MONASH University

AUSTRALIAN CYSTIC FIBROSIS DATA REGISTRY

ANNUAL REPORT 2017

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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

I am delighted to welcome you to this, the 19th Annual Report for the Australian Cystic Fibrosis Data Registry (ACFDR) encompassing the health outcomes and information garnered in 2017.

Equally, I would like to express the gratitude of everyone at Cystic Fibrosis Australia (CFA) to all the Cystic Fibrosis Centre staff around Australia for their commitment, expertise and rigor and to all those individuals and their families who have shared their medical histories and contributed to this vital initiative.

At the helm of the ACFDR, the Monash University Registry Sciences Unit has provided expert stewardship of the Registry, constantly enhancing its value and efficacy. In turn the ACFDR Steering Committee, chaired by Scott Bell has successfully combined the skillsets of medical, research and allied health professionals with new and highly rewarding consumer insights and valuable data.

Building on the knowledge gained so far the ACFDR Steering Committee is strategically implementing new initiatives designed to enhance monitoring of new treatments and therapies and integrate even more efficiently with complementary digital platforms.

While enriching operations from a clinical perspective the most prized outcome of all is improving the lives of people with CF.

This latest report has documented some significant developments. For example and of great importance, it points to a continuing upward trend in the age of Australians with CF. In 2014, the proportion of adult individuals with CF was 51.1 percent and in 2017 the proportion has grown to 53.7 percent. We can ascribe this escalation to the resolve of people with CF and their families and support networks who are committed to their complex and demanding treatment programs. In turn recognition and gratitude must go to the clinical teams tirelessly delivering exceptional standards of specialist care and practical, professional support.

As part of CFA's mission to improve the lives of people with CF we are also looking beyond the immediately identifiable traits and ripple effects of the disease to an aspect of fundamental importance to everyone – mental health. Following the success of our recent national Mental Health Roadshow, we are funding a major mental health trial at the CF Centres in Newcastle and we will continue to work with the Federal Government to provide greater access to new drugs and treatments that reduce the financial and physical demands of CF.

Again, on behalf of the CFA I would like to reiterate our sincere thanks to the CF community, CF centre staff, Monash University Registry Sciences Unit and the ACFDR Steering Committee. Without doubt your ardent support of and contributions to the ACFDR underscore shared goals that we are determined to realise - to allow people with CF to live a life like any other.

Nettie Burke
Chief Executive Officer
Cystic Fibrosis Australia

FROM THE CLINICAL LEAD OF THE REGISTRY

It is my pleasure to present the 2017 Annual Report of the Australian Cystic Fibrosis Data Registry (ACFDR). It has been a busy year for the data registry, with two significant projects undertaken throughout the year – the data element review, and the development of a new database – taking the data registry into the future.

The 2017 ACFDR Annual Report continues the key work of the registry in following the trajectory and outcomes of children and adults with cystic fibrosis (CF) in Australia. It also presents some new analyses and presentation of key clinical information including genetic mutations and nutrition information, in line with current best practice.

The ACFDR team has also undertaken work to validate key outcome data including patient transplant and death data, which are critical in describing and comparing CF outcomes. This data analysis will be completed in time for the 2018 Annual Report. This report continues to highlight the increasing use of the data registry for research and local study purposes, as well as communicating the benefits of the registry with patients by incorporating a pull-out infographic of key summary information.

I would like to acknowledge Cystic Fibrosis Australia, the Monash University ACFDR team, the ACFDR Steering Committee, and hospital clinical staff - committed physicians, nurses, allied health staff and data managers without whom this registry would not be possible. I would also 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), the ACFDR is managed by Monash University, 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 43. 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 has current ethical approval from Alfred Health for Monash University to manage and operate the registry. 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 39.

Data…are collected regularly with the aim to improve health service delivery and …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 1st October 2018 and pertains to data that relates to patient events from January 1st to December 31st 2017. 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 2013 TO 2017

	2013	2014	2015	2016	2017
Demographics					
Total number of patients, N	3,235	3,294	3,379	3,422	3,151 [a]
Adults, percent	49.9	51.1	52.0	53.2	53.7
Males, percent	52.9	53.0	53.2	53.4	53.7
Median age (years) for all people with CF	17.9	18.4	18.8	19.3	19.6
Diagnosis					
Pancreatic insufficient, percent	81.1	82.9	82.2	81.8	81.0
Genotyped, percent	89.1	92.1	91.7	95.2	94.1
New diagnoses, N	92	79	98	90 [b]	72
Newborn (<1 year) diagnoses, percent	81.5	72.2	73.5	61.1	76.6
New adult (>18 years) diagnoses, percent	8.7	6.3	3.1	4.4	4.2
Respiratory Microbiology [c] [d]					
Any P. aeruginosa, percent	49.6	48.5	50.1	48	55.9
Staphylococcus aureus, percent	43.1	41.8	33.9	31.9	50.9
Aspergillus, percent	25.0	24.0	18.2	14.7	22.9
Non tuberculous mycobacterium, percent	1.9	1.9	2.8	2.6	4.2
Patients with Moderate to Severe FEV_1pp for Each Age Category [e]					
6-11 years, percent	4.3	5.2	5.9	6.3	5.2
12-17 years, percent	16.1	14.7	12.7	13.7	15.2
18-29 years, percent	47.5	46.9	45.8	43.1	42.3
>30 years, percent	67.2	66.8	68.9	66.4	61.9
Nutrition Outcomes					
Median weight for length percentile, infant and child <3 years, males	64.2	57.3	63.1	67.1	69.0
Median weight for length percentile, infant and child <3 years, females	64.9	63.9	58.3	65.2	66.5
Median BMI percentile, child and adolescent, males	56.4	53.7	55.4	55.8	51.6
Median BMI percentile, child and adolescent, females	51.1	52.4	53.7	54.8	52.2
Average BMI, <18.5, adult males, percent	3.2	3.7	3.9	4.6	5.0
Average BMI, >25, adult males, percent	28.5	28.9	28.0	26.8	30.3
Average BMI, <18.5, adult females, percent	6.8	9.1	8.8	8.9	8.0
Average BMI, >25, adult females, percent	15.9	17.3	18.6	19.0	19.7

(a) Total number of patients for 2017 is lower than previous years due to the exclusion of two sites from the 2017 report. If these two sites had been excluded from the 2016 registry patient count, there would have been 3,119 patients in 2016. Therefore the number of people with CF on the registry continues to increase year on year.

(b) Diagnosis information for 17 new patients diagnosed in 2016 have been included in the report for 2017.

(c) Proportion represents only those with data reported.

(d) Top four most common.

(e) 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 2017 the Australian Cystic Fibrosis Data Registry (ACFDR) held records of 3,151 people with CF collected from 21 CF centres in Australia.

The mean age of the registry population was 21.7 years at 31 December 2017. This was increased from mean age of 21.5 years reported in 2016. The median age of 19.6 years at 31 December 2017 is also higher than at the end of previous years, having been 19.3 in 2016 and 18.8 in 2015. Median age for males (20.4 years) remained higher than that for females (18.7 years) in 2017, although both increased by approximately four months.

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 53.7 percent in 2017, from 53.2 percent in 2016.

Note: Two centres were excluded from this report due to incomplete data.

1.2 AGE DISTRIBUTION

Figure 1.1 and Table 1.1 show the age distribution of patients in the ACFDR for 2017. 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 2017: AGE DISTRIBUTION BY SEX

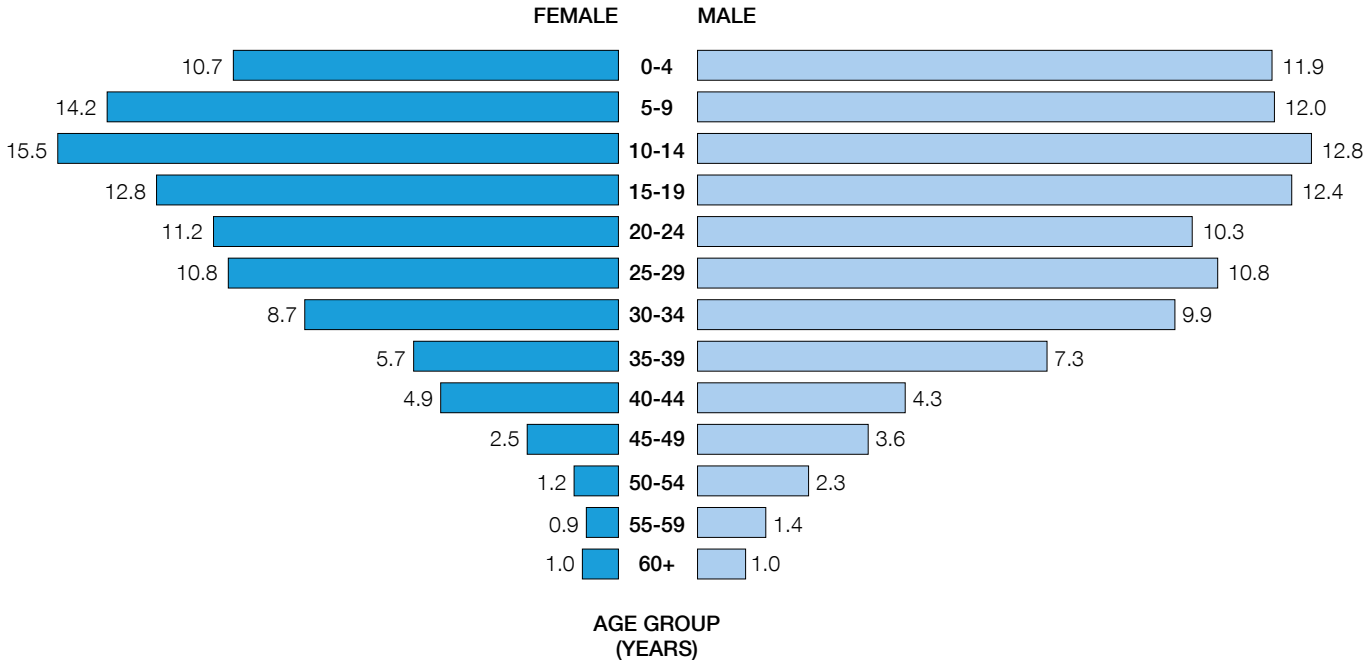


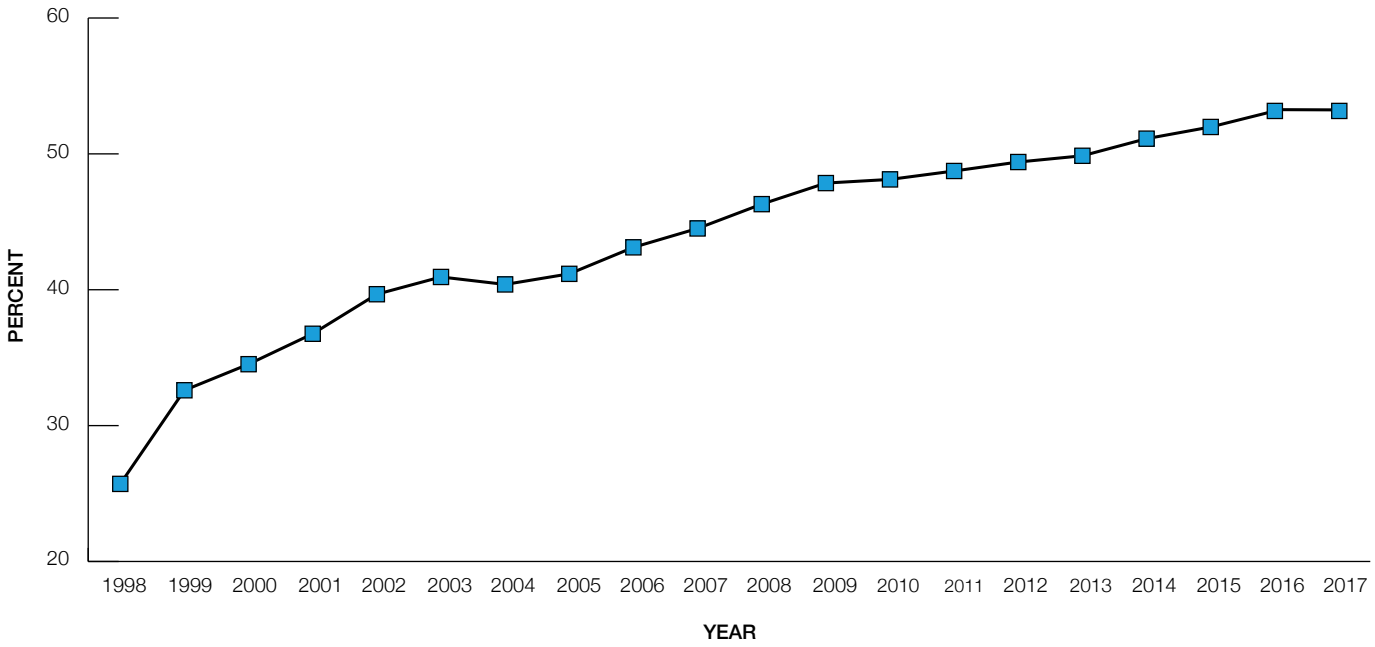
TABLE 1.1 – ACFDR 2017: AGE AND SEX OF REGISTRANTS AT 31 DECEMBER 2017

Age Group	Males	Females	Persons	Percent Male
Standard Demographic Age Groups				
0 – 4 years	202	156	358	56.4
5 – 9 years	203	207	410	49.5
10 – 14 years	216	227	443	48.8
15 – 19 years	209	187	396	52.8
20 – 24 years	174	164	338	51.5
25 – 29 years	183	158	341	53.7
30 – 34 years	168	127	295	56.9
35 – 39 years	123	83	206	59.7
40 – 44 years	73	72	145	50.3
45 – 49 years	60	37	97	61.9
50 – 54 years	39	18	57	68.4
55 – 59 years	24	13	37	64.9
60 + years	17	11	28	60.7
Alternative Age Groups and Totals				
0 – 1 years	68	49	117	58.1
2 – 5 years	168	132	300	56.0
6 – 11 years	274	277	551	49.7
12– 17 years	248	243	491	50.5
Total, Children and Adolescents	**758**	**701**	**1459**	**52.0**
18 – 29 years	429	398	827	51.9
30 + years	504	361	865	58.3
Total, Adults	**933**	**759**	**1,692**	**55.1**
Total, All Ages	**1,691**	**1,460**	**3,151**	**53.7**

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 2017, males made up 53.7 percent and females 46.3 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 (55.1%) than in the child and adolescent population (52%).

Figure 1.2 shows that the proportion of adults in the registry as a whole was 53.7 percent at 31 December 2017, a trend that continues to gradually increase since the registry commenced.

FIGURE 1.2: ACFDR 1998–2017: 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.

Note: the information below is based on the location of the treating site.

TABLE 1.2 – ACFDR 2017: ADULT STATUS BY STATE/TERRITORY OF THE TREATING SITE

State or Territory of Residence	Child/Adolescent	Adult	Total	Percent Adult
New South Wales	471	330	801	41.2
Victoria	316	449	765	58.7
Queensland	411	491	902	54.4
Western Australia	191	185	376	49.2
South Australia	1	152	153	99.3
Tasmania	42	63	105	60
Australian Capital Territory	20	21	41	51.2
Northern Territory	5	1	6	16.7
Overseas	2	0	2	0.1
Total	**1,459**	**1,692**	**3,151**	**53.8**

Note: Two centres (one in South Australia and one in New South Wales) were excluded from this report due to incomplete data.

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, 50 percent of male and female adult patients for whom marital status was reported were in a formal or informal marriage relationship.

TABLE 1.3 – ACFDR 2017: MARITAL STATUS OF ADULTS

	Males		Females	
Marital Status	Number	Percent	Number	Percent
Married (includes de facto)	156	50	156	50
Not married	222	55.6	177	44.4
Unknown/Not reported	555	56.6	426	43.4
Total	**933**	**55.1**	**759**	**44.9**

Of 41 percent, whose information was available in the registry in 2017, eight percent of adult male CF patients and 10 percent of adult female CF patients had at least one child.

Of all the adults with CF, 15.3 percent were reported having secondary (Year 12) education and a further 12.7 percent having completed university or other tertiary qualifications (Table 1.4).

TABLE 1.4 – ACFDR 2017: EDUCATIONAL ATTAINMENT OF ADULTS

	Number	Percent
Junior secondary (Year 10)	65	3.8
Senior secondary (Year 12)	258	15.3
Tertiary certificate or diploma	119	7.0
University degree	97	5.7
Left school prior to year 10	3	0.2
Unknown/Not reported	1,150	68.0
Total	**1,692**	**100**

Regarding employment, 26.9 percent of adults with CF were in either full–time or part–time paid employment during 2017.

TABLE 1.5 – ACFDR 2017: ACTIVITY STATUS OF ADULTS

	Number	Percent
Employed, full time paid	255	15.1
Employed, part time paid	199	11.8
Voluntary work only	3	0.2
Unemployed	29	1.7
Pensioner	57	3.4
Others not in labour force [a]	139	8.2
Unknown/not reported	1,010	59.7
Total	**1,692**	**100**

(a) Includes homemakers and students

2. DIAGNOSIS

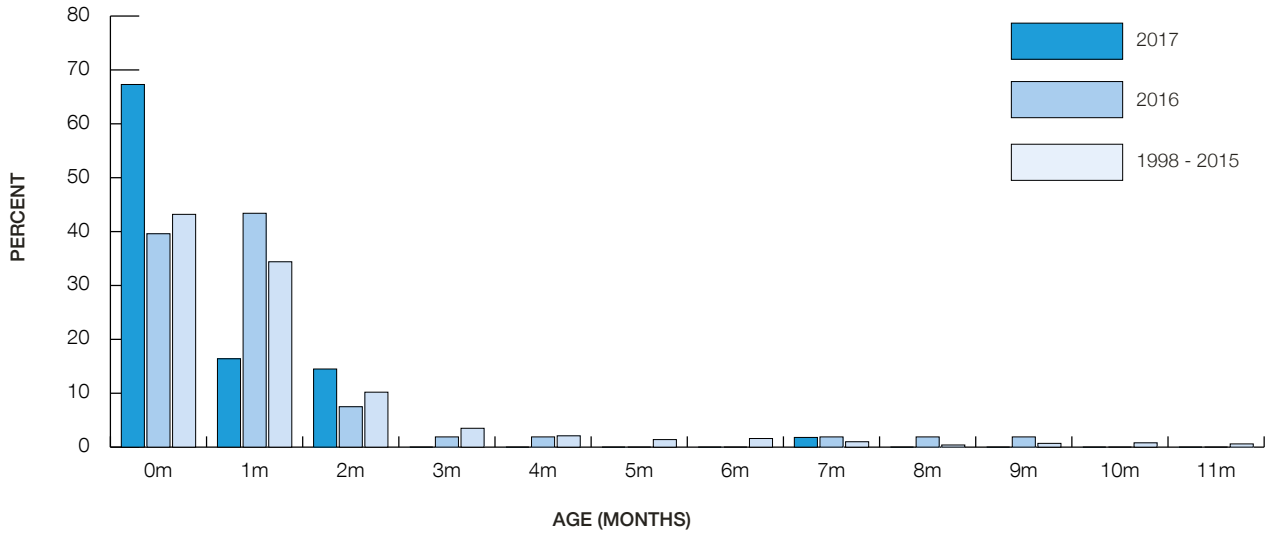
2.1 AGE AT DIAGNOSIS

The number of new diagnoses of CF notified to the registry for 2017 was 72, including 55 people diagnosed at less than one year of age (Figure 2.1).

All but one of the infant diagnoses where a diagnosis date was reported (54 out of the 55 new infant diagnoses) were completed by three months of age.

Australian CF centres reported three new cases that were diagnosed in early childhood (one to four years), one aged from 12 to 17 years, one in the age group 18 to 29 years and two diagnosed at ages 30 years and over.

FIGURE 2.1: ACFDR 2017: INFANT DIAGNOSIS AGE (MONTHS) (PERCENT DISTRIBUTION)



2.2 PRESENTATION AND DIAGNOSIS

Of the 72 new diagnoses reported in 2017, only 24 had an additional mode of presentation recorded (Table 2.1). There were seven new cases of CF diagnosed in 2017 for whom presentation mode reported included meconium ileus. Gastrointestinal and respiratory symptoms were reported in eight cases in 2017.

TABLE 2.1 – ACFDR 2017: MODE OF PRESENTATION OTHER THAN BY NEONATAL SCREENING [(a)] BY YEAR OF DIAGNOSIS

	All Years	2017
	Number	
Respiratory symptoms	402	4
Gastrointestinal symptoms	303	4
Meconium ileus	378	7
CF sibling	198	3
Minor manifestations	27	0
Pre–natal diagnosis	50	1
Infertility	15	0
Other	290	5

(a) Note: more than one mode of presentation can be recorded for a patient.

2.3 PHENOTYPE

Sweat chloride values have been reported for 47 percent of patients in the registry. Of these, there were 174 (11.7%) patients for whom sweat chloride values were below or equal to 60 mmol/L, 51 (68.9%) of whom had at least one copy of the R117H mutation. Of the 33 (2.2%) patients whose sweat chloride values were below 30 mmol/L, 17 (22.9%) had a copy of the R117H mutation.

2.4 GENOTYPE

Mutation information consolidated across reporting years was available for 2,968 (94.1%) patients in the registry at the end of 2017.

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 89.2 percent of patients for whom genotype details have been reported. Just under half of all patients (47.9%) are reported as homozygous for F508del. Another 36.6 percent of patients have a single copy of F508del and another mutation.

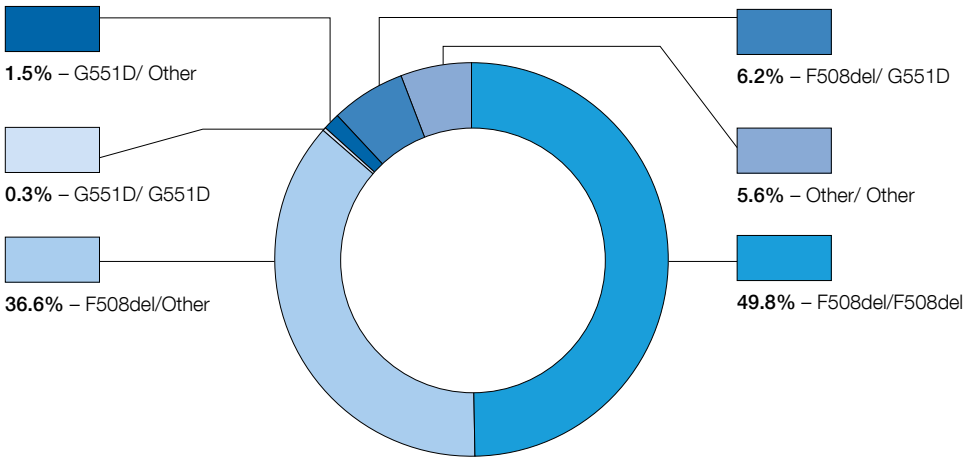
G551D was the next most prevalent mutation, with 8 percent of the CF population reporting genotype data having this mutation, mostly in combination with F508del or another mutation.

TABLE 2.2 – ACFDR 2017: GENOTYPE

Mutation 2	Mutation 1											
	F508del	G542X	G551D	N1303K	W1282X	R117H	1717–1G–>A	621+1G–>T	Other	Unknown	Not applicable	Total
	Percent											
F508del	47.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**47.9**
G542X	2.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**2.1**
G551D	6.0	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**6.5**
N1303K	1.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.3**
W1282X	0.6	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	**0.9**
R117H	3.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	**3.1**
1717–1G–>A	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.4**
621+1G–>T	1.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.3**
Other	16.1	0.4	0.6	0.1	0.1	0.2	0.3	0.3	1.3	0.0	0.0	**19.3**
Unknown	9.3	0.3	0.4	0.0	0.0	0.1	0.0	0.0	1.0	0.9	0.0	**12.0**
Not Applicable	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	**4.1**
Total	**89.2**	**1.0**	**1.6**	**0.3**	**0.4**	**0.5**	**0.3**	**0.3**	**2.3**	**0.9**	**3.3**	**100.0**

The most common genotypes identified in the Registry are homozygous 508del (49.8%) and heterozygous 508del (36%) (Figure 2.2).

FIGURE 2.2: ACFDR 2017: GENOTYPE, MAJOR CATEGORIES (PERCENT DISTRIBUTION)



The genotypes also vary somewhat by state/territory, with the ACT 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).

TABLE 2.3 – ACFDR 2017: GENOTYPE RESOLVED BY STATE/TERRITORY

	NSW	VIC	QLD	WA	SA	TAS	ACT	NT	Overseas	All [(a)]
	Percent									
Homozygous F508del	48.5	48.7	53.2	47	47.3	47.9	58.8	50	50	49.8
F508del/Other	37.7	36.7	34.2	38.9	38.7	40.4	29.4	16.7	50	36.6
F508del/G551D	5.8	6.4	6.5	6.5	5.3	5.3	8.8	16.7	0	6.2
G551D/G551D	0.3	0.1	0.7	0.3	0	0	0	0	0	0.3
G551D/other	1.3	2	1.5	1.1	0.7	1.1	0	16.7	0	1.5
Other mutations (Identified)	6.5	6	3.9	6.2	8	5.3	2.9	0	0	5.6
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

(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. A total of 37 mutations have a population prevalence of five or more.

TABLE 2.4 – ACFDR 2017: 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	2755	87.4	1478	4233
G551D	238	7.6	10	248
R117H	107	3.4	3	110
G542X	95	3.0	3	98
1717-1G->A	52	1.6	0	52
621+1G->T	48	1.5	1	49
N1303K	47	1.5	2	49
W1282X	31	1.0	8	39
R553X	24	0.8	1	25
P67L	20	0.6	0	20
3659delC	19	0.6	0	19
D1152H	19	0.6	0	19
3272-26A->G	19	0.6	0	19
2789+5G->A	16	0.5	0	16
I507del	15	0.5	0	15
1898+1G->A	15	0.5	0	15
2789+2insA	15	0.5	0	15
E60X	14	0.4	1	15
5T;TG	14	0.4	0	14
G85E	12	0.4	0	12
Q493X	12	0.4	0	12
1078delT	12	0.4	0	12
1154insTC	12	0.4	0	12
R1162X	11	0.3	0	11
R334W	11	0.3	0	11
V520F	11	0.3	0	11
R560T	10	0.3	0	10
A455E	10	0.3	0	10
3849+10kbC->T	9	0.3	0	9
R347P	9	0.3	0	9
2184delA	8	0.3	0	8
S549N	8	0.3	0	8
R1066C	7	0.2	0	7
L206W	6	0.2	0	6
394delTT	5	0.2	0	5
R352Q	5	0.2	0	5
L1077P	5	0.2	0	5
Other Mutations, not listed above	*298*	*9.5*	*12*	*310*
Unknown/Not Reported	*368*	*11.7*	*27*	*395*

(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 three most common genetic mutations were F508del, G551D, and R117H.

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 2017 had a mean of 4.5 tests of all types during the year. The median number of tests was four 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 2017. The latter method is mainly used with smaller children.

Taking sputum samples alone, 74 percent of the patients tested had at least two sputum samples in 2017. Respiratory cultures were not performed or not reported for 1,828 (58%) of patients.

TABLE 3.1 – ACFDR 2017: 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	55.1	51.3	30	14	1.4	0.3	13.8
1	2	9.7	7.5	6	15.4	16.5	12
2	4.1	5.3	10.3	12.5	16.6	18.6	14.1
3	8.2	0.9	8.9	10.5	16.8	16.2	12.8
4	0	8.8	10.3	9	13	13.2	11.2
5	2	12.4	13.6	15	11.4	11.1	12
6	8.2	3.5	2.8	6	6.9	7.2	5.9
7 or more	2.4	8	16.4	27	18.5	16.8	8.2
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
BAL/Bronchoscopy:							
None	71.4	83.2	90.1	87	97.9	98.5	92.9
1	20.4	15	9.4	12.5	1.4	1.5	6.3
2	8.2	1.8	0	0.5	0.5	0	0.7
3 or more	0	0	0.5	0	0.2	0	0.2
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
	Number of Patients						
Patients tested [a]	49	113	213	200	419	329	1,323
Unknown/ Not reported [b]	68	187	338	291	408	536	1,828
Total Patients	**117**	**300**	**551**	**491**	**827**	**865**	**3,151**

(a) By any method of obtaining culture

(b) Microbiology tables exclude lost-to-follow-up, transfer to private care, deaths, currently not seen, withdrawn consent, no longer CF.

The most commonly identified organisms in respiratory specimens are various species and forms of Pseudomonas. It can be seen in Table 3.2 that 56 percent of patients tested produced positive Pseudomonas aeruginosa cultures.

TABLE 3.2 – ACFDR 2017: 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:							
Any P. aeruginosa	6	18.6	31	38.5	69.9	84.7	55.9
Pseudomonas other species	0	2.7	4.2	3	3.1	3.9	3.3
				Number of Patients			
Patients tested	50	113	213	200	422	334	1,332
Unknown/Not Reported [b]	67	187	338	291	405	531	1,819
Total Patients	**117**	**300**	**551**	**491**	**827**	**865**	**3,151**

(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 lost-to-follow-up, transfer to private care, deaths, currently not seen, withdrawn consent, no longer CF.

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 50 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 third of children. The youngest age groups also had the highest proportions with positive cultures of the bacteria Escherichia coli; 26 percent, for those in the age group less than two years, being the highest. The prevalence of major and minor organisms in the lungs by year is shown in Figure 3.1 and Figure 3.2.

TABLE 3.3 – ACFDR 2017: OTHER RESPIRATORY CULTURE BY AGE GROUP

	<2 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	40.0	64.6	66.7	61.5	51.4	30.8	50.9
Haemophilus influenzae	26.0	33.6	23.5	10.0	8.1	3.9	12.6
Stenotrophomonas maltophilia	4.0	0.9	12.2	14.0	8.8	8.1	9.1
Achromobacter xylosoxidans	0.0	0.9	2.3	5.5	7.8	6.0	5.3
Non–tuberculous mycobacterium	2.0	1.8	4.7	9.0	4.0	2.4	4.2
MRSA [b]	8.0	5.3	4.7	4.5	5.0	3.3	4.6
Escherichia coli	26.0	9.7	5.6	4.0	1.4	1.2	4.1
Burkholderia cepacia complex	0.0	0.0	1.9	4.5	4.0	5.4	3.6
Serratia marcescens	2.0	2.7	1.4	2.5	2.4	0.9	1.9
Klebsiella (any species)	18.0	1.8	0.5	1.0	0.5	1.5	1.6
Fungi:							
Normal flora only	88.0	87.6	88.7	90.5	41.2	43.1	62.4
Candida	16.0	15.0	18.3	30.0	33.2	35.3	28.7
Other organisms not listed above	38.0	31.9	23.9	13.5	23.9	23.1	23.3
Aspergillus (any species)	2.0	2.7	16.0	35.5	29.1	19.2	22.2
Scediosporium (any species)	0.0	0.0	2.8	8.0	6.2	5.4	5.0
No growth/sterile culture	10.0	3.5	9.4	8.0	6.2	5.7	6.8
	Number of Patients						
Patients tested	50	113	213	200	422	334	1,332
Unknown/Not Reported [b]	67	187	338	291	405	531	1,819
Total Patients	**117**	**300**	**551**	**491**	**827**	**865**	**3,151**

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

(b) Microbiology tables exclude lost-to-follow-up, transfer to private care, deaths, currently not seen, withdrawn consent, no longer CF.

FIGURE 3.1: ACFDR 2017: BACTERIAL INFECTIONS COMMON PATHOGENS - HIGH PREVALENCE

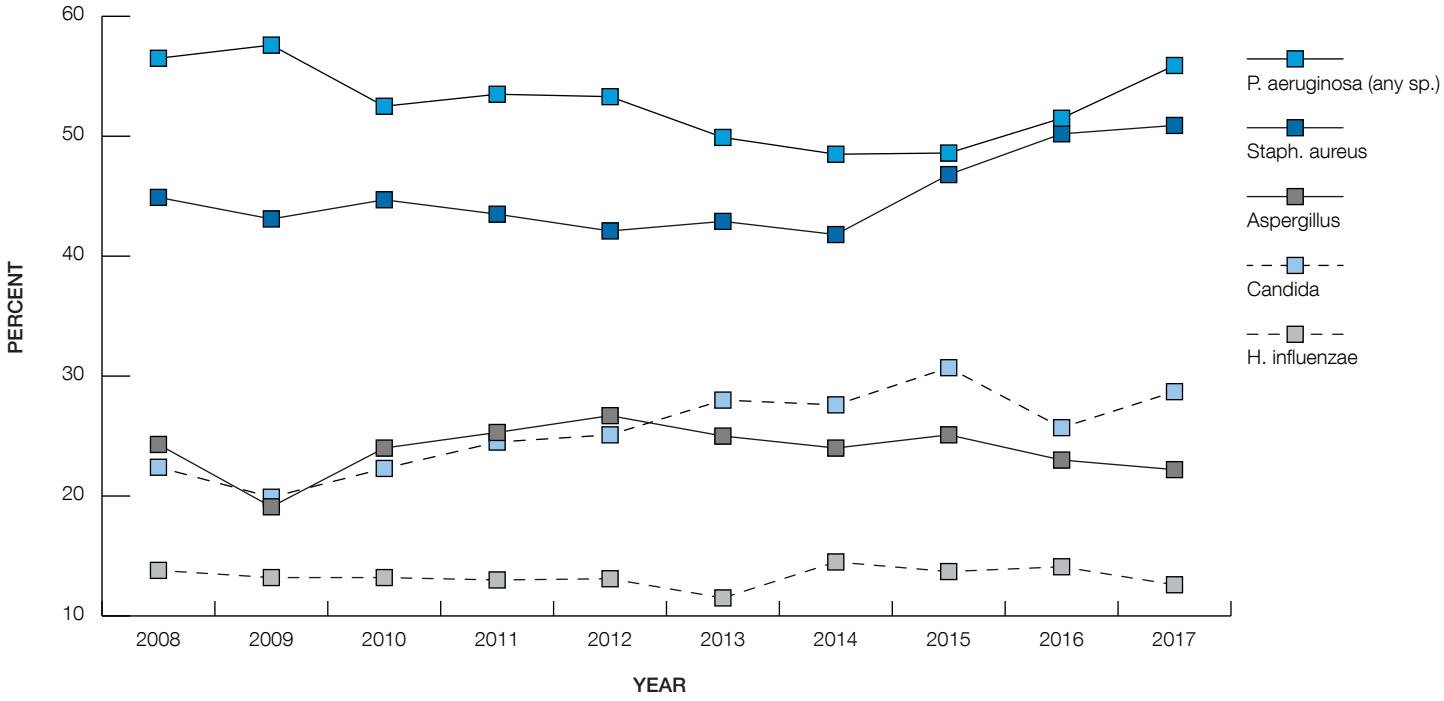
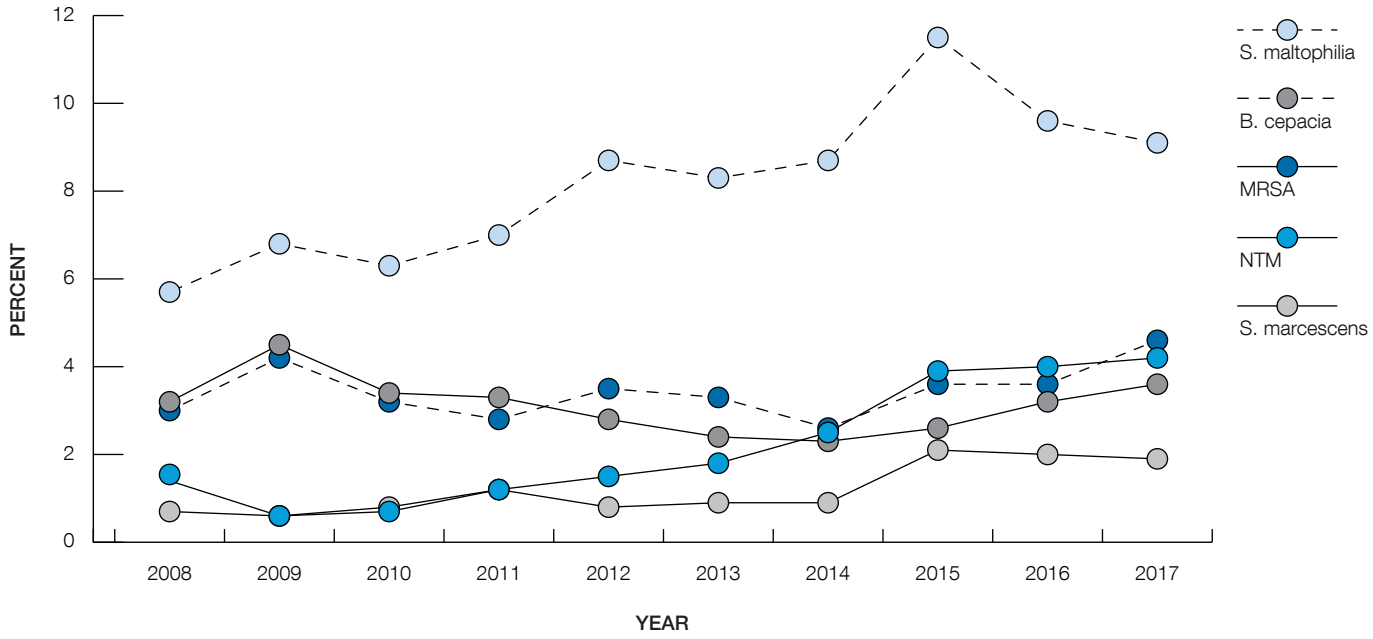


FIGURE 3.2: ACFDR 2017: BACTERIAL INFECTIONS COMMON PATHOGENS - LOWER PREVALENCE



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 45 percent of adult patients suffer gastro–oesophageal reflux, approximately 37 percent of patients aged 12 years and over experienced chronic insulin–dependent diabetes and over 17 percent of patients over 30 years have osteoporosis or osteopenia.

TABLE 3.4 – ACFDR 2017: MEDICAL COMPLICATIONS [a]

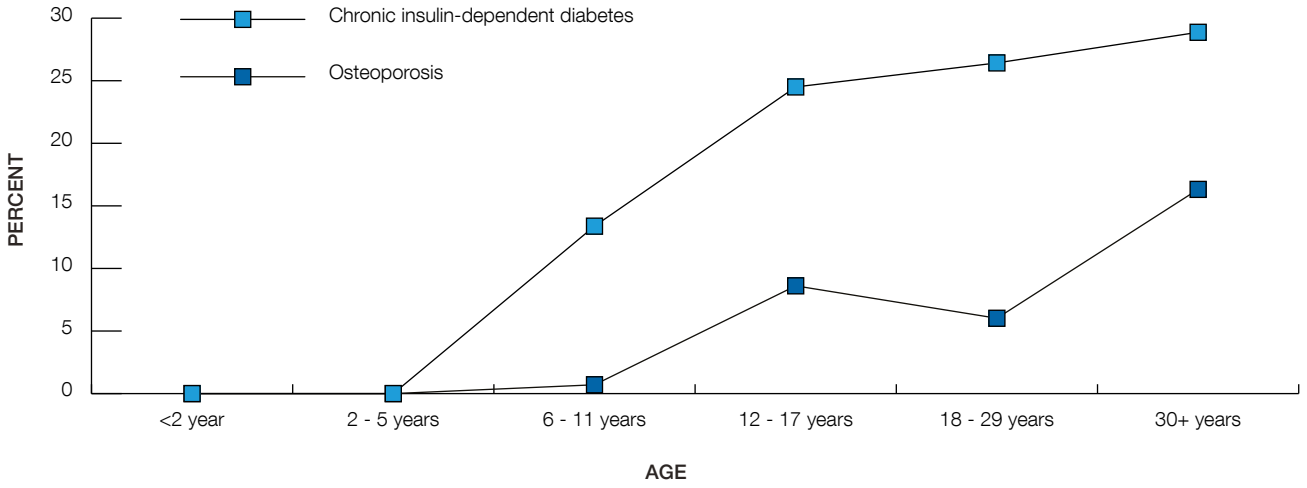
	<2 years	2–5 years	6–11 years	12–17 years	18–29 years	30+ years	All ages
	Percent of those whose data were reported or available						
Pulmonary:							
Major haemoptysis	0.0	0.0	0.2	0.6	4.7	2.2	1.9
Massive haemoptysis	0.0	0.0	0.0	0.0	0.6	0.0	0.1
Therapeutic bronchial artery embolisation	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pneumothorax	0.0	0.0	0.0	0.6	0.2	0.3	0.2
Any pulmonary above	0.0	0.0	0.2	1.2	4.9	2.6	2.1
Gastro–intestinal:							
Gastro–oesophageal reflux	9.2	2.5	6.1	12.4	22.9	22.5	15.4
– proven at endoscopy	0.0	0.0	0.7	2.1	4.2	4.3	2.6
Abnormal liver function test	5.7	4.6	7.3	7.9	15.0	12.0	10.2
Cirrhosis or portal hypertension	0.0	0.0	1.7	2.4	4.2	1.6	2.1
Pancreatitis	0.0	0.0	0.0	0.0	0.9	0.8	0.4
Any gastro–intestinal above	12.6	5.9	10.5	15.9	32.8	28.1	21.1
Endocrine:							
Chronic insulin–dependent diabetes	0.0	0.0	4.6	10.9	15.0	11.0	9.2
Intermittent insulin–dependent diabetes	0.0	0.0	0.2	1.8	0.9	0.8	0.8
Other glucose abnormality	0.0	0.4	2.9	10.6	6.4	4.6	5.0
Any endocrine above	0.0	0.4	7.3	22.6	22.0	16.0	14.5
Osteo:							
Osteoporosis	0.0	0.0	0.2	3.8	3.4	6.2	3.2
Osteopenia	0.0	0.0	0.7	9.7	13.3	11.3	7.9
Fracture this year	0.0	0.0	0.2	1.2	0.2	0.6	0.4
Any osteo above	0.0	0.0	0.7	9.7	15.9	16.8	10.1
Other:							
Cancer	0.0	0.0	0.0	0.0	0.0	0.6	0.2
None of the above [b]	21.8	19.7	17.8	12.1	11.7	5.0	12.3
	Number of Patients						
Total Reported	30	62	142	151	299	239	923
Unknown/Not Reported	87	238	409	340	528	626	2,228
Total Patients	**117**	**300**	**551**	**491**	**827**	**865**	**3,151**

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

(b) None of the above includes other complications not mentioned in the table

Although some prevalence of osteoporosis at younger ages is reported in the Table 3.4, this is not displayed in Figure 3.3 because of uncertainty about diagnosis at younger ages.

FIGURE 3.3: ACFDR 2017: PREVALENCE OF MAJOR COMPLICATIONS



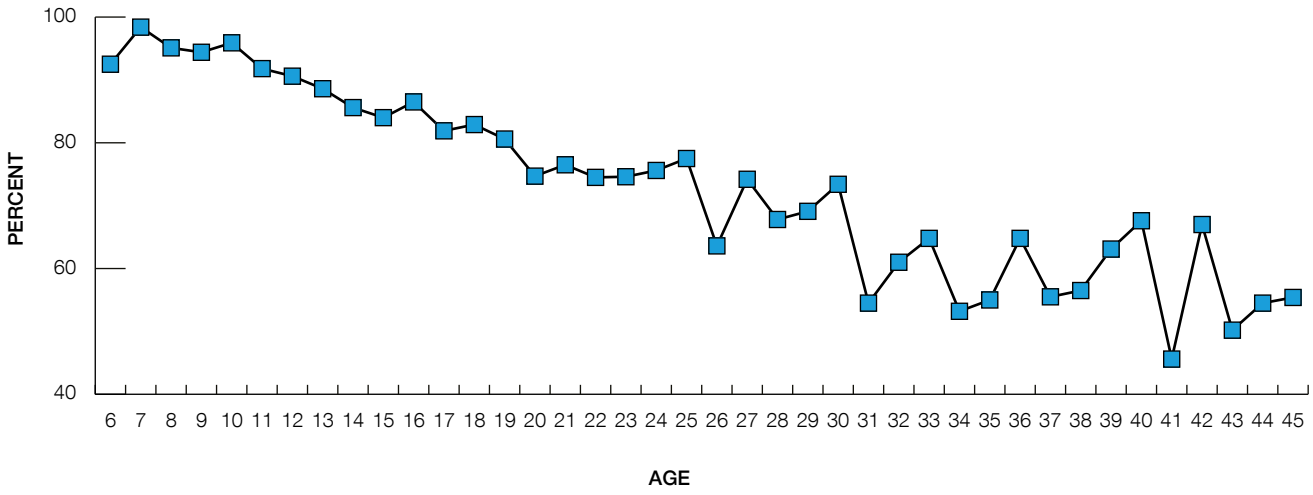
3.3 LUNG FUNCTION

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. Predicted values are based on Global Lung Initiative (GLI) formulae.

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 3.4). In 2017, median CF lung function in adults over 45 years of age was 60 percent of predicted.

Five percent of boys and six percent of girls aged 6 to 11 years have FEV values that are below 70 percent of predicted values, but nearly 15 percent of older children and adolescents are in this category (Table 3.5).

FIGURE 3.4: ACFDR 2017: MEDIAN LUNG FUNCTION BY AGE



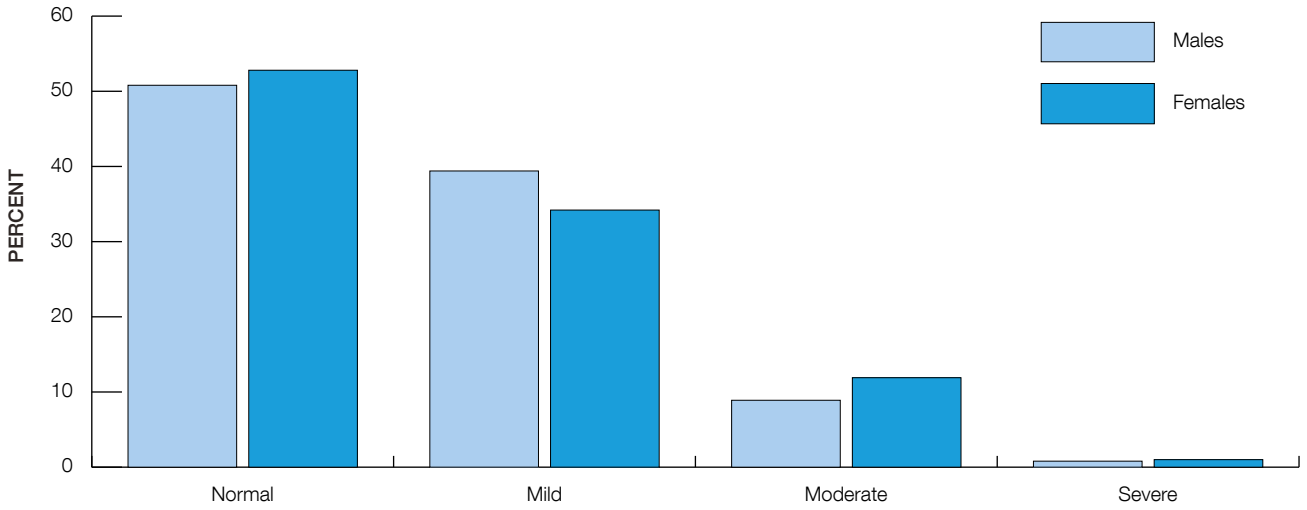
Generally greater proportions of patients have severe lung function impairment in successive older age groups, as described in Table 3.5.

TABLE 3.5 – ACFDR 2017: 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	0	12	69	174	255	0	4.7	27.1	68.2	100
12 – 17 years	3	26	73	125	227	1.3	11.5	32.2	55.1	100
18 – 29 years	40	114	123	86	363	11.0	31.4	33.9	23.7	100
30 + years	82	179	89	43	393	20.9	45.6	22.7	10.9	100
Total measured	**125**	**331**	**354**	**428**	**1238**	**10.1**	**26.7**	**28.6**	**34.6**	**100**
Females:										
6 – 11 years	0	15	62	173	250	0	6.0	24.8	69.2	100
12 – 17 years	4	37	69	117	227	1.8	16.3	30.4	51.5	100
18 – 29 years	28	113	105	87	333	8.4	33.9	31.5	26.1	100
30 + years	42	121	80	31	274	15.3	44.2	29.2	11.3	100
Total measured	**74**	**286**	**316**	**408**	**1084**	**6.8**	**26.4**	**29.2**	**37.6**	**100**
Persons:										
Total measured	**199**	**617**	**670**	**836**	**2322**	**8.6**	**26.6**	**28.9**	**36.0**	**100**

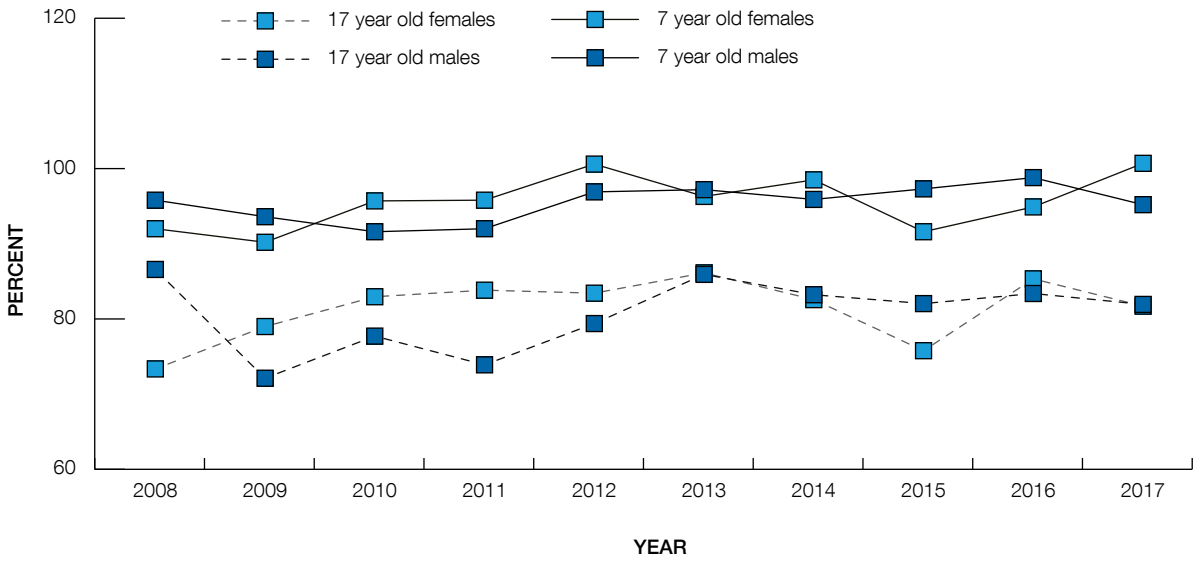
Figure 3.5 shows categories of lung function impairment experienced by the child and adolescent CF population as a whole. Fifty-one percent of male and 53 percent of female children and adolescents had lung function at or above 90 percent of predicted FEV_1.

FIGURE 3.5: ACFDR 2017: LUNG FUNCTION (GLI) – CHILDREN AND ADOLESCENTS



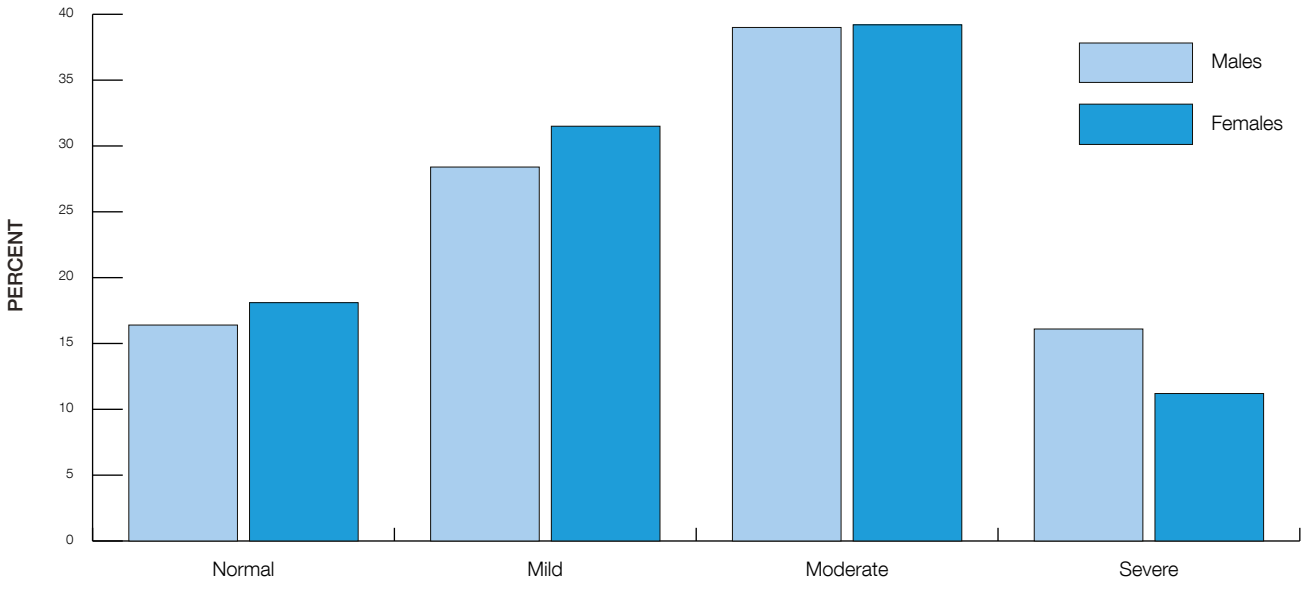
Upward trends over recent years in child and adolescent age groups were reported previously. The following view, from cross–sectional data for 7 and 17 year old children and adolescent suggests, however, that there may have been a plateauing of improvement since 2012 (Figure 3.6).

FIGURE 3.6: ACFDR 2017: MEDIAN FEV_1 PERCENT PREDICTED (AGE 7 & 17 YEARS) 2008 - 2017



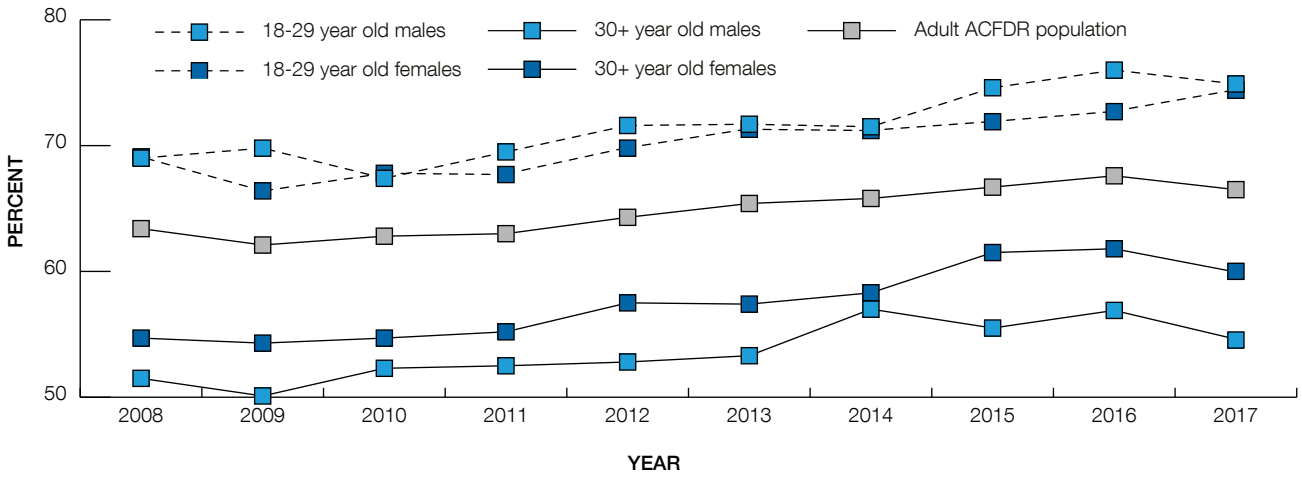
For adults with CF, a different pattern of lung function impairment is evident, with 16.4 percent of adult males and 18.1 percent of females having FEV_1 at or above 90 percent predicted in 2017. Lung function of less than 40 percent of FEV percent predicted was experienced by 16.1 percent of male adults and 11.2 percent of female adults.

FIGURE 3.7: ACFDR 2017: LUNG FUNCTION (GLI) – ADULTS



Trend data for adult lung function indicates an overall positive trend in FEV_1 percent predicted over the past 10 years. The most recent data, however, shows a slight reduction which is more aparent in males (Figure 3.8).

FIGURE 3.8: ACFDR 2017: MEDIAN FEV_1, PERCENT PREDICTED (ADULT) 2008 - 2017



3.4 NUTRITION: WEIGHT, HEIGHT AND BODY MASS INDEX

METHODOLOGICAL NOTE

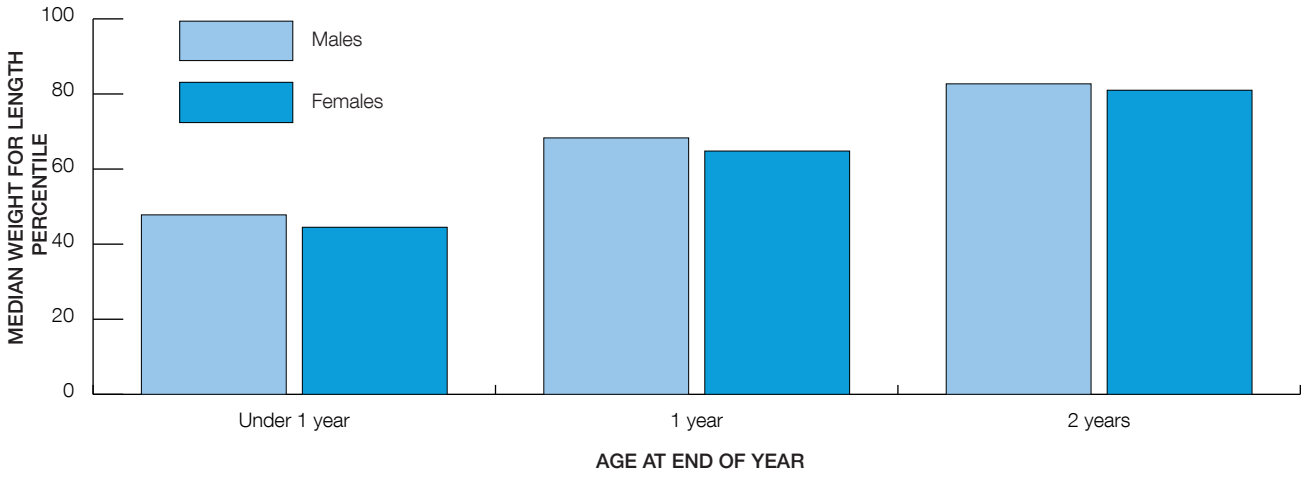
As for lung function measures reported in Section 3.3, values reported in this section are the average of the highest value recorded in each quarter of the year.

BMI percentiles for infants are derived from World Health Organisation Child Growth Standards (WHO, 2006). The data for children and adolescents aged from 2 to less than 18 years are compiled using growth charts published by Centres for Disease Control (CDC) and Prevention[1].

INFANTS AND YOUNG CHILDREN AGED UNDER 3 YEARS

For 2017, for children of one year the median value of weight for length is at the 65th percentile for females but for males it is at the 68th percentile. This difference may be cohort–specific.

FIGURE 3.9: ACFDR 2017: MEDIAN WEIGHT FOR LENGTH PERCENTILE



1. Centers for Disease Control and Prevention. National Center for Health Statistics. Data Tables. https://www.cdc.gov/growthcharts/data_tables.htm [2017].

CHILDREN AND ADOLESCENTS

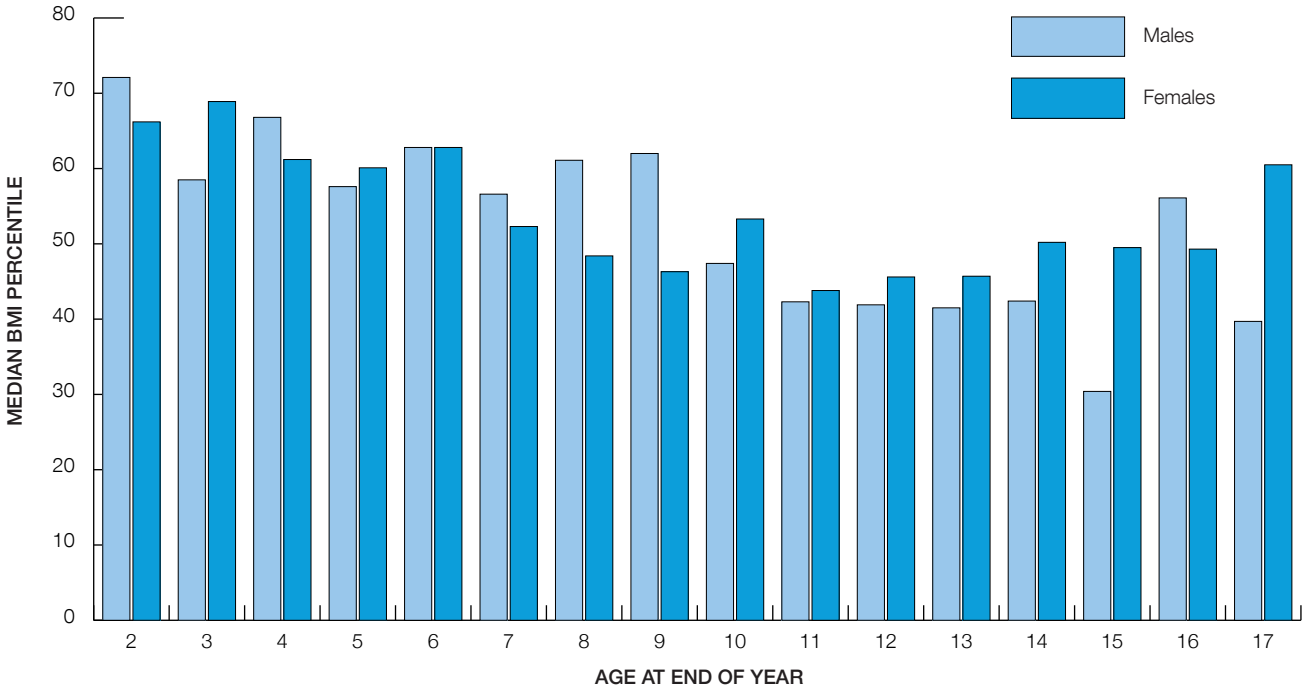
As shown in Table 3.6, median height percentile for young children is higher than the reference population, but is below the 50th percentile in older child and adolescent age groups in 2017, for both males and females. BMI percentiles are higher than height percentiles for each age and sex group, with the exception of male adolescents (41.4th percentile).

TABLE 3.6 – ACFDR 2017: CHILD AND ADOLESCENT HEIGHT AND BMI: MEDIAN PERCENTILES BY AGE GROUP AND SEX

	Height	BMI
Males		
2–5 years	59.0	61.6
6–11 years	44.5	56.2
12–17 years	42.5	41.4
Females		
2–5 years	58.8	65.9
6–11 years	46.7	52.0
12–17 years	47.1	47.7

As shown in Figure 3.10, BMI percentiles across individual year ages show a generally consistent pattern of lower values at older ages. Females between 10 and 15 years of age have a higher median BMI than their male counterparts.

FIGURE 3.10: ACFDR 2017: MEDIAN BMI PERCENTILE CHILDREN AND ADOLESCENTS



Nutritional status of child and adolescent was calculated as per recently published TSANZ Nutrition Guidelines for Cystic Fibrosis in Australia and New Zealand – August 2017[2]. Its distribution by age and sex is shown in Table 3.7. The majority of infants and nearly half of children and adolescent were within the optimal nutritional status. Thirty-two percent of males and females between 12-18 years of age were within the acceptable nutritional status.

TABLE 3.7 ACFDR 2017: CHILD AND ADOLESCENT NUTRITIONAL STATUS BY SEX

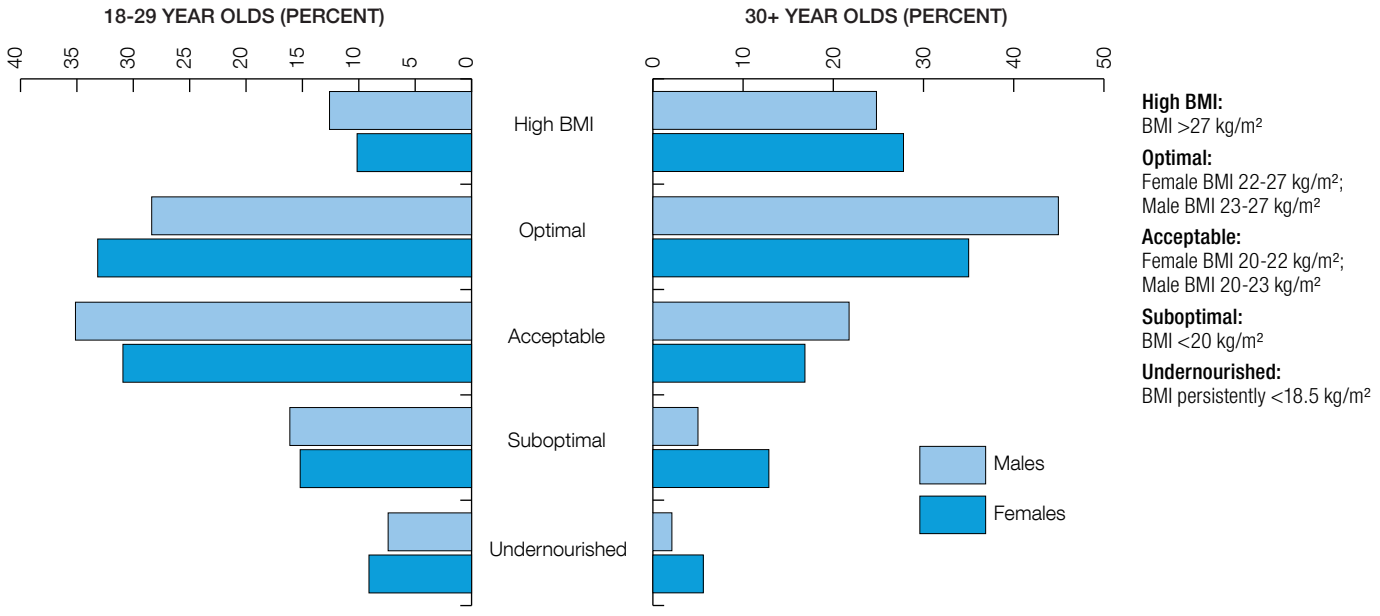
	Males (Percent)				Females (Percent)				
Nutritional status *	<2 years	2–5 years	6–11 years	12–18 years	<2 years	2–5 years	6–11 years	12–18 years	**Total Number**
High BMI (obese range)	n/a	9.9	3.4	5.2	n/a	5.3	2.3	2.2	49
High BMI (over-weight range)	n/a	13.2	7.2	3.4	n/a	13.7	6.2	6.1	86
Optimal	94.9	43	46.2	30.6	95.8	49.5	44	39	494
Acceptable	0	21.5	29.9	32.3	0	18.9	28.4	31.6	343
Suboptimal	0	7.4	11	16.4	0	6.3	14.4	14.9	153
Undernourished	5.1	5.0	2.3	12.1	4.2	6.3	4.7	6.1	72
	Number								
Total	**39**	**121**	**264**	**232**	**24**	**95**	**257**	**228**	**1,260**

* **High BMI (obese range):** BMI>95th percentile using CDC growth chart (children and adolescents 2-18 years).
High BMI (overweight range): BMI 85- 95th percentile using CDC growth chart (children and adolescents 2-18 years).
Optimal: weight-for-lengths >50th percentile (infants 0-1 years); BMI 50-85th percentile using CDC growth chart (children and adolescents 2-18 years). **Acceptable:** weight-for-lengths 25th-50th percentile (infants 0-1 years); BMI 25-50th percentile (children and adolescents 2-18 years). **Suboptimal:** Weight-for-length 10-25th percentile (infants 0-1 years); BMI 10-25th percentile (children and adolescents 2-18 years). **Undernourished:** Persistent weight for length <10th percentile (infants 0-1 years); BMI <10th percentile (children and adolescents 2-18 years)

ADULT BODY MASS INDEX

The distribution of adult nutritional status is based on per recently published TSANZ Nutrition Guidelines for Cystic Fibrosis in Australia and New Zealand – August 2017 and it is shown in Figure 3.11.

FIGURE 3.11: ACFDR 2017: ADULT NUTRITIONAL STATUS BY SEX



2. Saxby N., Painter C., Kench A., King S., Crowder T., van der Haak N. and the Australian and New Zealand Cystic Fibrosis Nutrition Guideline Authorship Group (2017). Nutrition Guidelines for Cystic Fibrosis in Australia and New Zealand, ed.Scott C. Bell, Thoracic Society of Australia and New Zealand, Sydney. https://www.thoracic.org.au/documents/item/1045

TABLE 3.8 ACFDR 2017: ADULT NUTRITIONAL STATUS BY SEX

	Males (Percent)		Females (Percent)		
Nutritional status *	18-30 years	30+ years	18-30 years	30+ years	**Total Number**
High BMI	12.1	25.3	10.7	28.3	**261**
Optimal	28.9	45.3	33.4	35.0	**497**
Acceptable	35.5	22.3	31.0	17.7	**372**
Suboptimal	16.3	5.0	15.8	13.4	**170**
Undernourished	7.2	2.3	9.0	5.7	**81**
	Number				
Total	**363**	**400**	**335**	**283**	**1,381**

* **High BMI (obese range):** BMI >27 kg/m². **Optimal:** Female BMI 22-27 kg/m²; Male BMI 23-27 kg/m².
Acceptable: Female BMI 20-22 kg/m²; Male BMI 20-23 kg/m². **Suboptimal:** BMI <20 kg/m².
Undernourished: BMI persistently <18.5 kg/m².

Table 3.9 shows adult Body Mass Index (BMI) scores for 2016 and 2017 calculated using conventional BMI formulae for adults. In 2017, 53.8 percent of males and 56.5 percent of females had an average quarterly BMI score in the range 20 to less than 25 kg/m2.

The proportion of females who had BMI scores below 18.5 (8.0%) is higher than the proportion of males (5.0%) in 2017. When compared to 2016, the proportion of males in this category has increased.

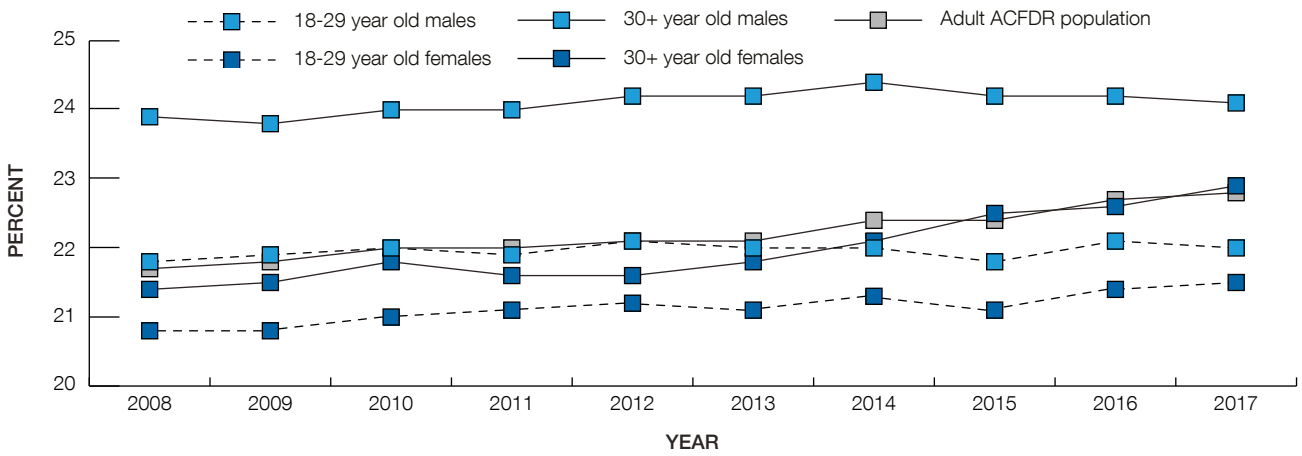
Just over 30 percent of adult males and 19.7 percent of females had a BMI above 25 in 2017. When compared to 2016, the proportion of males and females in this category has reduced. Figure 3.12 shows general increases in median BMI values for grouped adult age data since 2007.

TABLE 3.9: ACFDR 2017: ADULT BMI STATUS BY SEX IN 2016 AND 2017

	Males (Percent)		Females (Percent)	
BMI category	2016	2017	2016	2017
Less than 18.5	4.7	5.0	9.1	8.0
From 18.5 to <20	10.9	10.9	18.2	15.8
From 20 to <25	53.9	53.8	54.5	56.5
25 and over	30.5	30.3	18.3	19.7

Figure 3.12 shows general increases in median BMI values for grouped adult age data since 2008.

FIGURE 3.12: ACFDR 2017: MEDIAN BODY MASS INDEX (BMI) 2008 - 2017

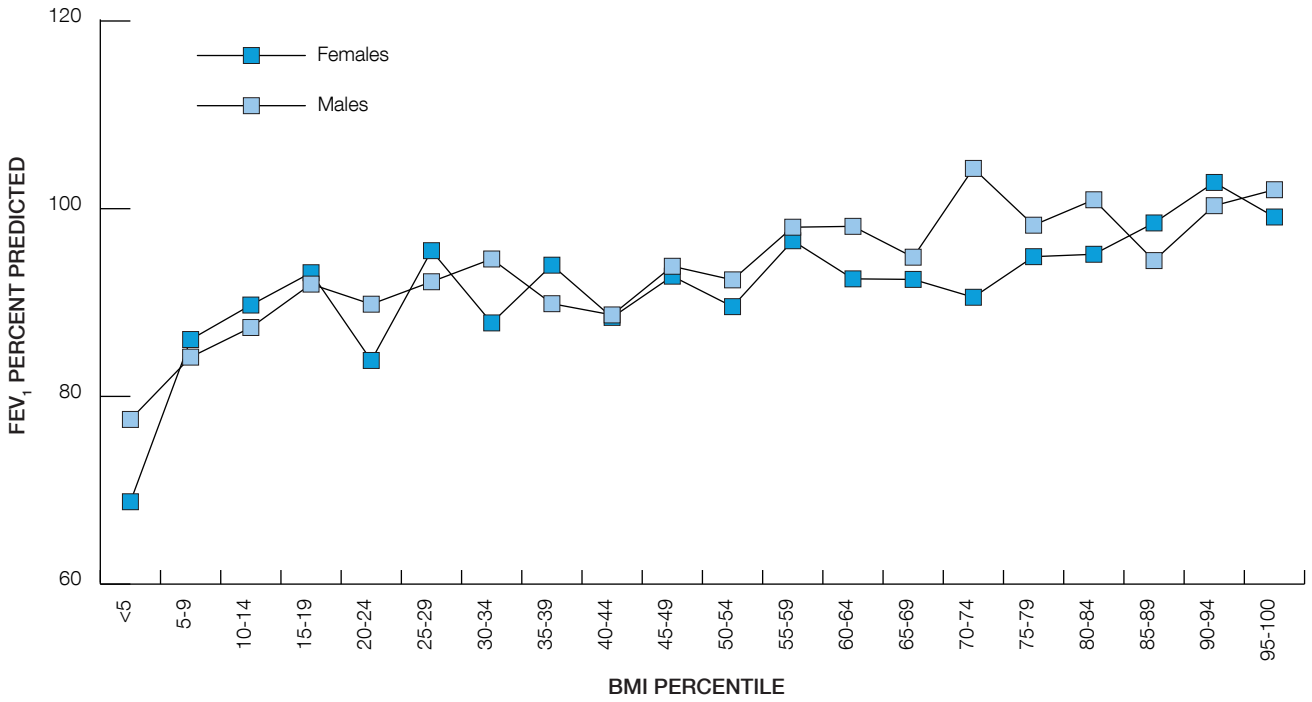


PULMONARY AND NUTRITIONAL OUTCOMES IN CHILDREN

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 3.13 shows FEV_1 percent predicted values vs BMI percentiles for children and adolescents in 2017. FEV_1 percent predicted values increase with the increasing BMI percentile and are higher in males than in females.

FIGURE 3.13: ACFDR 2017: FEV_1 PERCENT PREDICTED VS. BMI PERCENTILE IN CHILDREN

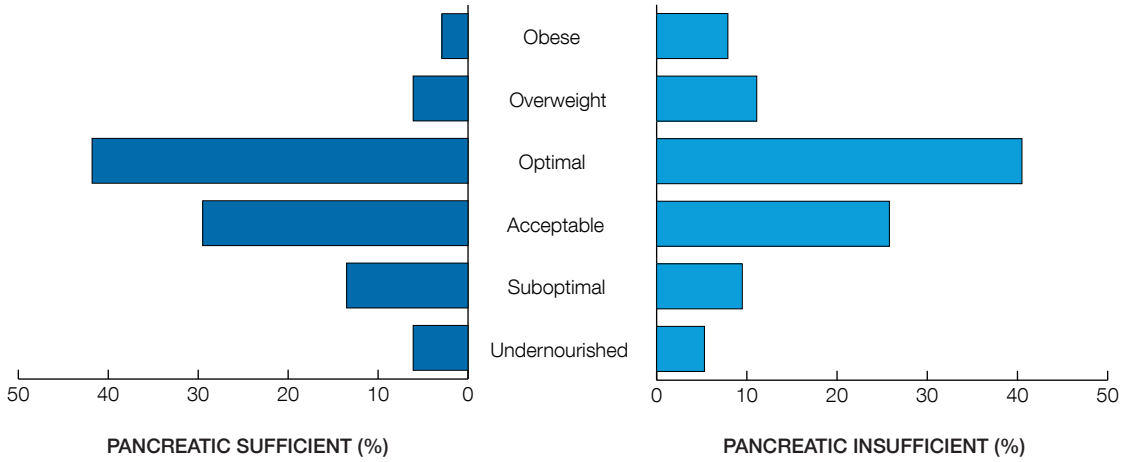


PANCREATIC SUFFICIENCY AND NUTRITIONAL OUTCOMES

Of 2,959 (93.9%) patients for whom pancreatic sufficiency information was available, 81.1 percent had pancreatic insufficiency.

Of those children and adolescents who were pancreatic sufficient, 40.5% were within the optimal nutritional status, followed by 25.8% who were within the acceptable nutritional status (Figure 3.14). Pancreatic sufficient adults tended to fall into the optimal and high BMI categories (38.2 and 30.0%, respectively), whereas pancreatic insufficient adults tended to fall into the optimal and acceptable categories (35.7 and 27.9%, respectively, Figure 3.15).

FIGURE 3.14: ACFDR 2017: PANCREATIC SUFFICIENCY BY NUTRITIONAL STATUS IN CHILDREN AND ADOLESCENTS (2-18 YEARS OF AGE) POPULATION



High BMI (obese range): BMI>95th percentile using CDC growth chart (children and adolescents 2-18 years).

High BMI (overweight range): BMI 85- 95th percentile using CDC growth chart (children and adolescents 2-18 years).

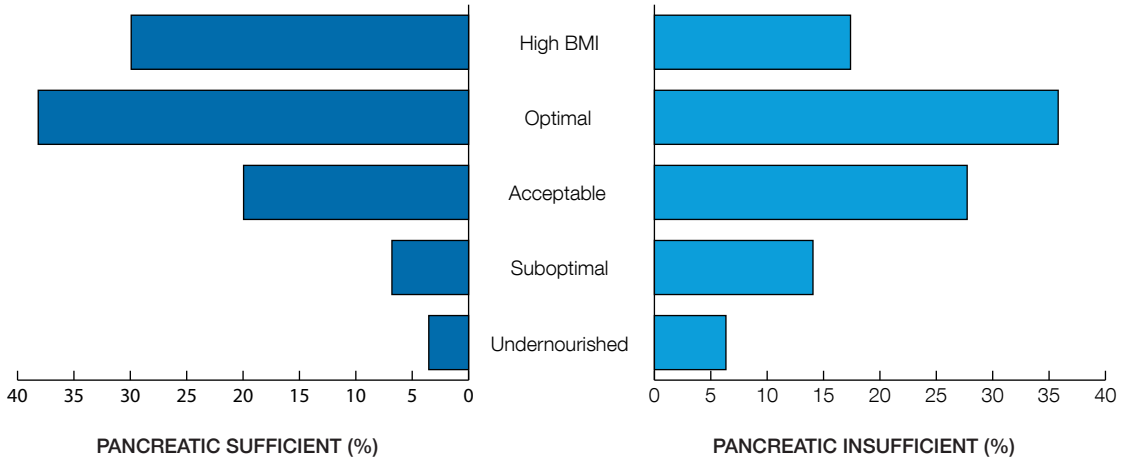
Optimal: weight-for-lengths >50th percentile (infants 0-1 years); BMI 50-85th percentile using CDC growth chart (children and adolescents 2-18 years).

Acceptable: weight-for-lengths 25th-50th percentile (infants 0-1 years); BMI 25-50th percentile (children and adolescents 2-18 years).

Suboptimal: Weight-for-length 10-25th percentile (infants 0-1 years); BMI 10-25th percentile (children and adolescents 2-18 years).

Undernourished: Persistent weight for length <10th percentile (infants 0-1 years); BMI <10th percentile (children and adolescents 2-18 years).

FIGURE 3.15: ACFDR 2017: PANCREATIC SUFFICIENCY BY NUTRITIONAL STATUS IN ADULTS (18 YEARS AND OVER)



High BMI:
BMI >27 kg/m²

Optimal:
Female BMI 22-27 kg/m²;
Male BMI 23-27 kg/m²

Acceptable:
Female BMI 20-22 kg/m²;
Male BMI 20-23 kg/m²

Suboptimal:
BMI <20 kg/m²

Undernourished:
BMI persistently <18.5 kg/m²

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 2017 was 5.9 for children and adolescents and 5.4 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 five for children and adolescents and four for adults in 2017.

4.2 THERAPY FOR CYSTIC FIBROSIS PATIENTS

Antibiotic therapy was prescribed for 64 percent of CF patients for whom data was reported (Table 4.1). Oral PRN (as needed) antibiotic therapy was prescribed for overall 34.6 percent of antibiotics users. Higher proportions of adolescents (>40%) and very young children (50%) than those in other age groups were prescribed oral antibiotics as needed.

Approximately twenty three percent of antibiotic users used inhaled and intravenous antibiotics in 2017, with proportions generally greater in successively older age groups.

TABLE 4.1 – ACFDR 2017: ORAL ANTIBIOTIC THERAPY – MODE OF USE BY AGE GROUP

	<2 years	2–5 years	6–11 years	12–17 years	18–29 years	30+ years	All ages
				Percent			
Oral Antibiotics							
As needed (PRN)	49.6	49	43.7	40.1	31	22	34.6
Continuous	17.9	2	5.3	11.6	19.5	15.1	12.9
Inhaled antibiotics							
As needed (PRN)	7.7	9.3	13.6	11.2	15.5	12.9	12.9
Continuous	0.9	0.3	7.4	17.3	13.8	10.5	10.6
Intravenous antibiotics	14.5	12.3	22.5	30.5	27.7	20.3	23.3
				Number			
Total oral antibiotics users	99	221	413	355	520	409	2,017
Missing/Not known [(a)]	18	79	138	136	306	456	1,134
Total Patients	**117**	**300**	**551**	**491**	**826**	**865**	**3,151**

(a) 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 4.2). The usage of therapies was reported for 36.7 percent of patients in the registry. Therapies used by the highest proportion of patients include pancreatic enzymes (16% of children/adolescents and 18% of adults), vitamin supplements (14.3% and 16.1% respectively), dornase alpha (13.2% and 14.2%) and bronchodilators (9.5% and 17.1%).

TABLE 4.2 – ACFDR 2017: OTHER THERAPY BY TYPE [a]

	Children/adolescents		Adults	
	Number	*Percent*	*Number*	*Percent*
Pancreatic enzymes	233	16	304	18
Vitamin supplements	209	14.3	272	16.1
Domase alpha	193	13.2	239	14.1
Bronchodilators	138	9.5	290	17.1
Salt tablets	97	6.6	28	1.7
Corticosteroids inhaled	70	4.8	210	12.4
Gastric acid secretion reducers	67	4.6	175	10.3
Macrolides	49	3.4	189	11.2
Ivacaftor	47	3.2	71	4.2
Insulin	29	2	101	6
Corticosteroids oral	25	1.7	43	2.5
Mannitol	20	1.4	19	1.1
Other therapies	133	9.1	178	10.5
Total reported	**554**	**37.9**	**603**	**35.6**

(a) Individuals may use more than one type of therapy.

Nutritional supplement information is provided in Table 4.3. The usage of nutritional supplements was reported for 26 percent patients in the registry.

TABLE 4.3 – ACFDR 2017: NUTRITIONAL SUPPLEMENTS BY AGE GROUP [a]

	<2 years	2–5 years	6–11 years	12–17 years	18–29 years	30+ years	All ages
				Percent			
Oral (prescribed)	2.6	3.7	5.4	5.1	2.4	1.7	3.3
Nasogastric	4.3	1.3	1.3	1.6	0.1	0	0.8
Total Parenteral Nutrition (TPN)	0.9	0	0	0	0.1	0	0.1
Gastrostomy tube/button	0	1	1.5	2.4	1.9	0	1.2
				Number			
Total with any nutritional supplementation reported	37	69	136	128	263	180	813
Missing	80	231	415	363	564	685	2,338
Total patients	**117**	**300**	**551**	**491**	**827**	**865**	**3,151**

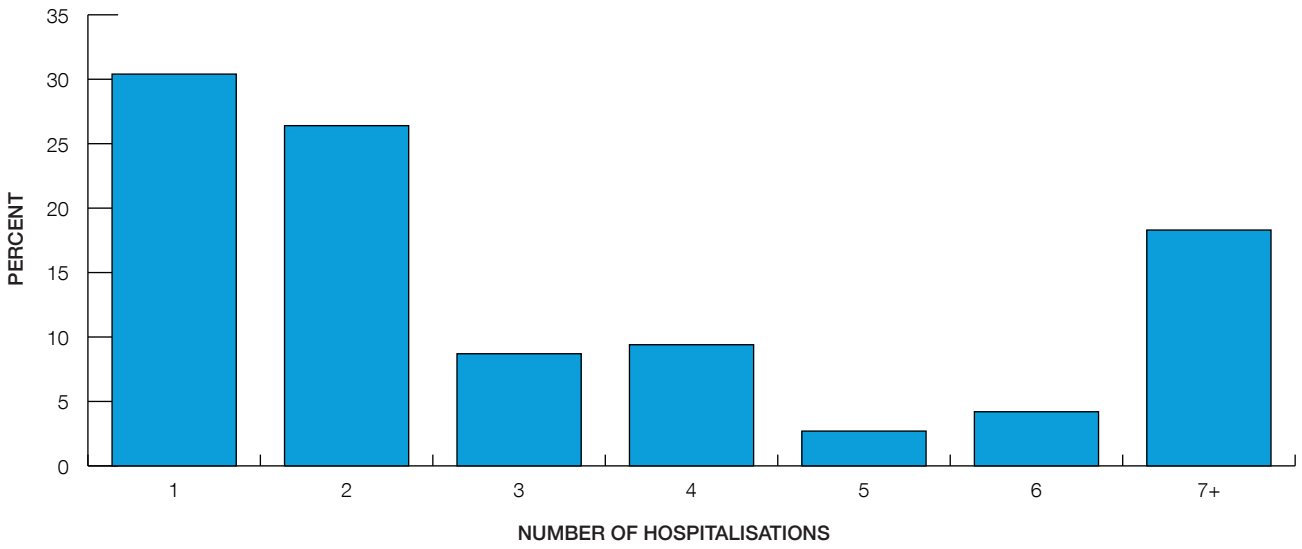
(a) Individuals may use more than one type of supplement.

4.3 HOSPITAL TREATMENT

Of the 1,054 patients attending hospitals that provided adequate data, 30.4 percent had one hospitalisation for any indication during 2017. About 70 percent 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 2017: HOSPITALISATIONS



The distribution of hospitalisations by age is shown in Table 4.4.

TABLE 4.4 – ACFDR 2017: HOSPITALISATION RELATED TO CYSTIC FIBROSIS, RESPIRATORY CAUSES

	Persons aged						
	<2 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							
None or none reported	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	35.0	53.7	51.5	35.7	30.6	26.6	34.5
2	35.0	26.8	24.2	31.8	27.5	28.1	28.2
3	5.0	7.3	10.1	21.7	9.1	11.1	11.7
4	5.0	4.9	5.1	4.7	9.4	13.6	8.8
5	10.0	0.0	4.0	1.6	5.7	2.0	3.6
6	0.0	2.4	1.0	2.3	5.7	5.5	4.1
More than 6	10.0	4.9	4.0	2.3	12.1	13.1	9.2
	Number						
Total reported	20	41	99	129	265	199	753
Missing	97	259	452	362	562	666	2,398
Total	**117**	**300**	**551**	**491**	**827**	**865**	**3,151**

Table 4.5 shows the age distribution of persons reported as having undergone selected non-transplant surgery during 2017. In view of the incompleteness of reporting, these numbers are likely to be under-estimates.

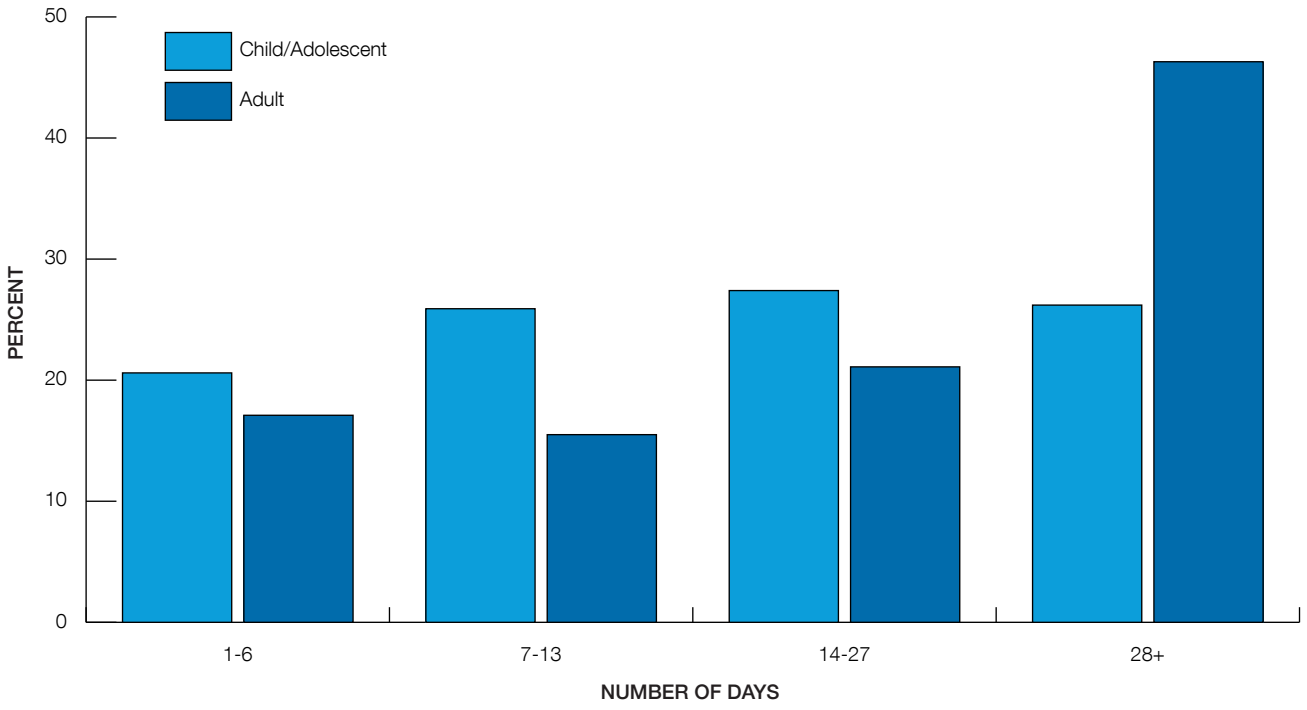
TABLE 4.5 – ACFDR 2017: NON-TRANSPLANT SURGERY DURING THE YEAR

	Persons aged						
	<2 years	2–5 years	6–11 years	12–17 years	18–29 years	30+ years	All ages
IV access devices	0	0	6	4	3	4	17
Gall bladder disease	0	0	0	0	1	0	1
Gastrostomy	0	2	4	6	0	2	14
Intestinal obstruction	5	0	0	0	0	1	6
Nasal (any surgery)	1	4	6	7	4	3	25
Other	19	49	29	26	49	47	219

Of the 1,054 persons hospitalised in 2017, 60 percent accumulated at least 14 admitted days throughout the year.

Adult patients (mean 46.0 days, median 24 days) generally spent more days as admitted patients in hospital than children and adolescents (19.6 and 14 days respectively) (Figure 4.2).

FIGURE 4.2: ACFDR 2017: ACCUMULATED HOSPITAL DAYS



4.4 HOME THERAPY

In 2017, home therapy data was available for 329 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 2017: HOME THERAPY

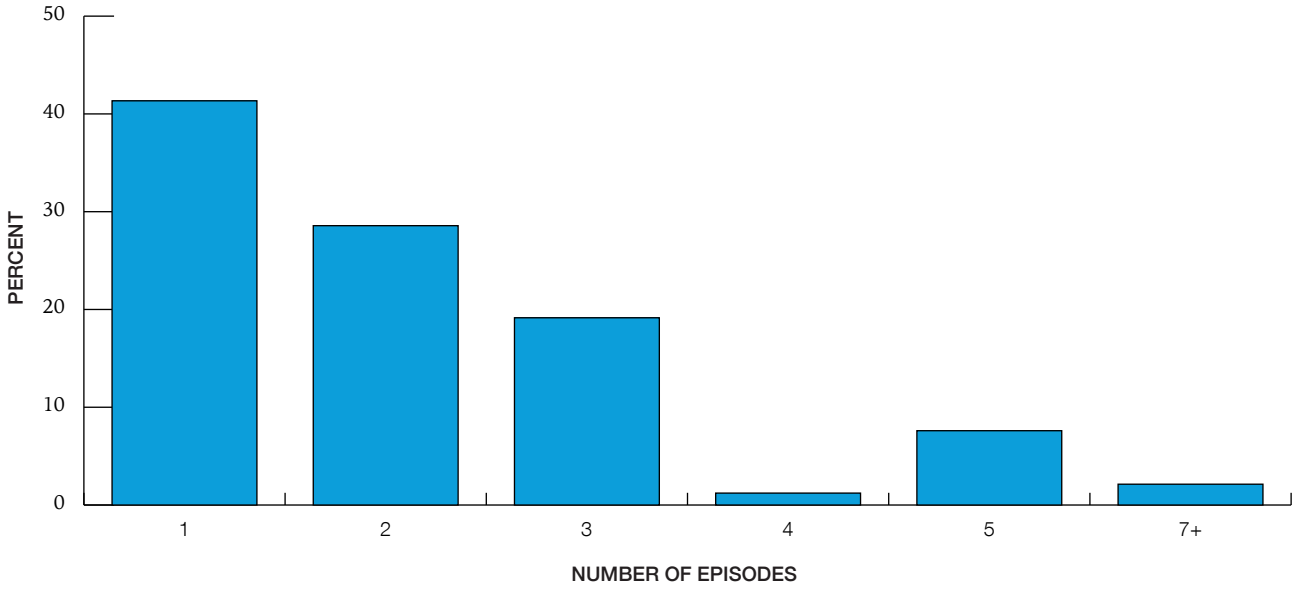
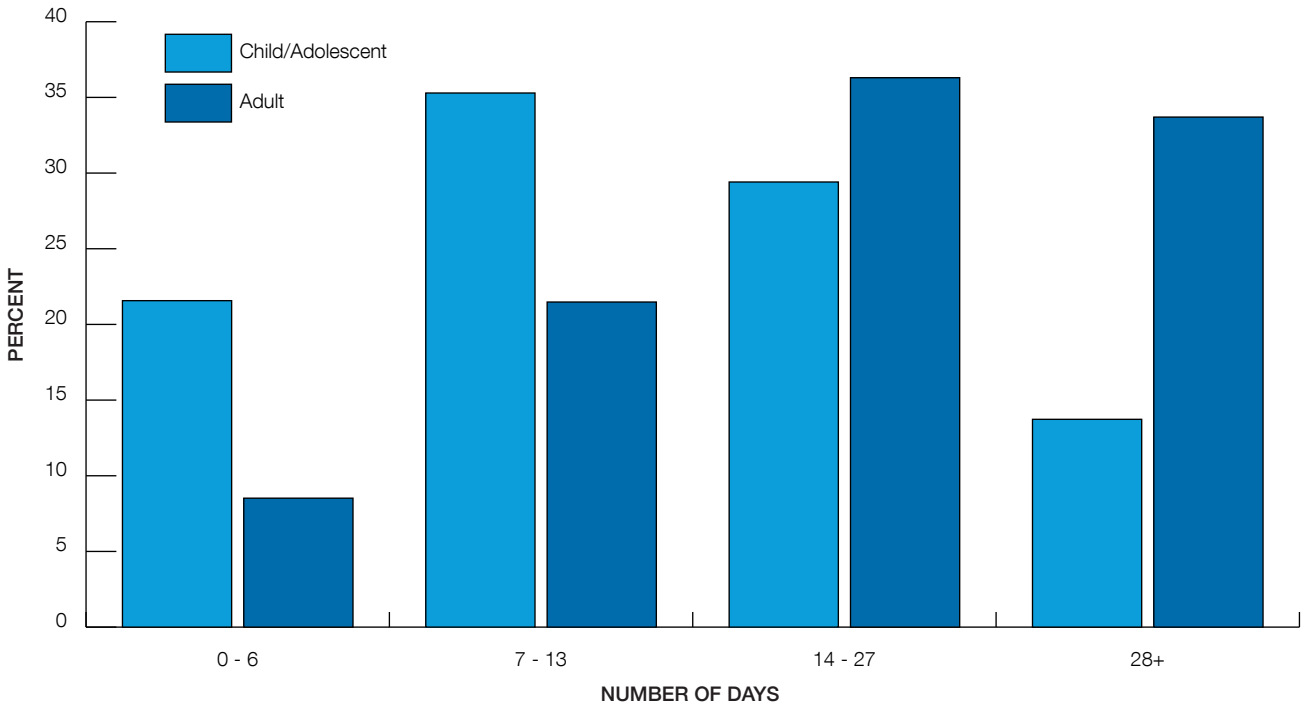


FIGURE 4.4: ACFDR 2017: ACCUMULATED HOME THERAPY DAYS



5. ORGAN TRANSPLANTS

5.1 TRANSPLANTS DURING 2017

Forty-three transplants were reported in 2017 (Table 5.1). Forty-one of them were bilateral lung transplants, one patient has bilateral lung and liver, and one – heart and lung transplants. Forty-one transplants were performed on adult patients, including 25 patients aged 30 years and over.

TABLE 5.1 – ACFDR 2017: PATIENTS RECEIVING LUNG TRANSPLANTS IN 2017

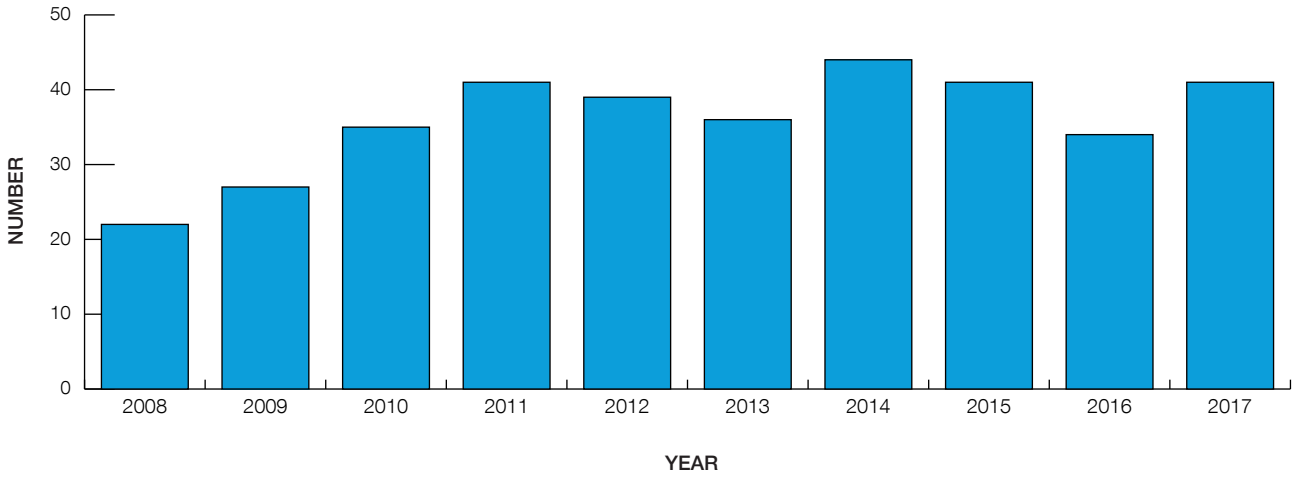
Age group:	Males	Females	Persons
6 – 11 years	1	0	1
12 – 17 years	0	1	1
18 – 29 years	7	9	16
30 years and over	13	12	25
Total, All Ages	**21**	**22**	**43**

5.2 TRANSPLANTS DURING 2008-2017

To improve the quality of the registry transplantation data linkage with the Australia and New Zealand Cardiothoracic Transplant Registry (ANZCOTR) has been conducted. Additional information on the type and date of the transplants has been sought from the individual centres.

Figure 5.1 shows the results of the data linkage - number of transplants from 2008 - 2017.

FIGURE 5.1: ACFDR 2017: NUMBER OF TRANSPLANTS BY YEAR



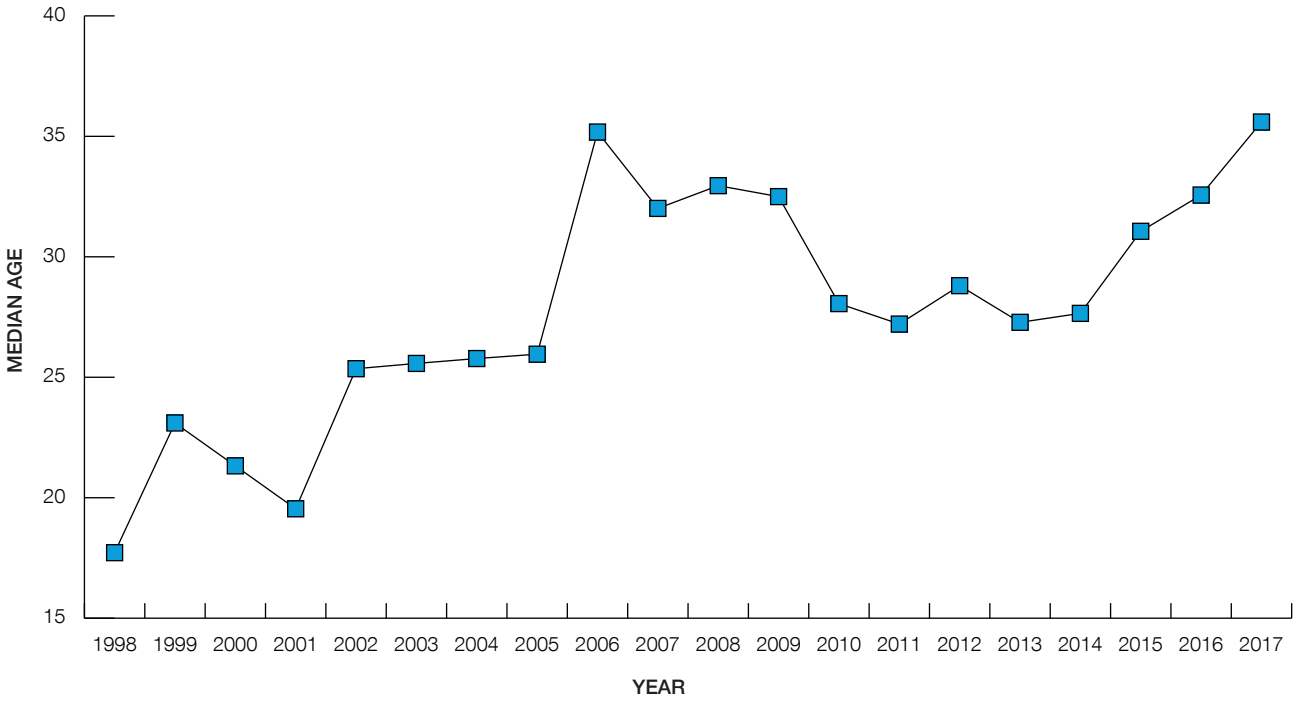
6. MORTALITY

6.1 DEATHS RECORDED IN 2017

The number of deaths reported to the registry in 2017 was 27. Nineteen of the deaths reported in 2017 were in persons aged more than 30 years.

The median age at death for patients who died in 2017 was 35.6 years, up from a median of 32.6 in 2015 (Figure 6.1).

FIGURE 6.1: ACFDR 1998-2017: MEDIAN AGE AT DEATH



Accurate survival information is an important outcome of the Registry, providing an understanding of the impact of quality improvements in practice and care over time. To ensure accuracy of the survival data, a linkage with the National Death Index is currently underway.

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 2016 and 2017.

TABLE 7.1 – ACFDR 2017: DATA AVAILABILITY

Category	Data Item	2017		2016	
		Number	*Percent*	*Number*	*Percent*
Socio-Demographic					
All participants	Age	3,151		3,422	
	Gender	3,151	100	3,422	100
	Postcode	2,933	93	3,222	94
Adults	Age	1,692	100	1,819	
	Gender	1,692	100	1,819	100
	Postcode	1,546	91	1,683	93
	Marriage status	720	43	926	51
	Activity status (any recorded)	711	42	912	50
Diagnostic					
	CF diagnosis date	2,288	73	2,494	73
	Presentation mode	2,480	79	2,763	81
	CFTR2 mutation 1	3,111	99	3,249	95
	CFTR2 mutation 2	3,045	97	3,244	95
Clinical Measures					
Children under 6	Age	321	100	456	100
	Height	311	97	341	75
	Weight	321	100	364	80
Children 6 to 17	Age	981	100	1,113	100
	Height	980	100	1,041	94
	Weight	980	100	1,062	95
	FEV_1	959	98	1,001	90
Adults	Age	1,383	100	1,674	100
	Height	1,382	100	1,430	85
	Weight	1,315	95	1,390	83
	FEV_1	1,343	97	1,448	86

TABLE 7.1 – ACFDR 2017: DATA AVAILABILITY (CONTINUED)

Category	Data Item	2017		2016	
		Number	*Percent*	*Number*	*Percent*
Clinical Interventions					
	Antibiotics	1,898	60	1,868	55
	Other therapy	1,889	60	1,853	54
	Other therapy (specified)	658	21	935	50
Complications					
Pulmonary	Major haemoptysis	1095	35	1547	45
	Massive haemoptysis	1085	34	1532	45
	Bronchial artery embolisation	0	0	0	0
Gastro-intestinal	Gastro-oesophogeal reflux	1094	35	1556	45
	Gastro-oesophogeal reflux (endoscopy)	687	22	979	29
	Abnormal liver function	1097	35	1571	46
	Cirrhosis or portal hypertension	1088	35	1540	45
	Pancreatitis	1087	34	1546	45
Endocrine	Chronic IDDM	1100	35	1564	46
	Intermittent IDDM	1085	34	1550	45
	Other glucose abnormalities	1079	34	1555	45
Skeletal	Osteoporosis	1081	34	1554	45
	Osteopaenia	1078	34	1549	45
Other	Bone fracture	623	20	945	28
Cancer	Cancer	1055	33	1519	44

8. ACADEMIC OUTPUTS

DATA ACCESS REQUESTS

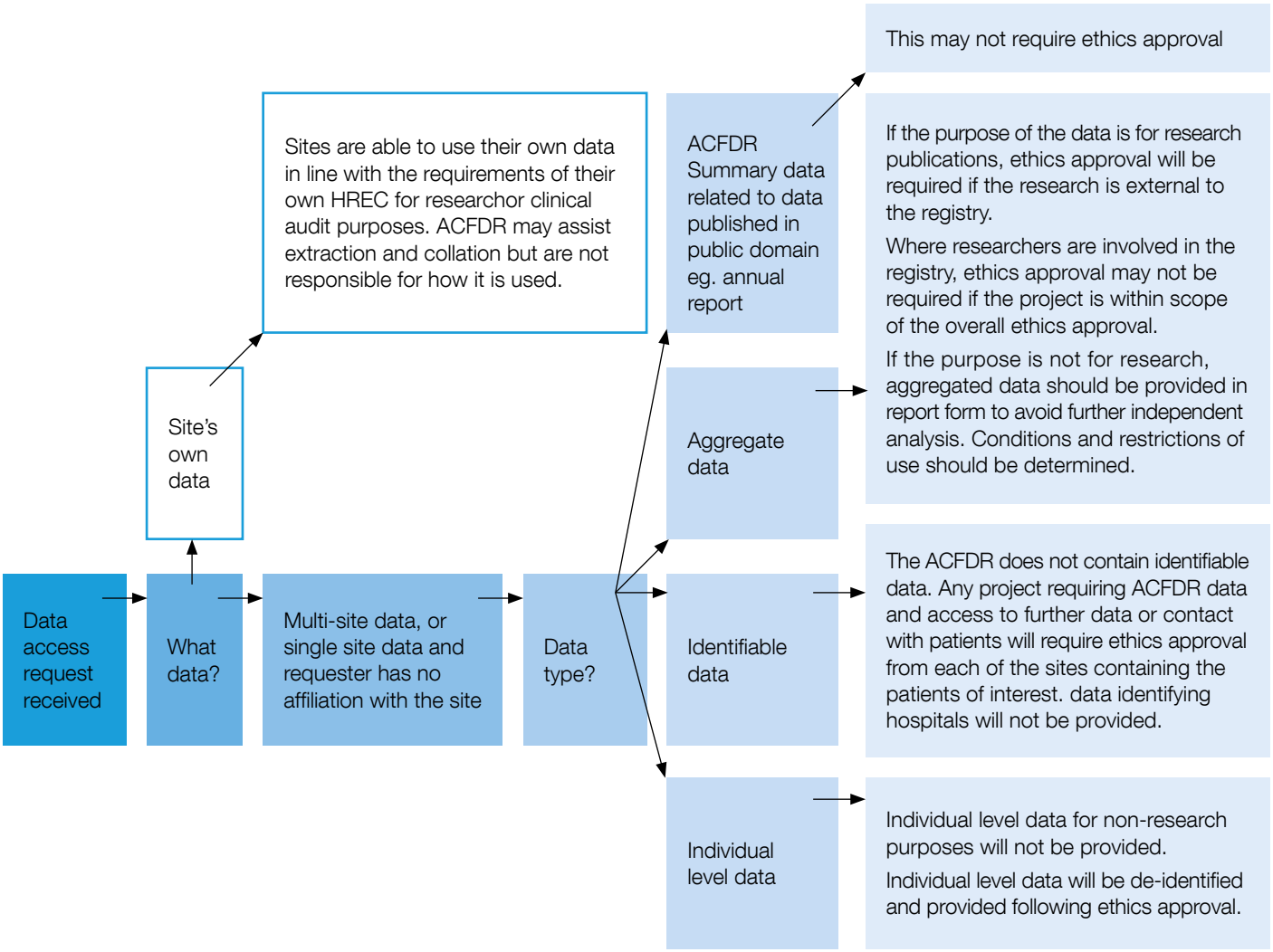
Nine data access requests were received and approved for the ACFDR in 2017.

Date	Name	Organisation	Request Type	Request
30/06/2017	Dr Abaigeal Jackson	CF Registry of Ireland	Non-research	Qualitative and quantitative information describing the ACFDR
10/08/2017	A/Prof David Armstrong	Monash Health	Research	Diabetes related CF
14/09/2017	Maxinne Orr	Vertex Pharmaceuticals	Non-research	CFTR mutation by age group
22/09/2017	Prof Peter Wark / Dr Anna Tai	John Hunter Hospital	Research	Comparing outcomes for patients with CF gating mutations in Australia and New Zealand
14/11/2017	A/Prof David Armstrong	Monash Health / Monash University	Research	Comparison of nutritional status following the introduction of clinical practise guidelines for nutrition
13/11/2017	Nettie Burke	CFA	Non-research	Compare survival of Australian CF patient with most recently reported for US and Canadian patients
15/11/2017	Prof Scott Bell	The Prince Charles Hospital	Non-research	To determine if study participants are representative of adult patients - small extension of registry annual report data
18/12/2017	Prof Claire Wainwright	Lady Cilento Children's Hospital	Non-research	Longitudinal trend data for weight/ height/BMI percentile
27/12/2017	Wendy Sun	WA Dept. of Health	Non-research	Severity of CF by age group, and compare indigenous/non-Indigenous and regional differences

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



9. FUTURE DEVELOPMENTS

In 2018 the ACFDR has undertaken a comprehensive review of its included data elements, through a data mapping process that compared data elements from the US, UK, Canadian and European Cystic Fibrosis Registries where possible, adapted to meet Australian purposes. This will result in changes to data collection to commence from 2019.

The ACFDR has also developed a new database to commence 2019 data collection that incorporates the updated data elements, and has improved data collection flow as well as enhanced data element selection processes that improve data quality and validity. The new database will continue to provide reporting capability to sites as well as provide for improved data importation via other databases or electronic medical records.

The ACFDR continues to develop its engagement with consumers with its infographic, based on feedback from CF centres, clinicians and patients. The ACFDR continues to provide an informative and engaging newsletter to clinical sites on a quarterly basis.

In 2018 the ACFDR completed 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 being used to undertake a 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. In response to the increase in requests for access to data, the ACFDR has established a sub-committee, the Data Access and Research Publications (DARP) Subcommittee which is able to review applications in a timely way without the majority being required to wait for formal Steering Committee approval.

The ACFDR has also developed a new database to commence 2019 data collection that incorporates the updated data elements, and has improved data collection flow as well as enhanced data element selection processes that improve data quality and validity.

10. APPENDICES

List of Figures

List of Tables

Registry Steering Committee Membership (2017)

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	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	CF Clinical Nurse Consultant	Westmead Hospital, NSW
Ms Morgan Gollan	Consumer Representative	NSW

List of Participating Sites

Site	
Sydney Children's Hospital (SCH)	Paediatric
The Children's Hospital, Westmead (CHW)	Paediatric
Royal Prince Alfred Hospital (RPA)*	Adult
Westmead Hospital (WMH)	Adult
Gosford Hospital (GOS)	Paediatric and Adult
John Hunter Children's Hospital (JHC)	Paediatric
John Hunter Hospital (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
Centenary Hospital for Women and Children (CHW)	Paediatric

Site	
Mater Hospital (MAH)	Adult
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
Perth Children's Hospital (PCH)	Paediatric
Sir Charles Gairdner Hospital (SCG)	Adult
Royal Hobart Hospital (RHH)	Paediatric and Adult
Launceston General Hospital (LGH)	Paediatric and Adult
North West Regional Hospital (BUR)	Paediatric
The Canberra Hospital (CHA)	Adult

*denotes sites for which 2017 data was excluded from this report due to lack of completeness.

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:
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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