbell et al. 1992; Westwood, Henley et al. 1999; Boyle, Farukhi et al. 2001; Flume, Anderson et al. 2001; Steinkamp, Ullrich et al. 2001; Anderson, Flume et al. 2002; Madge and Byron 2002; Palmer and Boisen 2002; Wallaert and Turck 2002; Cowland 2003; Zack, Jacobs et al. 2003; Brumfield and Lansbury 2004; Flume, Taylor et al. 2004).

Overall, there is very limited medical literature to guide practice [Level 3, Level 4]. What exists reflects local practices but the recommendations are inconsistent. Management of transition is included in some guidelines (Cystic Fibrosis Standards of Care 1998; Kerem, Conway et al. 2005), but not in others (Standards for the Clinical Care of Children and Adults with Cystic Fibrosis in the UK 2001). Practices vary considerably from country to country and probably between centres (Flume, Taylor et al. 2004). Thus, there is no high level evidence on which to base recommendations for a transition programme in Australia.

7.2. Guidelines

The recommendations are the consensus of the group, advocating strategies to address concerns found by the surveys [Expert opinion].

7.2.1. All CF centres should have a transition programme that prepares children and adolescents with CF to transfer to an adult CF centre.

- a. The programme should involve the person with CF, their family and staff of both the paediatric and adult CF centre.
- b. Communication between centres, patient and family (and other carers) is an important aspect of the transition process.
- c. Cooperation between staff of both centres is essential for a successful transition, including an understanding of the roles of team members in relation to the transition process.
- d. The transition programme should allow the assessment of the optimum time for transfer to the adult centre. For example, transition at a younger age may be appropriate for some individuals who are judged mature enough for transfer to adult care or delayed transfer may be indicated e.g. in patients who are progressing through the terminal stage of their disease.

7.2.2. Transition involves a judgement on the optimal time for an individual to transfer to the adult centre and should include specific educational material to facilitate the process.

- a. The concept of transition and transfer to adult services should be raised at diagnosis, with more active discussions incorporating self-management skills beginning at secondary school entry (12 years). Age of transfer to adult care should be flexible and guided by the individual with CF and their family, but will commonly occur at time of completion of secondary school (18 years).
- b. Every consultation should be viewed as an opportunity to improve the young person's capacity for self-management. The annual review provides an ideal opportunity to assess maturity and understanding of adult CF issues and to identify any barriers to transfer of care to an adult setting.
- c. Prior to transfer the adolescent/young adult should be able to manage many aspects of care.
- d. To facilitate self-management and ensure smooth transition, the paediatric and adult

- CF Centres will provide verbal, printed or electronic information on transition and details about the adult CF centre.
- e. Education should target any concerns expressed about transfer to an adult centre with the opportunity for patients and their families to contact relevant staff of both centres to answer questions. Written and verbal information should be available on fertility and genetic issues and there should be ready access to specific counselling services.
 - f. The local CF Association of the transition clinics should be notified so that their representatives can provide additional information and assistance.
 - g. Specific aspects of education such as how transition occurs and the need for increased independence in self-care need to be highlighted as transfer approaches. The adolescent should have access to information relating to available staff, facilities and services in the adult centre such as expertise with respect to fertility issues and career advice.

7.2.3. The paediatric and adult CF centre staff should facilitate transfer to adult care by ensuring regular communication and documentation.

- a. Adult and paediatric centre staff should undertake regular meetings to discuss individuals who are planned for transfer within the next year.
- b. Within 12 months of the planned "transfer" date, the person with CF and family member(s) should have the opportunity to meet (all) members of the adult care team at an agreed venue, which will usually be at the children's centre clinic. There should also be an opportunity to visit the adult CF Centre at this time.
- c. A complete summary from all disciplines (medical, nursing and allied health) of all medical and social issues and treatments of the individual transferring should be forwarded to the adult centre staff well in advance of the transfer date
- d. Communication regarding transfer of patients' care should be copied to all health care providers including general practitioners, regional physicians and local hospital staff.

- e. For regional and rural patients, transfer of care from a paediatrician to an adult care setting must involve active involvement of the specialist CF teams.

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8. Outreach Services and Clinics

(David Reid and Claire Wainwright)

- Standard 1** Outreach clinics should involve a multidisciplinary CF Specialist team from the CF Specialist Centre visiting the regional hospital or clinic.
- Standard 2** Management guidelines and processes for screening for complications, infection control, annual review and transition of care from paediatric to adult services should be agreed upon between the CF Specialist Centre and regional hospital/clinic.
- Standard 3** An educational programme for local health care providers should be incorporated into the outreach service.
- Standard 4** The CF Specialist Centre should be responsible for audit of outreach services.
- Standard 5** Communication between the patient and family, CF Specialist Centre, the regional hospital/clinic, fertility and genetic services and general practitioners should be optimised.
- Standard 6** The CF Specialist Centre should be responsible for data entry of patients attending outreach clinics into the national data registry.

8.1. Background

Outreach clinics have evolved as a means of providing specialist cystic fibrosis care to patients living at a distance from the CF Specialist Centre. Outreach clinics involve members of the CF specialist team attending a clinic at a site distant from the CF Specialist Centre.

Shared care and outreach clinics do not represent the same thing. Shared care occurs in all CF centres in Australia and refers to patients who are seen regularly both at the CF Specialist Centre and also by their local hospital, paediatrician or general practitioner.

The objective of outreach clinics is to develop a programme of shared care that ensures patients living at a distance from their CF Specialist Centre or attending regional hospitals are not disadvantaged and have appropriate access to multidisciplinary CF expertise, including up to date information on fertility options and genetic counselling services.

8.1.1. Evidence to support the utility of outreach services

Specialist outreach clinics have evolved across most clinical disciplines in many different countries as a means of providing access to specialist care for patients living in remote areas. Outreach services vary from simple consultation services through to complex multidisciplinary team visits, with educational services that have been shown to improve access to specialist care in isolated and geographically disadvantaged communities (Gruen, Bailie et al. 2006) [Level II]. A Cochrane review of 73 studies of specialist outreach clinics in primary care and rural hospital settings in 14 countries across five continents demonstrated that simple consultation based outreach services improved patient access, but had no effect on overall health care outcomes, while more complex multifaceted outreach clinics that involved collaboration with primary care, education and other services was associated with improved health care outcomes and more efficient and guideline-consistent care (Gruen, Weeramanthri et al. 2004) [Level I].

Cystic Fibrosis care delivered by a multidisciplinary team based in a CF Specialist Centre is believed to achieve the best outcomes for patients and therefore it would seem appropriate that a CF Specialist Centre

be involved in the care of all CF patients wherever they reside (Walters, Britton et al. 1994; Mahadeva, Webb et al. 1998; Merelle, Schouten et al. 2001) [Level III,IV]. For patients living at a distance from the CF Specialist Centre, the provision of regular outreach clinics would seem to be a reasonable compromise. The ideal frequency of outreach clinics and full extent of care provision by the outreach service is likely to vary, depending upon local facilities and resources, as well as on the resources available to the CF Specialist Centre. One paediatric CF Specialist Centre in Queensland recently reported that health outcomes for patients attending outreach clinics were equivalent to those achieved in patients who regularly attended the CF Specialist Centre (Thomas, O'Rourke et al. 2005) [Level III].

8.1.2. Experience in Australia

In Australia, eight (of 25) CF Specialist Centres currently provide outreach clinics for CF care with most of these being undertaken by paediatric teams. Distances travelled to outreach clinics currently vary between 50km to 3050 km away from the CF Specialist Centre. is the situation in Australia is unique, dictated by geography. The reported number of outreach sites attended and the frequency of visits varies considerably. The evolving nature of CF outreach teams means that the quality of the education programmes delivered by the local health care team are currently quite variable and regular audits of outreach clinic are not yet established. This lack of uniformity reflects the lack of resources available for this sort of service provision.

8.2. Guidelines

The frequency of CF Specialist Centre reviews needs to be agreed, but for geographically isolated patients, would typically occur between two and four times per year, depending upon available resources both locally and within the CF outreach team. The recommendations detailed below are based on consensus of the group [Expert opinion].

8.2.1. Procedures and investigations undertaken at outreach CF Clinics and regional hospitals/clinics should closely mirror those performed at the CF Specialist Centre.

- a. Measurement of height and weight (and head circumference in young children under 12 months of age).

- b. Sputum culture. Where possible some specimens should be sent on a regular basis to the CF Specialist Centre Microbiology Laboratory to ensure consistency and quality control of microbiological testing. This is most cost-effectively done at the time the specialist CF team visits.
- c. Spirometry for all adults and children able to perform reliably (usually five years and older).
- d. An agreement on screening for complications of CF should be reached between the CF Specialist Centre and regional hospital/clinic including how, when and where annual review is performed.
- e. Multi-disciplinary care plans should be developed for all CF patients.
- f. Transition of paediatric patients to adult care should occur via an agreed framework and discussions must involve all involved parties, including the paediatric and adult CF Specialist Centre teams, as well as the regional hospital/ clinic personnel.

8.2.2. Patients attending regional CF Clinics should have access to expert multi-disciplinary care.

- a. Review by CF Coordinator/Nurse. The coordinator will ensure the clinic is able to meet infection control standards. The coordinator will present an overview of the patient's care and venous access issues and identify major issues that need to be discussed and addressed, along with providing appropriate information and education to families and individuals with CF.
- b. Review by CF Specialist Centre Physiotherapist with local interested physiotherapy personnel in attendance if possible. Typically this will include a review of airway clearance techniques, exercise, musculoskeletal issues, stress incontinence and inhaled medication use.
- c. Review by CF Specialist Dietitian with local interested dietitian in attendance if possible. Assessment of nutritional status, enzyme and vitamin requirements, assessment of salt and fluid replacement and optimization of CF related diabetes, bone health and gastric motility.
- d. Review by a Social Worker should be available for all patients and their families if needed. While it may be helpful for the CF Specialist Centre social worker to attend, most outreach clinics do not currently offer this service.
- e. Review by CF Specialist Physician. This is

typically undertaken by a respiratory physician.

- f. There should be sufficient time to have an in-depth discussion with the patient and family and to review the medical history and information obtained from the rest of the CF team.
- g. Issues such as preventative strategies, respiratory status, overall health status with screening for complications, eradication or suppressive treatment of *P. aeruginosa* or other pulmonary infections, immunization, adherence, contraception, fertility, lung transplantation and substance abuse all need to be considered in the context of the patient's age and current health status.
- h. Specific members of the multidisciplinary team should take on the responsibility for:
 - i. Checking appropriate replacement of respiratory equipment, such as nebulisers, and servicing of equipment such as nebulisers pumps
 - j. Education of patients and families with regard to optimal use and cleaning of spacers and nebulisers.
- k. Organization of routine investigations including screening for CF related diabetes and ensuring that the annual review is undertaken.
- l. The individual with CF and their family should be given verbal and written information containing contact numbers for the nearest specialist fertility and genetic services.

8.2.3. An educational component should be incorporated into outreach clinics.

- a. Outreach clinics should provide an opportunity for education on each occasion. A long-term educational plan determined in conjunction with local health care providers and CF Specialist Centre may be helpful in ensuring the best outcomes.
- b. The regional allied health and medical practitioner should be in attendance or visit during the clinic. If this is not possible, regional health professionals involved in CF care should attend the multi-disciplinary team discussion at the completion of the clinic.
- c. A multidisciplinary meeting at completion of the outreach clinic should provide an opportunity for providing feedback on patients attending the clinic as well as providing some information on management strategies.
- d. Local health care providers should have the opportunity to regularly visit the CF Specialist

Centre for education. Videoconferencing could also be considered for this purpose. Written information and guidelines should be available and regularly updated by the CF Specialist Centre for use in regional hospitals and clinics.

- e. Outreach centres should have access to genetic counselling services.

8.2.4. An audit cycle should be built into outreach clinics

- a. Health care outcomes such as lung function, nutritional and growth parameters, interventions such as gastrostomy or central venous access, complications of CF and acquisition of infections should be recorded, and patient reported outcomes should be obtained where possible.
- b. Comparison of outcomes with the CF Specialist Centre, national data and international data should be undertaken.
- c. Electronic data recording should be considered to facilitate the process of audit and quality assurance which should be incorporated into the routine practice of the outreach clinic.

8.2.5. Clear lines of communication need to be established

- a. There should be good communication between the CF Specialist Centre and the regional hospital/clinic at all levels and across disciplines. This includes communication between CF specialist physicians, paediatricians / physicians and general practitioners, as well as nursing and allied health staff.
- b. Updates on admissions to hospital and clinic visits, particularly with respect to treatment plans, medication use and investigations required or performed should be included (with results).
- c. A worksheet for the clinic should be available with sections for each member of the team to complete. Important issues should be highlighted and appropriate action recommended.
- d. Where relevant, patients or families should receive copies of communication and be included in this process.
- e. Appropriate lines of communication between outreach patients and CF Specialist Centre personnel should be established. E-mail is a non-confronting way for patients to raise issues or send requests for medications etc.
- f. A 24-hour phone messaging service or on call CF specialist physician should also be available

for outreach patients. The CF Specialist Centre should endeavour to respond to all patient or family queries within one working day.

- g. The most appropriate first port of call for advice for patients or families needs to be decided. This may be the general practitioner, local paediatrician / physician or team. Maybe the CF Specialist Centre nurse or coordinator will be nominated to decide on where the query needs to be directed.
- h. Patients and their families in the case of children should be provided with appropriate lines of communication, information and guidelines on what to do in the event of acute illness or unexpected complications, either psychosocial or medical.
- i. Criteria for notifying the CF Specialist Centre of acute events should be agreed.
- j. Clinic letters following the outreach clinic should normally be mailed to the patient's physician and/or General Practitioner within 10 working days.

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9. Transplantation and End of Life Care

(Bruce Whitehead and Scott Bell)

- Standard 1** End of life care discussions, including the role of lung transplantation, should occur before the predicted life expectancy is less than two years.
- Standard 2** Clinical management of the patient during end of life should include a combination of active treatments and therapies to enhance symptom control.
- Standard 3** Patients with end stage lung or liver disease should receive referral for lung or liver transplantation assessment.
- Standard 4** Equitable access to lung or liver transplantation services should be available for all patients.
- Standard 5** There should be optimal post transplant care of CF-specific complications.
- Standard 6** Prior to and during the end of life period effective communication with the patient and their family/carers must be provided.
- Standard 7** Patients with end stage lung or liver disease should have access to palliative care services when available and desired by the patient.
- Standard 8** Following the death of a patient with CF, ongoing support should be available for the family/carers.

9.1. Background

Despite significant improvements in survival for people with cystic fibrosis (CF), more than 90% of patients die as a consequence of CF lung disease, with the majority dying in their 20s to 40s (Elborn, Shale et al. 1991; Dodge and Lewis 2005). The median age of survival is currently 35 years.

Lung transplantation is an accepted therapy for the management of end-stage CF lung disease with evidence for quality of life and survival benefits (Aurora, Whitehead et al. 1999; Studer, Levy et al. 2004; Liou, Woo et al. 2006). The current one-year survival for patients undergoing lung transplantation in Australia is 87%, three-year survival is 70% and five year survival is 60% (Australian and New Zealand Cardiothoracic Organ Transplant Registry. 2005). Unfortunately, limited donor organ availability means some patients die waiting for transplantation and others may wish not to undergo transplant assessment.

The advent of successful lung transplantation for patients with end-stage lung disease has had a significant impact on end of life decisions. The paradox between active treatments to ensure maintenance of health in the patient awaiting lung transplantation and the need to control severe symptoms is a frequent dilemma for the patient with CF, their family and health care providers (Ferrin, Happ et al. 2001).

9.1.1. Definitions

- a. End of life is a period of time when the clinical status of the patient is inexorably declining and death is likely within a limited time frame (usually two years).
- b. Transplantation and palliative care are the treatment options that should be considered at this time.
- c. Palliative care is defined as the provision of co-ordinated nursing, medical and allied services for people facing a life-limited illness. Palliative care provides physical, psychological, social, emotional and spiritual support and for the patient and their family and friends, ideally in the environment of choice of the patient (WHO, 2004).

9.1.2 Evidence

There is little evidence to guide the clinician and family in the care of patients with end stage lung disease in cystic fibrosis. From the limited literature on end of life care, the following published studies raise several important points for clinical practice:-

- a. End of life discussions are often held too close to the time of death (Mitchell, Nakielna et al. 2000) [Level IV]. Patients (and their families) require earlier discussion with senior CF team members to allow time to adjust and carefully consider options (Robinson, Ravilly et al. 1997; Mitchell, Nakielna et al. 2000; Chapman, Landy et al. 2005) [Level IV].
- b. For the majority of dying patients, the possibility of transplantation is considered (Mitchell, Nakielna et al. 2000) [Level IV].
- c. Patients receive some form of therapeutic or life-prolonging care in the last 24 hours of life and most receive opioids during their final day (Philips, Gold et al. 2008).
- d. The balance between effective active treatment delivery whilst providing adequate symptom control can be difficult especially in patients waiting for transplant (Bell and Shale 1994; Robinson, Ravilly et al. 1997; Tonelli 1998; Robinson 2000; Ferrin, Happ et al. 2001; Yankaskas, Marshall et al. 2004; Dellon, Leigh et al. 2007; Ford and Flume 2007) [Level IV]. Symptom control does not preclude lung transplantation, however close communication between the CF team and the transplant team is vital (Tonelli 1998; Dellon, Leigh et al. 2007; Ford and Flume 2007) [Level IV].
- e. Patients prefer to have staff whom they know well providing palliative care in a familiar environment (Robinson 2000; Chapman, Landy et al. 2005) [Level IV] and many patients elect to receive palliative treatment in the hospital (Robinson, Ravilly et al. 1997; Mitchell, Nakielna et al. 2000) [Level IV].
- f. Symptoms which frequently require control include dyspnoea, chest pain, headaches, fatigue and poor sleep quality (Robinson, Ravilly et al. 1997; Mitchell, Nakielna et al. 2000) [Level IV].
- g. The management of these symptoms and a holistic approach to palliative care for children dying of respiratory failure has been recently reviewed with an emphasis upon the care of

children with CF (Collins and Fitzgerald 2006) [Level IV].

- h. The death of a patient can have a significant effect on other patients managed by the centre and staff members at the hospital. Support of both other patients with CF, team members and other treating staff members may be required after a patient with CF dies.

There is no evidence to guide the delivery of end of life care for patients with CF. There are many Cochrane Reviews published in the field of palliative care. To date these have not specifically focussed on evidence to support home therapy for the dying patient. Further useful information can be found in a Cochrane Review of "Opioids for the palliation of breathlessness in terminal illness" (Jennings, Davies et al. 2002).

9.2. Guidelines

The following guidelines for the provision of treatment are derived from descriptive studies and consensus of the steering committee. This document therefore aims to present an approach to the holistic management of the CF patient entering the terminal phase of their disease and is based on consensus of the group [Expert opinion]. The guidelines specifically cover aspects of transplantation and palliative care for people with CF.

9.2.1. General considerations

- a. End of life discussions should be initiated when it is estimated that the expected survival of the patient is less than two years.
- b. Adequate time for further discussions with partners, families and carers, involving the future planning of therapy and for the patient to participate in transplantation assessment if deemed suitable. Support of family and friends and access to written information about transplantation is important.
- c. Patients often under-estimate survival times and consider end of life discussions best from team members they are most familiar. Written information regarding options is also encouraged.
- d. At present, the number of lung transplants performed is seriously limited by the availability of donor organs. All measures which increase donor availability are likely to have a positive

impact on lung transplant rates for people with CF.

- e. Members of the CF team should be notified that this topic has been discussed at an appropriate time so that follow-up and support can be initiated.
- f. Advanced care planning is likely to provide the patient with an opportunity to assist the patient in identifying goals and values about their health. Some patients may wish to organise an advance health care directive, a will and consider appointing a power of attorney.
- g. Importantly, whilst transplantation offers an important therapeutic option for patients with end-stage lung disease, it may not be an option for all people with CF due to medical considerations (eg. contraindication) or personal preference. Discussion about transplantation and an assessment process should provide an opportunity for discussion of end of life issues rather than be a cause for delay of such discussions. The provision of written information about palliative care and end of life may be useful for the patient and their family.
- h. Discussions should occur with of the multidisciplinary team in order for all disciplines to be able to contribute their skills where relevant when health is declining. In addition, where relevant and possible, palliative care medical physicians and community supports (eg. general practitioner or outpatient palliative care services) should be invited to multidisciplinary team meetings to provide seamless and coordinated care to the patient and their family.

9.2.2. Transplantation

The following specifically relates to transplantation of the lungs (except where stated).

9.2.2.1. When to refer

The following guidelines for the selection of lung transplant candidates are based upon a consensus report from the Pulmonary Scientific Council of the International Society for Heart and Lung Transplantation (Orens, Estenne et al. 2006).

Guidelines for referral:

- a. FEV1 below 30% predicted or a rapid decline in FEV1. Many transplant centres encourage earlier referral (e.g. < 40% predicted) in female

patients.

- b. Hypercapnic respiratory failure.
- c. Exacerbation of pulmonary disease requiring ICU stay.
- d. Increasing frequency of pulmonary exacerbations requiring antibiotic therapy.
- e. Refractory and/or recurrent pneumothorax.
- f. Recurrent haemoptysis not controlled by bronchial artery embolisation.
- g. Other specific criteria may include:
- h. A reduced six minute walk (less than 300m).
- i. Nutritional compromise e.g. BMI less than 18.5 or a weight less than 40 kg.

Guidelines for transplantation:

- a. Oxygen-dependent respiratory failure.
- b. Hypercapnia.
- c. Pulmonary hypertension.

Absolute contraindications to transplantation include:

- a. Malignancy in the last two years, with the exception of cutaneous squamous and basal cell tumors. In general, a five-year disease-free interval is prudent.
- b. Untreatable advanced dysfunction of another major organ system (e.g., heart). Coronary artery disease not amenable to percutaneous intervention or bypass grafting, or associated with significant
- c. Impairment of left ventricular function, is an absolute contraindication to lung transplantation, but heart-lung transplantation could be considered in highly selected cases. Combined organ transplants have been performed occasionally for specific complications (e.g. heart, lung and liver transplants).
- d. Incurable chronic extrapulmonary infection including chronic active viral hepatitis B, hepatitis C, and human immunodeficiency virus.
- e. Severe chest wall/spinal deformity.
- f. An inability to adhere with therapy or follow-up.
- g. Untreatable psychiatric or psychological condition associated with the inability to cooperate or comply with medical therapy.
- h. Absence of a consistent or reliable social support system.
- i. Substance addiction (e.g. alcohol, tobacco, or opioids) - either active or within the last six months.

Relative contraindications include:

- a. Age - older patients (>65 years) have less optimal survival outcomes due to comorbidities. In Australia, centres will consider children depending upon size and thus donor availability.
- b. Critical or unstable clinical condition (e.g., shock, mechanical ventilation or extra-corporeal membrane oxygenation).
- c. Severely limited functional status with poor rehabilitation potential.
- d. Colonisation with highly resistant or highly virulent bacteria, fungi, or mycobacteria.
- e. Severe or symptomatic osteoporosis.
- f. Other medical conditions that have not resulted in end-stage organ damage, such as diabetes mellitus, systemic hypertension, peptic ulcer disease, or gastroesophageal reflux should be optimally treated before transplantation.

9.2.2.2 Where to refer

- a. There are currently four centres performing lung transplantation in patients with CF (NSW: St Vincent's Hospital; Victoria: The Alfred Hospital; Qld: The Prince Charles Hospital; Western Australia: Royal Perth Hospital).
- b. Initial referral should be to the transplant physician with a detailed summary of the person's clinical features. (Prior to formal referral for transplantation assessment, each centre has indicated a willingness to discuss individual cases and to provide preliminary information to a prospective transplant recipient). Once the formal referral process has been initiated, a number of preliminary investigations may need to be performed at the referring centre.
- c. Formal inpatient assessment at the transplant centre may enable further education to be given, an opportunity to meet the transplant team and confirmation of a comprehensive understanding of transplantation. In addition, counselling related to issues around transplantation as well as fears and anxieties may also be beneficial.

9.2.2.3. Pre and Post transplant care

- a. Pre transplant care should be supervised by the local CF centre.
- b. Close liaison with the transplant centre should be maintained once the patient is listed for transplantation.

- c. Any change in clinical status should be notified immediately (eg pneumothorax, massive haemoptysis, institution of non-invasive ventilation, new bacterial infections, etc).
- d. Transplant centres may require at least temporary relocation of the distant patient close to the transplant centre in the pre and early post-transplant period.
- e. Relocation expenses should be subsidised by the state government. In some settings additional support is available from local state CF organisations.
- f. The majority of post transplant care is coordinated by the transplant centre, although shared care arrangements may be possible.
- g. Post transplant patients are encouraged to maintain contact with their local CF centre particularly with regard to management of other, non-transplant related, medical problems (eg. CF specific issues).

9.2.2.4. Liver Transplantation

- a. Liver transplantation is a less frequent issue than lung transplantation although occasionally these overlap. The possibility of liver transplantation may be a consideration for up to 5% of the CF population.
- b. Many such patients with CF and end-stage liver disease will not receive liver transplantation for reasons including poor general condition or failure to obtain suitable multiple organ donation for multiple organ failure.
- c. Isolated liver transplantation for patients with CF is successful and has comparable survival outcomes as for other indications. Furthermore, lung function will often improve following liver transplantation.
- d. Information regarding assessment for liver disease is found in the Outpatient Section of these guidelines. For further details regarding lung and liver transplantation in patients with CF, please refer to the local state liver and lung transplant services.

9.2.2.5. Living-related Lung Transplantation

Living-related lung transplantation has been successfully performed in patients with CF. The procedure requires very careful evaluation of individual cases due to its complexity in terms of the nature of the surgery and its planning, organ

allocation and management of the waiting list and the potential effect on the family.

9.2.3. End of Life Care

- a. The patient should actively participate in treatment decisions. Families need regular contact during palliative care.
- b. Inpatient care of the dying patient with CF is generally delivered in the usual ward accommodation for the patient. If an alternative ward is required, this should be discussed in advance with the patient and their family.
- c. Discussion between the CF Specialist and Palliative Care Teams can be useful to facilitate optimal care for the dying patient with CF, whether care is delivered in the cystic fibrosis/respiratory ward or the palliative care unit.
- d. Knowledge of the patient's progress and the family's knowledge of the patient's condition are vital to effective delivery of care. A multidisciplinary approach should be taken with patient care; in particular, regular meetings to update all involved team members and ward staff are required and will optimise continuity of care.
- e. Consultation with the Palliative Care team should be considered in all patients in the palliative phase of their illness. Although most CF specialist centres have experience and expertise in the care of the dying person with CF, the Palliative Care service can provide further expertise in their overall management especially for the control of adverse symptoms. are not being adequately controlled, and consultation is considered likely to be of assistance by the treating team.
- f. When the option of dying at home is sought by the patient, this should be discussed with the multi-disciplinary CF and palliative care teams as considerable planning will be required.
- g. Involvement of the general practitioner, community nursing and physiotherapy services, the local CF organisation and palliative care teams is highly desirable. The family general practitioner may not have had regular contact with the patient in administering CF care, so comprehensive explanation of treatment goals, follow-up requirements and key points of hospital contact (CF Specialist staff or Palliative Care staff) for the dying patient with

CF is vital. Case conferencing is important function, involving all members of the treating team (hospital-based and community-based) to allow coordinated care delivery with clear lines of communication for the patient, their family, all consulting services and the general practitioner.

- h. The patient and their family will require regular contact with the CF team. Twenty- four hour phone access for advice, and to arrange hospital admission when indicated, is important as respite care may be required.
- i. If the patient is listed for lung transplantation, discussion with the transplant centre is mandatory.
- j. In many dying patients with CF the decision to withdraw or withhold active therapies is a difficult one. In many patients a combination of active treatments (including intravenous antibiotics, airway clearance procedures and sometimes non-invasive ventilation support) and palliative care (symptom control) may be considered desirable to enhance the patient's quality of life. All members of the treating team (CF Specialist staff, ward staff and Palliative Care team) need to be aware of decisions about treatments which are continuing and those which are being withdrawn.
- k. Patients may experience weight loss; however, aggressive nutrition support may be inappropriate. Nutrition interventions for preventative goals should be reviewed and ceased where indicated. Adequate hydration for comfort should be maintained.
- l. Symptom control may require opioid analgesia (eg. for pain, dyspnoea). This may be administered by mouth, subcutaneously, intravenously or a combination of routes. On occasions, anxiolytic agents (eg. diazepam, midazolam, lorazepam) and anti-emetics (eg. metoclopramide) are useful to assist with the control of unremitting anxiety and nausea.
- m. Constipation is an important consideration and may require specific treatment.
- n. Lowered mood and anxiety are frequent problems experienced by patients when their health declines significantly or during their last admission. Also the uncertainty of their health can lead to feelings of helplessness and hopelessness. Appropriately qualified and

experienced clinicians should be sought to support patients or families in this situation.

- o. The patient's and their family's psychological and spiritual well-being needs to be monitored and provided appropriate specialist support.
- p. All staff should maintain professional relationships with patients and families to enable objective decision making when required.
- q. CF Specialist team and ward staff benefit from support in how to manage patients and family's psychosocial issues (Braithwaite 2007)
- r. Enquiries from friends with CF should be directed to the family or handled by the CF physician or CF nurse co-ordinator / specialist.
- s. Care of the dying person with CF who has undergone transplantation is also important. Realistic discussions of treatment options including re-transplantation and palliative care should be initiated early and can include CF centre and lung transplant team members and staff from the palliative care team.

9.2.4. Invasive ventilatory support

- a. Invasive ventilation for patients with respiratory failure, and in whom there is no potentially reversible complication, have an extremely poor prognosis and rarely survive. This should be discussed with the patient, their family if invasive ventilation is considered.
- b. Acute potentially reversible complications of CF may be suitable indications for the patient to be admitted to the ICU and invasive ventilation (eg. massive haemoptysis pending bronchial artery embolisation and large pneumothorax precipitating respiratory failure, post-thoracic surgery, etc).
- c. Non-invasive ventilation may be used for symptomatic relief and avoid the need for invasive ventilation. This can be undertaken in the ward or ICU depending on local policy and available resources.
- d. The transplant centre should be notified of an admission to the ICU if the patient is actively listed for lung transplantation.

9.2.5. Family (and care providers) and health team support

- a. Ongoing bereavement support may be desired by the family following the death of a person with CF. Loss and grief support can be provided

- by the CF team and/or by referral to appropriate agencies outside the hospital. The CF social worker can provide practical advice regarding funeral arrangements.
- b. For families, ongoing contact with the CF team may be helpful. The CF team should make contact after the funeral to ensure specific needs of the family are being met.
 - c. Staff attendance at the patient's funeral or memorial service should be based on an individual decision by each staff member.
 - d. All staff members who have been closely involved (CF team, ward staff, out-of-hours staff, non-clinical staff (eg. cleaning, wardsmen, chaplains, lung function scientists, etc) may benefit from debriefing and counselling. Staff should be encouraged to access local facilities for support (eg. confidential psychological support if required).
 - e. Development of a Palliative Care model for people with CF is considered highly desirable.

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10. Australian Cystic Fibrosis Data Registry

(Geoff Sims, Philip Robinson and Scott Bell)

- Standard 1** The acquisition of de-identified clinical data in a registry to monitor the progress of people with CF in Australia.
- Standard 2** The utilisation of data to compare centres nationally and internationally in terms of implementing best clinical practice.
- Standard 3** The provision of opportunities for clinical research.

The Australian Cystic Fibrosis Data Registry has been co-ordinated by Cystic Fibrosis Australia (CFA) since 1998 and includes clinical and demographic data about Australians with CF attending CF centres and CF clinics. It is estimated that between 80 and 85% of the estimated 2700 Australians with CF are included in the Data Registry analysis.

Day-to-Day data registry management is provided by a Data Registry Co-ordinator and Data Registry Statistician. The Data Registry Co-ordinator oversees data collection, data quality, queries about accuracy and training. The role of the Data Registry Statistician is to co-ordinate data analysis, report preparation, access to data for research and developmental aspects of the Data Registry. The Data Registry is supported by a Medical Advisory Committee which has State representation from clinicians from paediatric and adult CF services. The Data Registry is supported by funding from CFA and an annual report is published, which includes demographic details

and clinical characteristics of our CF population, including genetic, pulmonary function, nutritional status, therapies administered, health care utilisation and complications of CF. Individual patient consent is provided and the data is entered on site at each of the contributing CF centres on a yearly basis.

Since early 2006 data entry has been web-based, and from 2007 centre-specific summary data and de-identified centre-to-centre comparisons are provided to contributing CF centres. It is envisaged that longitudinal analysis will become available in 2008, and that the Data Registry will increasingly be utilised for undertaking clinical research. The Australian Data Registry now provides the option of regular updating (eg. following each consultation) rather than retrospective data entry (once yearly) only, and a current enhancement will provide an opportunity for downloading current summary information of individual patients in the CF centre.

11. Role of Cystic Fibrosis Organisations in Australia

(Kerry Mordaunt, Christopher O'Connor and Conrad Guerra)

Cystic Fibrosis Australia (CFA) the national organisation provides a coordination role to ensure consistent quality of CF care across the nation, as well as administering the Australian CF Research Trust, information services, the Australian CF Data Registry, Infection Control Guidelines, the Bi-annual Cystic Fibrosis Conference and other issues that affect people living with CF nationally.

All states and territories throughout Australia, with the exception of the Northern Territory, have Cystic Fibrosis Associations who comprise members of CFA. As not-for-profit, non-government organisations, the level of resources and capacity for support varies. However the local CF organisation is a valuable additional network for families and health professionals to assist with the care of the person with CF.

Families and health professionals are encouraged to access services available from each of the CF associations that will complement clinical care of people with CF. For a full description of the level and type of services and support available please refer to:

www.cysticfibrosis.org.au

or contact the local association directly.

For further information see:

www.cysticfibrosis.org.au/states/orgs/

State and Territory Associations

Western Australia

Cystic Fibrosis WA
The Niche, 11 Aberdare Road
Nedlands WA 6009

PO Box 959
Nedlands WA 6909
Tel 08 93467333

Victoria

Cystic Fibrosis Victoria
80 Dodds Street
Southbank, Melbourne
Victoria 3006
Tel: 03 06861811

New South Wales

Cystic Fibrosis New South Wales
51 Wicks Road
North Ryde
NSW 2113

PO Box 149
North Ryde NSW 1670
Tel: 02 98782075

Queensland

Cystic Fibrosis Queensland
31 Kate St
Kedron Qld 4031

PO Box 2245
Chermside Qld 4032
Tel: 07 3359 8000

Tasmania

Cystic Fibrosis Tasmania
GPO Box 245
Hobart 7001 TAS
Tel: 1800 23 28 23

South Australia

Cystic Fibrosis South Australia
143 Sturt Street
ADELAIDE SA 5000
Tel: 08 8221 5585

ACT

CF Association ACT
PO Box 909
Civic Square ACT 2608
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12. Appendices

Appendix 1.

Diagnosis and guidelines for the management of children with cystic fibrosis for health care professionals

Claire Wainwright and Dominic Fitzgerald

Cystic fibrosis (CF) is an autosomal recessive condition. The gene is carried by around 1/25 in the Caucasian population and around 1/2800 children are born with the condition in Australia. The prognosis for children with CF has improved over the last 20 years and most children with CF will reach adult life and require ongoing care at adult centres. The change in prognosis is thought to be related to earlier diagnosis, improved nutrition, aggressive treatment of respiratory infection and specialist multidisciplinary care.

This outline is designed as a guide to the basic treatments and protocols employed by paediatric Cystic Fibrosis Clinics across Australia. Its aim is to assist you in providing shared care for children with cystic fibrosis. It is not intended as a comprehensive outline of cystic fibrosis care. Any questions regarding the care of specific patients should be directed to the child's CF consultant. If at any time you have questions regarding the care of a patient with CF please contact the consultant or clinical nurse consultant involved. Background information available on line, which may be useful for patients, includes: Cystic Fibrosis Australia [<http://www.cysticfibrosis.org.au>] and the North American Cystic Fibrosis Foundation [<http://www.cff.org>]

Diagnosis

The results of the child's newborn screening may have been sent to you. If two genetic mutations have been identified on neonatal screening it is almost certain the child has cystic fibrosis and the child should be assessed clinically and urgent referral to the CF Centre is required. Sweat testing should generally be deferred until the child is seen at the CF Centre. Information on cystic fibrosis that is used for the families of newly diagnosed children

will be provided for the families in a timely manner.

If one mutation is identified on the neonatal screen the diagnosis is uncertain. The child may be a carrier for a CF mutation or have CF. The child should be assessed clinically. The two most important questions to answer are; is the child failing to thrive and does the child have any respiratory symptoms? If the answer to either question is yes, then the child needs urgent referral to the CF Centre. If the child is completely well and is thriving then, although there is less urgency required about referral, the child and family need timely and thorough assessment of the diagnosis. A sweat test is required and should be performed at a centre that routinely performs 50 or more sweat tests per year. A sweat chloride of >60mmol/L is diagnostic of CF. However, both false positive and false negative sweat tests can occur if the sweat testing is not conducted rigorously. The closest CF Centre is usually the best place to obtain a reliable sweat test.

If the sweat test is completely normal with a chloride of < 30mmol/L and there are no clinical symptoms suggestive of CF, the child is almost certainly only an asymptomatic, well carrier for a CF gene rather than someone with cystic fibrosis. The family should be referred to the nearest Clinical Genetics Service for cascade screening and counselling. If the sweat test reveals a chloride level of 30mmol/L or above, the child should be referred urgently to the CF Centre for further assessment with the diagnosis of cystic fibrosis being more likely.

Respiratory exacerbation

These are indicated by any increase in symptoms above the child's usual baseline eg. significant upper respiratory tract infections associated with increased cough and/or increased sputum. Although many of these have viral triggers they should be treated with broad-spectrum antibiotics. Most children with mild to moderate lung disease will have a clear chest on auscultation and will not have any shortness of breath or increased respiratory effort.

Antibiotic of choice should ideally be based on the child's previous sputum cultures and given until

the symptoms return to baseline although sputum may not have previously been obtained. A typical course of antibiotics will last for two to three weeks but should continue longer if symptoms continue. Young children should receive antibiotics that cover *S. aureus*, *S. pneumoniae* and *H. influenzae* [eg. Amoxicillin + clavulanic Acid].

Children with a first isolate of *Pseudomonas aeruginosa* must be notified to the CF centre. Children with chronic *Pseudomonas aeruginosa* may require oral ciprofloxacin and nebulised antibiotic therapy [eg Tobramycin] to treat exacerbations. Respiratory symptoms not responding to treatment after five to seven days require a sputum culture and copies of results should always be sent to the CF centre. In addition to antibiotics, physiotherapy should be increased during exacerbations. If the child is wheezy, bronchodilators may be helpful. Children with increased symptoms lasting more than two weeks despite antibiotic therapy should be referred to the CF clinical nurse consultant, CF treatment centre or to the clinic for consideration of intravenous therapy.

Microbiology

Children with CF show fairly consistent organisms in their sputum. Typical organisms include *Staphylococcus aureus*, *Haemophilus influenzae*, *Streptococcus pneumoniae* and *Pseudomonas aeruginosa*. Less commonly children and adolescents can be infected with other resistant organisms like atypical Mycobacteria, MRSA or *Burkholderia cepacia*. Prompt treatment of initial isolates of *Pseudomonas* (especially non-mucoid strains) may delay chronic infection. Once persistently infected with *Pseudomonas aeruginosa* patients are treated on the basis of symptoms. Cross infection with *Pseudomonas aeruginosa* or *Burkholderia cepacia* can occur between patients with CF and thus care should be taken to avoid close contact or shared use of equipment between patients with CF.

Over the counter preparations

We do not recommend any products designed to dry respiratory secretions or suppress cough for patients with CF.

Airway clearance physiotherapy (Chest physiotherapy)

Physiotherapy is an important aspect of respiratory care. PEP and oscillating PEP therapy (devices used for airway clearance) may be used as an alternative to percussion and vibration. Patients must be taught how to use these devices by the physiotherapist. During respiratory exacerbations, airway clearance physiotherapy should be increased to twice or three times per day depending on the individual.

Enzyme replacement

The majority of children with CF are pancreatic insufficient and require enzyme replacement therapy. Three preparations are available: Panzytrat, Creon and Cotazyme. These products can differ in strength and Creon is available in a range of strengths. Preparations containing 5000 or 10000 lipase units are the only ones recommended for young children. As a guide the enzyme replacement dose is 5000 Lipase units per 3-4g fat or approximately 1 capsule [5000 lipase units] per kilo of body weight per day delivered in divided doses with food. This dose is tailored to the individual by the CF physicians and dietitian.

Enzymes should be swallowed whole immediately before and/or during eating. For infants and children unable to swallow capsules, enzymes should be opened and placed in acidic fruit gel.

Salt replacement

Increased salt loss puts children at serious risk of dehydration in hot weather. Parents are advised to add extra salt to food, eat salty snacks and/or take salt tablets, Glucolyte or other electrolyte replacement fluid. Salt replacement may be required several times per day. Nausea and vomiting may be a sign of severe hyponatraemia [salt depletion] and dehydration and urgent assessment may be required.

Abdominal pain

Possible causes: Inadequate enzyme replacement, constipation, distal intestinal obstruction syndrome (DIOS), and appendicitis. The treatment of choice for constipation is paraffin oil or lactulose. Patients with severe

abdominal pain should be referred to hospital. Patients with unresolved sub acute abdominal pain or constipation lasting several days should be referred to the treatment centre, clinic or the gastroenterologist.

Weight loss

Possible causes: Inadequate food intake, inadequate enzyme replacement or non-compliance with therapy, chest infection and cystic fibrosis related diabetes. Anyone with significant, ongoing weight loss should be referred to the clinic.

Vitamin replacement

It is recommended that children (particularly if pancreatic insufficient) receive daily vitamin supplementation. Specific vitamin regimes may vary with each clinic and the individual child's diet, enzyme use and vitamin levels measured. However, broadly considered, infants and children under 2 years can take Pentavite liquid 0.45-0.9ml daily, Micelle E 0.2ml daily and Vitamin K 2.5mg twice weekly. Alternatively, some children will be well managed on VitABDECK 1-2mls daily as a single multivitamin preparation. Preschoolers usually take Pentavite chewable one daily, micelle E 0.4 ml daily and Vitamin K 5 mg twice weekly or 2 VitABDECK capsules daily with additional micelle

A + E if required. School age children usually take Vitamin A 5000 units daily, Vitamin E 100 units daily and Vitamin K 10mg twice weekly.

Immunisation

Children with CF require all the routine immunisations. Infants should be given Prevenar with their initial immunisations. Older children can receive Pneumovax every 5 years. Annual immunisation for influenza is recommended from infancy onwards.

Antibiotic treatment

CF patients require higher doses of antibiotics than non-CF patients. The following table outlines common antibiotics and their dosage for different organisms common in CF. Brand substitution for individual antibiotics is acceptable.

Nebulised / Inhaled Therapy

Many children with CF will require regular inhaled therapy. This may include bronchodilators, inhaled steroids, antibiotics, Pulmozyme (a medication which breaks down sputum enabling more effective clearance) and hypertonic saline (increases mucociliary clearance). Nebulised antibiotics and Pulmozyme require the use of special nebuliser units which patients can obtain by contacting their CF specialist nurse or CF physiotherapist.

Antibiotic	Dose	Frequency	Staph. aureus	Strep. pneumoniae	H. influenzae	P. aeruginosa
Flucloxacillin	50-150 mg/kg/day	tds qid	++			
Amoxicillin	50mg/kg/day	tds		++	++	
Amoxicillin+clavulanic acid (Augmentin Duo Forte)	50mg/kg/day	bd	+	++	++ Betalactamase +ve	
Erythromycin*	50-75mg/kg/day	tds	+*	++		
Bactrim® Septrin® Trimethoprim- ulphamethoxazole	0.4mg Trimethoprim (0.5 ml of mixture) / kg /dose (<5yrs) 80mg-400mg (6-12yrs) 160mg -800mg (adult)	bd		+	+	
Roxithromycin (Rulide®)	5mg/kg (<12yrs) 150mg (>12yrs)	bd	+	+		
Ciprofloxacin (Tablets can be dissolved)	15 mg/kg/dose	bd	+		+	++
Colistin Nebulised	One-two million units	bd				++
Tobramycin Nebulised	80-160mg	bd				++
Use if Mycoplasma suspected. Some patients may take regular azithromycin (<40kg 250mg three times per week, >40kg 500mg three times per week) which, has been shown to reduce chest exacerbations requiring IV antibiotics and may act as an anti-inflammatory agent.						

Appendix 2.

Potential conflicts of interest by membership of the Steering Committee during the past five years

Scott Bell has received consultancy fees from Inspire Pharmaceuticals Inc. He has supervised clinical research projects funded by Pharmaxis and Aradigm.

Philip Robinson has received consultancy fees from Solvay Pharmaceuticals and research funding from Roche Pharmaceuticals. In addition he has supervised pharmaceutical clinical research projects funded by Pharmaxis, Roche Pharmaceuticals and Corus Pharmaceuticals.

Brenda Button has no conflict of interest.

Peter Bye has supervised a clinical research project funded by Pharmaxis and has received research support for clinical trials from Pari, Germany in the form of aerosol delivery devices.

Clare Collins has no conflict of interest.

Conrad Guerra has no conflict of interest.

Colleen Jackson has no conflict of interest.

Lisa Martin has no conflict of interest.

Kerry Mordaunt has no conflict of interest.

Carmel Moriarty has no conflict of interest.

Christopher O'Connor has no conflict of interest.

David Reid has no conflict of interest.

Pamela Rowell has no conflict of interest.

Gerard Ryan has supervised pharmaceutical clinical research projects funded by Pharmaxis, Aradigm and Corus Pharmaceuticals.

Esta-Lee Tannenbaum has no conflict of interest.

Claire Wainwright has received consultancy fees from Genentech. She has been an associate investigator in a clinical research project funded by Pharmaxis and has received clinical research support with supply of pharmaceutical products from Pathogenesis, Chiron Corporation, GlaxoSmithKline and Novartis. In addition she has received research funding from Merck Sharp & Dohme, Corus Pharmaceuticals and Gilead Sciences and some support and funding from Roche Pharmaceuticals for clinical meetings.

Bruce Whitehead has no conflict of interest.

