MONASH University

AUSTRALIAN CYSTIC FIBROSIS DATA REGISTRY

ANNUAL REPORT 2016

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CYSTIC FIBROSIS Australia

MONASH University

The Thoracic Society of Australia & New Zealand
LEADERS IN LUNG HEALTH

FOREWORD

FROM THE CEO OF CYSTIC FIBROSIS AUSTRALIA

Welcome to the 19th Annual Report from the Australian Cystic Fibrosis Data Registry (ACFDR) for the year 2016. Every year cystic fibrosis (CF) centres gather an enormous amount of incredibly valuable information that informs clinical care and provides data for researchers.

Cystic Fibrosis Australia (CFA) would like to thank the CF centre staff for their ongoing commitment to the ACFDR and applaud the families and individuals who selflessly share their health outcomes and information.

For the past two years the Monash University Registry Sciences Unit has been managing the ACFDR and the Registry continues to benefit from their expertise and experience. The ACFDR Steering Committee brings together medical, research and allied health professionals and in recent times consumers have been a valuable addition to the Steering Committee.

CFA and the ACFDR Steering Committee have great plans to further develop the ACFDR in late 2018 and 2019. This will ensure we are able to monitor new treatments and therapies, integrate with complementary digital platforms and provide a clinical perspective that continues to make lives better for people with CF.

This 2016 report has identified some important statistics and it is pleasing to note a continuing upward trend in the age of Australians with CF. In 2014, the proportion of individuals with CF who were adult was 51.1 percent, however in 2016 the proportion has grown to 53.2 percent. We can attribute this increase to the determination of people with CF, their families and support networks who are committed to their complex and demanding treatment programs and the clinical teams who support them by providing the highest standards of care.

CFA's mission is to improve lives for people with CF and we understand the great burden of the disease. With this in mind we are funding a mental health trial at the CF centres in Newcastle and a Mental Health Training Roadshow throughout Australia. We also are working with the Federal Government to improve access to new drugs and therapies and reduce the financial impediments of CF.

To the CF community, the CF centre staff, Monash University Registry Sciences Unit and the ACFDR Steering Committee, CFA would like to thank you for your passionate commitment to the ACFDR and dedication to our shared goals that will allow people with CF live a life like any other.

Nettie Burke
Chief Executive Officer
Cystic Fibrosis Australia
October 2018

CYSTIC FIBROSIS Australia

FROM THE CLINICAL LEAD OF THE REGISTRY

It is my pleasure to present the 2016 Annual Report of the Australian Cystic Fibrosis Data Registry (ACFDR). This report highlights the strong collaborative relationship between CF clinicians, CF centre staff, patients, researchers and the broader CF community, all of whom come together to collect and analyse key patient information to support quality of care and outcomes.

The 2016 report contains some new information, in line with international best practice – including a five-year summary table of key metrics; further description of genetic and microbiology information captured by the registry; and collated presentation of lung function and nutritional status to highlight their interaction. This report also provides further information regarding data completeness provided by the participating sites, and highlights the significant work undertaken by the sites over the last 12 months to provide comprehensive patient data. We have also introduced a section regarding academic outputs that highlights how ACFDR data is being used for research, projects and broader quality of care and information purposes.

I would like to gratefully acknowledge Cystic Fibrosis Australia, the Monash University ACFDR team, the members of the ACFDR Steering Committee, and hospital clinical staff - committed physicians, nursing and allied health staff and data managers without whom this registry would not be possible, and I would like to thank participating CF patients for whom this information seeks to provide better care.

Professor Scott Bell, MBBS, FRACP, MD
Clinical Lead, Australian Cystic Fibrosis Data Registry

Executive Director – Research
Metro North Hospital and Health Service

Senior Physician, Department of Thoracic Medicine
The Prince Charles Hospital

INTRODUCTION

The ACFDR is a long standing Registry which commenced in 1996. Since 1998 it has collected diagnostic and treatment data on over 90 percent of the population of cystic fibrosis (CF) patients in Australia, leading to a greater understanding of the disease's characteristics and the standard and type of care provided to patients across Australia. Patients diagnosed with CF are invited to participate in the Registry through their treating site. Data about a CF patient's diagnosis, treatment and related complications are collected regularly with the aim to improve health service delivery and better understand the treatment of CF and outcomes for patients. The ACFDR dataset enables reporting in a manner generally consistent with other CF registries, such as in Europe, the United Kingdom and the United States.

Funded by Cystic Fibrosis Australia (CFA), as of September 2016, the ACFDR is managed by Monash University, Melbourne under a shared data custodianship arrangement. The Registry is actively supported by a multidisciplinary Steering Committee, and project-related subcommittees. The composition of the current ACFDR Steering Committee is listed on page 44. The role of the Steering Committee is to lead the strategic direction of the ACFDR, to review requests for access to ACFDR data, to develop and review relevant ACFDR policies and procedures, and to review the quality of outputs from the Registry.

The ACFDR conforms to the national operating principles for clinical quality registries, as set out by the Australian Commission of Safety and Quality in Healthcare (ACSQHC). It received ethical approval that reflected the new management of the Registry by Alfred Health in February 2017. Patient recruitment is by the specialist CF centres and data collection is generally submitted by most sites by direct data entry using the ACFDR web–based interface, although increasingly electronic transmission of data from electronic medical records or other databases to and from the registry is being requested. The ACFDR provides a publicly–available Annual Report and Jurisdictional Reports. It also provides annual reports to centres regarding centre data trends and comparisons. The ACFDR data may also be accessed by or analysed and provided to researchers and other interested parties, further information on which is available on page 40.

Data about CF patient's diagnosis, treatment, and related complications are collected regularly with the aim to improve health service delivery and better understand the treatment of CF and outcomes for patients.

Data Period

The data contained in this document was extracted from the Australian Cystic Fibrosis Data Registry on 21st March 2018 and pertains to data that relates to patient events from January 1st to December 31st 2016. As the Registry does not capture data in real time, there can be a lag between occurrence of an event and capture in the ACFDR.

Abbreviations

ACFDR	Australian Cystic Fibrosis Data Registry
BAL	Bronchi Alveolar Lavage
BMI	Body Mass Index
CF	Cystic Fibrosis
CFA	Cystic Fibrosis Australia
FEV_1	Forced Expiratory Volume (Litres) in 1 Second
GLI	Global Lung Initiative
MRSA	Methicillin–Resistant Staphylococcus Aureus
TPN	Total Parenteral Nutrition
WHO	World Health Organisation

SUMMARY OF THE REGISTRY DATA

THIS SECTION PROVIDES AN OVERVIEW OF THE CF POPULATION, HEALTH OUTCOMES, AND CARE IN AUSTRALIA FROM 2012 TO 2016

	2012	2013	2014	2015	2016
Demographics					
Total number of patients, N	3,156	3,235	3,294	3,379	3,422
Adults, percent	49.3	49.9	51.1	52.0	53.2
Males, percent	52.9	52.9	53.0	53.2	53.4
Median age (years) for all people with CF	17.7	17.9	18.4	18.8	19.3
Diagnosis					
Pancreatic insufficient, percent	83	81.1	82.9	82.2	81.8
Genotyped, percent	87.9	89.1	92.1	91.7	95.2
New diagnoses, N	66	92	79	98	90 [(a)]
Newborn (<1 year) diagnoses, percent	75.8	81.5	72.2	73.5	61.1
New adult (>18 years) diagnoses, percent	7.6	8.7	6.3	3.1	4.4
Respiratory Microbiology [(b) (c)]					
Any P. aeruginosa, percent	53.3	49.6	48.5	50.1	48
Staphylococcus aureus, percent	42.4	43.1	41.8	33.9	31.9
Aspergillus, percent	26.8	25.0	24.0	18.2	14.7
Non tuberculous mycobacterium, percent	1.5	1.9	1.9	2.8	2.6
Patients with Moderate to Severe FEV_1pp for Each Age Category [(d)]					
6-11 years, percent	7.0	4.3	5.2	5.9	6.3
12-17 years, percent	15.3	16.1	14.7	12.7	13.7
18-29 years, percent	49.1	47.5	46.9	45.8	43.1
>30 years, percent	68.0	67.2	66.8	68.9	66.4
Nutrition Outcomes					
Median weight for length percentile, infant and child <3 years, males	NA	64.2	57.3	63.1	67.1
Median weight for length percentile, infant and child <3 years, females	NA	64.9	63.9	58.3	65.2
Median BMI percentile, child and adolescent, males	53.6	56.4	53.7	55.4	55.8
Median BMI percentile, child and adolescent, females	53.2	51.1	52.4	53.7	54.8
Average BMI, <18.5, adult males, percent	3.4	3.2	3.7	3.9	4.6
Average BMI, >25, adult males, percent	26.9	28.5	28.9	28.0	26.8
Average BMI, <18.5, adult females, percent	7.9	6.8	9.1	8.8	8.9
Average BMI, >25, adult females, percent	15.0	15.9	17.3	18.6	19.0

(a) Diagnosis information for 17 new patients was not complete; therefore, data of these patients was not included in the overall number of 3,422 and not presented in this report

(b) Proportion represents only those with data reported

(c) Top four most common

(d) Normal lung function: >90 percent of FEV_1pp; mild impairment: 70-90 percent of FEV_1pp; moderate impairment: 40-70 percent of FEV_1pp; severe impairment: <40 percent of FEV_1pp.

1. PEOPLE WITH CYSTIC FIBROSIS

1.1 OVERVIEW

At 31 December 2016 the Australian Cystic Fibrosis Data Registry (ACFDR) held records of 3,422 people with CF, 43 more than at the end of 2015.

The mean age of the Registry population was 21.5 years at 31 December 2016. This was up from 20.9 years reported in 2015. Reflecting a steady upward trend in age of Australians with CF, the proportion of the Registry population that is adult (18 years and over) increased to 53.2 percent in 2016, from 52.0 percent in 2015. For the third year running, more than half of the Australian CF population as recorded by the Registry are adults.

The median age of 19.3 years at 31 December 2016 is also higher than at the end of previous years, having been 18.8 in 2015 and 18.4 in 2014. Median age for males (20.2 years) remained higher than that for females (18.4 years) in 2016, although both increased by approximately four months.

1.2 AGE DISTRIBUTION

Figure 1.1 and Table 1.1 show the age distribution of patients in the ACFDR for 2016. The lower table area shows age alternative CF age groupings that have been recommended for international comparison of CF data. All of the tables and charts later in this report use this age dissection.

FIGURE 1.1: ACFDR 2016: AGE DISTRIBUTION BY SEX

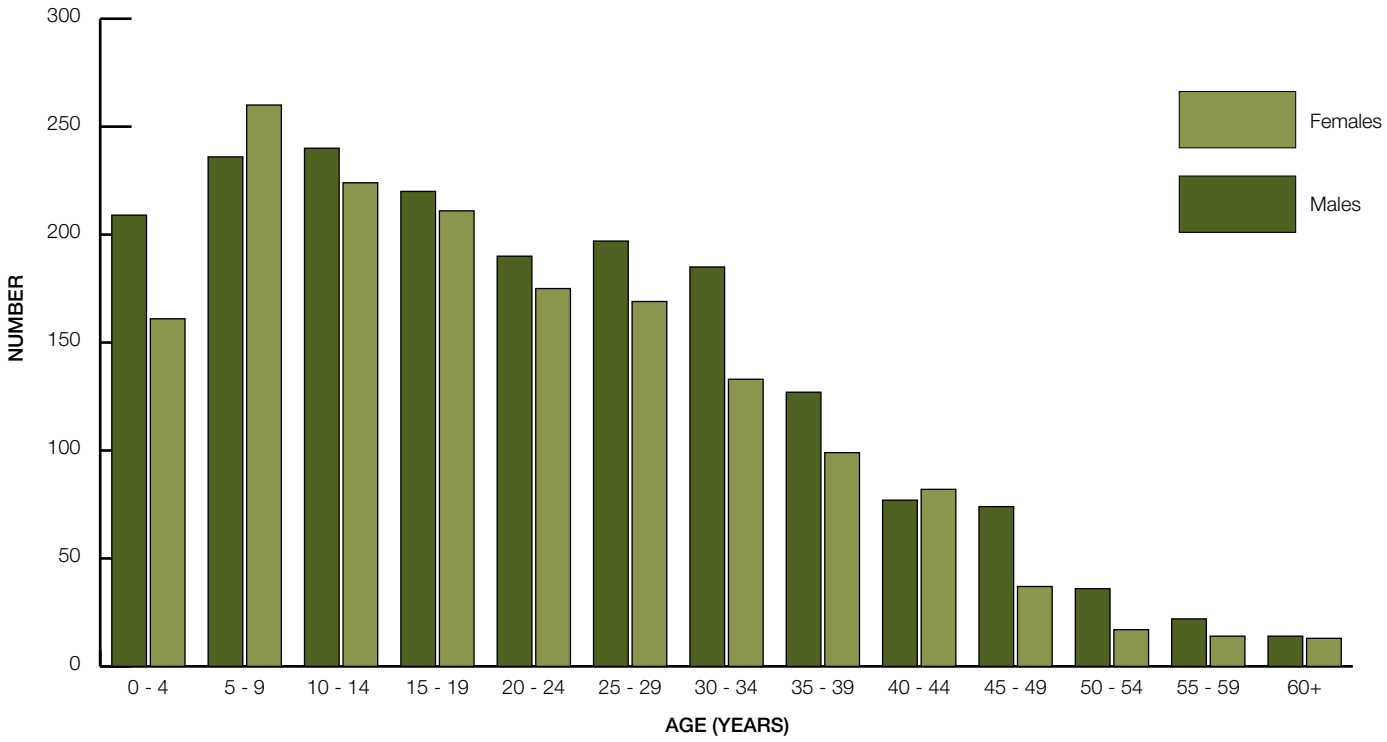


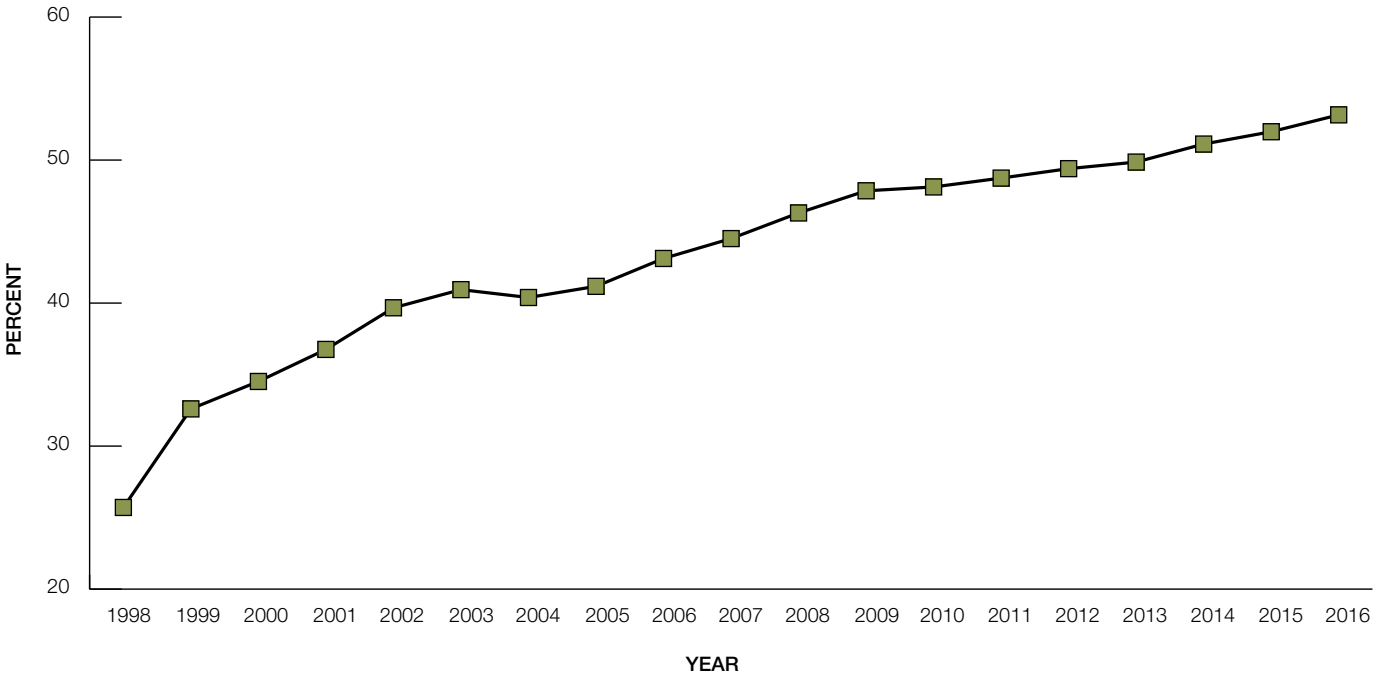
TABLE 1.1 – ACFDR 2016: AGE AND SEX OF REGISTRANTS AT 31 DECEMBER 2016

Age Group	Males	Females	Persons	Percent Male
Standard Demographic Age Groups				
0 – 4 years	209	161	370	56.5
5 – 9 years	236	260	496	47.6
10 – 14 years	240	224	464	51.7
15 – 19 years	220	211	431	51.0
20 – 24 years	190	175	365	52.1
25 – 29 years	197	169	366	53.8
30 – 34 years	185	133	318	58.2
35 – 39 years	127	99	226	56.2
40 – 44 years	77	82	159	48.4
45 – 49 years	74	37	111	66.7
50 – 54 years	36	17	53	67.9
55 – 59 years	22	14	36	61.1
60 + years	14	13	27	51.9
Alternative Age Groups and Totals				
0 – 1 years	75	61	136	55.1
2 – 5 years	175	154	329	53.2
6 – 11 years	305	304	609	50.1
12– 17 years	264	265	529	49.9
Total, Children and Adolescents	**819**	**784**	**1,603**	**51.1**
18 – 29 years	473	416	889	53.2
30 + years	535	395	930	57.5
Total, Adults	**1,008**	**811**	**1,819**	**55.4**
Total, All Ages	**1,827**	**1,595**	**3,422**	**53.4**

Consistent with international data, the proportion of males in the Australian CF population shows generally better survival of males compared to females with CF. At 31 December 2016, males made up 53.4 percent and females 46.6 percent of the ACFDR population. This has remained a consistent proportion since establishment of the Registry in 1998. The proportion of males is higher amongst the adult population (55.2%) than in the child and adolescent population (44.8%).

Figure 1.2 shows that the proportion of adults in the Registry as a whole was 53.2 percent at 31 December 2016, a trend that continues to gradually increase since the Registry commenced.

FIGURE 1.2: ACFDR 1998–2016: PROPORTION WHO ARE ADULT



The proportions for states and territories are shown in Table 1.2, although those for smaller jurisdictions should be interpreted in the context of their smaller populations.

TABLE 1.2 – ACFDR 2016: ADULT STATUS BY STATE/TERRITORY OF RESIDENCE

State or Territory of Residence	Child/Adolescent	Adult	Total	Percent Adult
New South Wales	472	473	945	50.1
Victoria	326	453	779	58.2
Queensland	398	450	848	53.1
Western Australia	200	182	382	47.6
South Australia	136	171	307	55.7
Tasmania	41	61	102	59.8
Australian Capital Territory	22	23	45	51.1
Northern Territory	7	5	12	41.7
Overseas	1	1	2	50.0
Total	**1,603**	**1,819**	**3,422**	**53.2**

1.3 ADULT MARITAL STATUS, EDUCATION AND ACTIVITY

The following needs to be interpreted in the light of under–reporting (or complete non–reporting) of social characteristics by some CF centres.

Regarding marital status, as shown in Table 1.3, 38.7 percent of male adult patients and 44.9 percent of adult female patients for whom marital status was reported were in a formal or informal marriage relationship.

TABLE 1.3 – ACFDR 2016: MARITAL STATUS OF ADULTS

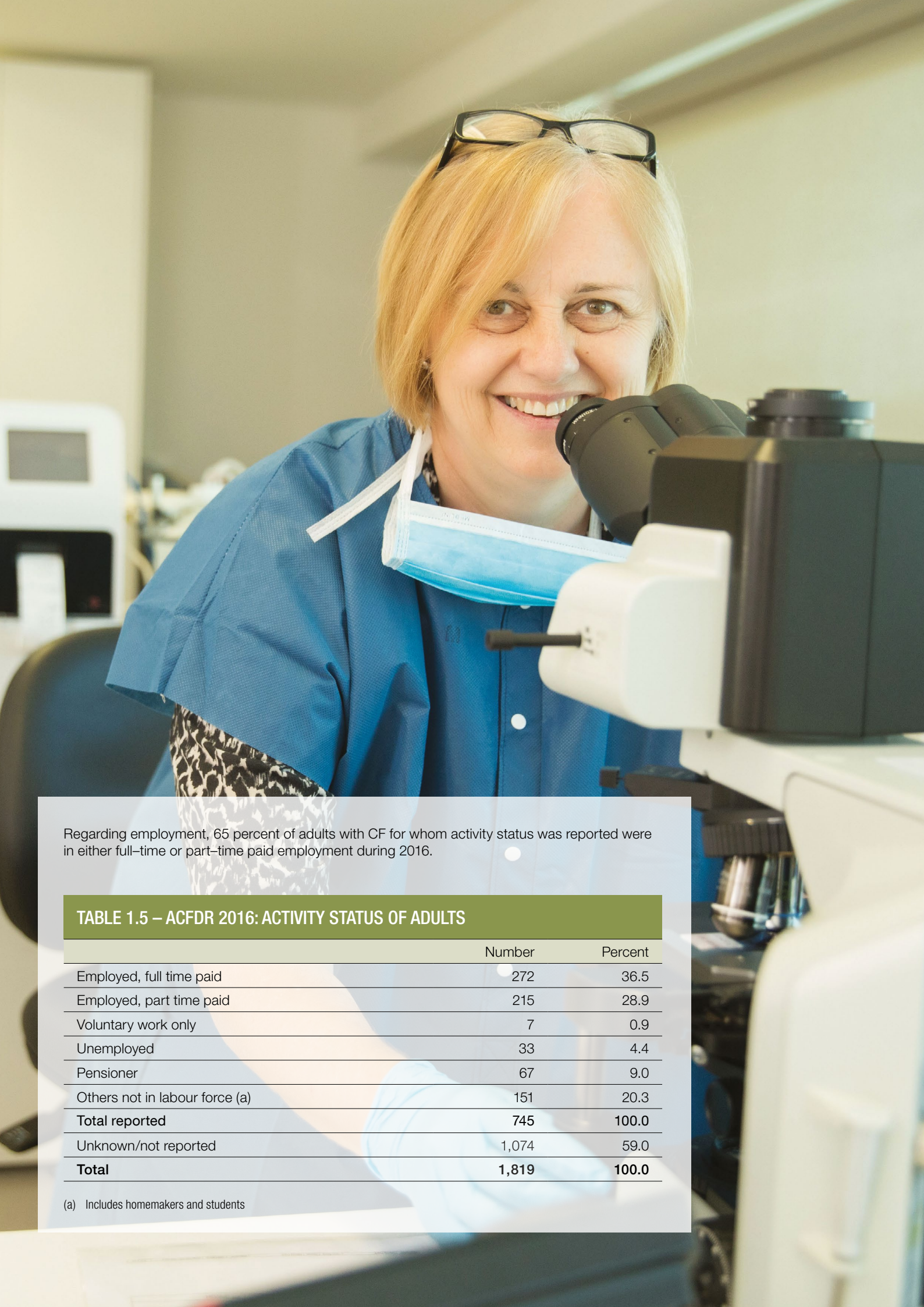
	Males		Females	
Marital Status	Number	Percent	Number	Percent
Married (includes de facto)	193	38.7	191	44.9
Not married	306	61.3	219	55.1
Total reported	**499**	**100**	**410**	**100**
Unknown/Not reported	509	50.5	401	49.4
Total	**1,008**	**100**	**811**	**100**

Of 49 percent, whose information was available in the registry, nine percent of adult male CF patients and 11 percent of adult female CF patients had at least one child.

Many people with CF continue with education beyond senior secondary school level, with 17.7 percent of adult CF patients for whom educational attainment was reported having university qualifications and a further 25.4 percent having completed other study beyond high school.

TABLE 1.4 – ACFDR 2016: EDUCATIONAL ATTAINMENT OF ADULTS

	Number	Percent
Junior secondary (Year 10)	88	12.8
Senior secondary (Year 12)	293	42.5
Tertiary certificate or diploma	175	25.4
University degree	122	17.7
Left school prior to year 10	12	1.7
Total reported	**690**	**100**
Unknown/Not reported	1,129	62.1
Total	**1,819**	**100.0**



Regarding employment, 65 percent of adults with CF for whom activity status was reported were in either full–time or part–time paid employment during 2016.

TABLE 1.5 – ACFDR 2016: ACTIVITY STATUS OF ADULTS

	Number	Percent
Employed, full time paid	272	36.5
Employed, part time paid	215	28.9
Voluntary work only	7	0.9
Unemployed	33	4.4
Pensioner	67	9.0
Others not in labour force (a)	151	20.3
Total reported	**745**	**100.0**
Unknown/not reported	1,074	59.0
Total	**1,819**	**100.0**

(a) Includes homemakers and students

2. DIAGNOSIS

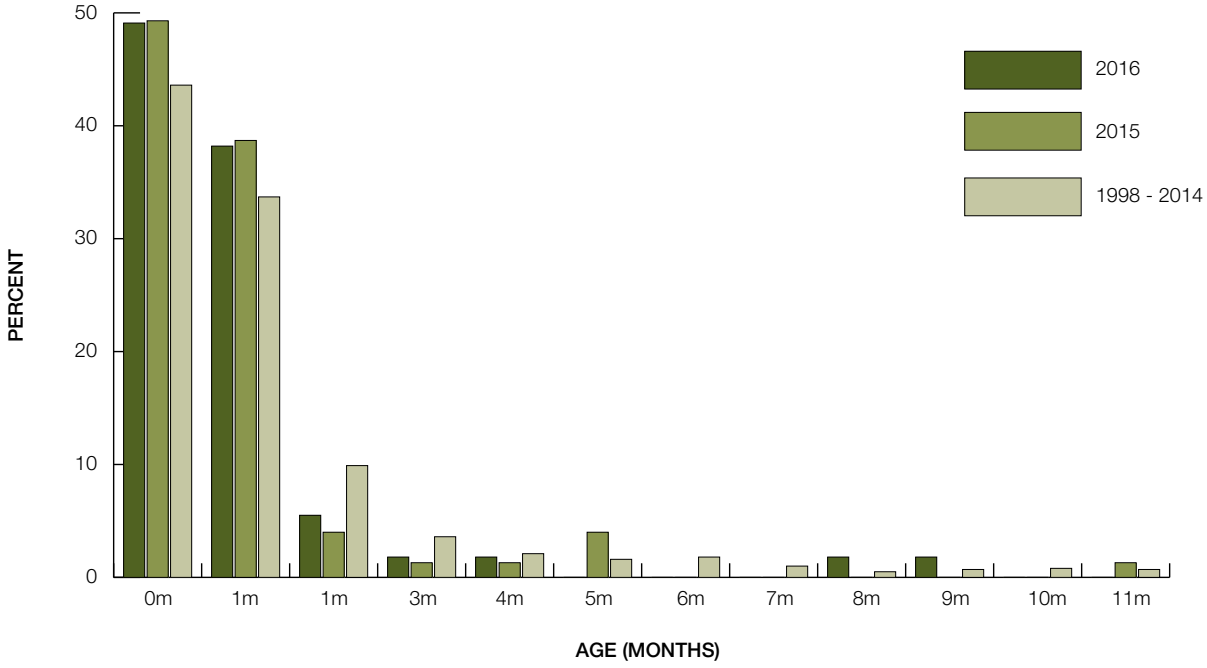
2.1 AGE AT DIAGNOSIS

The number of new diagnoses of CF notified to the Registry for 2016 was 73, including 55 diagnosed at less than one year of age (Figure 2.1).

All but three of the infant diagnoses where a diagnosis date was reported (52 out of the 55 new infant diagnoses) were completed by three months of age, assisted by neonatal screening programs that operate in all States and Territories of Australia. There were eight infant diagnoses in 2015 where a diagnosis date was not reported but where the fact of infant diagnosis was inferred from their age being less than 12 months at the end of the year.

Australian CF centres reported two new cases that were diagnosed in early childhood (one to four years), three aged from five to nine years, one in the age group 30 to 34 years and three diagnosed at ages 35 years and over.

FIGURE 2.1: ACFDR 2016: INFANT DIAGNOSIS AGE (MONTHS) (PERCENT DISTRIBUTION)



2.2 PRESENTATION AND DIAGNOSIS

Approximately 60 percent of new cases of CF diagnosed in 2016 included neonatal screening as a mode of presentation, and six percent reported meconium ileus, as indicated in Table 2.1. Gastrointestinal symptoms were reported in 11 percent, and respiratory symptoms in 10 percent.

TABLE 2.1 – ACFDR 2016: MODE OF PRESENTATION [(a)] BY YEAR OF DIAGNOSIS

	All Years	2016	All Years	2016
	Number		*Percent*	
Neonatal screening	1,733	43	50.6	59.7
Respiratory symptoms	458	7	13.4	9.7
Gastrointestinal symptoms	346	8	10.1	11.1
Meconium ileus	402	4	11.7	5.6
CF sibling	245	3	7.2	4.2
Minor manifestations	31	0	0.9	0.0
Pre–natal diagnosis	52	4	1.5	5.6
Infertility	19	0	0.6	0.0
Other	315	3	9.2	4.2
Unknown	169	1	4.9	1.4
Total	3,422	73	100.0	100.0

(a) More than one mode of presentation can be recorded for a patient so numbers in this section add to more than the total number of registrants and percentage columns add to more than 100.0.

2.3 PHENOTYPE

The proportion of patients who are pancreatic insufficient in 2016 is 81.8 percent, based on consolidated data across all years of reporting. Information on pancreatic insufficiency for the remaining patients was not available.

Sweat chloride values have been reported for over half (54.8%) of patients in the Registry. Of these, there were 165 (9.3%) patients for whom sweat chloride values were below or equal to 60 mmol/L, 49 (30%) of whom had at least one copy of the R117H mutation. Of the 34 (1.9%) patients whose sweat chloride values were below 30 mmol/L, 21 (62%) had a copy of the R117H mutation.

2.4 GENOTYPE

Mutation information consolidated across reporting years was available for 3,259 patients, or 95.2 percent of all patients in the Registry at the end of 2016.

As shown in Table 2.2, the genetic mutation F508del has been identified as at least one of the paired mutations responsible for the inheritance of CF in 92.2 percent of patients for whom genotype details have been reported. Nearly half of all patients (49.3%) are reported as homozygous for F508del. Another 42.9 percent have a single copy of F508del and another mutation.

G551D was the next most prevalent mutation, with 6.4 percent of the CF population reporting genotype data having this mutation, mostly in combination with F508del or another mutation.

TABLE 2.2 – ACFDR 2016: GENOTYPE

Mutation 2	Mutation 1										
	F508del	G542X	G551D	N1303K	W1282X	R117H	1717–1G–>A	621+1G–>T	Other	Unknown	Total
	Percent										
F508del	49.3										**49.3**
G542X	2.3	0.1									**2.4**
G551D	6.0	0.2	0.3								**6.4**
N1303K	1.1	0.1	0.1	0.1							**1.3**
W1282X	0.6	0.0	0.0	0.0	0.2						**0.8**
R117H	3.4	0.0	0.1	0.0	0.0	0.2					**3.7**
1717–1G–>A	1.2	0.0	0.0	0.0	0.0	0.0	0.2				**1.3**
621+1G–>T	1.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0			**1.4**
Other	16.8	0.4	0.6	0.1	0.1	0.1	0.2	0.3	1.5		**20.2**
Unknown	10.2	0.3	0.5	0.0	0.0	0.0	0.1	0.0	1.0	0.9	**12.3**
Total	**92.2**	**1.1**	**1.6**	**0.2**	**0.3**	**0.3**	**0.5**	**0.3**	**2.5**	**0.9**	**100.0**

The most common genotypes identified in the Registry are homozygous 508del (47.0%), then heterozygous 508del (40.9%) then other (7.4%) (Figure 2.2). The genotypes also vary somewhat by state/territory, with the NT and Queensland having the highest proportion of patients with the homozygous 508del genotype, and Tasmania, South Australia and Western Australia the lowest (Table 2.3).

FIGURE 2.2: ACFDR 2016: GENTOYPE, MAJOR CATEGORIES (PERCENT DISTRIBUTION)

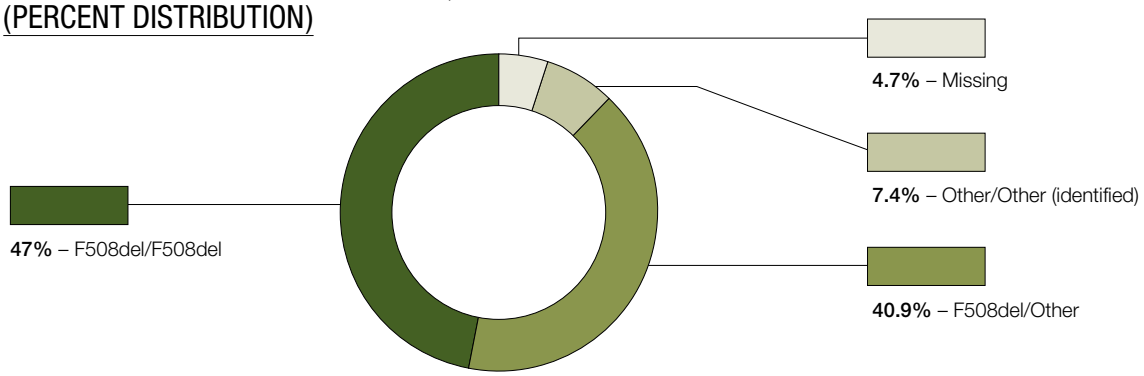


TABLE 2.3 – ACFDR 2016: GENOTYPE RESOLVED BY STATE/TERRITORY

	NSW	VIC	QLD	WA	SA	TAS	ACT	NT	All [a]
	Percent								
Homozygous F508del	48.0	45.3	50.5	44.2	43.3	41.2	46.7	*58.3*	47.0
Compound heterozygous F508del	40.3	39.3	40.2	43.2	46.3	42.2	40.0	*25.0*	40.9
Other mutations (Identified)	7.4	8.2	5.9	7.6	9.8	5.9	4.4	*8.3*	7.4
Unknown/Not Reported	*4.2*	*7.2*	*3.4*	*5.0*	*0.7*	*10.8*	*8.9*	*8.3*	*4.8*
	Number of Patients								
Total	**945**	**779**	**848**	**382**	**307**	**102**	**45**	**12**	**3,422**

a) Includes 2 patients from overseas

Table 2.4 shows population and allele prevalence of the most common CFTR mutations found in the Australian CF population. A more extended list is available on request. Just 28 mutations have a population prevalence of 10 or more.

TABLE 2.4 – ACFDR 2016: PATIENTS AND ALLELES – MOST COMMON CFTR MUTATIONS [(a)] IN AUSTRALIAN CF POPULATION

CFTR Mutation	Patient with at least One Allele	Proportion of Total	Homozygous Patient	Allele Number
F508del	3,007	87.9	1,607	4,614
G551D	253	7.4	10	263
R117H	131	3.8	5	136
G542X	111	3.2	3	114
621+1G–>T	54	1.6	1	55
1717–1G–>A	50	1.5	0	50
N1303K	49	1.4	2	51
W1282X	31	0.9	6	37
R553X	26	0.8	2	28
3272–26A–>G	22	0.6	0	22
D1152H	21	0.6	0	21
P67L	21	0.6	0	21
3659delC	19	0.6	0	19
5T;TG	18	0.5	0	18
I507del	15	0.4	0	15
E60X	15	0.4	1	16
1898+1G–>A	15	0.4	0	15
2789+2insA	15	0.4	0	15
2789+5G–>A	14	0.4	0	14
Q493X	14	0.4	0	14
R1162X	13	0.4	0	13
G85E	12	0.4	0	12
R334W	12	0.4	0	12
V520F	12	0.4	0	12
1078delT	12	0.4	0	12
1154insTC	12	0.4	0	12
A455E	11	0.3	0	11
R560T	10	0.3	0	10
Other mutations not listed above	404	11.8		
Unknown/Not Reported	593	17.3		

(a) More than one CFTR mutation can be recorded for a patient so numbers in this section add to more than the total number of patients genotyped and percentage columns add to more than 100.0.


The genetic mutation
F508del, G551D
or G542X is present
in nearly 95 percent
of CF patients

3. HEALTH AND FUNCTIONING

Information in this chapter covers respiratory infections, medical complications, lung function and nutritional measures.

3.1 RESPIRATORY INFECTIONS

Patients who were tested for respiratory infections in 2016 had a mean of 3.9 tests of all types during the year. The median number of tests was three overall, four – in the age group between 6-11 years, and five in the age groups between 12 and 17 years.

Table 3.1 shows the distribution of CF patients according to the number of both sputum and BAL/bronchoscopy samples examined during 2016. The latter method is used mainly on smaller children.

Taking sputum samples alone, 70 percent of the patients tested had at least two sputum samples in 2016. Respiratory cultures were not performed or not reported for 1,520 (47%) of patients.

TABLE 3.1 – ACFDR 2016: NUMBER OF SPUTUM AND BAL/BRONCHOSCOPY CULTURES

	0–1 years	2–5 years	6–11 years	12–17 years	18–29 years	30+ years	All ages
				Percent of Patients Tested (a)			
Sputum Cultures:							
None	62.7	57.3	21.4	8.5	1.3	0.8	15.0
1	1.3	7.0	12.7	11.9	20.7	19.7	15.0
2	8.0	7.0	10.1	10.0	19.7	18.1	13.8
3	8.0	3.8	8.5	10.3	13.5	15.1	11.0
4	2.7	5.4	8.5	11.0	12.4	11.9	10.1
5	4.0	6.5	9.0	10.0	5.8	8.4	7.7
6	5.3	5.4	8.7	9.4	10.0	6.7	8.3
7 or more	8.0	7.6	21.2	28.8	16.7	19.4	19.0
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
BAL/Bronchoscopy:							
None	80.0	87.0	92.9	95.6	98.1	98.7	94.8
1	14.7	11.9	6.6	3.8	1.7	1.3	4.6
2	5.3	0.5	0.5	0.3	0.0	0.0	0.5
3 or more	0.0	0.5	0.0	0.3	0.2	0.0	0.2
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
				Number of Patients			
Patients tested (a)	*75*	*185*	*378*	*319*	*468*	*371*	*1,796*
Culture not done	60	142	230	208	190	199	1,029
Total reported	*75*	*185*	*378*	*319*	*468*	*371*	*1,796*
Unknown/ Not reported (b)	61	142	230	208	399	480	1,520
Total Patients	**136**	**327**	**608**	**527**	**867**	**851**	**3,316**

(a) By any method of obtaining culture

(b) Microbiology tables exclude loss-to-follow-up, transfer to private care, deaths, currently not seen, withdrawn consent, no longer CF. The total excluded is 106.

The most commonly identified organisms in respiratory specimens are various species and forms of Pseudomonas. It can be seen in Table 3.2 that 48 percent of patients tested produced positive Pseudomonas aeruginosa cultures, with the mucoid form showing in 21.2 percent. Its prevalence is greater in adult patients, with 43.5 percent of tested adult CF patients producing samples indicating the mucoid form of Pseudomonas aeruginosa, four times the corresponding proportion for adolescents and twenty times than that for children.

TABLE 3.2 – ACFDR 2016: PSEUDOMONAS INFECTION BY AGE GROUP [(a)]

	0–1 years	2–5 years	6–11 years	12–17 years	18–29 years	30+ years	All ages
				Percent			
Pseudomonas aeruginosa:							
Mucoid	1.5	0.6	4.3	11.4	38.5	44.7	21.2
Rough/non–mucoid	6.7	7.0	15.1	19.9	26.3	27.4	19.8
Not differentiated	0.0	1.8	3.0	3.8	12.0	13.7	7.1
Any P.s aeruginosa	8.2	9.5	22.4	35.1	76.8	85.8	48.0
Pseudomonas other species	2.2	2.5	1.8	2.5	1.1	1.4	1.8
				Number of Patients			
Patients tested	135	327	608	527	658	570	2,825
Unknown/Not Reported (b)	1	0	0	0	209	281	491
Total Patients	**136**	**327**	**608**	**527**	**867**	**851**	**3,316**

(a) Patient may have had more than one type of Pseudomonas infection. Percentages for individual types may add to more than totals.

(b) Microbiology tables exclude loss-to-follow-up, transfer to private care, deaths, currently not seen, withdrawn consent, no longer CF. The total excluded is 106.

While prevalence of Pseudomonas organisms is lower in children than in adults, young children are just as likely as adult patients to produce cultures showing presence of Staphylococcus aureus (Table 3.3). Over 30 percent of all child/adolescent and adult patients had this bacterial infection. Haemophilus influenzae is evident in relatively high proportions of child patients, highest in children aged from two to five years, where this organism was cultured for around one fifth of children. The youngest age groups also had the highest proportions with positive cultures of the bacteria Escherichia coli; 11 percent, for those in the age group less than two years, being the highest. The prevalence of these major organisms in the lungs by age group is shown in Figure 3.1.

TABLE 3.3 – ACFDR 2016: OTHER RESPIRATORY CULTURE BY AGE GROUP

	0–1 years	2–5 years	6–11 years	12–17 years	18–29 years	30+ years	All ages
				Percent of Patients Tested (a)			
Bacteria:							
Staphylococcus aureus	20.7	30.6	38.8	35.9	34.5	21.4	31.9
Haemophilus influenzae	16.3	20.8	11.7	6.6	6.2	3.2	9.0
Stenotrophomonas maltophilia	0.7	2.4	6.7	8.9	7.9	4.0	6.1
Alcaligenes xylosoxidans	1.5	0.9	1.3	4.9	4.7	3.0	3.1
Non–tuberculous mycobacterium	0.0	0.3	3.0	4.4	2.9	2.1	2.6
MRSA (b)	3.0	1.2	2.1	1.9	2.6	3.0	2.3
Escherichia coli	11.1	4.9	1.5	1.3	0.9	1.2	2.1
Burkholderia cepacia complex	0.7	0.0	1.2	1.9	2.4	4.0	2.0
Serratia marcescens	0.7	2.1	1.0	1.9	0.8	1.2	1.3
Klebsiella (any species)	5.9	2.1	0.5	1.3	0.6	0.2	1.1
Fungi:							
Normal flora only	53.3	49.8	58.2	54.8	19.3	13.3	38.3
Candida	14.8	7.6	16.0	21.4	17.3	16.1	16.3
Other organisms not listed above	18.5	19.3	15.3	17.3	16.3	11.6	15.8
Aspergillus (any species)	0.0	3.1	14.0	20.9	19.5	14.2	14.7
Scediosporium (any species)	0.0	0.6	2.0	5.7	3.5	3.3	3.0
No growth/sterile culture	4.4	4.0	5.3	3.4	3.2	3.7	3.9
				Number of Patients			
Patients tested	135	327	608	527	658	570	2,825
Unknown/Not Reported (c)	1	0	0	0	209	281	491
Total Patients	**136**	**327**	**608**	**527**	**867**	**851**	**3,316**

(a) Patients may have multiple infections during the year. Percentages may add to more than 100.0.

b) Methicillin–resistant Staphylococcus aureus

c) Microbiology tables exclude loss-to-follow-up, transfer to private care, deaths, currently not seen, withdrawn consent, no longer CF. The total excluded is 106.

FIGURE 3.1: ACFDR 2016: PREVALENCE OF MAJOR ORGANISMS IN LUNGS

3.2 OTHER MEDICAL COMPLICATIONS

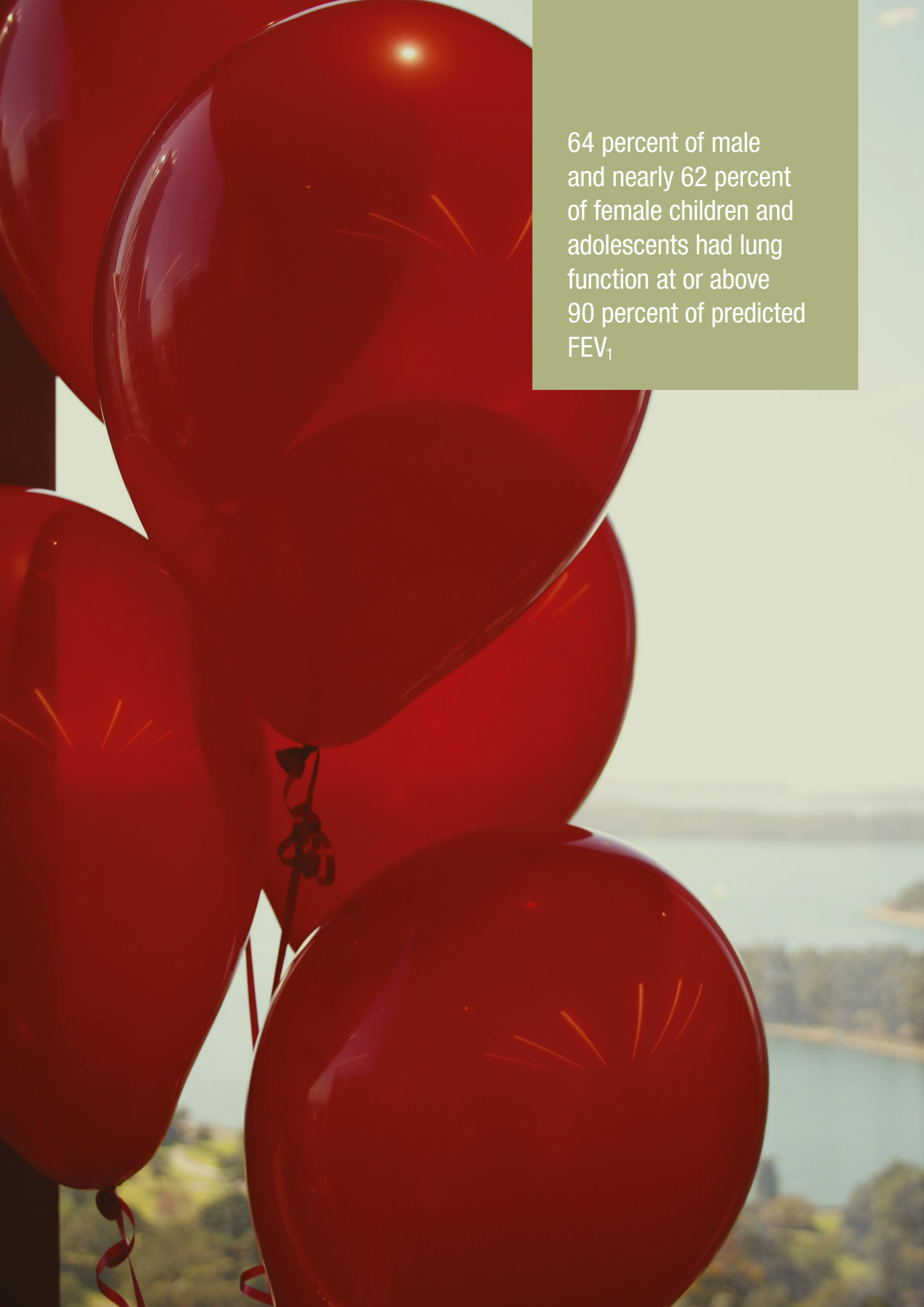
Table 3.4 shows that the prevalence of medical complications increases with age in CF patients. For instance, more than 50 percent of adult patients suffer gastro–oesophageal reflux, approximately 30 percent of patients aged 12 years and over experienced chronic insulin–dependent diabetes and over 40 percent of patients over 30 years have osteoporosis or osteopenia.

TABLE 3.4 – ACFDR 2016: MEDICAL COMPLICATIONS [a]

	0–1 years	2–5 years	6–11 years	12–17 years	18–29 years	30+ years	All ages
				Percent			
Pulmonary:							
Major haemoptysis	0.0	0.0	0.0	2.0	6.8	7.9	5.0
Massive haemoptysis	0.0	0.0	0.0	0.0	0.4	0.0	0.1
Therapeutic bronchial artery embolisation	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pneumothorax	0.0	0.0	0.8	0.0	1.1	1.2	0.8
Any pulmonary above	0.0	0.0	0.8	2.0	7.9	8.7	5.7
Gastro–intestinal:							
Gastro–oesophageal reflux	50.0	26.1	32.2	38.4	53.0	64.0	50.0
– proven at endoscopy	0.0	4.3	3.4	5.3	10.0	14.2	9.2
Abnormal liver function test	56.3	65.2	46.6	39.7	30.5	31.6	36.2
Cirrhosis or portal hypertension	0.0	4.3	5.1	6.6	9.0	4.3	6.3
Pancreatitis	0.0	0.0	1.7	1.3	7.9	6.3	5.0
Any gastro–intestinal above	100	82.6	72.0	59.6	76.7	81.8	75.1
Endocrine:							
Chronic insulin–dependent diabetes	0.0	4.3	14.4	33.8	26.5	32.4	26.8
Intermittent insulin–dependent diabetes	0.0	0.0	3.4	2.0	1.8	2.8	2.3
Other glucose abnormality	0.0	13.0	24.6	29.1	17.6	15.0	19.4
Any endocrine above	0.0	17.4	40.7	64.2	45.2	49.4	47.6
Osteo:							
Osteoporosis	0.0	0.0	0.0	11.3	8.2	14.6	9.2
Osteopenia	0.0	0.0	4.2	25.8	22.2	30.4	21.8
Fracture this year	0.0	0.0	0.8	1.3	1.4	1.6	1.3
Any Osteo above	0.0	0.0	4.2	28.5	29.0	44.7	28.8
Other:							
Cancer	0.0	0.0	0.0	0.7	0.4	2.0	0.8
Total Reported (b)	100.0	100.0	100.0	100.0	100.0	100.0	100.0
				Number of Patients			
Total Reported	16	23	118	151	279	253	840
Unknown/Not Reported	120	306	491	378	610	677	2,582
Total Patients	**136**	**329**	**609**	**529**	**889**	**930**	**3,422**

(a) Patient may have had more than one complication. Percentages add to more than 100.0.

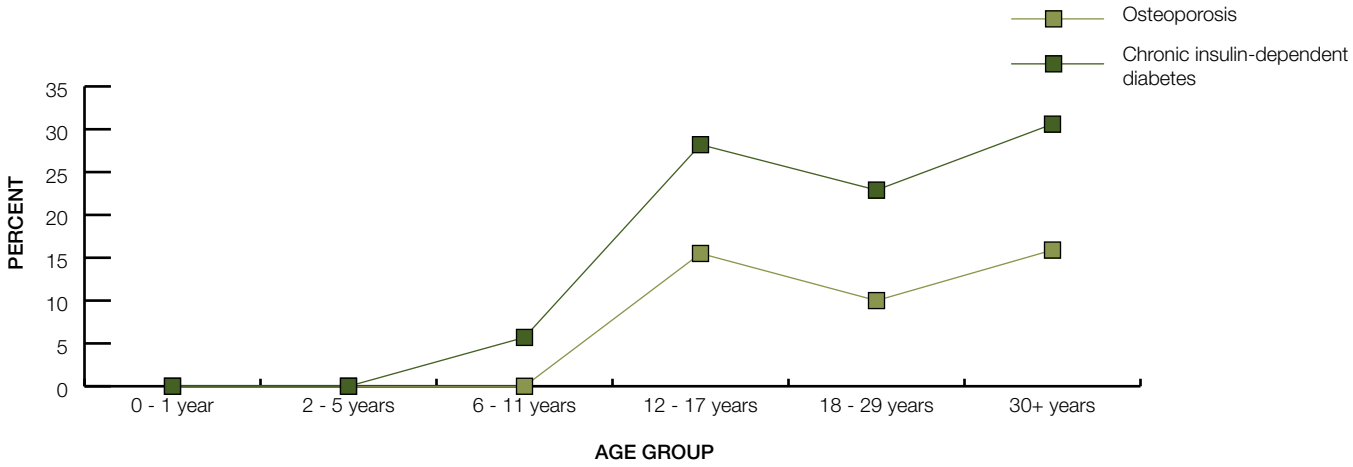
(b) Total reported includes other complications not mentioned in the table



64 percent of male and nearly 62 percent of female children and adolescents had lung function at or above 90 percent of predicted FEV_1

Although some prevalence of osteoporosis at younger ages is reported in the Table 3.4, this is not displayed in Figure 3.2 because of uncertainty about diagnosis at younger ages.

FIGURE 3.2: ACFDR 2016: PREVALENCE OF MAJOR COMPLICATIONS

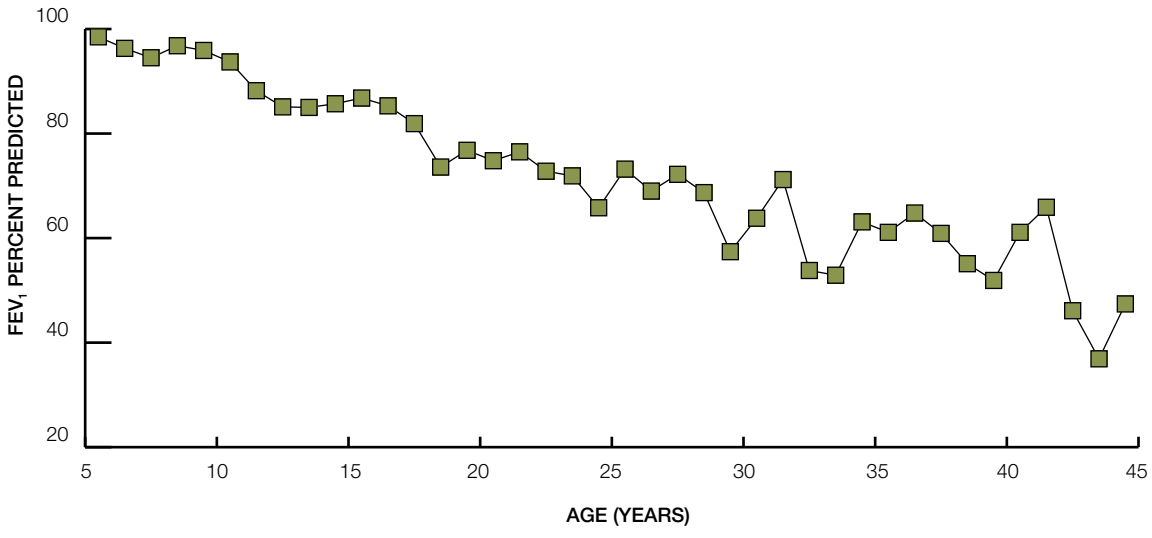


3.3 LUNG FUNCTION

Lung function measures compiled for this report are aligned with methods used in the United States' Cystic Fibrosis Foundation's Patient Registry, that is the lung function measure included for each patient is the average of the highest FEV_1 percent predicted value recorded in each quarter of the year.

Median CF lung function, measured as FEV_1 percent predicted, is within the normal range for young children, but is lower than 70 percent of predicted, the level at which moderate lung function impairment is experienced, in adult patients aged from around 25 years (Figure 3.3). Five percent of children aged 6 to 11 years have FEV values that are below 70 percent of predicted values, but nearly 10 percent of older children and adolescents are in this category (Table 3.5).

FIGURE 3.3: ACFDR 2016: MEDIAN LUNG FUNCTION BY AGE



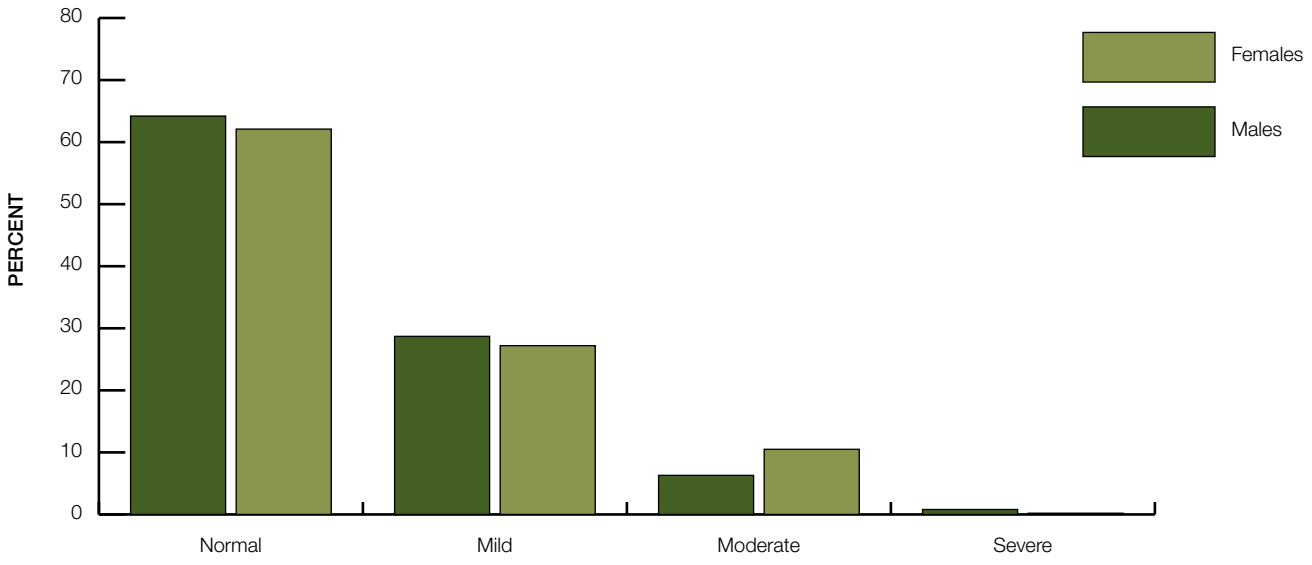
Generally greater proportions of patients have severe lung function impairment in successive older age groups, as described in Table 3.5.

TABLE 3.5 – ACFDR 2016: LUNG FUNCTION IMPAIRMENT BY AGE GROUP AND SEX

	<40	≥40–70	≥70–90	≥90	Total	<40	≥40–70	≥70–90	≥90	Total
			Number					*Percent*		
Males:										
6 – 11 years	2	11	63	195	271	0.7	4.1	23.2	72.0	100.0
12 – 17 years	2	21	83	131	237	0.8	8.9	35.0	55.3	100.0
18 – 29 years	33	115	132	89	369	8.9	31.2	35.8	24.1	100.0
30 + years	92	161	82	40	375	24.5	42.9	21.9	10.7	100.0
Total measured	**129**	**308**	**360**	**455**	**1,252**	**10.3**	**24.6**	**28.8**	**36.3**	**100.0**
Females:										
6 – 11 years	0	12	62	197	271	0.0	4.4	22.9	72.7	100.0
12 – 17 years	1	42	78	123	244	0.4	17.2	32.0	50.4	100.0
18 – 29 years	32	117	94	80	323	9.9	36.2	29.1	24.8	100.0
30 + years	41	109	60	22	232	17.7	47.0	25.9	9.5	100.0
Total measured	**74**	**280**	**294**	**422**	**1,070**	**6.9**	**26.2**	**27.5**	**39.4**	**100.0**
Persons:										
Total measured	**203**	**588**	**654**	**877**	**2,322**	**8.7**	**25.3**	**28.2**	**37.8**	**100.0**

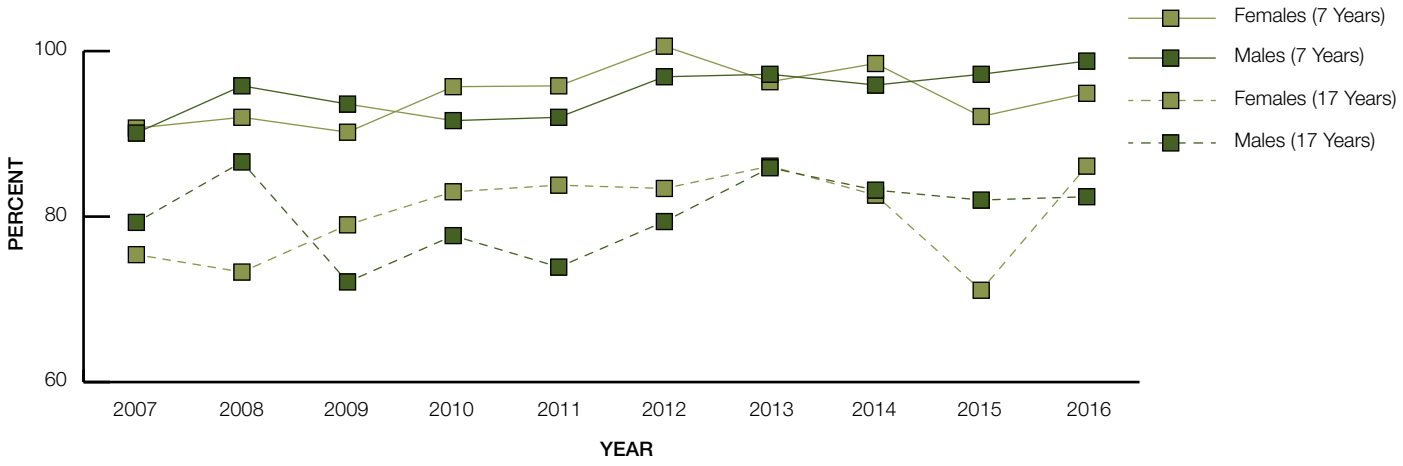
Figure 3.4 shows categories of lung function impairment experienced by the child and adolescent CF population as a whole. Sixty-four percent of male and 62 percent of female children and adolescents had lung function at or above 90 percent of predicted FEV_1.

FIGURE 3.4: ACFDR 2016: LUNG FUNCTION (GLI) – CHILDREN AND ADOLESCENTS



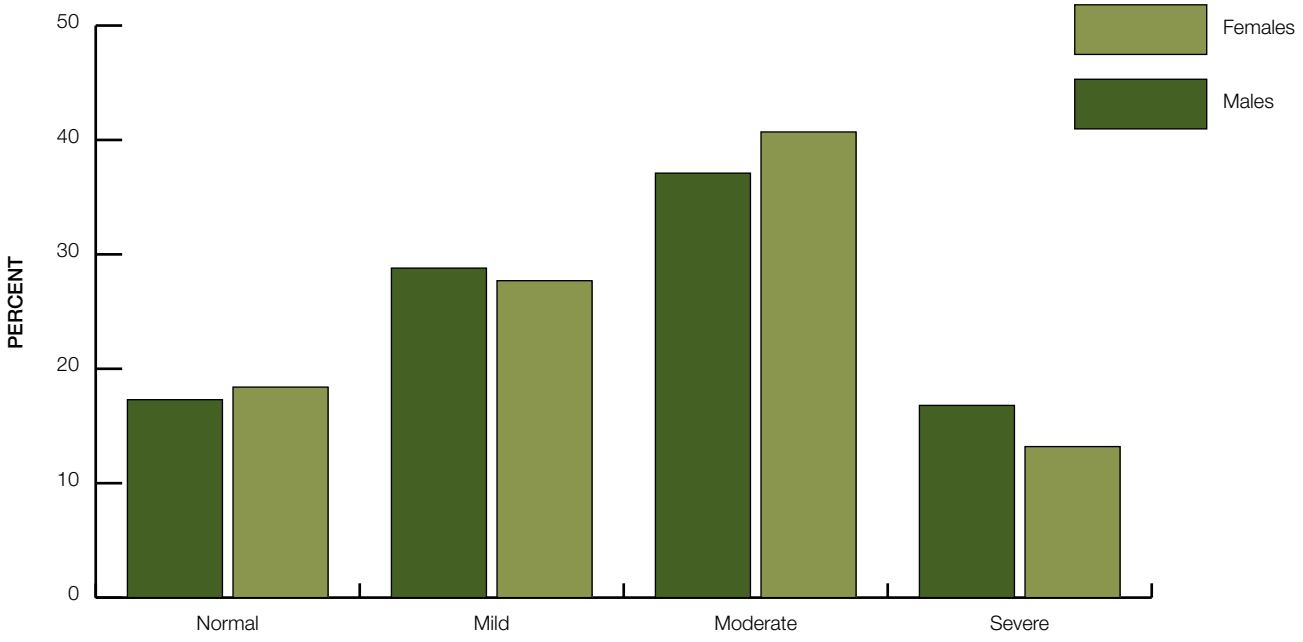
Upward trends over recent years in child and adolescent age groups were reported previously. The following view, from cross–sectional data for 7 and 17 year old children and adolescent suggests, however, that there may have been a plateauing of improvement since 2012 (Figure 3.5).

FIGURE 3.5: ACFDR 2016: MEDIAN FEV_1 PERCENT PREDICTED (AGE 7 & 17 YEARS) 2007 - 2016



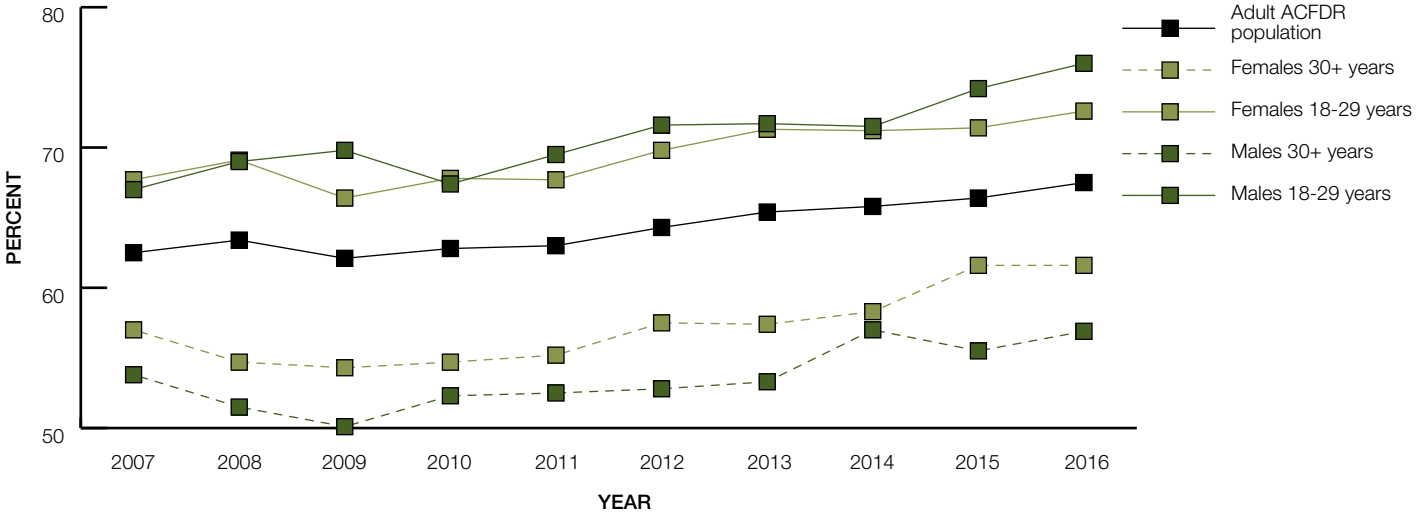
For adults with CF, a different pattern of lung function impairment is evident, with roughly 18 percent of both adult males and females having FEV_1 at or above 90 percent predicted in 2016. Lung function of less than 40 percent of FEV percent predicted was experienced by 17 percent of male adults and 13.2 percent of female adults (Figure 3.6).

FIGURE 3.6: ACFDR 2016: LUNG FUNCTION (GLI) – ADULTS



Trend data for adult lung function indicate improvement for the 18 to 29 years age group since 2005, for both males and females (Figure 3.7). A flatter trend for adults aged 30 and over may be confounded by possible increased survival.

FIGURE 3.7: ACFDR 2016: MEDIAN FEV_1, PERCENT PREDICTED (ADULT) 2007 - 2016



3.4 NUTRITION: WEIGHT, HEIGHT AND BODY MASS INDEX

METHODOLOGICAL NOTE

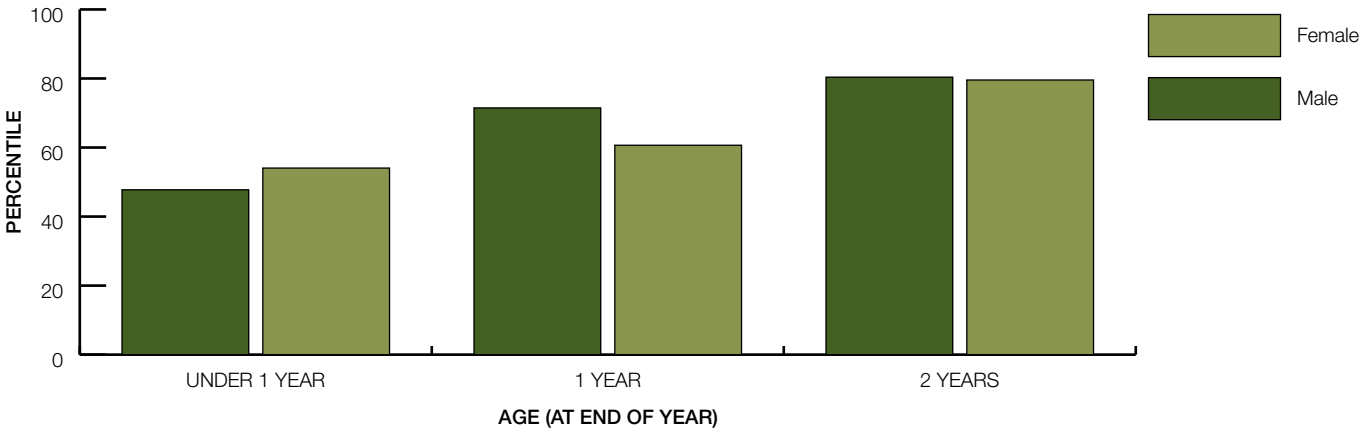
As for lung function measures reported in Section 3.3, values reported in this section are the average of the highest value recorded in each quarter of the year.

INFANTS AND YOUNG CHILDREN AGED UNDER 3 YEARS

Figure 3.8 shows the median weight for length percentile for children up to 3 years old. For 2016, for children of 1 year the median value of weight for length is at the 61st percentile for females but for males it is at the 71st percentile. This difference may be cohort–specific.

Percentiles are derived from World Health Organisation Child Growth Standards (WHO 2006).

FIGURE 3.8: ACFDR 2016: MEDIAN WEIGHT FOR LENGTH PERCENTILE



CHILDREN AND ADOLESCENTS

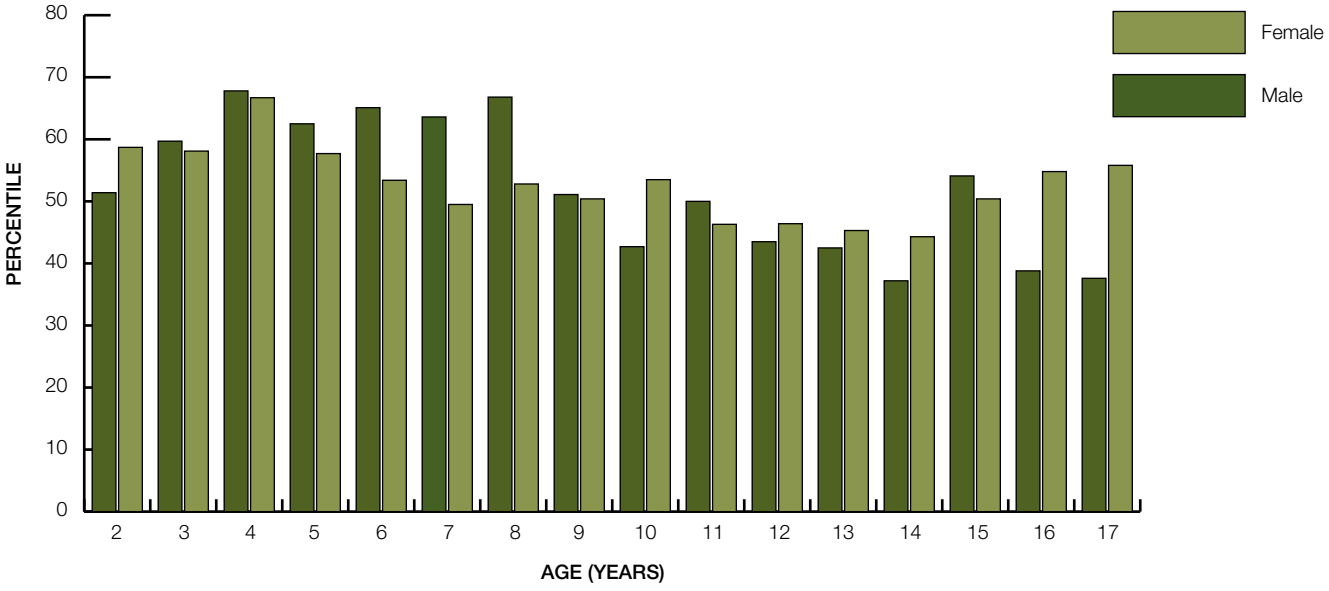
As shown in Table 3.6, median height percentile for young children is higher than the reference population, but is below the 50th percentile in older child and adolescent age groups in 2016, for both males and females with the exception of females six to eleven years. BMI percentiles are higher than height percentiles for each age and sex group, with the exception of male adolescents (42.8th percentile).

TABLE 3.6 – ACFDR 2016: CHILD AND ADOLESCENT HEIGHT AND BMI: MEDIAN PERCENTILES BY AGE GROUP AND SEX

	Height	BMI
Males		
2–5 years	59.5	61.5
6–11 years	46.0	58.0
12–17 years	40.3	42.8
Females		
2–5 years	52.1	60.9
6–11 years	50.0	50.6
12–17 years	44.6	50.5

As shown in Figure 3.9, BMI percentiles across individual year ages show a generally consistent pattern of lower values at higher ages. The younger males have a higher median BMI than their female counterparts.

FIGURE 3.9: ACFDR 2016: MEDIAN BMI PERCENTILE CHILDREN AND ADOLESCENTS



Overall, about half (52.9 percent of males and 51.1 percent of females) children and adolescents were below the 50th percentile for BMI in 2016. The distribution is shown in Table 3.7.

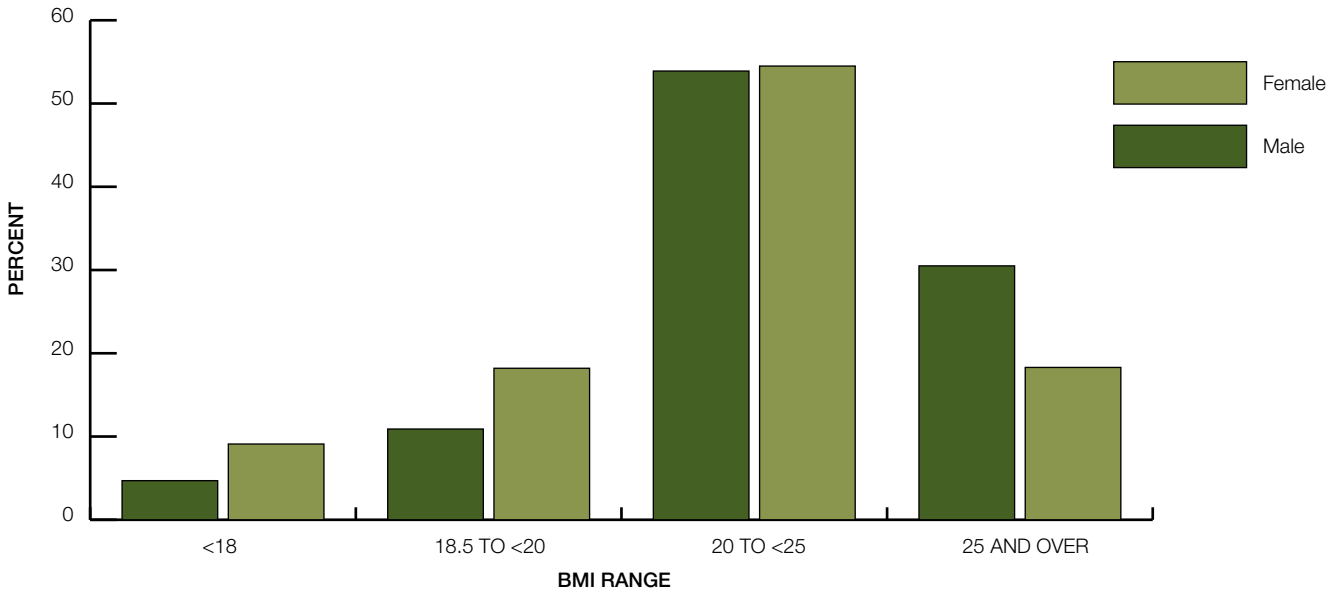
TABLE 3.7 – ACFDR 2016: CHILD AND ADOLESCENT HEIGHT AND BMI PERCENTILE DISTRIBUTIONS BY SEX

	Height			BMI		
	Males	**Females**	**Persons**	**Males**	**Females**	**Persons**
	Percent			*Percent*		
< 3rd	3.1	3.4	3.3	1.1	0.6	0.9
3rd – 4.99th	0.9	2.7	1.8	0.8	0.8	0.8
5th – 9.99th	5.6	6.2	5.9	2.8	3.0	2.9
10th – 24.99th	17.1	14.8	16.0	14.5	12.6	13.6
25th – 49.99th	26.2	24.0	25.1	27.9	28.7	28.3
50th – 74.99th	24.5	28.4	26.4	30.8	34.7	32.8
75th – 89.99th	14.6	13.6	14.1	14.8	14.2	14.5
90th – 94.99th	3.2	4.2	3.7	3.7	3.1	3.4
95th – 96.99th	1.7	1.3	1.5	1.9	1.1	1.5
>= 97th	3.1	1.6	2.3	1.9	1.3	1.6
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
	Number			*Number*		
Total	**629**	**642**	**1,291**	**629**	**642**	**1,291**

ADULT BODY MASS INDEX

Adult Body Mass Index (BMI) scores show 53.9 percent of males and 54.5 percent of females had an average quarterly BMI score in the range 20 to less than 25 kg/m^2 (Figure 3.10). The proportion of females who had BMI scores below 20 (18.2%) is higher than the proportion of males (11%). Thirty-one percent of adult males and 18 percent of females had a BMI above 25.

FIGURE 3.10: ACFDR 2016: ADULT BMI DISTRIBUTION



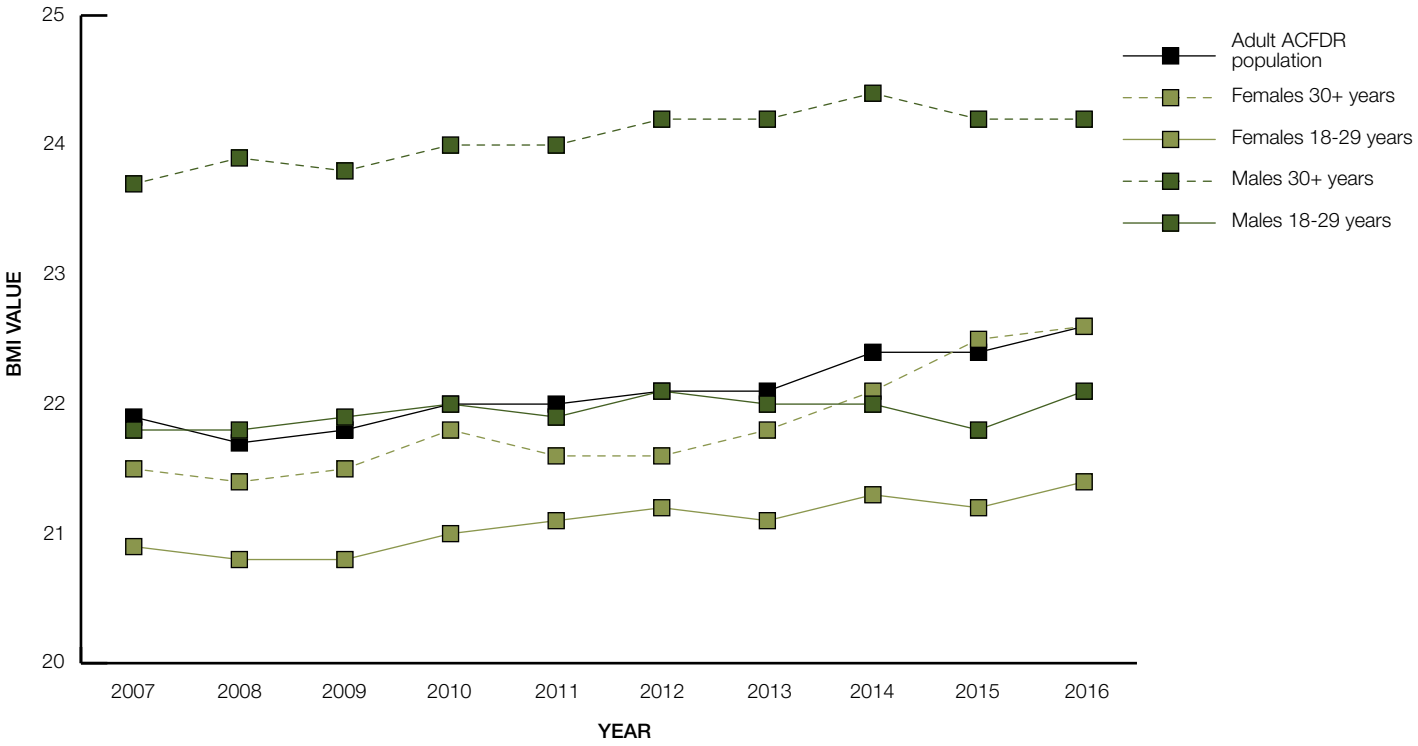
The distribution of adult BMI is further described in Table 3.8.

TABLE 3.8 – ACFDR 2016: ADULT BMI DISTRIBUTION

	BMI range				
	Less than 18.5	**From 18.5 to <20**	**From 20 to <25**	**25 and over**	**Total**
			Males: Percent		
18 – 29 years	8.4	14.9	56.1	20.6	100.0
30 + years	1.1	7.1	51.7	40.2	100.0
Male adults measured	4.7	10.9	53.9	30.5	100.0
			Males: Number		
Male adults measured	35	82	404	229	750
			Females: Percent		
18 – 29 years	11.0	19.9	54.6	14.4	100.0
30 + years	6.4	15.7	54.2	23.7	100.0
Female adults measured	9.1	18.2	54.5	18.3	100.0
			Females: Number		
Female adults measured	51	102	306	103	562

Figure 3.11 shows general increases in median BMI values for grouped adult age data since 2007.

FIGURE 3.11: ACFDR 2016: MEDIAN BODY MASS INDEX (BMI) 2007 - 2016

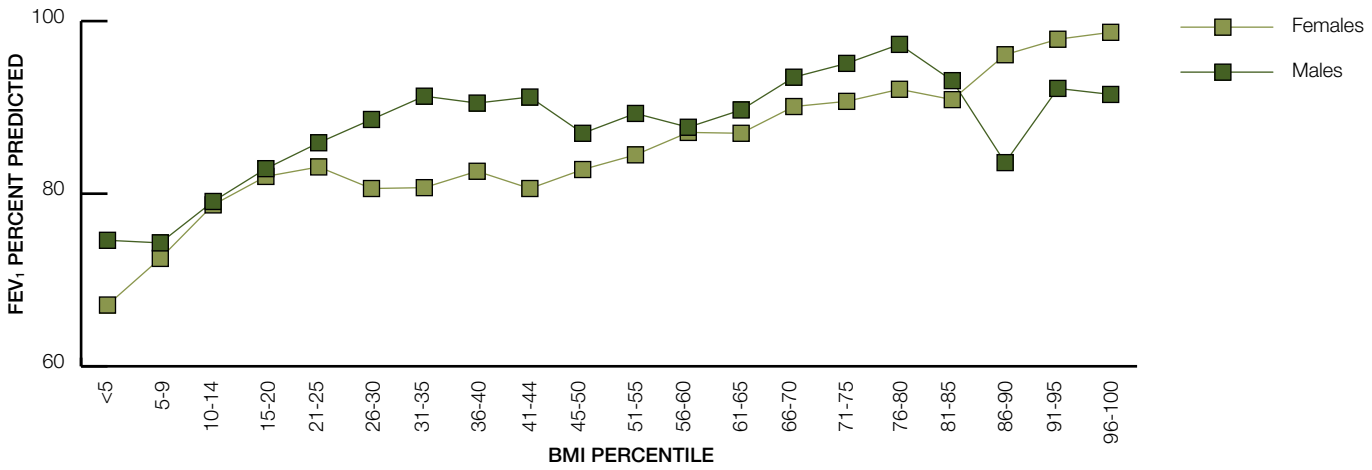


PULMONARY AND NUTRITIONAL OUTCOMES IN CHILDREN

Pulmonary and nutritional outcomes are two key measures of CF health. The data show that for all people with CF, pulmonary function and nutrition status are related, and improvements in one metric are associated with improvements in the other.

Figure 3.12 shows FEV_1 percent predicted values vs BMI percentiles for children and adolescents in 2016. FEV_1 percent predicted values increase with the increasing BMI percentile and are higher in males than in females.

FIGURE 3.12: ACFDR 2016: FEV_1 PERCENT PREDICTED VS. BMI PERCENTILE IN CHILDREN



4. TREATMENT OF CYSTIC FIBROSIS

This chapter describes the treatments and therapies recorded for patients in the Australian Cystic Fibrosis Data Registry.

4.1 VISITS TO CLINICS

The average number of clinic visits during 2016 was 9.1 for children and adolescents and 8.6 for adults. These figures should be treated with some caution as they may have been affected by different practices in recording clinic visits at contributing centres. The median number of visits to clinics stood at eight for children and adolescents and six for adults in 2016.

4.2 THERAPY FOR CYSTIC FIBROSIS PATIENTS

Antibiotic therapy was prescribed for 86 percent of CF patients for whom data was reported, and for more than 80 percent of patients in each age group. Oral antibiotic therapy was prescribed for 87.7 percent of antibiotics users (Table 4.1). Both PRN (as needed) and continuous usage was prescribed for these patients at some time during 2016, as shown in the following table. Higher proportions of adolescents (31%) and very young children (32.2%) than those in other age groups were prescribed oral antibiotics for continuous use.

TABLE 4.1 – ACFDR 2016: ORAL ANTIBIOTIC THERAPY – MODE OF USE BY AGE GROUP

	0–1 years	2–5 years	6–11 years	12–17 years	18–29 years	30+ years	All ages
				Percent			
Mode of Use							
As needed (PRN)	68.9	96.5	93.8	85.6	86.4	85.8	87.7
Continuous	32.2	4.6	8.6	18.5	31.0	30.3	21.3
Mode of use unknown	3.3	0.0	0.6	0.3	0.0	0.0	0.4
Total oral antibiotics users (a)	100.0	100.0	100.0	100.0	100.0	100.0	100.0
				Number			
Total oral antibiotics users	97	193	362	321	504	418	1,895
Missing/Not known	39	136	247	208	385	512	1,527
Total Patients	**136**	**329**	**609**	**529**	**889**	**930**	**3,422**

(a) More than one mode of use can be recorded so numbers add to more than 100.0.
As well, mode of use was not recorded for all patients where oral antibiotics were reported.

Forty-two percent of antibiotic users used inhaled antibiotics in 2016, with proportions generally greater in successively older age groups (Table 4.2).

TABLE 4.2 – ACFDR 2016: INHALED ANTIBIOTICS BY AGE GROUP

	0–1 years	2–5 years	6–11 years	12–17 years	18–29 years	30+ years	All ages
				Percent			
Inhaled antibiotics							
Yes	10.3	21.2	36.2	45.8	48.2	53.6	42.0
No	76.3	66.8	56.4	42.4	22.4	19.9	39.0
Unknown	13.4	11.9	7.5	11.8	29.4	26.6	19.0
Total antibiotics users	100.0	100.0	100.0	100.0	100.0	100.0	100.0
				Number			
Total antibiotics users	**97**	**193**	**362**	**321**	**504**	**418**	**1,895**
Mode of use							
As needed (PRN)	80.0	78.0	64.1	40.1	65.4	70.1	62.7
Continuous	10.0	19.5	34.4	59.2	39.9	35.7	39.9
Mode of use unknown	10.0	4.9	0.9	0.7	0.4	0.0	0.6
Total inhaled antibiotics users (a)	100.0	100.0	100.0	100.0	100.0	100.0	100.0
				Number			
Total Inhaled Antibiotics Users	**9**	**42**	**130**	**147**	**257**	**237**	**822**

(a) More than one mode of use can be recorded so numbers add to more than 100.0.
As well, mode of use was not recorded for all patients where oral antibiotics were reported.

Almost all CF patients use a range of other therapies to manage conditions other than infections, and many take nutritional supplements (Table 4.3). The usage of therapies was reported for 50.7 percent of patients in the Registry. Therapies used by the highest proportion of patients include pancreatic enzymes (32.9% of children/adolescents and 37.1% of adults), vitamin supplements (32.2 percent and 35.4 percent respectively), bronchodilators (18.8% and 39.7%) and salt tablets (17.9% and 6.8%).

TABLE 4.3 – ACFDR 2016: OTHER THERAPY BY TYPE [(a)]

	Child/adolescent		Adult	
	Number	*Percent*	*Number*	*Percent*
Dornase alpha	231	23.7	271	29.4
Pancreatic enzymes	320	32.9	342	37.1
Vitamin supplements	313	32.2	326	35.4
Bronchodilators	183	18.8	366	39.7
Corticosteroids inhaled	89	9.1	226	24.5
Corticosteroids oral	26	2.7	55	6.0
Mannitol	19	2.0	31	3.4
Insulin	38	3.9	101	11.0
Macrolides	43	4.4	269	29.2
Salt tablets	174	17.9	63	6.8
Antihypercalcaemics	3	0.3	3	0.3
Gastric acid secretion reducers	80	8.2	198	21.5
Other	195	20.0	223	24.2
Patients with therapies reported	973	60.7	922	50.7
Unknown/Not Reported	630	39.3	897	49.3
Total Patients	**1,603**	**100.0**	**1,819**	**100.0**

(a) Individuals may use more than one type of therapy; percentages by type of therapy add to more than 100.0

Nutritional supplement information is provided in Table 4.4. The usage of nutritional supplements was reported for 51.6 percent patients in the Registry. The majority of those taking nutritional supplements take them orally, however type of the nutritional supplements remains unknown for 14.5 percent of the participants.

TABLE 4.4 – ACFDR 2016: NUTRITIONAL SUPPLEMENTS BY AGE GROUP [a]

	0–1 years	2–5 years	6–11 years	12–17 years	18–29 years	30+ years	All ages
				Percent			
Oral (prescribed)	2.2	8.1	10.4	10.3	10.6	9.7	9.6
Nasogastric	2.2	0.5	2.3	2.3	0.2	0.5	1.2
Total Parenteral Nutrition (TPN)	0.0	0.0	0.0	0.0	0.2	0.0	0.1
Gastrostomy tube/button	0.0	2.2	2.0	4.6	3.4	1.5	2.4
Nutritional supp. type unknown	1.1	8.6	18.2	15.2	16.6	13.9	14.5
Total using nutritional supplements	5.6	19.5	32.9	32.5	31.0	24.7	27.8
Not using nutritional supplements	94.4	80.5	67.1	67.5	69.0	75.3	72.2
Patients with nutritional supplements reported	100.0	100.0	100.0	100.0	100.0	100.0	100.0
				Number			
Total with nutritional supplements reported	90	185	346	302	471	373	1,767
Missing/Not known	46	144	263	227	418	557	1,655
Total Patients	**136**	**329**	**609**	**529**	**889**	**930**	**3,422**

(a) Individuals may use more than one type.

Of the 1,767 patients for whom treatment data were reported in 2016, 18 were reported to have commenced oxygen therapy during 2016 and 29 remained on oxygen therapy commenced in a previous year. The majority in each category (12 and 21 respectively) were adults.

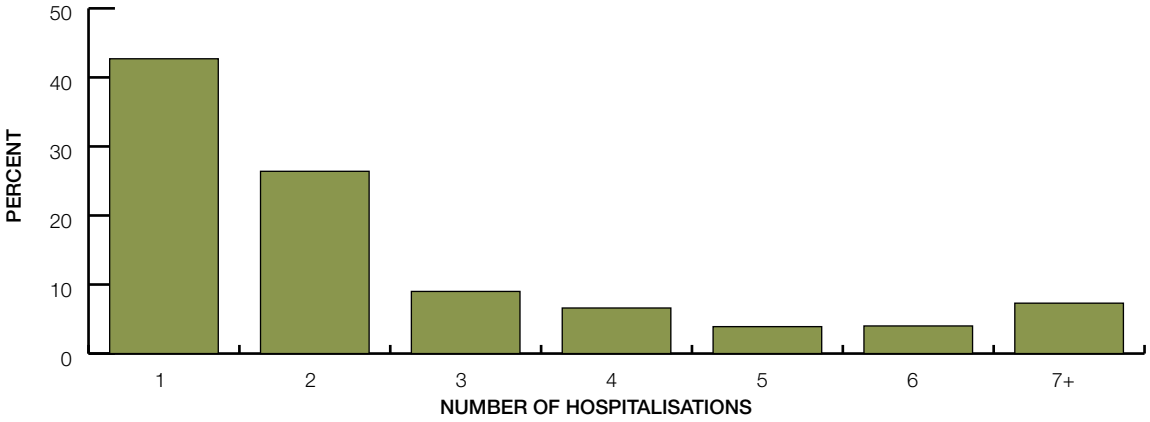
Eight patients commenced using non–invasive ventilation in 2015, and 14 had commenced in earlier years. Thirteen of those commencing during 2016 were adults and one patients was from children/adolescents group.

4.3 HOSPITAL TREATMENT

Of the 966 patients attending hospitals that provided adequate data, 42.7 percent had one hospitalisation for any indication during 2016. Half of these had more than one period in hospital during the year (Figure 4.1).

Note: The manner of collection of hospitalisation data for the Registry does not allow a clear distinction to be drawn between 'no hospitalisation' and missing data in relation to a patient.

FIGURE 4.1: ACFDR 2016: HOSPITALISATIONS



The distribution of hospitalisations by age is shown in Table 4.5.

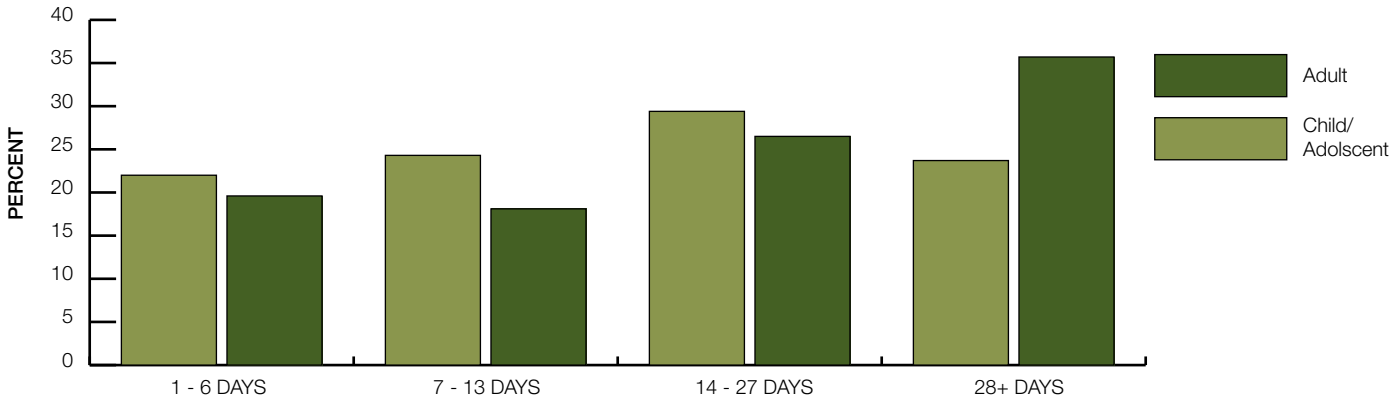
TABLE 4.5 – ACFDR 2016: HOSPITALISATION RELATED TO CYSTIC FIBROSIS, RESPIRATORY CAUSES

	Persons aged						
	0–1 years	2–5 years	6–11 years	12–17 years	18–29 years	30+ years	All ages
	Percent of persons in age group						
Number of hospitalisations							
1	5.9	7.9	11.3	12.1	13.9	13.0	12.0
2	3.7	4.3	5.1	6.8	9.9	8.7	7.5
3	0.7	0.0	1.5	2.6	3.5	3.4	2.5
4	0.0	0.6	0.7	1.9	2.0	3.2	1.9
5	0.0	0.6	0.7	0.4	2.0	1.3	1.1
6	0.0	0.3	0.3	0.6	1.5	2.2	1.1
More than 6	0.7	1.1	1.1	2.1	2.4	2.9	2.1
None/Not Reported	89.0	85.1	79.3	73.5	64.8	65.3	71.8
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
	Number						
Total reported	15	49	126	140	313	323	966
Unknown/Not Reported	121	280	483	389	576	607	2,456
Total Patients	**136**	**329**	**609**	**529**	**889**	**930**	**3,422**

Of the 966 persons hospitalised in 2016, 28 percent accumulated at least 14 admitted days through the year.

Adult patients (mean 48.0 days, median 17 days) generally spent more days as admitted patients in hospital than children and adolescents (26.6 and 14 days respectively) (Figure 4.2).

FIGURE 4.2: ACFDR 2016: ACCUMULATED HOSPITAL DAYS

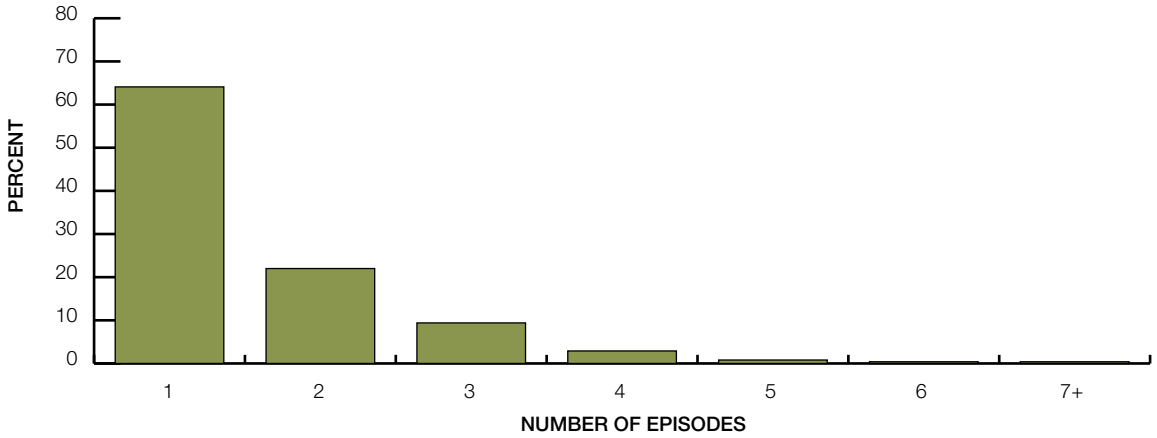


4.4 HOME THERAPY

In 2016, home therapy data was available for 234 patients and frequency of episodes for these patients is shown in Figure 4.3.

Note. As for hospitalisation data, the manner of collection of data about intravenous antibiotic therapy administered at home does not allow a clear distinction to be drawn between 'no home therapy' and missing data in relation to a patient.

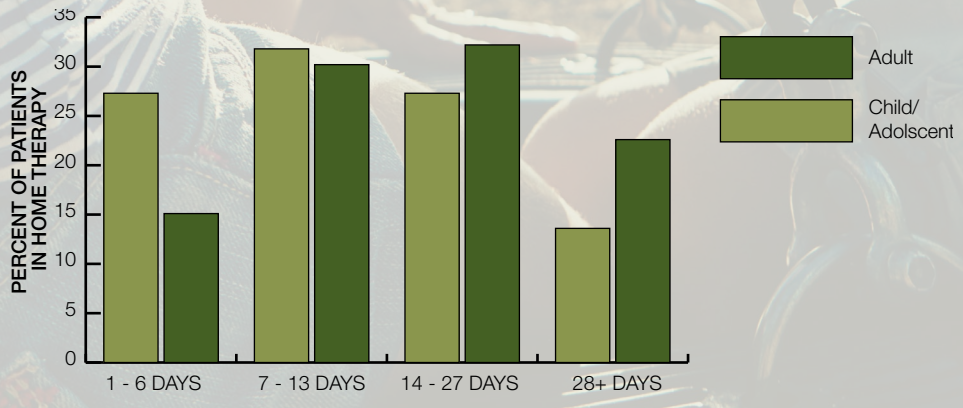
FIGURE 4.3: ACFDR 2016: HOME THERAPY



A total of 42 child or adolescent patients and 192 adult patients whose data were available spent a mean of 21.5 days and 22.1 days respectively having intravenous antibiotic therapy at home.

Median values were 10 and 14 days for each group respectively. Figure 4.4 shows the distributions of those days.

FIGURE 4.4: ACFDR 2016: ACCUMULATED HOME THERAPY DAYS



5. ORGAN TRANSPLANTS

5.1 PATIENTS ASSESSED FOR TRANSPLANT IN 2016

CF centres reported 51 patients assessed for organ transplant during 2016. Of these, 29 (28 adult) had been accepted onto transplant waiting lists (Table 5.1).

Thirty-nine patients were accepted for a bilateral lung transplant and four for a heart and lung transplant. For eight other patients accepted, the organ to be transplanted was not specified.

TABLE 5.1 – ACFDR 2016: PATIENTS ASSESSED FOR TRANSPLANTS IN 2016

Age group:	Males	Females	Persons
12 – 17 years	1	1	2
18 – 29 years	3	12	15
30 years and over	18	16	34
Total, All Ages	**22**	**29**	**51**

5.2 TRANSPLANTS DURING 2016

Thirty-two transplants were reported in 2016. Twenty-nine bilateral lung transplants were reported by CF centres as having occurred in 2016 (Table 5.2). Twenty eight of these transplants were performed on adult patients, including 16 patients aged 30 years and over. One male and two females had liver transplants.

TABLE 5.2 – ACFDR 2016: PATIENTS RECEIVING LUNG TRANSPLANTS IN 2016

Age group:	Males	Females	Persons
12 – 17 years	1	0	1
18 – 29 years	6	10	16
30 years and over	10	2	12
Total, All Ages	**17**	**12**	**29**

6. MORTALITY

6.1 DEATHS RECORDED IN 2016

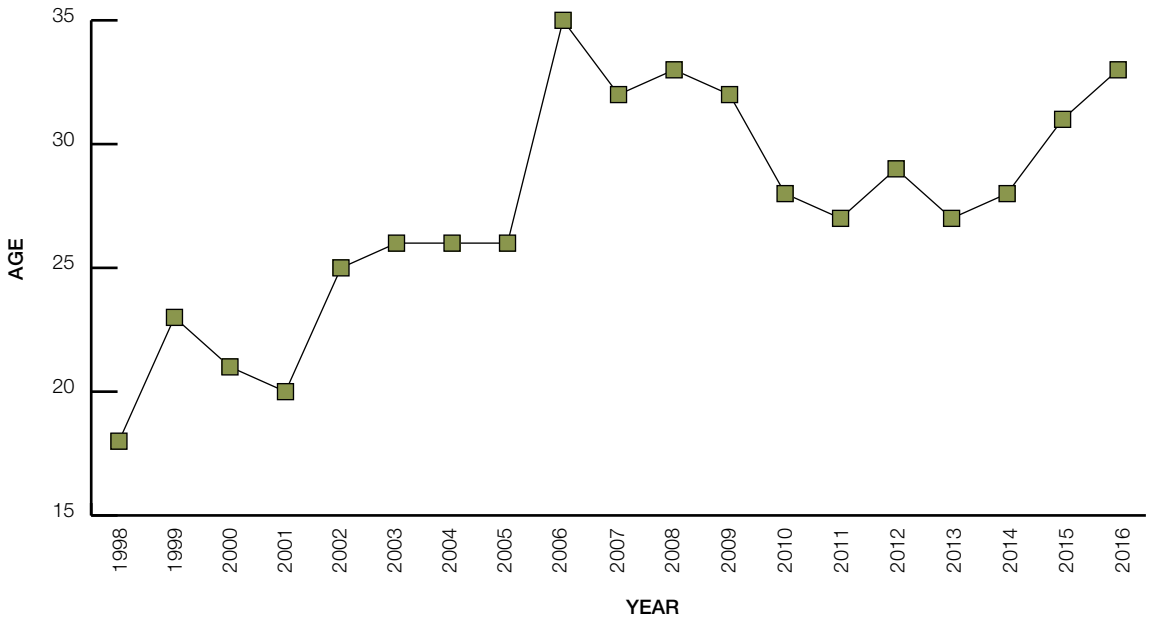
The number of deaths reported to the Registry in 2016 was 19. One of the deaths reported in 2016 was of a child aged less than 12 years and one of a person aged less than 18 years (Table 6.1).

TABLE 6.1 – ACFDR 2016: DEATHS, BY AGE AND SEX

Age group:	Males	Females	Persons
6 – 11 years	1	0	1
12 – 17 years	1	0	1
18 – 29 years	3	4	7
30 years and over	4	6	10
Total, All Ages	**9**	**10**	**19**

The median age at death for patients who died in 2016 was 32.6 years, up from a median of 31.6 in 2015 (Figure 6.1).

FIGURE 6.1: ACFDR 1998-2016: MEDIAN AGE AT DEATH



6.1 CAUSES OF DEATH

Eleven of the 19 deaths reported in 2016 were due to pulmonary causes with another four cases as a result of post–transplant complications. Four causes of death were unknown or stated (Table 6.2).

TABLE 6.2 – ACFDR 2016: CAUSE OF DEATH

	Males	Females	Persons
Related to CF			
Pulmonary	6	5	11
Other (including post-transplant)	1	3	4
Cause unknown or unstated	2	2	4
Total, All Causes	**9**	**10**	**19**

7. REGISTRY QUALITY ASSURANCE

Registry Quality Assurance comprises review of data completeness and data quality.

Quality assurance processes regarding data completion are undertaken by the ACFDR Data Manager and Registry Coordinator when data is entered via the web–based system via system validation checks, and follow up of incomplete data with the participating centres.

DATA COMPLETENESS

Similar to international Registry comparisons, completeness of ACFDR data varies significantly depending on the data type, but also varies by hospital.

Table 7 summarises the categories of data collection, and the percent of data available for 2015 and 2016. Please note that in this report we included all the sites in the analysis, whereas in 2015 sites with missing data were excluded.

TABLE 7 – ACFDR 2016: DATA AVAILABILITY

Category	Data Item	2016		2015	
		Number	*Percent*	*Number*	*Percent*
Socio-Demographic					
All participants	Age	3,422	100	3,378	100
	Gender	3,422	100	3,378	100
	Postcode	3,222	94	2,802	83
Adults	Age	1,819	100	1,756	100
	Gender	1,819	100	1,756	100
	Postcode	1,683	93	1,624	92
	Marriage status	926	51	1,024	58
	Activity status (any recorded)	912	50	1,020	58
Diagnostic					
	CF diagnosis date	2,494	73	2,498	74
	Presentation mode	2,763	81	2,803	83
	CFTR2 mutation 1	3,249	95	3,311	98
	CFTR2 mutation 2	3,244	95	3,306	98
Clinical Measures					
Children under 6	Age	455	100	489	100
	Height	307	67	314	64
	Weight	310	68	316	65
Children 6 to 17	Age	1,111	100	1,133	100
	Height	1,062	96	717	63
	Weight	1,066	96	717	63
	FEV_1	1,044	94	710	63
Adults	Age	1,652	100	1,756	100
	Height	1,409	85	1,063	61
	Weight	1,407	85	1,062	60
	FEV_1	1,400	85	1,069	61

TABLE 7 – ACFDR 2016: DATA AVAILABILITY (CONTINUED)

Category	Data Item	2016		2015	
		Number	*Percent*	*Number*	*Percent*
Clinical Interventions					
	Antibiotics	1,868	55	2,130	63
	Other therapy	1,853	54	2,123	63
	Other therapy (specified)	935	50	1,514	71
	Transplant status	183	5	173	5
	Date of death	0	0	0	0
Complications					
Pulmonary	Major haemoptysis	1547	45	1585	47
	Massive haemoptysis	1532	45	1573	47
	Bronchial artery embolisation	0	0	1507	45
Gastro-intestinal	Gastro-oesophogeal reflux	1556	45	1605	48
	Gastro-oesophogeal reflux (endoscopy)	979	29	1027	30
	Abnormal liver function	1571	46	1619	48
	Cirrhosis or portal hypertension	1540	45	1445	43
	Pancreatitis	1546	45	1571	47
Endocrine	Chronic IDDM	1564	46	1622	48
	Intermittent IDDM	1550	45	1569	46
	Other glucose abnormalities	1555	45	1570	46
Skeletal	Osteoporosis	1554	45	1571	47
	Osteopaenia	1549	45	1563	46
Other	Bone fracture	945	28	728	22
Cancer	Cancer	1519	44	1563	46

8. ACADEMIC OUTPUTS

DATA ACCESS REQUESTS

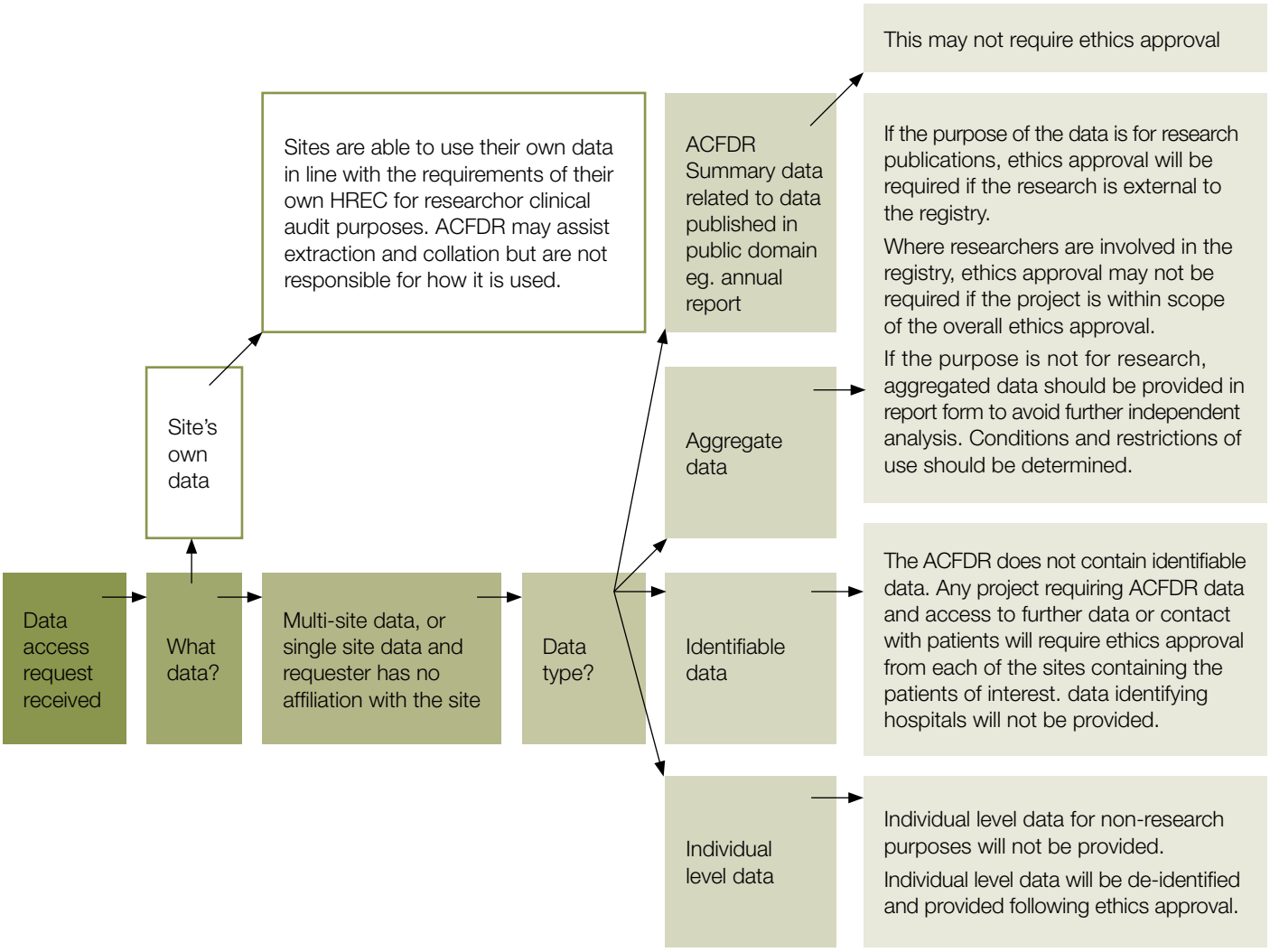
One data access request was approved for the ACFDR in 2016:

Date	Name	Organisation	Request Type	Request
26/09/2016	Guy Gavagna	Vertex Pharmaceuticals	Non-research	Longitudinal FEV_1, Weight and Hospitalisation data in People with CF who have F508del/F508del mutations in the CFTR gene who are age 12 years and older 2012-2013

HOW CAN I REQUEST DATA FROM THE ACFDR?

Data access requests are subject to approval by the Registry's Steering Committee and relevant ethics committees, and Monash University's conditions of use. Interested researchers/individuals are advised to contact Monash University for details and to arrange consideration of their research proposal. In accordance with the ACFDR data access policy, a fee may be charged to recover costs for data extraction and/or analysis. Flow chart for ACFDR data requests to determine access and ethics approvals required is shown below, in Figure 7.

FIGURE 7. FLOW CHART FOR ACFDR DATA REQUESTS TO DETERMINE ACCESS AND ETHICS APPROVALS REQUIRED



GRANTS AND PUBLICATIONS

In 2016, the ACFDR, led by chief investigator David Armstrong, was successful in receiving funding from Monash Partners for a study regarding the impact of guidelines on the nutritional status of children in the registry. This project has been completed, a poster was presented at the European CF conference in Belgrade, and a research paper has been published.

Ruseckaite R., Pekin N., King S., Carr E., Ahern S., Oldroyd J., Earnest A., Wainwright C., and Armstrong D. Evaluating the impact of 2006 Australasian Clinical Practice Guidelines for nutrition in children with CF in Australia. Respiratory Medicine 142 (2018) 7-14. https://doi.org/10.1016/j.rmed.2018.07.007

9. FUTURE DEVELOPMENTS

In 2018 the ACFDR has established a Data Element Working Party comprising Steering Committee members and which will interact with the broader CF community, to review and refine the current data items collected by the ACFDR. In particular it is expected that revisions will include changes to diagnostic criteria to allow for the iidentification of patients as CF screen positive, inconclusive diagnosis (CF-SPID) or other recognised CF variations, in addition to those patients with a confirmed diagnosis of CF. Following these patients up via the ACFDR will allow for a better understanding of the natural history of these conditions and key factors related to their transition into CF. It will also allow for updating of the collection of therapies currently available to CF patients, including CF modulator drugs.

The ACFDR is currently working with Queensland Health to integrate key ACFDR data items into its new electronic medical record (EMR) that is being developed. Once completed, this will allow for the ACFDR to extract many items directly from the EMR without requiring further data entry. It will also be establish a model to allow other hospitals to import selected data items into the ACFDR over time also, thus reducing duplicate data entry more broadly.

The ACFDR is continuing to develop its reporting to participating sites and to jurisdictions. For the first time with this report the ACFDR has developed a consumer-focused Infographic. It is a key aim of the ACFDR to produce information that is relevant, meaningful and timely to all stakeholders, and we encourage your feedback on this.

It is a key aim of the ACFDR to produce information that is relevant, meaningful and timely to all stakeholders, and we encourage your feedback on this.

In 2018 the ACFDR will undertake a data linkage project with the Australian Institute of Health and Welfare and with the Cardiothoracic Organ Transplantation Registry to enable the registry to validate the accuracy of its data in relation to patients who have deceased and those who have received organ transplants. This information is required so that the ACFDR can undertake survival analysis of CF patients in Australia, and compare our results with those published from other international registries including the UK, US and Canada.

The ACFDR is also collaborating with three national/international clinical trials in relation to microbiology, infections and respiratory exacerbations of patients with CF. This will involve sharing data from the ACFDR as well as time-limited collection of specific data sets directly within the registry. Embedding clinical trials into registries has been shown to be a cost-effective and efficient way of supporting clinical trials, and has potential to be a significant activity of the ACFDR into the future.

10. APPENDICES

List of Figures

List of Tables

Registry Steering Committee Membership (from September 2016)

Steering committee members	Role/specialisation	Institution/Association
A/Professor Susannah Ahern	Coordinating Investigator/Academic Lead	Monash University, VIC
Professor Scott Bell	Clinical Lead ACFDR/ CF Physician	The Prince Charles Hospital, QLD
Professor Claire Wainwright	CF Physician – Paediatrics	Lady Cilento Children's Hospital, QLD
Dr Andre Schultz	CF Physician – Paediatrics	Princess Margaret Hospital (currently known as Perth Children's Hospital), WA
Professor Peter Wark	CF Physician – Adults	John Hunter Hospital, NSW
A/Professor Peter Middleton	CF Physician – Adults	Westmead Hospital, NSW
A/Professor Tom Kotsimbos	CF Physician Adults	Alfred Health, VIC
Ms Nettie Burke	CEO	Cystic Fibrosis Australia
Dr Rasa Ruseckaite	Data Manager – ACFDR	Monash University, VIC
Dr Susannah King	Dietitian	Alfred Hospital, VIC
Ms Lucy Keatley	Nurse/Data Entry	Westmead Hospital, NSW
Ms Morgan Gollan	Consumer Representative	NSW

List of Participating Sites

Site	
Sydney Children's Hospital (SCH)	Paediatric
Royal Prince Alfred Hospital (RPA)	Adult
The Children's Hospital, Westmead (CHW)	Paediatric
Westmead Hospital (Adults) (WMH)	Adult
Gosford Hospital (GOS)	Adult
John Hunter Children's Hospital (JHC)	Paediatric
John Hunter Hospital (Adults) (JHA)	Adult
Royal Children's Hospital (RCM)	Paediatric
The Alfred Hospital (ALF)	Adult
Monash Medical Centre (MMC)	Paediatric and Adult
The Prince Charles Hospital (PCH)	Adult
Mater Hospital (Adults) (MAH)	Adult

Site	
Gold Coast University Hospital (GCH)	Adult
Lady Cilento Children's Hospital (LCC)	Paediatric
Royal Adelaide Hospital (RAH)	Adult
Women and Children's Hospital (WCH)	Paediatric
Princess Margaret Hospital for Children (PMH) (to be known as Perth Children's Hospital from 2017)	Paediatric
Sir Charles Gairdner Hospital (SCG)	Adult
Royal Hobart Hospital (RHH)	Paediatric
Launceston General Hospital (LGH)	Paediatric
North West Regional Hospital (BUR)	Paediatric
Tasmanian Adults (incorporating RHH and LGH)	Adult
The Canberra Hospital – adult clinic (CHA)	Adult

ACFDR Coordinating Centre, Monash University

The ACFDR coordinating team encourages contact regarding all Registry related activities and operations, including access to data through the email account below

Email: med–acfdregistry@monash.edu

Registry Academic Lead: A/Prof Susannah Ahern

Registry Data Manager: Dr Rasa Ruseckaite

Registry Coordinator: Madeleine Gardam

Phone: +61 (0)3 9903 1656

ACFDR website page:
https://www.cysticfibrosis.org.au/data-registry

Access to Registry data

Requests for information from the Australian Cystic Fibrosis Data Registry are welcome.

Application should be made to the ACFDR Coordinating Centre, Monash University.

Email: med–acfdregistry@monash.edu

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