

Report



# Australian and New Zealand Paediatric Intensive Care Registry 2008



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Australian & New Zealand  
Intensive Care Society



**ANZICS**  
Centre for Outcome  
and Resource Evaluation

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## Contents

Tables .....	ii
Figures .....	iii
Acknowledgements .....	v
Foreword .....	vii
1. Introduction	
1.1 History of the ANZPIC Registry .....	1
1.2 ICU classification .....	2
2. Data Set	
2.1 Data set .....	3
2.2 Data collection .....	3
2.3 Data verification .....	3
2.4 Registry Data limitations .....	4
2.5 Data completeness .....	4
3. Demographics	
3.1 Population .....	6
3.2 Age .....	7
4. Admission Characteristics	
4.1 Admission source .....	8
4.2 Admission type .....	8
4.3 Admission diagnosis .....	10
4.4 Other admission characteristics .....	12
5. Length of Stay	
5.1 Median length of stay .....	15
5.2 Occupied bed days .....	18
6. Mortality	
6.1 Mortality rates .....	19
6.2 Diagnosis specific mortality .....	20
6.3 Paediatric cardiac surgery .....	21
6.4 Risk adjusted mortality (PIM2) .....	23
6.5 Mode of death and organ donation .....	26
7. Monitoring Performance of Paediatric Intensive Care	
7.1 Risk adjusted LOS and LORS .....	27
7.2 PICU Efficiency .....	28
7.3 Risk adjusted mortality .....	28
7.4 Sequential control charts (CUSUMS) .....	30
Appendices	
I Minimum data set .....	40
II Diagnosis codes .....	46
III Diagnostic groups used in Annual Report .....	50
IV Participating ICUs contact details .....	51

## Tables

Table 1.1.1	Hospitals contributing to the ANZPIC Registry in 2008 .....	2
Table 1.2.1	ICU Classifications .....	2
Table 2.5.1	Summary of fields where data collection for all patients is not intended (2008) .....	4
Table 2.5.2	Summary of fields where data collection for all patients is intended (2008) .....	5
Table 3.1.1	Regional admission prevalence and sex-specific admissions to ANZPIC Registry hospitals in 2008 .....	6
Table 4.1.1	Intensive care admission source by admission classification, 2007-2008 .....	8
Table 4.1.2	Intensive care admission source by ICU type, 2008.....	8
Table 4.3.1	Number of admissions and mortality rate by diagnostic group, 2008 .....	10
Table 4.3.2	Top 10 reasons for non-elective admissions to ICU, the percent of all admissions, and median LOS, in 2008 .....	11
Table 4.3.3	Top 10 reasons for elective admissions to ICU, the percent of all admissions, and median LOS, in 2008 .....	11
Table 4.4.1	Number of admissions and ventilated patients by unit in 2008 .....	13
Table 5.1.1	Comparison of ICU LOS between Australia & New Zealand, and the UK in 2008.....	16
Table 5.1.2	Median LOS, interquartile range (IQR), and percent of occupied bed days (OBD), by admission type, 2008 .....	17
Table 5.1.3	Median LOS, IQR, and percent of OBD, by principal diagnostic group, 2008 .....	17
Table 5.2.1	Admission diagnoses & percent OBD for long stay patients (> 28 days), 2008 .....	18
Table 6.1.1	Age Specific Mortality Rates, 2008 .....	19
Table 6.3.1	Occurrences of cardiac surgical procedures, 2008 .....	22
Table 6.3.2	Mortality in cardiac surgery cases, 2008.....	23
Table 6.4.1	PIM2-ANZ08 logistic regression model.....	24

## Figures

Figure 1.1.1	Location of all sites contributing to the 2008 data collection .....	1
Figure 3.2.1	ICU admission numbers by age (years) and sex, 2008 .....	7
Figure 3.2.2	ICU admission numbers by age (months) and sex, 2008 .....	7
Figure 4.2.1	Elective and non-elective admissions for each hospital, 2008 .....	9
Figure 4.2.2	Elective and non-elective admissions by age, 2008 .....	9
Figure 4.3.1	Diagnostic categories by age group, 2008 .....	10
Figure 4.4.1	Number of patients admitted to ICUs by ICU classification, 2004-2008 .....	12
Figure 4.4.2	Monthly admission numbers by diagnostic groups, 2007-2008 .....	14
Figure 4.4.3	Monthly admission numbers by age, 2007-2008 .....	14
Figure 5.1.1	Length of stay distribution in 2008 .....	15
Figure 5.1.2	Median LOS and IQR for all hospitals by ICU classification, 2008 .....	16
Figure 5.1.3	Median LOS and IQR for intubated admissions by ICU classification, in 2008 .....	17
Figure 5.2.1	Occupied bed days by age group and sex, 2008 .....	18
Figure 6.1.1	Mortality rate for 18 hospitals by ICU classification in 2008 .....	19
Figure 6.2.1	Diagnostic categories of patients not surviving ICU, by sex in 2008 .....	20
Figure 6.2.2	Diagnostic categories of patients aged <1 year not surviving ICU, by sex, 2008 .....	20
Figure 6.2.3	Diagnostic categories of patients aged 1-15 years not surviving ICU, by sex, 2008.....	21
Figure 6.4.1	Standardised mortality rate with 95% confidence intervals for seven participating PICUs, 2008 .....	24
Figure 6.4.2	Number of admissions and vital status at discharge by PIM2-ANZ08 mortality risk category, 2008 .....	25
Figure 6.4.3	Observed vs expected number of deaths by mortality risk category, as predicted by PIM2-ANZ06, 2008 .....	25
Figure 6.5.1	Mode of death for all patients who died in ICU in 2008 .....	26
Figure 6.5.2	Organ donation responses for 43 deaths in ICU for brain death or NBHD .....	26
Figure 7.1.1	Risk adjusted mean LOS and LORS for PICUs in 2008 .....	27
Figure 7.2.1	Rapoport-Teres plot of efficiency for PICUs in 2008 .....	28
Figure 7.3.1	Funnel plot representation of SMRs for contributing sites in 2008 .....	29
Figure 7.3.2	Funnel plot representation of PIM2-ANZ08 SMRs for sites using combined 2007 and 2008 data .....	29
Figure 7.4.1	Sequential cumulative sum control chart for doubling and halving the odds of death of PICU A, 2007-2008 .....	31
Figure 7.4.2	Sequential cumulative sum control chart for doubling and halving the odds of death of PICU B, 2007-2008 .....	32

## Figures cont.

Figure 7.4.3	Sequential cumulative sum control chart for doubling and halving the odds of death of PICU C, 2007-2008 .....	33
Figure 7.4.4	Sequential cumulative sum control chart for doubling and halving the odds of death of PICU D, 2007-2008 .....	34
Figure 7.4.5	Sequential cumulative sum control chart for doubling and halving the odds of death of PICU E, 2007-2008 .....	35
Figure 7.4.6	Sequential cumulative sum control chart for doubling and halving the odds of death of PICU F, 2007-2008 .....	36
Figure 7.4.7	Sequential cumulative sum control chart for doubling and halving the odds of death of PICU G, 2007-2008 .....	37
Figure 7.4.8	Sequential cumulative sum control chart for doubling and halving the odds of death of PICU H, 2007-2008 .....	38

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Many of the participating hospitals and people listed below have been associated with the Registry for many years and we thank them for their continued active support. As the Registry continues to grow with additional sites each year, we also thank those newer sites for contributions which help to present a more comprehensive picture of paediatric admissions to intensive care in Australia and New Zealand.

In addition to those listed, we also give our thanks to the many other individuals who are involved in the data collection, collation, cleaning, and submission of data to the Registry.

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## Foreword

### *'Be alert but not alarmed'*

John Howard's famous line in 2002, which forever tarnished the important role of fridge magnets in our lives, was prophetic in many senses. The sense of vigilance, which we were told was essential for terrorism, is also important in other aspects of life. In paediatric intensive care, critically ill children are cared for, on the whole, with excellence. However with new technologies, emotional and physical strains on staff and often unpredictable disease processes, there is always the potential for things to go wrong. When system failure starts to occur, it is often difficult to detect and difficult to arrest.

This is why safety monitoring is so essential in critical care, particularly in paediatric intensive care. Overall mortality rates in children are much lower than in adults but as we all know, one death is one too many.

One of the most important roles of the ANZPIC Registry is to analyse the performance of individual units and ensure that quality is maintained. As there are many factors contributing to the performance of an intensive care unit, early identification of any deviations from the standard mortality risk is likely to facilitate investigation and rectification of any system-wide or individual performance issues within a paediatric ICU.

The Registry data also gives a snapshot into the demographics, overall PICU burden and workforce requirements and is good indicator for clinical research feasibility.

The 2008 report contains data collected from 9 paediatric intensive care units and 14 metropolitan and regional intensive care units which care for children. Data was collected from over 8000 admissions in Australia and New Zealand. Newer developments include the collection of Risk Adjustment in Congenital Heart Surgery. Continued aims for the development of the Registry include refinement and interpretation of Congenital Heart Surgery data and the establishment of an Outcomes Review Committee to formally assess performance and relay any adverse findings to individual units in a confidential manner. While the performance of the registry has become part of the fabric of paediatric intensive care in Australia and New Zealand, it is essential that the data collection process remains a priority for paediatric intensive care units.

Finally, on behalf of ANZICS, I would like to thank Tony Slater and Jan Alexander for their continued commitment to this process, which has now become so efficient that many of us often take it for granted. And to those dedicated members who collect the data, we are also very grateful.

Dr. Simon Erickson FRACP FJFICM  
Chair, Paediatric Division  
ANZICS



## 1. Introduction

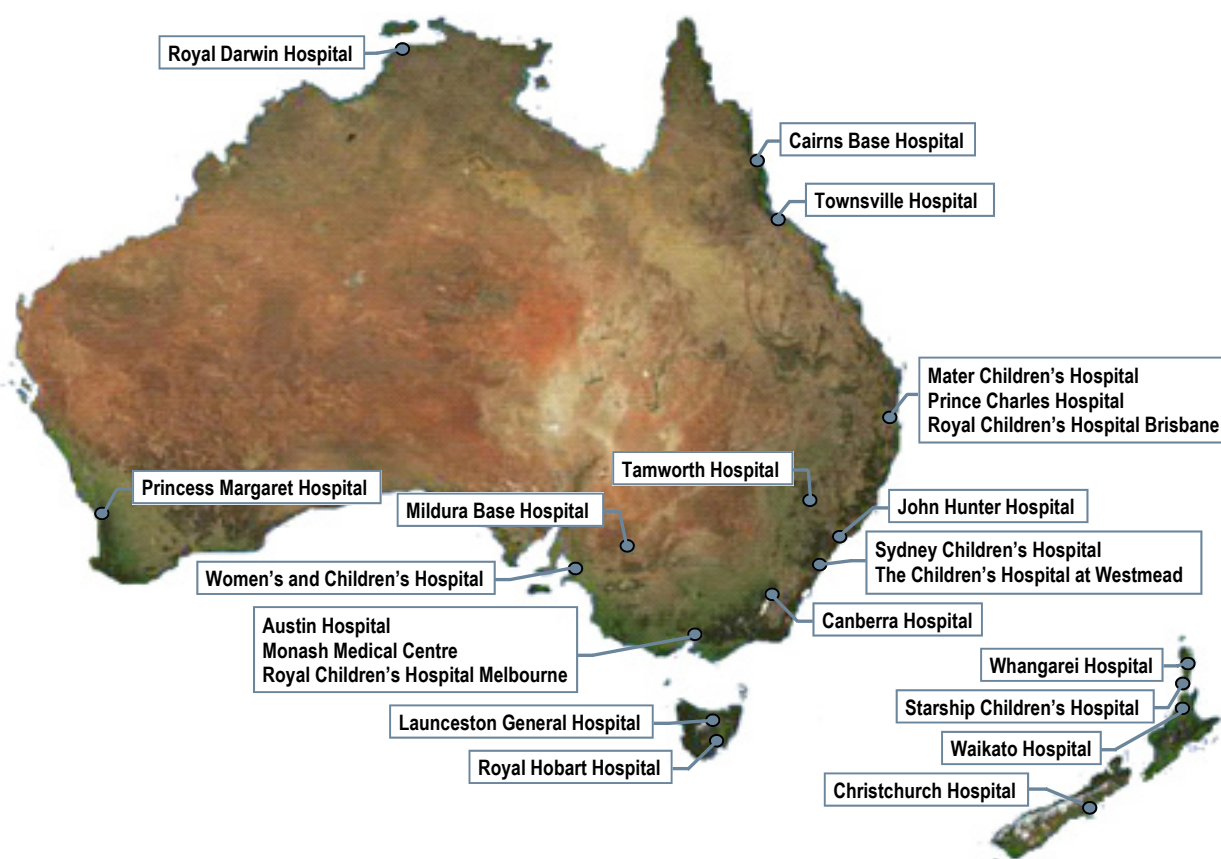
### 1.1 History of the Australian and New Zealand Paediatric Intensive Care Registry

The Paediatric Study Group (PSG) of the Australian and New Zealand Intensive Care Society (ANZICS) established the Australian and New Zealand Paediatric Intensive Care (ANZPIC) Registry in 1997. The aims of the Registry are:

- To describe paediatric intensive care practices and outcomes in Australia and New Zealand.
- To provide contributing units with efficacy and efficiency reports that compare performance in their units against national and international standards.
- To facilitate research in paediatric intensive care.

This report is the eighth Annual report describing paediatric intensive care practices and outcomes within Paediatric Intensive Care Units (PICUs) across Australia and New Zealand. Data collected from twenty-three intensive care units (ICUs) (nine PICUs, fourteen general ICUs), during the 2008 calendar year was used to generate this report. The geographical depiction of the location of contributing sites is shown in Figure 1.1.1 below.

Figure 1.1.1 Location of all sites contributing to the 2008 data collection



The nine PICUs are tertiary referral centres for children requiring intensive care and are based in university affiliated children's hospitals. Data on all patients admitted to these nine units have been included; their age ranges from birth to young adulthood (16 years).

Thirteen general ICUs admitting predominantly adults also contributed data on their paediatric admissions (patients < 16 years of age). These ICUs are based in metropolitan or regional hospitals in Australia and New Zealand, with the Austin Hospital providing data to the ANZPIC Registry for the first time in 2008. Table 1.1.1 lists the contributing hospitals.

*Table 1.1.1* Hospitals contributing to the ANZPIC Registry in 2008

Hospital	State	ICU Type
Austin Hospital	VIC	Metropolitan
Cairns Base Hospital	QLD	Regional
The Canberra Hospital	ACT	Metropolitan
Children's Hospital at Westmead	NSW	PICU
Christchurch Hospital	NZ	Metropolitan
John Hunter Hospital	NSW	Regional
Launceston Hospital	TAS	Regional
Mater Children's Hospital	QLD	PICU
Mildura Base Hospital	VIC	Regional
Monash Medical Centre	VIC	Metropolitan
Prince Charles' Hospital	QLD	PICU - Cardiac
Princess Margaret Hospital	WA	PICU
Royal Children's Hospital - Brisbane	QLD	PICU
Royal Children's Hospital - Melbourne	VIC	PICU
Royal Darwin Hospital	NT	Metropolitan
Royal Hobart Hospital	TAS	Metropolitan
Starship Children's Hospital	NZ	PICU
Sydney Children's Hospital	NSW	PICU
Tamworth Base Hospital	NSW	Regional
Townsville Hospital	QLD	Regional
Waikato Hospital	NZ	Regional
Whangarei Hospital	NZ	Regional
Women's & Children's Hospital	SA	PICU

## 1.2 ICU Classification

Table 1.2.1 defines the ICU classifications used by the ANZPIC Registry.

*Table 1.2.1* ICU Classifications

Classification	Description
PICU	Paediatric, tertiary referral intensive care units based in a capital city
Metropolitan	All other general intensive care units in capital cities
Regional	General intensive care units outside a capital city

## 2. Data set

### 2.1 Data set

The minimum data set analysed for this report includes 53 variables; their definitions are described in Appendix 1. Information collected for the minimum data set includes demographic data, the diagnosis directly responsible for ICU admission, as well as underlying and additional diagnoses. Additionally, physiological variables measured at the time of first face to face contact between the patient and the doctor from the ICU (or a specialist retrieval team), the ICU outcome, hospital outcome, and the length of stay are recorded. All participating units collect the minimum data set. All variables are routinely measured or recorded in the patients' medical record. Due to software restrictions, many contributing general (i.e. non-paediatric) ICUs were not able to collect the five additional cardiac-related fields in their 2008 data as these additions had not been programmed into their electronic data collection tool. However, given that these general units do not admit any paediatric cardiac surgery patients, the lack of data from these sites had no impact on the RACHS calculations.

### 2.2 Data collection

Data are collected in the hospitals by either completion of the specific ANZPIC Registry form, or by incorporating the ANZPIC Registry data items into the local clinical information system. Participating hospitals maintain unit specific databases and submit electronic copies of the de-identified data in a predefined format to the ANZPIC Registry every six months. Some of the paediatric units use specially written ANZPIC Registry software for data entry, while the remaining units have incorporated the ANZPIC Registry data fields into their unit specific databases.

In 2004, a paediatric component was added to the Australasian Outcome Research Tool for Intensive Care (AORTIC), software developed by the ANZICS Adult Patient Database (APD). This has allowed the general units already using AORTIC to collect and submit data on any paediatric admissions. In AORTIC, a paediatric admission is defined as a child less than sixteen years of age at hospital admission.

### 2.3 Data verification

Missing, inconsistent, or unusual data are identified and flagged at the time of submission to the Registry. This initial filtering is performed automatically, and consists of both logic and range checks. Error reports are sent to each site, and the data is cleaned and resubmitted to the Registry before being approved and uploaded into the main database.

As part of ensuring the integrity and uniformity of all Registry data, site audits need to be routinely performed. During the fourth quarter of 2008, all nine PICUs had an audit completed on their 2007 data based on a random sample of 50 records. The randomisation process was stratified by the risk of death, predicted by PIM2 (1), to ensure that the random sample included patients with a representative range of mortality risk. An independent data collector from another PICU then re-extracted information from hospital medical records and used database software to compare the two sources of data. Comparison reports were then centrally generated and sent to each site. These reports included measures of agreement on all fields required for the calculation of PIM2, as well as Bland-Altman plots (2) displaying the agreement between the PIM2 risk of death calculated from the original and re-extracted data. After examining discrepancies, the original data submitted by sites showed very few and minor errors. Auditing of sites will occur again in the second quarter, 2010.

## 2.4 Registry Data Limitations

Limitations to the Registry data are related to the data collection process, the small population of paediatric patients admitted to ICUs in Australia and New Zealand, and the outcome measures used to assess unit performance.

Not all participating units have designated data managers. In the remaining ICUs, data is collected by a range of staff, from clinical nurses to senior medical staff. It has been noted previously that data collection errors are more common in units where a greater number of staff are involved with the collection of data compared to units who have dedicated data collectors/managers. Study days are organised by the Registry and held annually for site staff in an effort to ensure consistency and accuracy of data submissions.

One other limitation is the lack of physiological measurements for many admissions. The usual explanation for physiological measurements not being available is that the performance of invasive measurements was not considered necessary for patient care. Physiological testing is not performed solely for the purposes of data collection.

## 2.5 Data Completeness

Table 2.5.2 provides a data completeness summary for the majority of fields within the registry for the 8356 admission records in 2008. These fields are a subset of all fields submitted and are the ones which are expected to be completed for all admissions, irrespective of treatment given. Other fields such as Intubation hours, Systolic BP, and Death Mode, are not relevant to every patient, and therefore it is not intended that these fields are completed for all records. Therefore these fields have been displayed separately in Table 2.5.1. A data dictionary for all registry fields collected can be found in Appendix 2.

*Table 2.5.1* Summary of fields where data collection for all patients is not intended (2008).

Field Name	Maximum Possible Responses	Number of Measureable Responses	% Complete	Explanation
SBPA	8356	7427	88.9	} for the remaining responses, this measurement was either not recorded, or not recorded within the first hour of ICU admission
PO2A	8356	3299	39.5	
FIO2A	8356	4171	49.9	
BEA	8356	3839	45.9	
DEATH_MODE	245	244	99.6	} there were only 245 deaths, so this information relates only to those who died and then to the 104 who had a limitation of therapy order
ECM	245	244	99.6	
LIMIT	245	245	100.0	
LIMIT_D	104	104	100.0	
ORG_DON	245	244	99.6	} only those recording intubation times or respiratory support times are included in the measureable responses
Intub_hrs	8356	4089	48.9	
RS_hrs	7122 <sup>1</sup>	3952	55.5	

<sup>1</sup> One site does not collect information on respiratory support hours

Table 2.5.2 Summary of fields where data collection for all patients is intended (2008).

Field Name	Maximum Possible Responses	Number of Valid Responses	% Complete
DOB	8356	8356	100.0
WT	8356	8355	100.0
POST	7252 <sup>1</sup>	7249	100.0
HADM_SC	8356	8356	100.0
RETRIEV	8356	8356	100.0
IADM_SC	8356	8356	100.0
PREV_AD	8356	8356	100.0
ADM_DT	8356	8356	100.0
DIS_DT	8356	8356	100.0
PDX	8356	8356	100.0
UDX	8356	7949	95.1
OUTCOME	8356	8356	100.0
PIM_UC	8356	8356	100.0
HADM_DT	8356	8340	99.8
HDIS_DT	8356	8319	99.6
HOSP_OUT	8356	8317	99.5
1ST_CONT	8356	8255	98.8
PIM_VAL	8356	8356	100.0
PUPILS	8356	8356	100.0
PIM_LR	8356	8356	100.0
ELECTIVE	8356	8356	100.0
RECOVERY	8356	8356	100.0
BYPASS	8356	8356	100.0
CVVH	8356	8355	100.0
HD	8356	8354	100.0
PD	8356	8354	100.0
PF	8356	8354	100.0
HFO	8356	8352	100.0
INO	8356	8354	100.0
ECMO	8356	8354	100.0
VAD	8356	8354	100.0
ICPM	8356	8354	100.0
IND_STATUS	7537 <sup>2</sup>	7236	96.0
GESTATION	7537 <sup>2</sup>	6234	82.7
NC_STAN	7537 <sup>2</sup>	7536	100.0
CP_SOP	7537 <sup>2</sup>	7537	100.0
AD_STAN	7537 <sup>2</sup>	7537	100.0
CARDIAC	7537 <sup>2</sup>	7006	93.0

<sup>1</sup> Applicable to Australian sites only

<sup>2</sup> Field not recorded in software for some sites

### 3. Demographics

#### 3.1 Population

Past annual reports for the ANZPIC Registry have based the reporting figures on admissions during the year. More recently, a decision has been taken to report on discharges instead, in an effort to more accurately report on bed usage. When reporting on admissions, those patients still in ICU will have incomplete information on their length of stay. More clerical effort is also required to notify the Registry of updated information when children are finally discharged. Therefore, from 2008 onwards, the annual report is based on discharges. The term "admissions" has been used in this report in the context of ICU admission episodes.

For 2008, the ANZPIC Registry received data from 8,356 paediatric admissions to 23 ICUs in Australia and New Zealand. As a comparison, in 2006, the ANZPIC Registry received data from 7,823 admissions (to 17 ICUs), and in 2007, 8086 admissions (to 22 ICUs), although numbers presented in that year were based on ICU episodes that were both admitted and discharged in 2007, and so they are not directly comparable to data presented in this report. During 2008, the Paediatric Cardiac Services located at the Prince Charles' Hospital in Brisbane was relocated to the Mater Children's Hospital in Brisbane. The figures presented for the Prince Charles' Hospital in this report are therefore representative of 4 months' data only.

The number of admissions to the Registry varies depending on the individual admission numbers and classification of the ICUs submitting data. Admissions by region are displayed in Table 3.1.1. Note that the postcodes of patients admitted to ICUs were used to assign a home state, irrespective of their admission hospital. Overseas admissions ( $N=79$ ) were excluded, as was missing data ( $N=3$ ). The child population (<16 yrs) for each state or territory was obtained from the Australian Bureau of Statistics (ABS) Australian Demographic Statistics (3), and Statistics New Zealand (4).

In 2008, the prevalence rate for paediatric ICU admissions was 1.54 per 1,000 children. The ANZPIC Registry prevalence rate is slightly higher than the rate recorded by the Paediatric Intensive Care Audit Network (PICANet) in the UK (1.38 in 2008) (5). Each year a number of children are admitted to general ICUs in Australia and New Zealand which are not contributing to the ANZPIC Registry. In 2008 the number of children admitted to these units was estimated to be 600 (7).

Table 3.1.1 Regional admission prevalence and sex-specific admissions to ANZPIC Registry hospitals in 2008.

Region	Prevalence (per 1,000)	Males	Females	Population
ACT	0.92	31	32	68,227
NSW	1.59	1287	985	1,424,761
NT	2.12	63	55	55,617
QLD	1.95	1018	783	921,334
SA	2.09	369	278	310,108
TAS	2.52	153	109	103,896
VIC	1.18	760	491	1,064,120
WA	1.66	429	327	456,248
NZ	1.16	666	438	953,300
Total	1.54	4776	3498	5,357,611

### 3.2 Age

As in previous years, the majority of admissions to ICU in 2008 were for children less than 5 years of age (66.1%), with infants < 12 months of age making up more than half this group (58.7%) and 39% of all ICU admissions. A greater number of males were admitted (57.6%) than females (42.4%) across the majority of ages as illustrated in figure 3.2.1. Figure 3.2.2 displays the admission numbers for patients under one year of age. Over 26% of infants admitted less than one year old were neonates (< 28 days old). All of these percentages are consistent with 2007 data.

Figure 3.2.1 ICU admission numbers by age (years) and sex 2008.

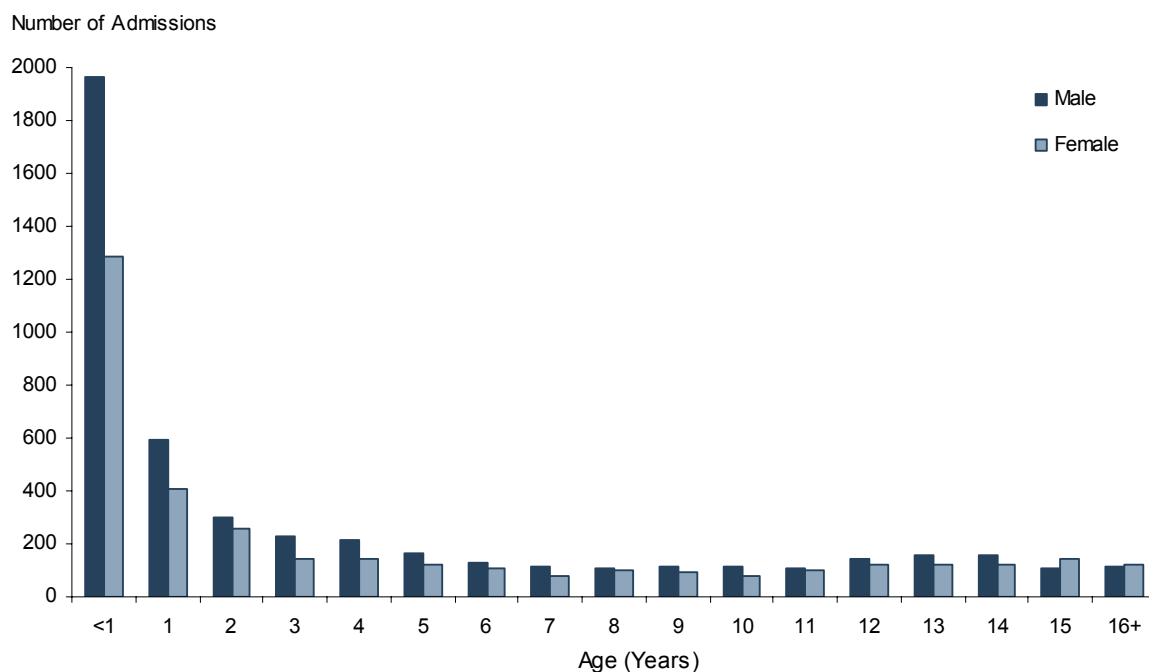
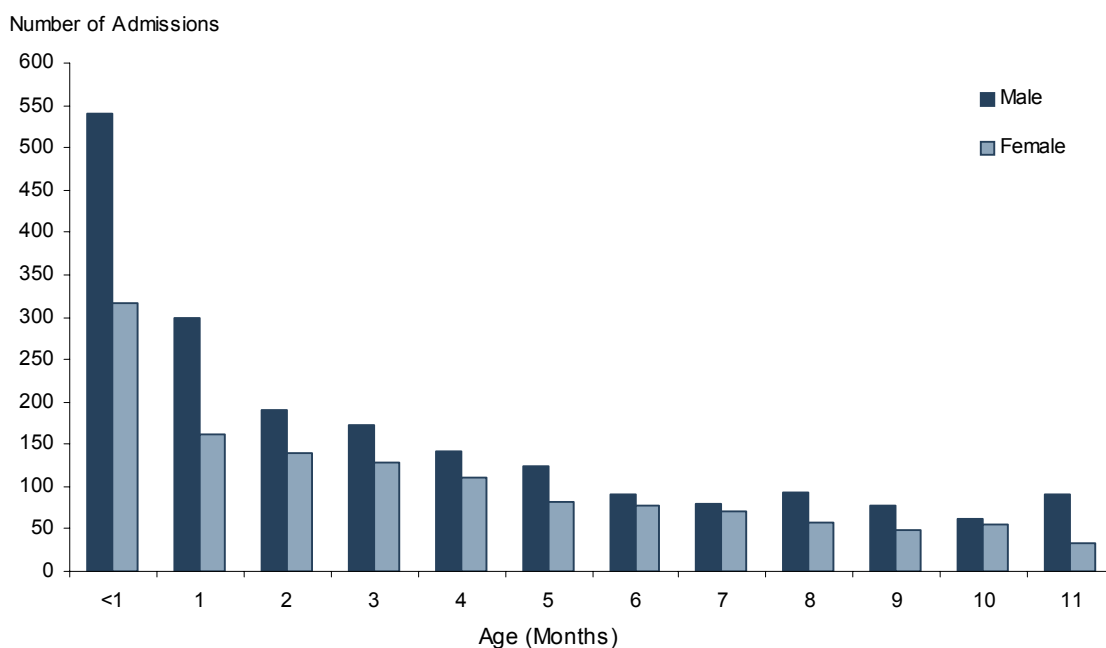


Figure 3.2.2 ICU admission numbers by age (months) and sex, for infants <12 months of age 2008.



## 4. Admission Characteristics

### 4.1 ICU Admission Source

In 2008, admissions from the operating theatre accounted for 44% of all ICU admissions. Over 17.3% of admissions were from the emergency department, while 16.6% of admissions were from other wards. Twenty-one percent of paediatric admissions were direct to the ICU from outside the hospital (Table 4.1.1).

### 4.2 Admission Type

Admissions are classified as either elective or non-elective. An admission is elective if it is (1) booked to follow elective surgery, or (2) for an elective ICU procedure, or (3) a review of home ventilation, or (4) for elective monitoring. Surgery or an ICU procedure are defined as being elective if they could be postponed for more than six hours without an adverse effect. An unplanned admission that was not expected, is regarded as non-elective.

Almost 58% of all ICU admissions in 2008 were non-elective; a very similar pattern to the 2007 figures (see Table 4.1.1). Direct ICU admissions accounted for 34.3% of non-elective admissions, with only a small percentage (11.9%) of non-elective admissions coming from other ICUs, NICUs, operating theatre or recovery. In contrast, admissions from the operating theatre or recovery accounted for approximately 88.9% of all elective admissions, an increase of over 5% from 2007.

Table 4.1.1 Intensive care admission source by admission classification, 2007 - 2008.

Admission Source	2007		2008	
	% Non-elective	% Elective	% Non-elective	% Elective
Direct ICU Admission	19.5	1.8	19.9	1.6
Emergency Department	17.8	0.6	16.9	0.4
Operating Theatre or Recovery	6.4	35.7	6.6	37.4
Other ICU or NICU	0.3	0.2	0.3	0.3
Ward	14.1	3.5	14.2	2.4
Grand Total	58.2	41.8	57.9	42.1

The source of ICU admission differed between specialist PICUs and general ICUs with the operating theatre providing the majority (48%) of PICU admissions, while the emergency department provided the majority (40%) of general ICU paediatric admissions. Comparative admission source data is presented in Table 4.1.2.

Table 4.1.2 Intensive care admission source by ICU type, 2008.

Admission Source	ICU Type	
	PICU (%)	General ICU (%)
Direct ICU Admission	21.4	21.3
Emergency Department	13.7	40.0
Operating Theatre or Recovery	48.0	19.3
Other ICU or NICU	0.6	0.1
Ward	16.2	19.3

## Australia and New Zealand Paediatric Intensive Care Registry, 2008

Figure 4.2.1 displays elective and non-elective admissions for each hospital. While unplanned admissions are the greatest source of admissions for nearly all hospitals, the proportion of elective and non-elective admissions varies considerably across hospitals. While there is data for less than four months from the Prince Charles Hospital (PCH) in 2008, over 96% of admissions were elective. The PICU at PCH was a cardiac PICU and this accounts for the high percentage of elective admissions to this unit. Elective admissions for other hospitals ranged from 0 to 52 percent.

Figure 4.2.1 Elective and non-elective admissions for each hospital, 2008.

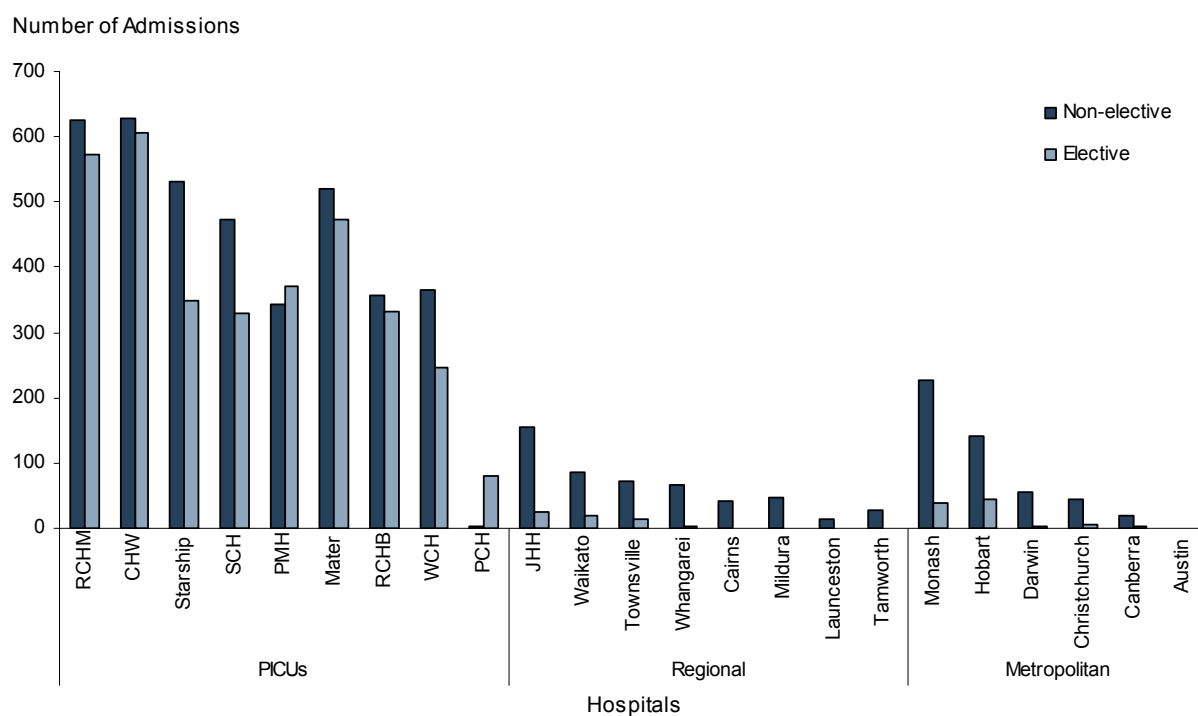
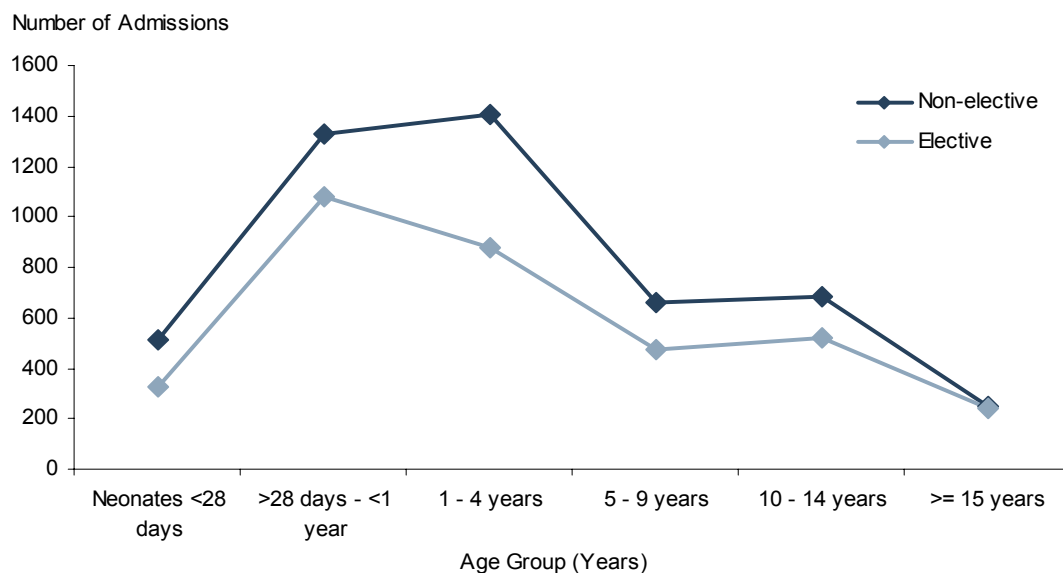


Figure 4.2.2 displays the elective and non-elective admissions for each age group. The difference between the number of non-elective and elective admissions is greatest for children in the < 1, and 1 - 4 year old age groups.

Figure 4.2.2 Elective and non-elective admissions by age, 2008.



### 4.3 Admission Diagnosis

Diagnosis codes developed by the ANZICS PSG (6) are used to code the principal reason for ICU admission. The underlying diagnosis, and up to five additional diagnoses, can also be assigned for each admission. The ANZPIC Registry diagnosis codes used in 2008 are listed in Appendix II.

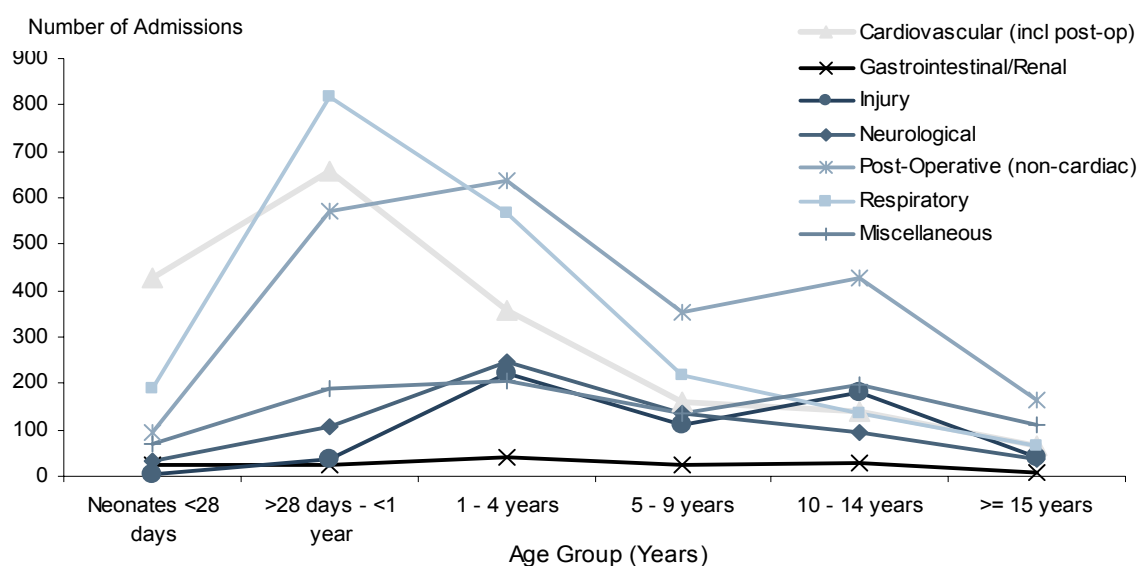
For this annual report, the principal reason for ICU admission has been grouped into seven broad diagnostic categories (refer to Appendix III for details). While most post-procedural diagnoses have been coded into one category, all cardiac procedures have been included with other cardiovascular diagnoses in an attempt to provide better information about all cardiac related reasons for admission. Table 4.3.1 gives details of admissions by diagnostic group, and includes a percentage breakdown of PICUs versus general ICUs.

Table 4.3.1 Number of admissions, and mortality rate by diagnostic group, 2008.

Diagnostic Group	Frequency	% of Admissions		Mortality Rate (95% CI)
		Total (PICU, General ICU)		
Post-Operative (non-cardiac)	2245	26.9 (28.3, 18.0)		0.4 (0.1 - 0.7)
Respiratory	1996	23.9 (21.3, 40.1)		2.6 (1.9 - 3.4)
Cardiovascular (incl post-op)	1809	21.6 (24.6, 3.4)		2.5 (1.7 - 3.2)
Miscellaneous	908	10.9 (11.1, 9.7)		9.0 (7.0 - 11.0)
Neurological	651	7.8 (7.1, 12.2)		5.8 (3.9 - 7.7)
Injury	596	7.1 (6.0, 14.0)		4.8 (3.0 - 6.6)
Gastrointestinal/Renal	151	1.8 (1.2, 2.6)		7.4 (3.0 - 11.8)

As in 2007, the post operative (non-cardiac) category was the most common diagnostic group (26.9%) for the Registry as a whole, followed by respiratory (23.9%). Differing trends can be observed when these diagnostic categories are presented by age groups (see Figure 4.3.1), where respiratory (31.1%) and cardiovascular (33.5%) problems are the most commonly occurring diagnostic groups for children under one year of age, while in children 10 years of age and over, the most common diagnostic group was non-cardiac post-operative (34.8%). This too, is consistent with previous years.

Figure 4.3.1 Diagnostic categories by age group, 2008.



Tables 4.3.2 and Table 4.3.3 display the 10 most common diagnoses for non-elective and elective admissions to ICU respectively. Also displayed are the median length of stay (LOS) for each diagnosis category. Bronchiolitis (11.5%) was the most common reason for non-elective admissions to ICU, followed by seizures (7.9%). The most common reason for an elective admission to an ICU was for Spinal Instrumentation (6.4%). Adenoidectomy and/or Tonsillectomy was the next most common elective reason (5.5%).

*Table 4.3.2* Top 10 reasons for non-elective admission to ICU, the percent of all non-elective admissions, and median Length of Stay (LOS) in 2008.

<b>Principal Admission Diagnosis</b>	<b>Frequency</b>	<b>Percent</b>	<b>Median LOS</b>	<b>Mean LOS</b>
Bronchiolitis	556	11.5	2.42	3.82
Seizures	383	7.9	0.96	2.27
Asthma	288	5.9	0.88	1.24
Trauma - Head	273	5.6	1.67	3.90
Pneumonia or Pneumonitis	243	5.0	4.00	6.77
Diabetes Mellitus with Ketoacidosis	184	3.8	0.88	1.15
Respiratory Failure	153	3.2	3.79	7.65
Shock - Septic	141	2.9	3.63	7.05
Upper Airway Obstruction - Other	118	2.4	2.02	4.88
Croup	99	2.0	1.29	2.59

*Table 4.3.3* Top 10 reasons for elective admission to ICU, the percent of all elective admissions, and median Length of Stay (LOS) in 2008.

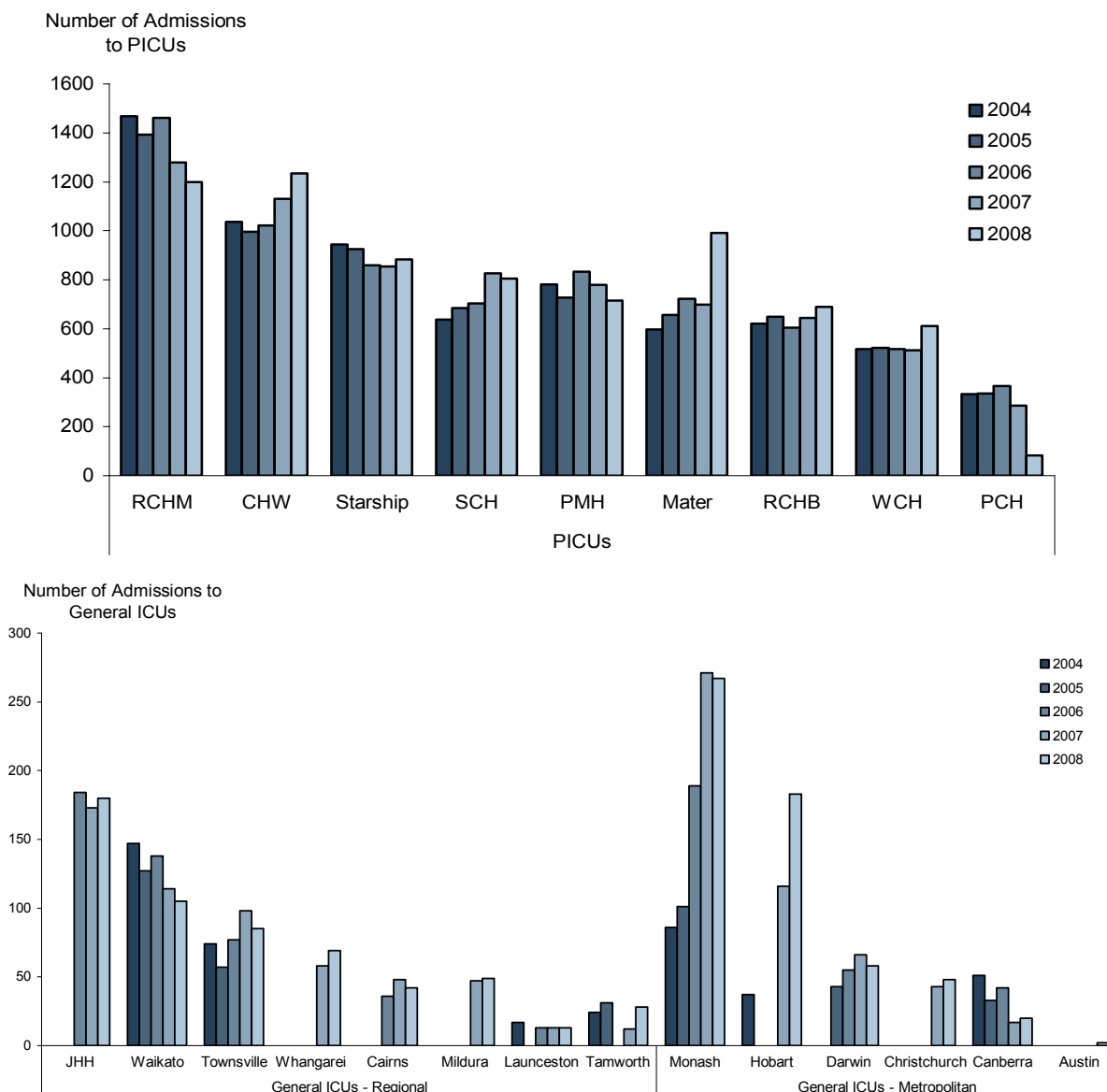
<b>Principal Admission Diagnosis</b>	<b>Frequency</b>	<b>Percent</b>	<b>Median LOS</b>	<b>Mean LOS</b>
Spinal Instrumentation	226	6.4	0.96	1.67
Adenoidectomy and/or Tonsillectomy	193	5.5	0.75	0.71
VSD Repair	133	3.8	1.04	1.68
General Surgery - Other	125	3.6	0.83	1.57
ICU Procedure (eg. CVC Insertion)	112	3.2	0.17	1.16
ASD Surgery	86	2.4	0.96	1.02
Total Repair of Tetralogy of Fallot	82	2.3	1.98	2.82
ENT - Other	78	2.2	0.81	1.93
Craniotomy - Anterior Fossa	77	2.2	1.00	1.65
Laryngobronchoscopy	77	2.2	0.75	1.24

#### 4.4 Other Admission Characteristics

Annual admission numbers per hospital each year since 2004 are displayed in the two parts of Figure 4.4.1 below, where, to assist readability, the specialist paediatric intensive care units are displayed separately to the general ICUs. The Austin Hospital contributed to the registry for the first time in 2008. The relocation of the paediatric cardiac services from the Prince Charles' Hospital (PCH) to the Mater Hospital in Brisbane during 2008 is reflected in the change of admission numbers for both hospitals.

The total number of submissions has increased over the years as more ICUs contribute data to the Registry. However, the number of admissions from individual ICUs remains relatively stable from year to year. Over 12.5% of admissions are readmissions of the same patients during the year, with 8.5% of those readmissions being within the same hospital episode of care.

Figure 4.4.1 Number of patients admitted to ICUs (PICUs and general ICUs) participating in the ANZPIC Registry by ICU classification, 2004-2008.



The proportion of children ventilated during ICU admission is considered a simple indicator of admission threshold. The number of admissions in each ICU and the proportion of ventilated admissions are displayed in table 4.4.1. After the Austin Hospital, Christchurch Hospital reported the highest ventilation rate, which is attributed to the hospital having a specialist paediatric HDU with primarily only children requiring ventilation being admitted to the general ICU. The ventilation rate for the Prince Charles Hospital (87.8%) and the Royal Children's Hospital in Melbourne (80.9%) were also high, reflecting the cardiac caseload of both ICUs.

Table 4.4.1 Number of admissions and ventilated patients by unit in 2008.

Hospital	Admissions	Number Ventiladed	%
Children's Hospital at Westmead	1234	748	60.6
Royal Children's Hospital - Melbourne	1199	970	80.9
Mater Children's Hospital	992	483	48.7
Starship Children's Hospital	882	686	77.8
Sydney Children's Hospital	804	451	56.1
Princess Margaret Hospital	715	286	40.0
Royal Children's Hospital - Brisbane	688	230	33.4
Women's & Children's Hospital	611	225	36.8
Monash Medical Centre	267	111	41.6
Royal Hobart Hospital	183	99	54.1
John Hunter Hospital	180	137	76.1
Waikato Hospital	105	47	44.8
Townsville Hospital	85	35	41.2
Prince Charles Hospital	82	72	87.8
Whangarei Hospital	69	3	4.3
Royal Darwin Hospital	58	22	37.9
Mildura	49	16	32.7
Christchurch	48	44	91.7
Cairns Base Hospital	42	15	35.7
Tamworth Hospital	28	1	3.6
Canberra Hospital	20	13	65.0
Launceston Hospital	13	4	30.8
Austin	2	2	100.0

In Figures 4.4.2 and 4.4.3, the monthly admission numbers by diagnostic group, and monthly admission numbers by age group, are displayed for the 2007-2008 period. In the first figure, an increase in admissions for respiratory related conditions is apparent during the winter months. This pattern is reinforced by data presented in the second figure, where many of the respiratory admissions during the winter months are for children less than one year old. A comparison over two years shows the pattern repeating over time.

## Australia and New Zealand Paediatric Intensive Care Registry, 2008

Figure 4.4.2 Monthly admission numbers by diagnostic group, 2007–2008.

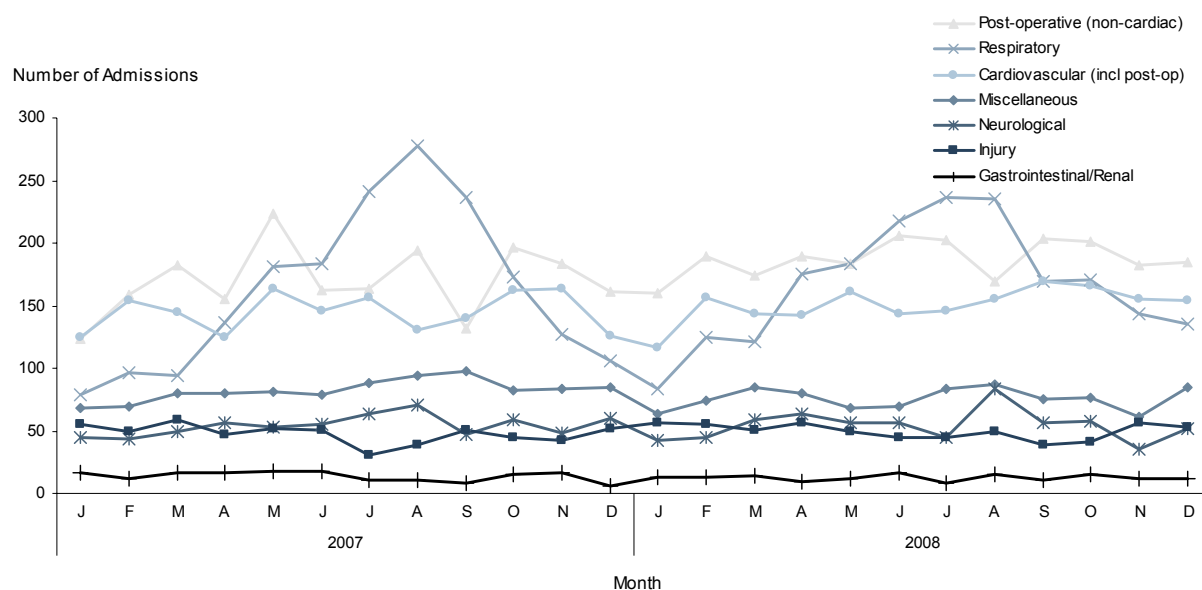
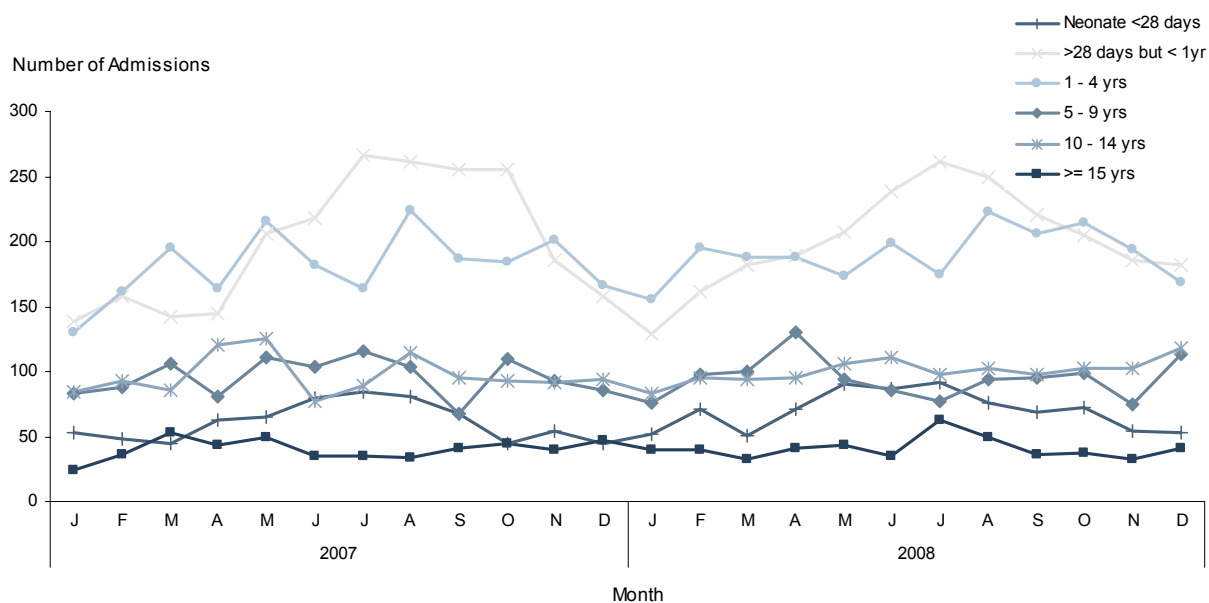


Figure 4.4.3 Monthly admission numbers by age, 2007–2008.



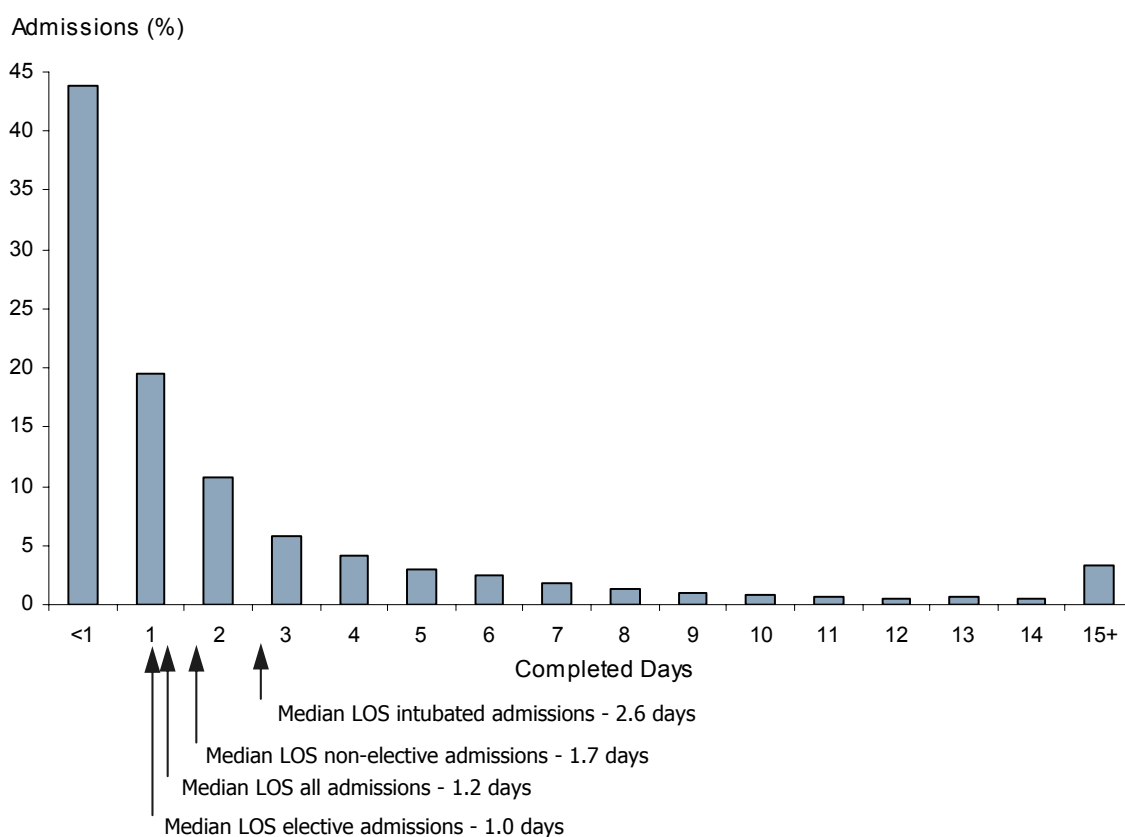
## 5. Length of Stay

### 5.1 Median Length of Stay

Length of Stay (LOS) is defined as the difference between discharge date and time, and admission date and time. The LOS data analysed in this report is only for patients surviving ICU. The ICU LOS is positively skewed with the majority of patients staying less than two days. (see Figure 5.1.1).

The median LOS was used to compare the LOS across groups. The median LOS was used as the measure of central tendency as the mean LOS is disproportionately influenced by prolonged admissions. For example, in 2008, 3.3% of patients had a length of stay greater than 14 days. These included 1.16% of patients who stayed longer than 28 days and occupied 19.8% of bed days. Four patients stayed in ICU longer than six months, occupying 4.7% of bed days.

Figure 5.1.1 Length of stay distribution in 2008.



Paediatric ICU LOS in Australia and New Zealand contrasts with that reported by PICANet in the UK, with 43.8% of admissions in ANZ staying less than 24 hours, while in the UK in 2008, it was 30.1% (see Table 5.1.1). The UK data also had a higher percentage of patients staying in ICU beyond one week.

Table 5.1.1 Comparison of ICU LOS between Australia &amp; New Zealand, and the United Kingdom in 2008.

LOS	ANZPIC Registry		PICANet	
	Frequency	%	Frequency	%
<1hr	9	0.1	28	0.2
1 - <4hrs	153	1.9	411	2.6
4 - <12hrs	738	9.1	1193	7.4
12 - <24hrs	2652	32.7	3204	19.9
1 - <3days	2451	30.2	5122	31.8
3 - <7 days	1255	15.5	3514	21.8
7+ days	853	10.5	2584	16.1

The median LOS varied depending on ICU classification (Figure 5.1.2), with PICUs having the longest stay (1.48), versus Metropolitan hospitals (1.17), and Regional hospitals (1.03). Expectedly, LOS varied amongst admission type (Table 5.1.2). The median LOS for intubated patients was 2.58 days, compared to 0.88 days for non-intubated patients. Non-elective admissions had a greater median LOS (1.67) compared to elective admissions (1.00). The Interquartile Range (IQR) is also shown for each of these measurements.

Figure 5.1.2 Median LOS and Interquartile Range (IQR) for all hospitals by ICU classification in 2008.

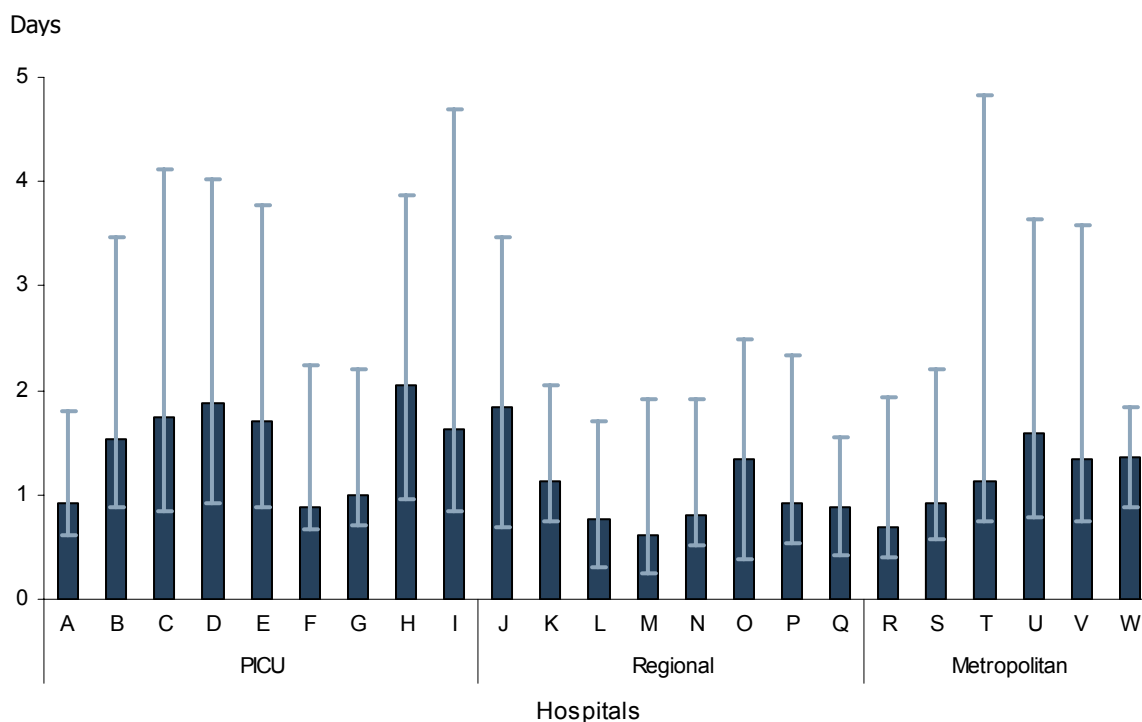
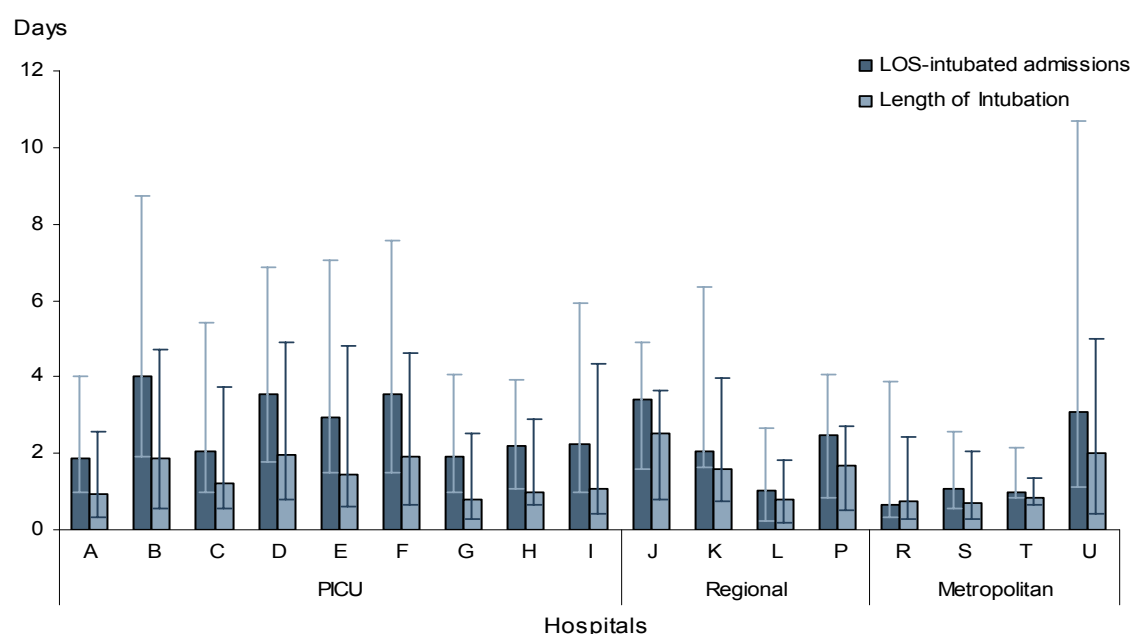


Table 5.1.2 Mean &amp; Median LOS, IQR, and percent of occupied bed days (OBD) by admission type, 2008.

	Mean LOS	Median LOS	IQR	OBD%
All admissions	3.45	1.21	0.8 - 3.2	100.0
Elective admissions	2.56	1.00	0.8 - 2.1	31.9
Non-elective admissions	4.13	1.67	0.8 - 4.3	68.1
Intubated admissions	5.49	2.58	1.0 - 5.8	75.7
Non-intubated admissions	1.60	0.88	0.6 - 1.7	24.3

Figure 5.1.3 displays the median LOS for intubated patients, and the median duration of intubation, for hospitals with intubated patients. Hospitals with <10 intubated admissions have been excluded ( $N = 5$ ) from this figure.

Figure 5.1.3 Median LOS and IQR for intubated admissions in each hospital, by ICU classification in 2008.



The LOS for each diagnostic group is summarised in Table 5.1.2. The longest LOS was observed in the gastrointestinal/renal diagnostic group (median LOS 2.13 days) followed by the respiratory diagnostic group (2.04 days).

Table 5.1.2 Mean &amp; Median LOS, IQR, and percent of OBD by principal diagnostic group, 2008.

Diagnostic Group	Mean LOS	Median LOS	IQR	OBD%
Cardiovascular(incl post-op)	4.08	1.83	1.0 - 4.0	25.7
Gastrointestinal/Renal	3.78	2.13	0.8 - 4.3	1.9
Injury	3.42	1.33	0.6 - 3.5	6.9
Miscellaneous	4.00	1.13	0.6 - 3.8	11.9
Neurological	3.48	1.19	0.7 - 2.6	7.6
Post-Operative(non-cardiac)	1.96	0.92	0.7 - 1.7	15.6
Respiratory	4.36	2.04	0.9 - 4.7	30.3

## 5.2 Occupied Bed Days

There were a total of 30,141 Occupied Bed Days (OBD) in 2008. Children aged > 28 days but less than one year occupied 33.5% of ICU bed days (Figure 5.2.1). Intubated admissions utilised 75.7% of bed days, while non-elective admissions utilised 68.1% of bed days (Table 5.1.2).

Patients who stayed in ICU longer than 28 days (1.16%) occupied a total of 5,561 (19.8%) bed days. Table 5.2.1 displays the admission diagnosis categories for patients who stayed longer than 28 days. Diagnoses associated with a requirement for long term respiratory support occupied the greatest number of bed days (31.3%).

Figure 5.2.1 Occupied Bed Days by age group and sex, 2008.

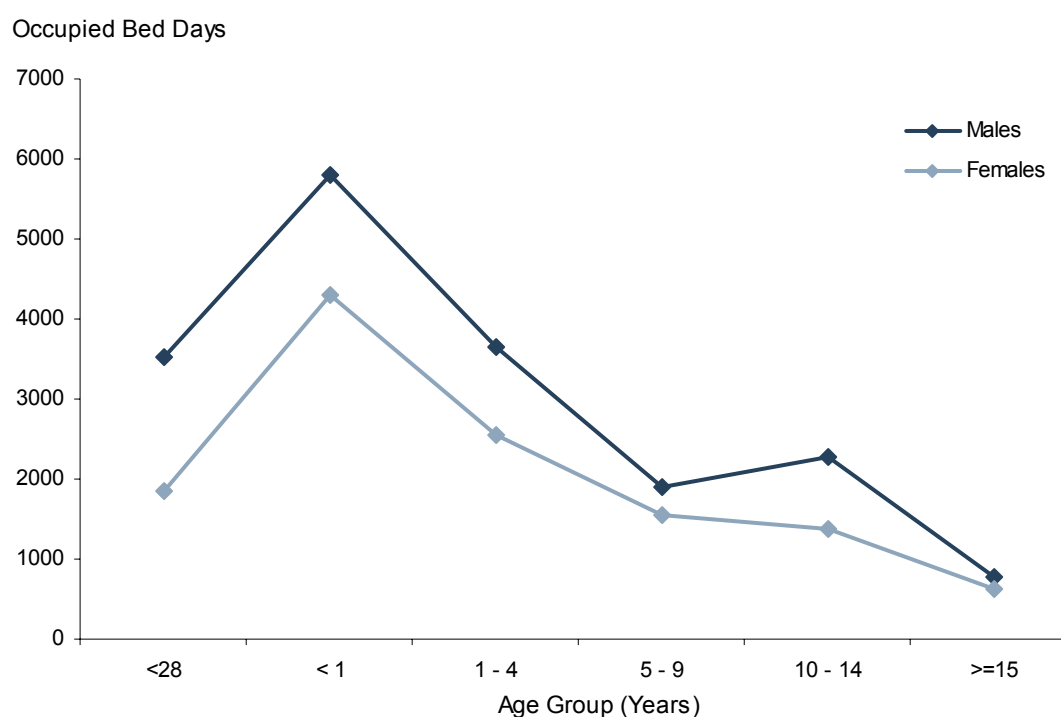


Table 5.2.1 Admission diagnoses for long stay patients (> 28 days), 2008.

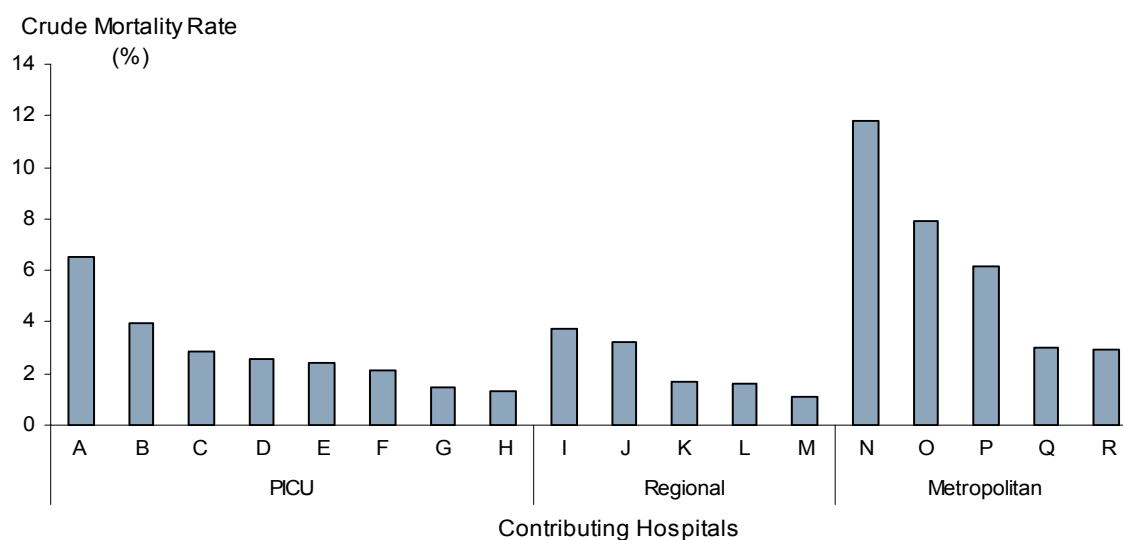
Diagnostic Group	Number of patients	Bed days	(% days)
Cardiovascular (incl post-op)	25	1834.7	28.1
Gastrointestinal/Renal	2	73.6	1.1
Injury	4	236.4	3.6
Miscellaneous	21	1052.5	16.1
Neurological	6	690.3	10.6
Post-Operative (non-cardiac)	11	591.8	9.1
Respiratory	37	2038.4	31.3

## 6. Mortality

### 6.1 Mortality Rates

The ANZPIC Registry collected data on ICU outcome and hospital outcome from all participating units. In 2008, 245 patients died in ICU. The crude mortality rate was 3.0% (Males 3.0%, Females 3.0%). This rate is consistent with previous reports where, over the past five years, annual rates have ranged from 2.9% to 3.6%. The crude mortality rates for each unit are shown in Figure 6.1.1. Hospitals that recorded <2 deaths were excluded (N=5). To ensure confidentiality of contributing sites, the hospital codes used in this section are not the same codes used in earlier sections.

Figure 6.1.1 Mortality rate for 18 hospitals by ICU classification in 2008.



In 2008 neonates recorded the highest age specific mortality (5.7%), followed by the >15 years age group (3.1%). The mortality rates in the other age groups ranged from 2.2 - 2.9% (Table 6.1.1).

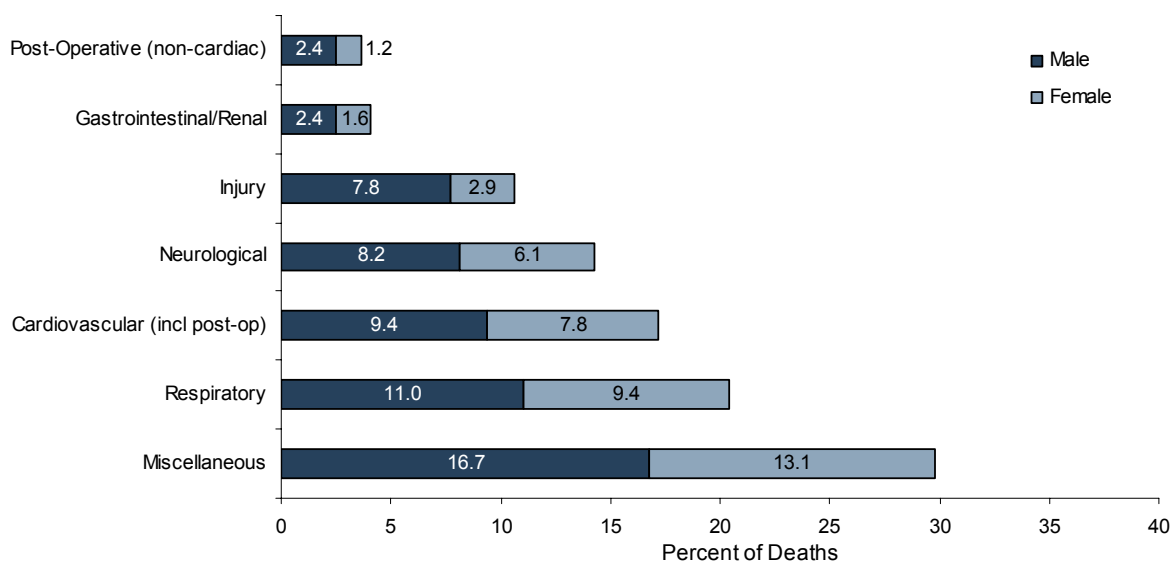
Table 6.1.1 Age specific mortality rates, 2008.

Age Group	Number	Deaths	Age Specific Mortality (95% CI)
Neonates <28 days	778	44	5.7 (4.0-7.3)
>28 days - <1 year	2368	65	2.7 (2.1-3.4)
1 - 4 years	2228	65	2.9 (2.2-3.6)
5 - 9 years	1117	25	2.2 (1.4-3.1)
10 - 14 years	1189	31	2.6 (1.7-3.5)
>= 15 years	485	15	3.1 (1.6-4.6)

## 6.2 Diagnosis Specific Mortality

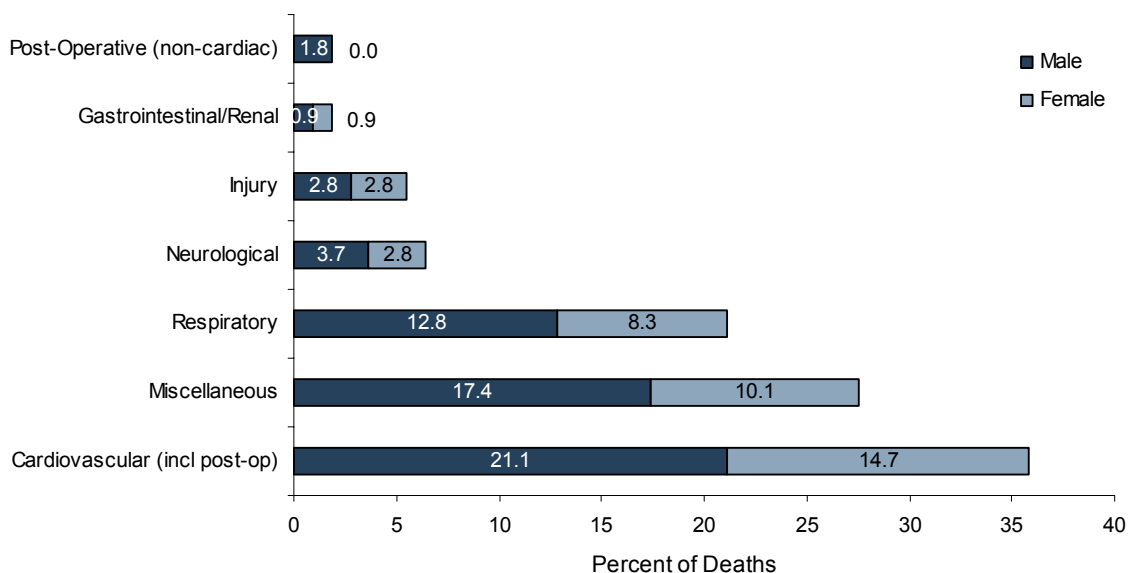
In 2008, 29.8% of all deaths had a principal diagnosis in the miscellaneous diagnostic category (Figure 6.2.1). Within this category, 28.8% of deaths were for children who had been admitted with septic shock. Other diagnoses in this category leading to death were cardiac arrest out of hospital (28.8%) and cardiac arrest in hospital (16.4%). Children admitted with head trauma comprised 7.8% of all deaths. The mortality rates for males were greater than or equal to female mortality rates in all diagnostic categories. The injury category accounted for 13.4% of all male deaths, yet only 6.8% of female deaths.

Figure 6.2.1 Diagnostic categories of patients not surviving ICU, by sex in 2008.



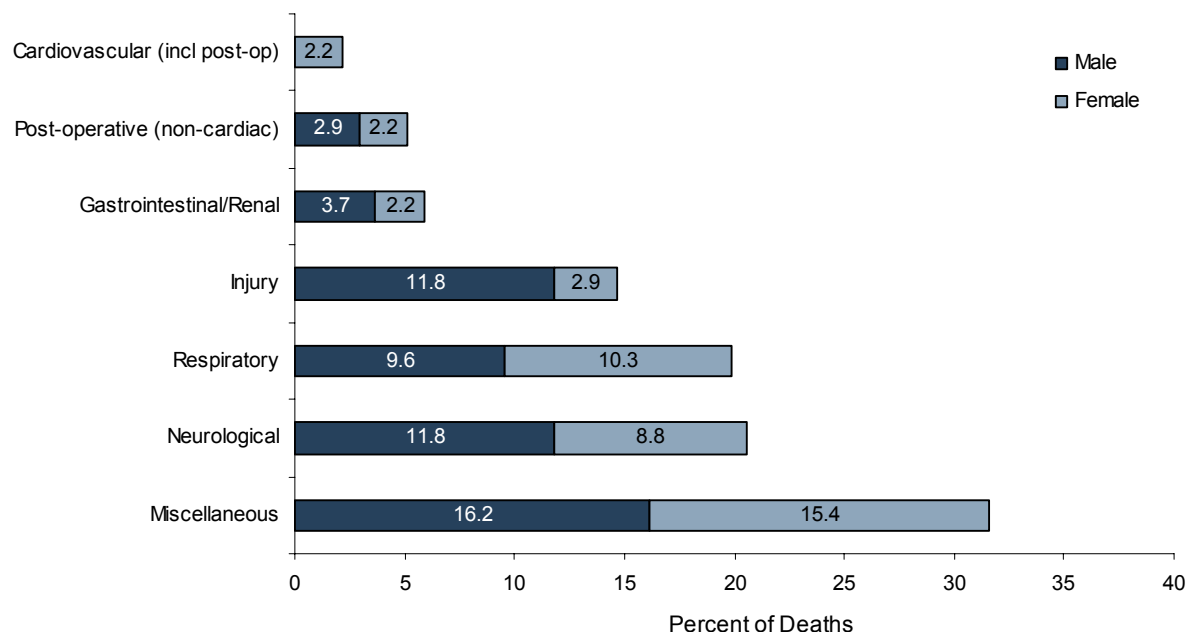
The proportion of deaths in specific diagnosis groups varied across age groups. The highest proportion of deaths among infants less than one year old was recorded in the cardiovascular post-op category (35.8%), of which 41% were congenital cardiovascular conditions.

Figure 6.2.2 Diagnostic categories of patients aged < 1 year not surviving ICU, by sex, 2008.



In 2008 the highest proportion of deaths for the 1 - 15 year age group was the miscellaneous category (31.6%), with out of hospital cardiac arrest comprising 34.9% of deaths in this category, and 11% of deaths overall in this age group. A further 10% of deaths in this age group were children admitted with head trauma.

Figure 6.2.3 Diagnostic categories of patients aged 1 - 15 years not surviving ICU, by sex, 2008.



### 6.3 Paediatric Cardiac Surgery (PCS)

From 2007 onwards, it was decided to collect additional registry fields to enable the calculation of a RACHS (risk adjustment for congenital heart surgery) (9) score for patients in ICU who had undergone cardiac surgery. In Australia, the majority of paediatric cardiac surgery (PCS) is performed at the Royal Children's Hospital in Melbourne, the Children's Hospital at Westmead, the Sydney Children's Hospital, the Princess Margaret Hospital in Perth, and, from April 2008 onwards, the Mater Hospital in Brisbane (previously performed at the Prince Charles' Hospital in Brisbane). In New Zealand, this surgery is performed at the Starship Hospital in Auckland.

The Registry's list of diagnoses was also expanded in 2007 to include all cardiac procedures in the six risk categories for RACHS. Table 6.3.1 gives a breakdown of the number of cardiac procedures recorded, listed in RACHS risk category order. As up to six procedures can be recorded for each admission, the numbers in the table represent total procedures, not admissions.

## Australia and New Zealand Paediatric Intensive Care Registry, 2008

Table 6.3.1 Occurrences of cardiac surgical procedures, 2008.

RACHS Category	Procedure	Frequency
1	Aortopexy	2
	ASD surgery	152
	Coarction repair >30d of age	66
	Partially anomalous pulmonary venous connection surgery	22
	PDA surgery >30d of age	86
	<b>Total</b>	<b>328</b>
2	Aortic valvotomy - valvuloplasty >30d of age	54
	ASD and VSD repair	78
	ASD primum repair	17
	Coarction repair <=30d of age	54
	Glenn shunt	86
	Pulmonary outflow tract augmentation	40
	Pulmonary valve replacement	22
	Pulmonary valvotomy - valvuloplasty	22
	Repair of AP window	3
	Repair of coronary AV fistula	1
	Repair of pulmonary artery stenosis	26
	Repair of total anomalous pulmonary veins >30d of age	15
	Repair of unspecified septal defect	1
	Right ventricular infundibulectomy	11
	Subaortic stenosis resection	29
	Total repair of tetralogy of Fallot	96
	Vascular ring surgery	12
	VSD closure and pulmonary artery band removal	17
VSD closure and pulmonary valvotomy or infundibular resection	17	
VSD repair	171	
	<b>Total</b>	<b>772</b>
3	Annuloplasty	7
	Aortic valve replacement	29
	Aortoplasty (not arch)	8
	Arterial switch operation	64
	Atrial switch operation	5
	Excision of intracardiac tumour	4
	Fontan procedure	51
	Left ventricular outflow tract patch	5
	Mitral valve replacement	18
	Mitral valvotomy - valvuloplasty	71
	Pulmonary artery banding	46
	Reimplantation of anomalous pulmonary artery	2
	Repair anomalous coronary art. with intrapulmonary tunnel (Takeuchi)	3
	Repair of anomalous coronary artery repair w/o intrapulmonary tunnel	3
	Repair of coarction and VSD closure	7
	Repair of cor triatriatum	4
	Repair of double-outlet right ventricle with/without repair of right ventricle	5
	Repair of tetralogy of Fallot with pulmonary atresia	6
	Repair of transitional/complete atrioventricular canal with/without valve	66
	Right ventricular to pulmonary artery conduit	64
	Ross procedure	10
Systemic to pulmonary artery shunt	120	
Tricuspid valve replacement	1	
Tricuspid valve repositioning for Ebstein anomaly >30d of age	2	
Tricuspid valvotomy - valvuloplasty	45	
Ventriculomyotomy	5	
	<b>Total</b>	<b>651</b>
4	Aortic valvotomy - valvuloplasty <=30d of age	5
	Arterial switch operation with pulmonary artery band removal	1
	Arterial switch operation with repair of sub PS	3
	Arterial switch operation with VSD closure	24
	Atrial septectomy	35
	Atrial switch operation with VSD closure	2
	Complex anomaly (single ventricle) repair by VSD enlargement	2
	Double switch	1
	Hypoplastic or interrupted arch repair with VSD closure	15
	Hypoplastic or interrupted arch repair without VSD closure	20
	Konno procedure	5
	Repair of transposition-VSD sub PS (Rastelli)	3
	Total repair of anomalous pulmonary veins <=30d of age	19
	Transverse arch graft	11
	Truncus arteriosus repair	11
Unifocalization for tetralogy of Fallot - pulmonary atresia	9	
	<b>Total</b>	<b>166</b>
5	Tricuspid valve repositioning for neonatal Ebstein <=30d of age	2
	Truncus arteriosus and interrupted arch repair	2
	<b>Total</b>	<b>4</b>
6	Damus-Kaye-Stansel procedure	14
	Stage 1 repair of hypoplastic left heart syndrome (Norwood)	33
	Stage 1 repair of nonhypoplastic left heart syndrome conditions	3
	<b>Total</b>	<b>50</b>
Unclassified	Cardiac Surgery Closed – Other	58
	Cardiac Surgery Open – Other	58
	PA Plasty or Repair	12
	Pacemaker insertion/replacement	31
	PDA surgery <= 30 days	50
Transplant – Heart	12	
	<b>Total</b>	<b>221</b>

A summary of the patient based cardiac surgery mortality data is given in Table 6.3.2. If more than one procedure was performed at a single operation or during the ICU episode, the case was classified based on the procedure with the highest RACHS category.

In 2008 there were 1462 children admitted to PICU following cardiac surgery or receiving cardiac surgery during their ICU admission. There were 40 deaths during their hospitalisation (including eight after ICU discharge), giving a crude mortality of 2.7% which was slightly higher than the 2007 rate of 1.7%. As expected, the mortality varied with surgical complexity (Table 6.3.2).

As the Registry has collected RACHS data in 2007 and 2008, further analyses will now be carried out to determine the performance of the RACHS model in the Australia and New Zealand setting.

Table 6.3.2 Mortality in cardiac surgery cases, 2008.

	Total Number	% of total	Number of Deaths	Unadjusted mortality rate (%)
<b>Total</b>	1462	100	40	2.7
<b>Highest RACHS category for patient</b>				
1	200	13.7	2	1.0
2	535	36.6	3	0.6
3	530	36.3	11	2.1
4	146	10.0	13	8.9
5	4	0.3	2	50.0
6	47	3.2	9	19.1

#### 6.4 Risk Adjusted Mortality (PIM2)

Risk adjusted standardised mortality ratios (SMR) were calculated for each unit contributing to the ANZPIC Registry. The SMR is the ratio of the number of deaths observed in a given population to the number of deaths predicted for that population. A logistic regression model is used to calculate the expected number of deaths for the population. The Paediatric Index of Mortality, PIM2 (1), is the model used by the ANZPIC Registry for this purpose.

Risk adjusted mortality prediction models drift in calibration over time. This has occurred with PIM2 risk of death where the SMR for all patient records in the Registry for 2006 to 2008 was 0.81 (95% CI 0.75-0.86). To overcome this drift in calibration the model was recalibrated before the production of this 2008 Annual Report using patient records for 2007 and 2008 only. The new calculation, referred to as PIM2-ANZ08, is described in Table 6.4.1 The variable definitions have not changed from the variable definitions used for PIM2. The recalibration results in new variable coefficients and has the effect of resetting the SMR for the population to 1.0. In this report we have included results using both PIM2 and PIM2-ANZ08. The PIM2 results allow comparison over time against the standard that has been used since 2003. The PIM2-ANZ08 results allow comparison against the standard of care in Australia and New Zealand in 2007 and 2008.

Table 6.4.1 PIM2-ANZ08 logistic regression model (n=16088, 506 deaths)

PIM2-ANZ08 Variables	Coefficient	95% CI
Absolute (SBP-120), mmHg	0.0100186	0.0052202 to 0.014817
Pupils fixed to light (Y/N)	4.613758	3.935058 to 5.292459
100 x FiO <sub>2</sub> /PaO <sub>2</sub> , mmHg <sup>-1</sup>	0.3986429	0.2306107 to 0.5666752
Absolute (base excess), mmol/l	0.0606854	0.0421815 to 0.0791894
Mechanical ventilation (Y/N)	1.087207	0.8126181 to 1.361796
Elective admission (Y/N)	-0.2564245	-0.687692 to 0.174843
Recovery post procedure (Y/N)	-1.864904	-2.371753 to -1.358054
Bypass (Y/N)	-0.1319602	-0.7609757 to 0.4970552
High risk diagnosis (Y/N)	1.702392	1.479056 to 1.925727
Low risk diagnosis (Y/N)	-2.1124	-2.781772 to -1.443027
Constant	-4.598864	-4.877859 to -4.319869

Hosmer-Lemeshow goodness-of-fit  $\chi^2 = 6.05$ , 8df,  $p=0.6411$

Figure 6.4.1 displays the SMRs with 95% confidence intervals for PIM2 and PIM2-ANZ08 for seven PICUs in 2008. Two PICUs, as well as the metropolitan and regional hospitals, were excluded from Figure 6.4.1 as they recorded less than ten deaths in the year. For all seven PICUs, the 95% confidence interval of the SMRs included the number 1.0, which indicates that for those units, the observed outcome was not significantly different from the expected outcome. This interpretation held for both PIM2 and also the recalibrated PIM2-ANZ08.

Figure 6.4.1 Standardised mortality rates (based on PIM2 & PIM2-ANZ08) with 95% confidence intervals for seven PICUs in 2008.

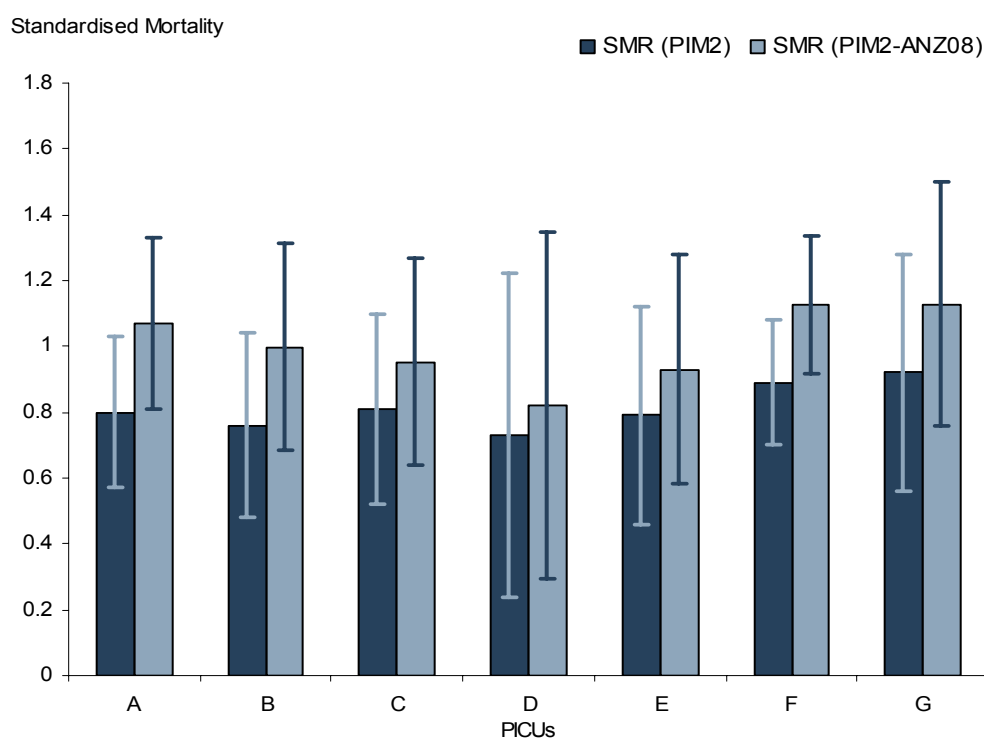


Figure 6.4.2 illustrates the distribution of PIM2-ANZ08 mortality risk for patients submitted to the Registry. The majority of children admitted to ICU have a low risk of mortality.

Figure 6.4.2 Number of admissions and vital status at discharge by PIM2-ANZ08 mortality risk category, 2008.

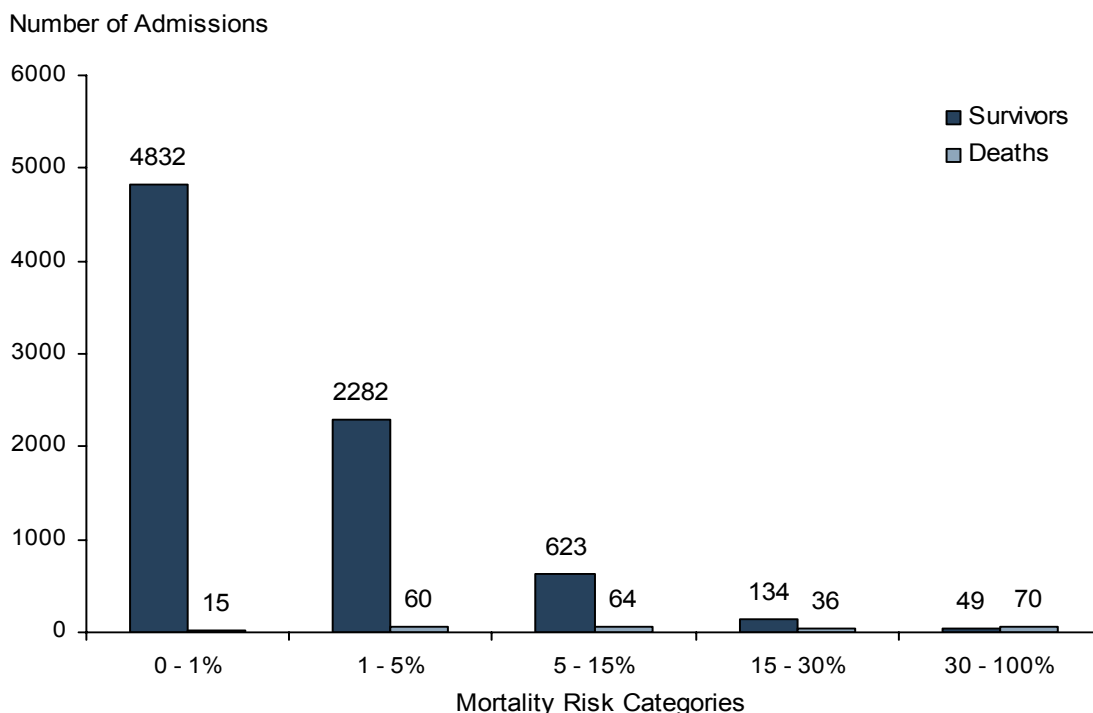
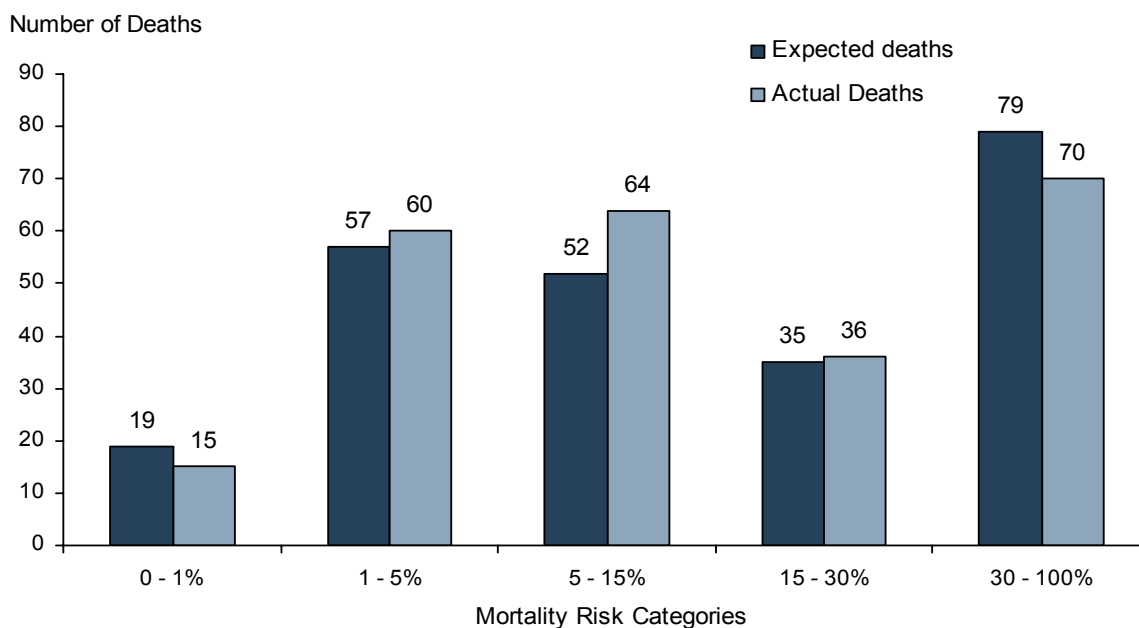


Figure 6.4.3 compares the observed deaths to the expected number of deaths using PIM2-ANZ08 risk of death in the five mortality risk categories.

Figure 6.4.3 Observed vs Expected number of deaths by PIM2-ANZ08 mortality risk category in 2008.

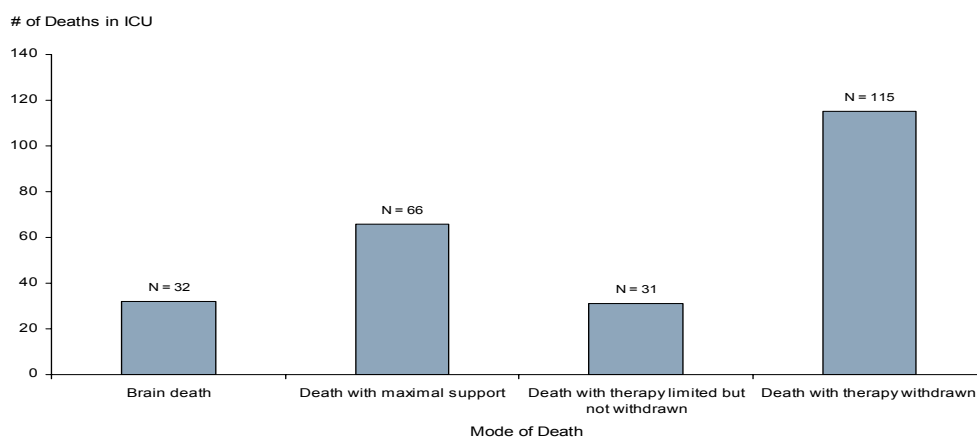


### 6.5 Mode of Death and Organ Donation

In 2005, the minimum data set was expanded to collect additional information for patients who died in ICUs. These fields include information on organ donation and the level of intervention in place at the time of death, and have been summarized in annual reports since then.

Figure 6.5.1 summarizes the mode of death and level of intervention in place for the 245 patients who died in 2008. Sixty percent (146) of the deaths occurred after therapy was limited or withdrawn, and eight of these were additional brain deaths.

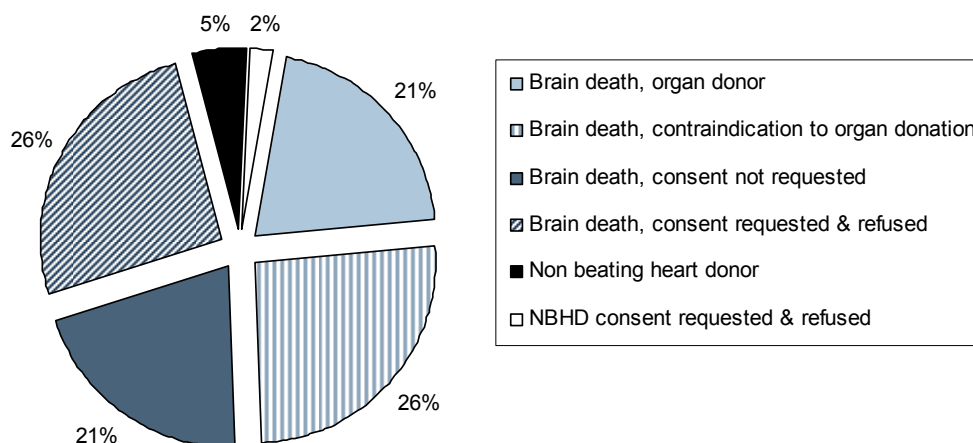
Figure 6.5.1 Mode of death for all\* patients who died in ICU in 2008.



\*missing data for 1 patient

When considering organ donation from the children who had died, the majority of deaths (201) were in patients where brain death was not present and were not considered for non-beating heart donors (NBHD). Where brain death was diagnosed (n=40), organ donation was contraindicated for 11 of the patients, and not requested in 9 cases. Of the remaining patients, consent for organ donation was requested in 20 cases and consent obtained in 9 of those cases. In addition to the patients meeting brain death criteria, consent for NBHD was requested in three patients and consented in two of those cases. Figure 6.5.2 summarizes the response to organ donation for the 43 patients where organ donation was considered.

Figure 6.5.2 Organ donation responses for the 43 deaths in ICU with brain death or potential non-beating heart donation, in 2008.



## 7. Monitoring Performance of Paediatric Intensive Care

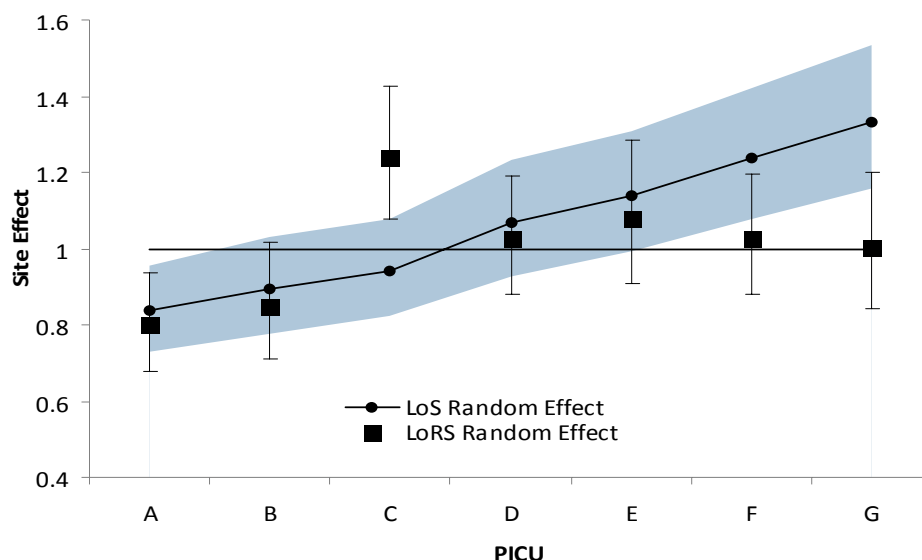
In order to assess PICU performance and benchmark performance between units, it is necessary to have methods to adjust outcome based on patient risk factors. Methods for risk adjusting mortality have been available for many years. The funnel plots (Figures 7.3.1 and 7.3.2) and the sequential control charts (Figures 7.4.1 to 7.4.8) represent the results of analysis of risk adjusted mortality. These figures were constructed using the recalibrated PIM2 model (PIM2-ANZ08). In this report we are able, for the first time, to use a new method for risk adjusting PICU length of stay (LOS) and length of respiratory support (LORS) (Figure 7.1.1). Finally, risk adjusted mortality and LOS are used together to generate a measure of unit efficiency represented by the modified Rapoport-Teres plot (Figure 7.2.1).

### 7.1 Risk adjusted Length of Stay and Length of Respiratory Support

A gamma regression model of LOS and a lognormal regression model of LORS were constructed using all patient records in the Registry for 2008 (10,13). Both models included the unit the patient was managed in as a random effect. Therefore, for each unit, a 'site effect' was generated that represents the risk adjusted mean LOS and mean LORS relative to the population overall. For example, a site effect of 1.2 for LOS indicates that the risk adjusted mean LOS for that ICU was 1.2 times the risk adjusted mean LOS for the Registry overall. Units where the 95% confidence interval for the site effect did not include one were considered significant.

Figure 7.1.1 illustrates the results of the analysis for seven PICUs in 2008; one PICU was excluded from the analysis as the unit did not collect data on LORS. The figure illustrates that unit A had a significantly shorter risk adjusted mean LOS while units F and G had significantly longer risk adjusted LOS than the population overall. The prolonged LOS in units F and G was not associated in either unit with prolonged LORS suggesting that in these units administrative factors were more likely than clinical factors to be influencing LOS. Administrative factors potentially associated with prolonged LOS include ICU exit block or step down facilities provided within the ICU. Unit C had a risk adjusted mean LORS that was significantly longer than the population overall, however this was not associated with prolonged LOS.

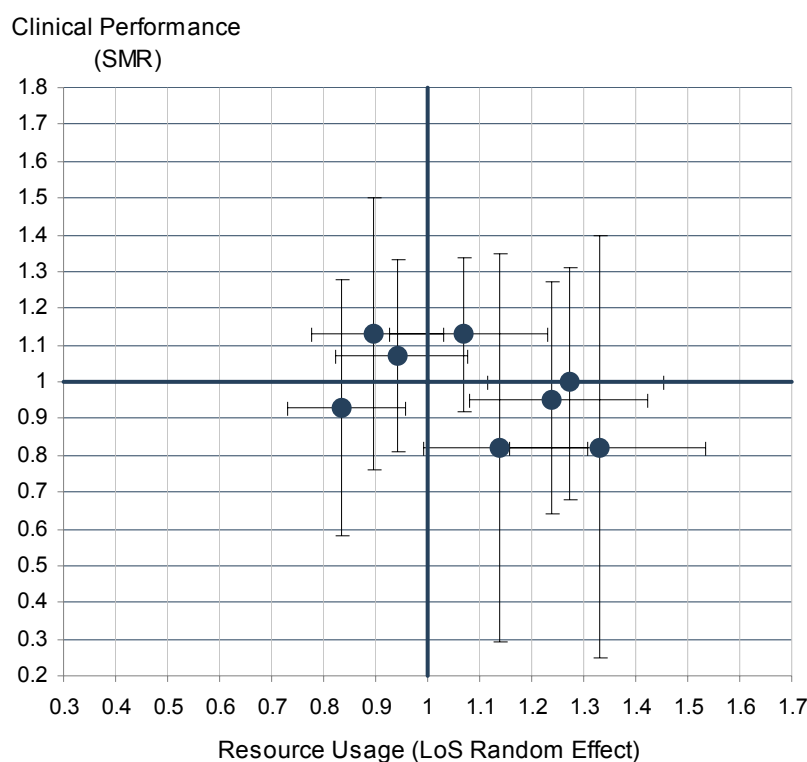
Figure 7.1.1 Risk adjusted mean LOS and LORS for PICUs in 2008.



## 7.2 PICU Efficiency

Efficiency in healthcare is a measure of both the effectiveness and cost of care. For intensive care, a unit can be considered efficient if optimum clinical outcomes are achieved with low resource use. Figure 7.2.1, a modified Rapoport-Teres plot, provides a simple visual representation of PICU efficiency. The standardised mortality rate (SMR) serves as an indicator of intensive care clinical performance, while the site effect for mean length of stay (LOS) provides a marker of resource use. When considered together, the plot illustrates efficiency (11). The quadrants of the plot can be designated as most efficient, least efficient, effective but at the expense of high resource use and poor performance.

Figure 7.2.1 Rapoport-Teres plot of efficiency for PICUs, in 2008.



## 7.3 Risk adjusted mortality

Funnel plots (Figures 7.3.1 and 7.3.2) have been used as an alternative graphical representation of the SMRs for each site. As a comparative report, the funnel plot compares a unit's SMR against the SMRs of all units within the Registry. This plot can identify potential outliers, as they will fall outside the control lines. Figure 7.3.1 represents values from each site in 2008, while Figure 7.3.2 combines their data for 2007 and 2008. Both PICUs and general ICUs are represented on the funnel plots. No outliers were identified using this method.

Figure 7.3.1 Funnel plot representation of PIM2-ANZ08 SMRs for contributing sites in 2008.

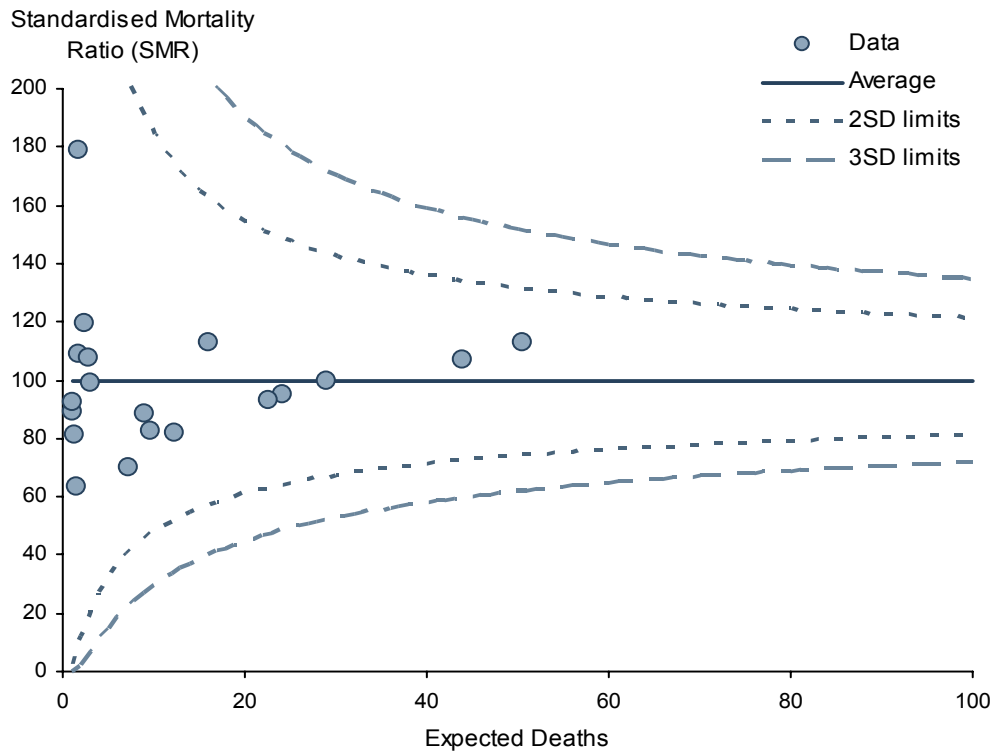
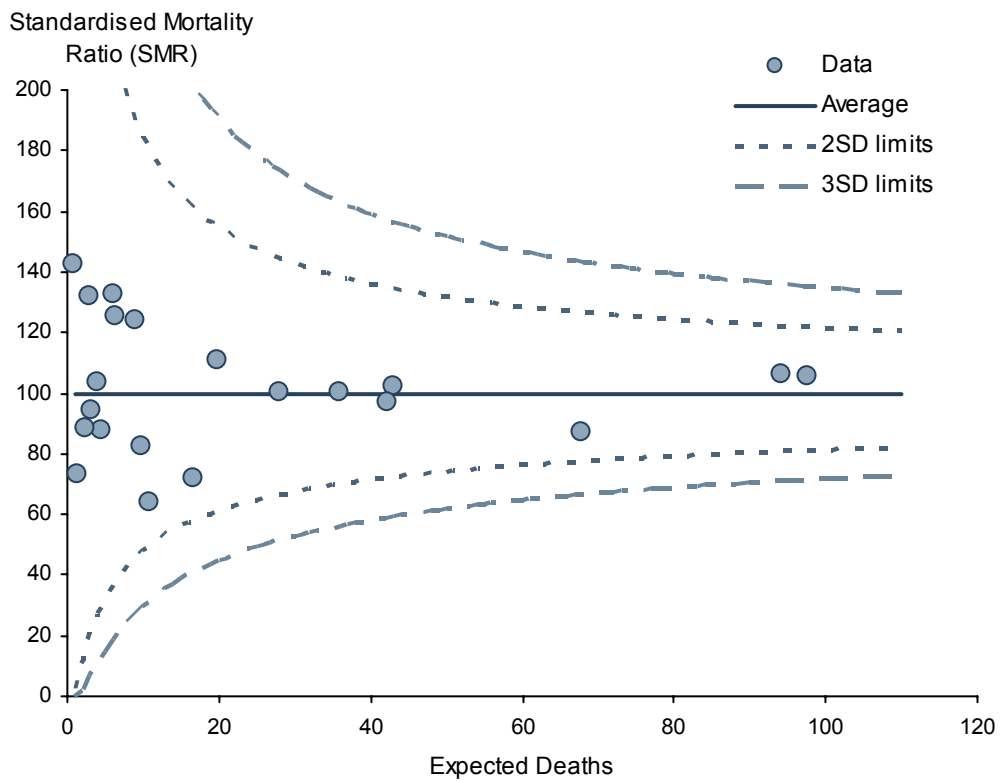


Figure 7.3.2 Funnel plot representation of PIM2-ANZ08 SMRs for sites using combined 2007 and 2008 data.



#### 7.4 Sequential Control Charts (CUSUMS)

CUSUM charts (8) have been constructed for eight units with greater than 200 admissions per year for the years 2007 and 2008 (Figures 7.4.1 - 7.4.8). To construct the risk adjusted Cumulative sum charts, the PIM2-ANZ08 model was used. Therefore these charts test for 'out-of-control' signals where the loss of control is defined as doubling or halving of the odds of death in the test ICU relative to all paediatric patients admitted to intensive care in Australia and New Zealand during 2007 and 2008 that were reported to the Registry.

The upper chart in each figure represents the cumulative excess deaths. The dark blue line represents the cumulative number of excess deaths - relative to the number of deaths predicted by PIM2-ANZ08. The light blue line represents the cumulative number of excess deaths without adjustment for mortality risk, using an expected crude mortality of 3.34%, and illustrates the effect of risk adjustment. The lower chart represents sequential probability ratio testing for an increase or decrease in the odds of death.

For both charts the x axis represents each admission to ICU in sequence for the two year period 2007 - 2008. The y axis in the upper chart represents the cumulative excess deaths that have occurred relative to the number of deaths predicted. The y axis in the lower chart represents 'process control' where the process is the cumulative observed outcome relative to that predicted by PIM2-ANZ08. The chart is designed to test two hypotheses; Hypothesis A (HA) that the odds of deaths in the unit have doubled relative to the population used to derive PIM2-ANZ08, and Hypothesis B (HB) that the odds of death in the unit have halved relative to the PIM2-ANZ08 population.

If the upper line crosses the control limits, HA is accepted, whereas if the lower line crosses the control limits HB is accepted. The control limits of  $\pm 2.9$  and  $\pm 4.6$  are set arbitrarily. Conceptually the control limits correspond to the hypotheses being accepted at  $\alpha = \beta = 0.05$  ( $\pm 2.9$ ) or at  $\alpha = \beta = 0.01$  ( $\pm 4.6$ ). It should be noted, however, that the resetting of the chart and repeated testing mean that the thresholds no longer represent true probabilities, but become more pragmatic thresholds for deciding if the process is in or out of control. For a more detailed explanation of the methods of constructing these charts and their interpretation see reference (8).

For the two year period there was one alarm signalled by the charts for all of the PICUs (Figures 7.4.1 - 7.4.8). The chart for unit F signalled an alarm for an increase in the odds of death in 2008 (Figure 7.4.6). It can be seen from the figure that the 'process as out of control' for a period in early 2008 that represents approximately 300 admissions, but did not remain 'out of control' for the remainder of 2008. The SMR for 2008 overall for this unit was 'in control' (see Figure 7.3.1). Therefore this signal may represent a chance clustering of cases. The unit has been notified of the signal so that alternative explanations relating to the process of care can be investigated. While it is important that the signal is investigated, it should be remembered that the expected frequency of false alarms from this method of sequential probability ratio testing has been estimated to be once in every 800 to 1800 cases (8).

Figure 7.4.1 Sequential cumulative sum control chart for doubling and halving the odds of death for PICU A, 2007 - 2008.

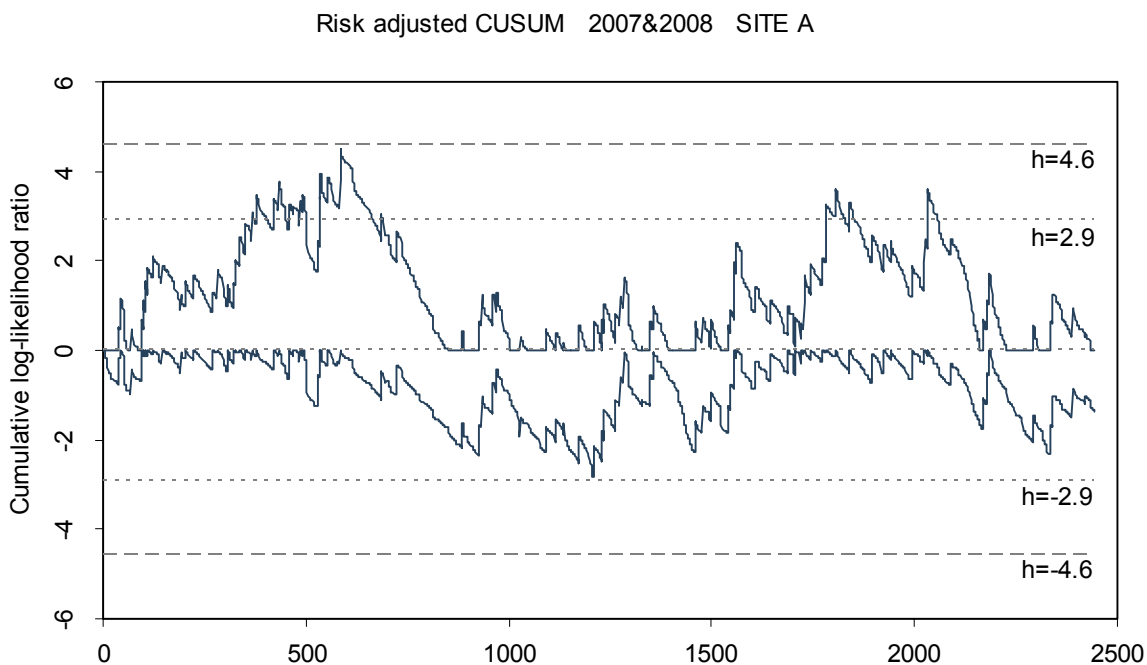
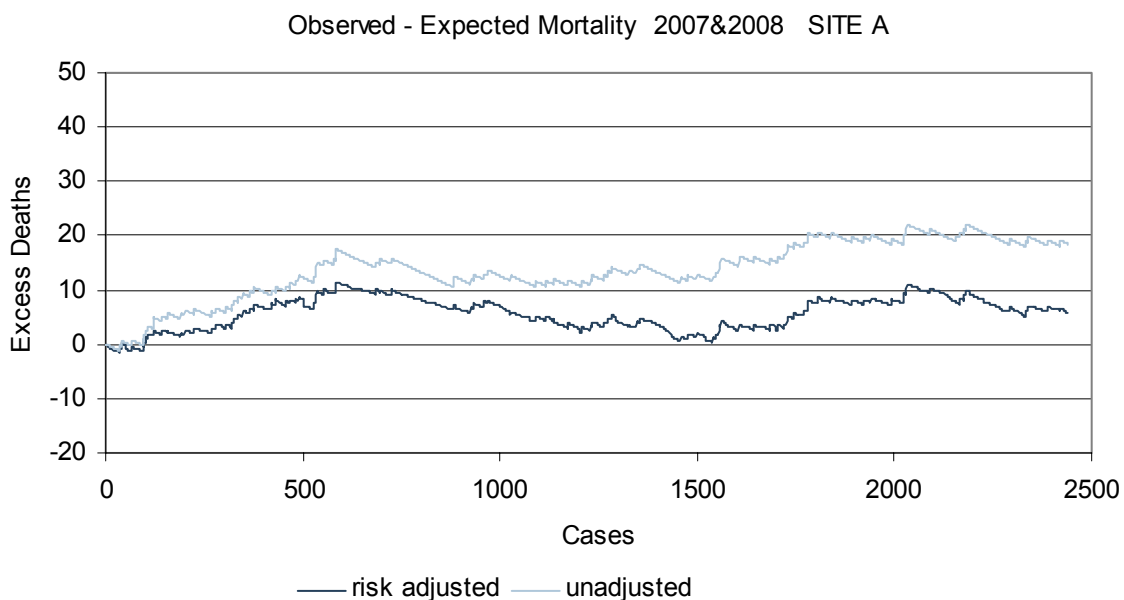


Figure 7.4.2 Sequential cumulative sum control chart for doubling and halving the odds of death for PICU B, 2007 - 2008.

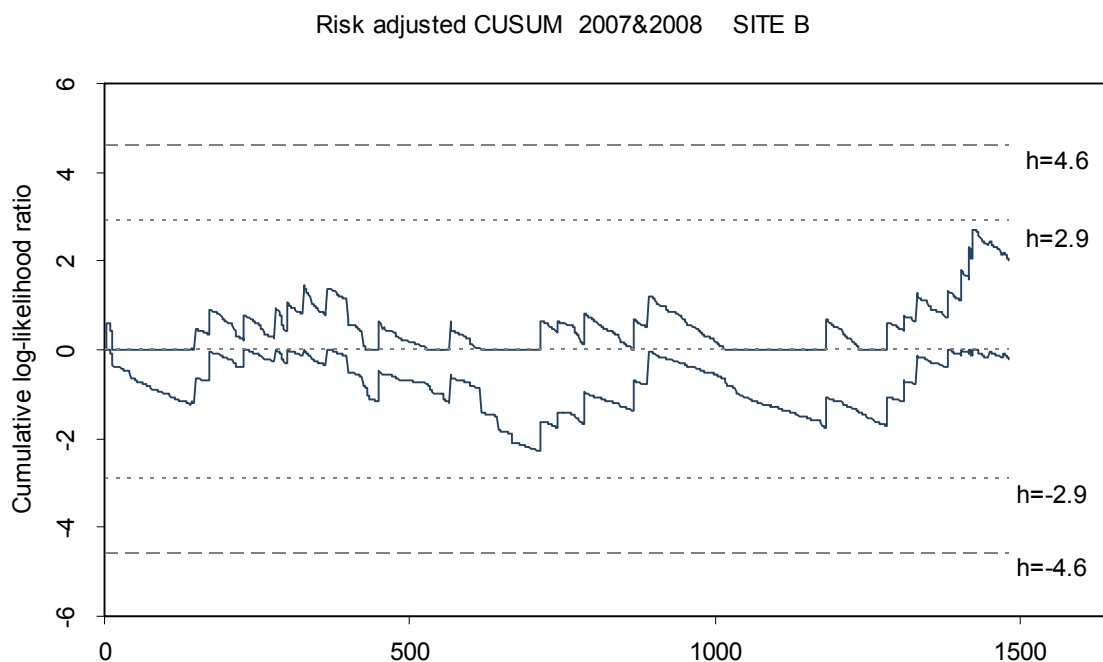


Figure 7.4.3 Sequential cumulative sum control chart for doubling and halving the odds of death for PICU C, 2007 - 2008.

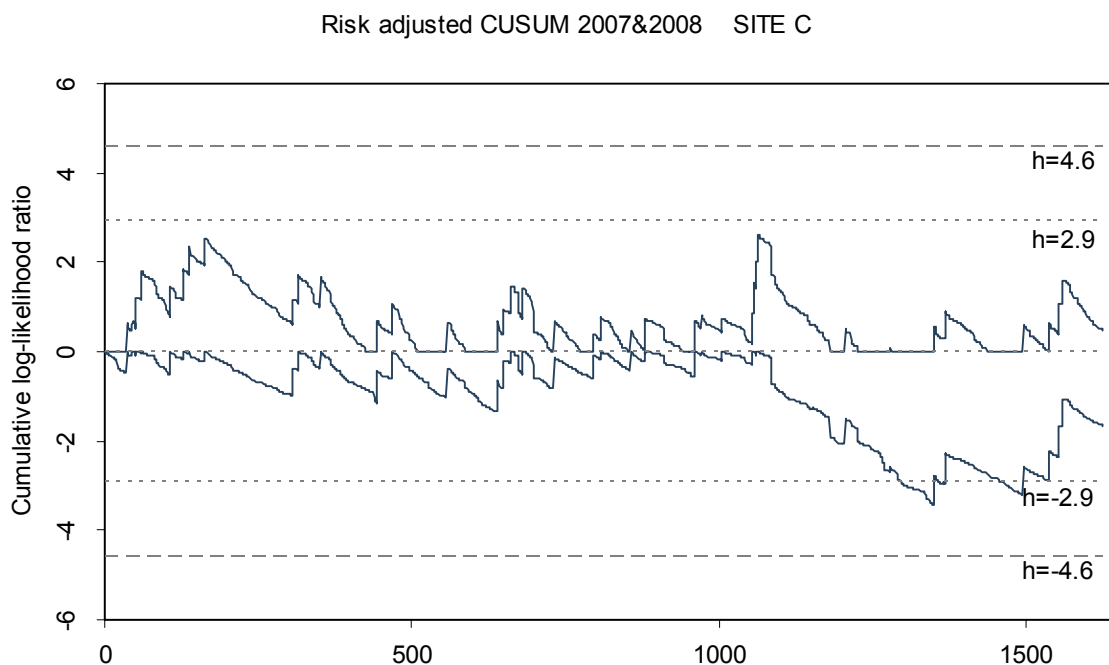
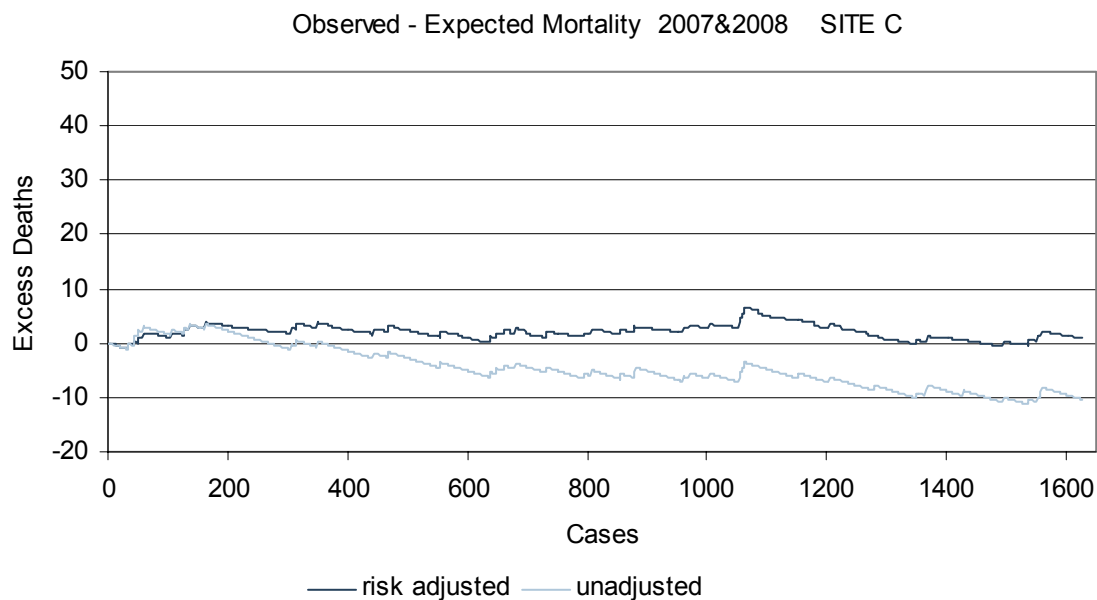


Figure 7.4.4 Sequential cumulative sum control chart for doubling and halving the odds of death for PICU D, 2007 - 2008.

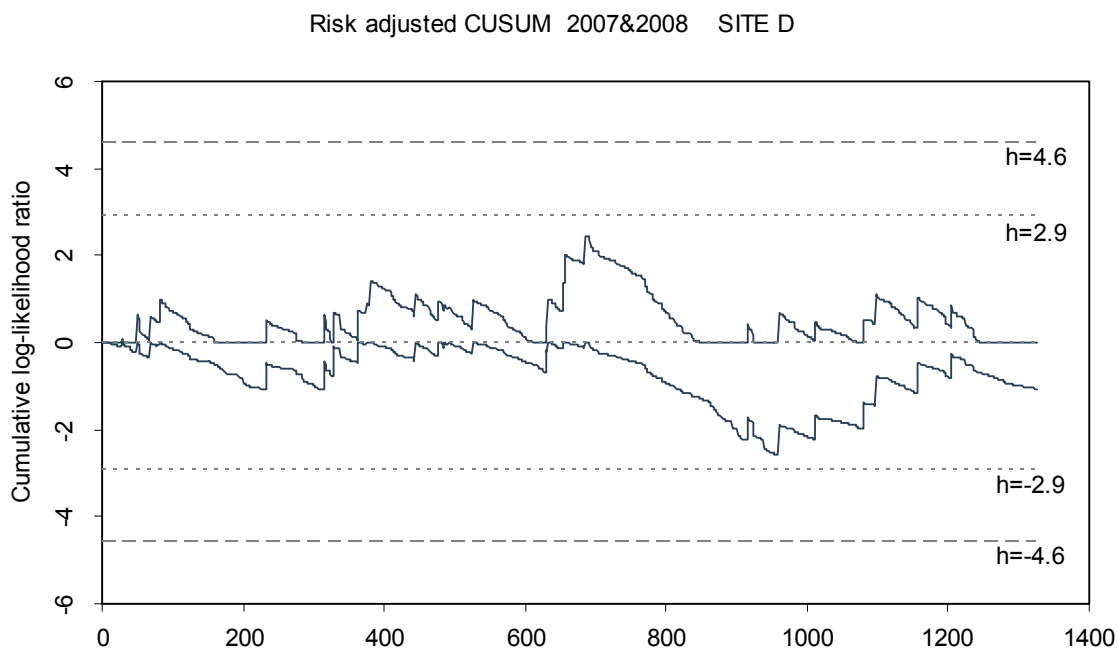


Figure 7.4.5 Sequential cumulative sum control chart for doubling and halving the odds of death for PICU E, 2007 - 2008.

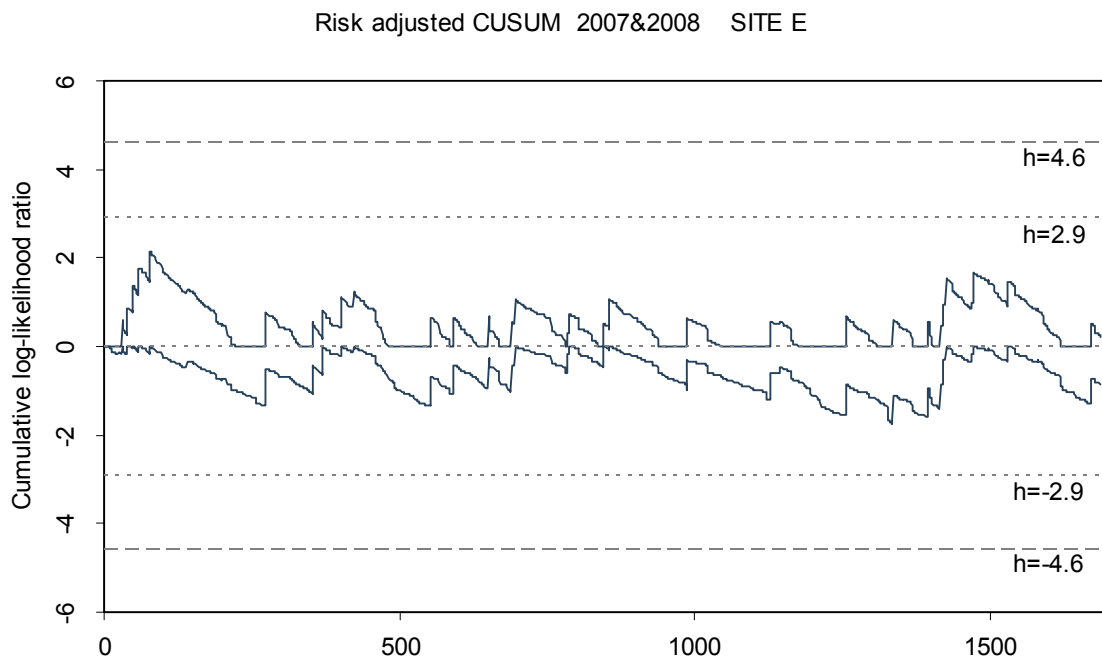


Figure 7.4.6 Sequential cumulative sum control chart for doubling and halving the odds of death for PICU F, 2007 - 2008.

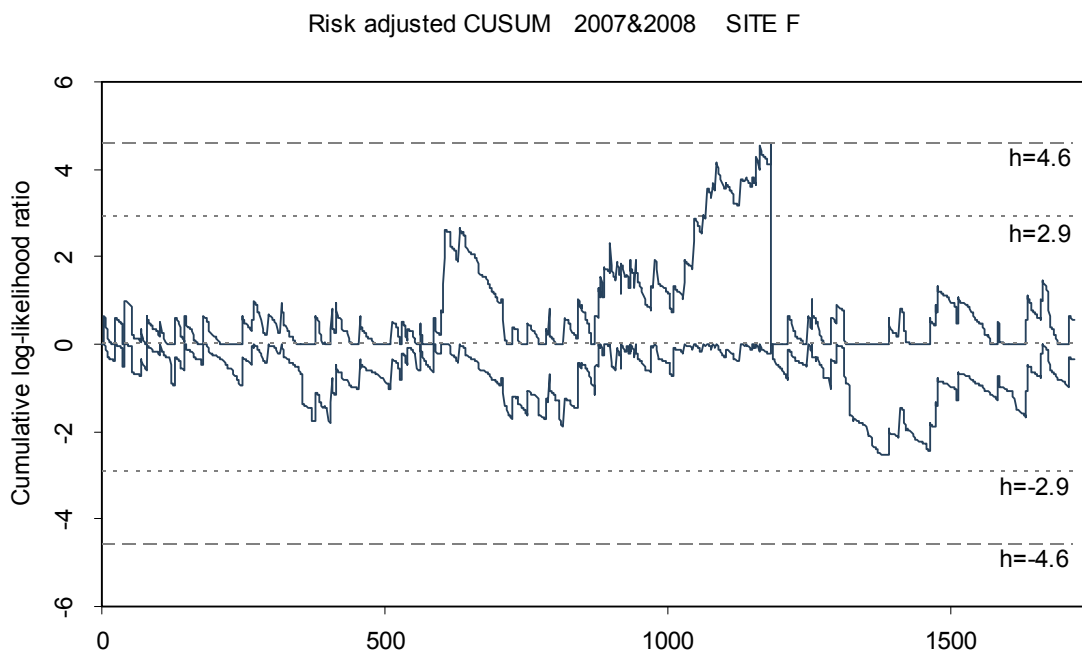


Figure 7.4.7 Sequential cumulative sum control chart for doubling and halving the odds of death for PICU G, 2007 - 2008.

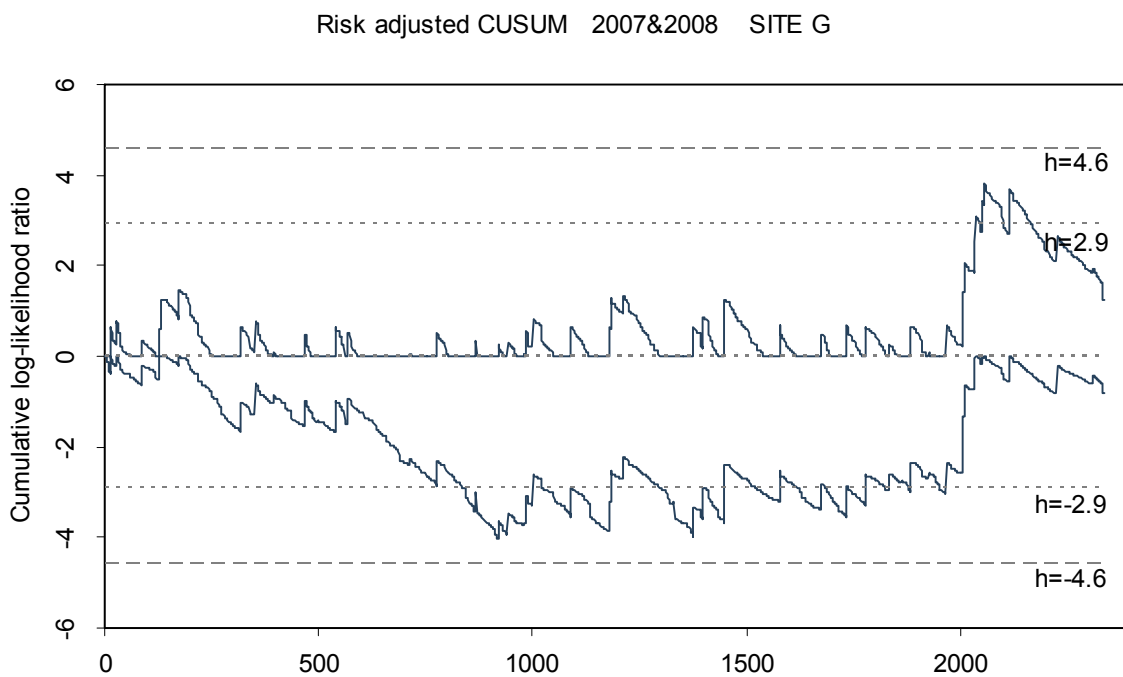
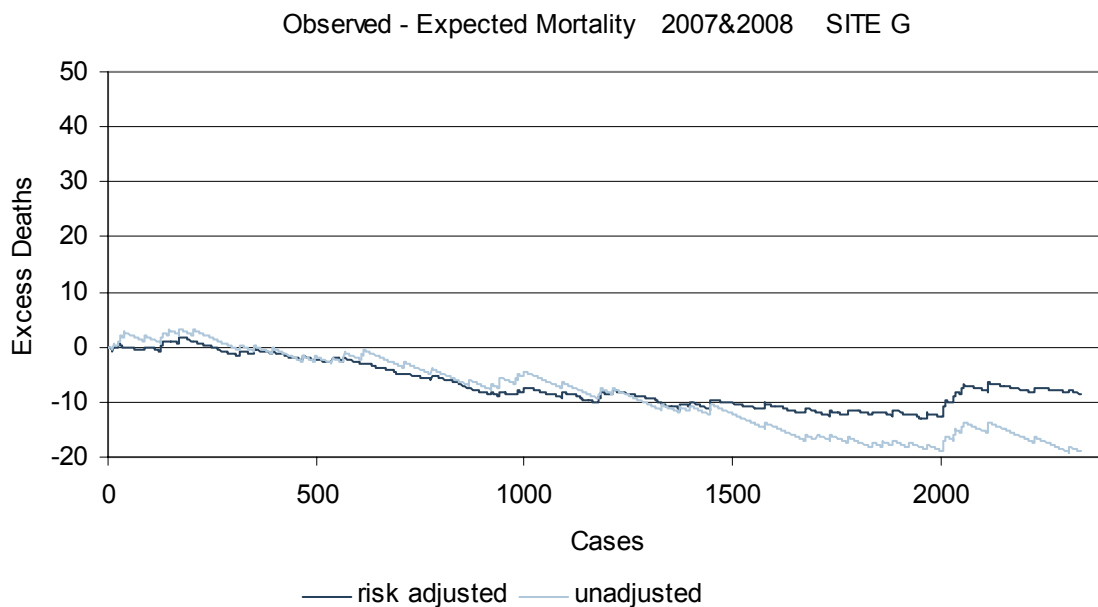


Figure 7.4.8 Sequential cumulative sum control chart for doubling and halving the odds of death for PICU H, 2007 - 2008.

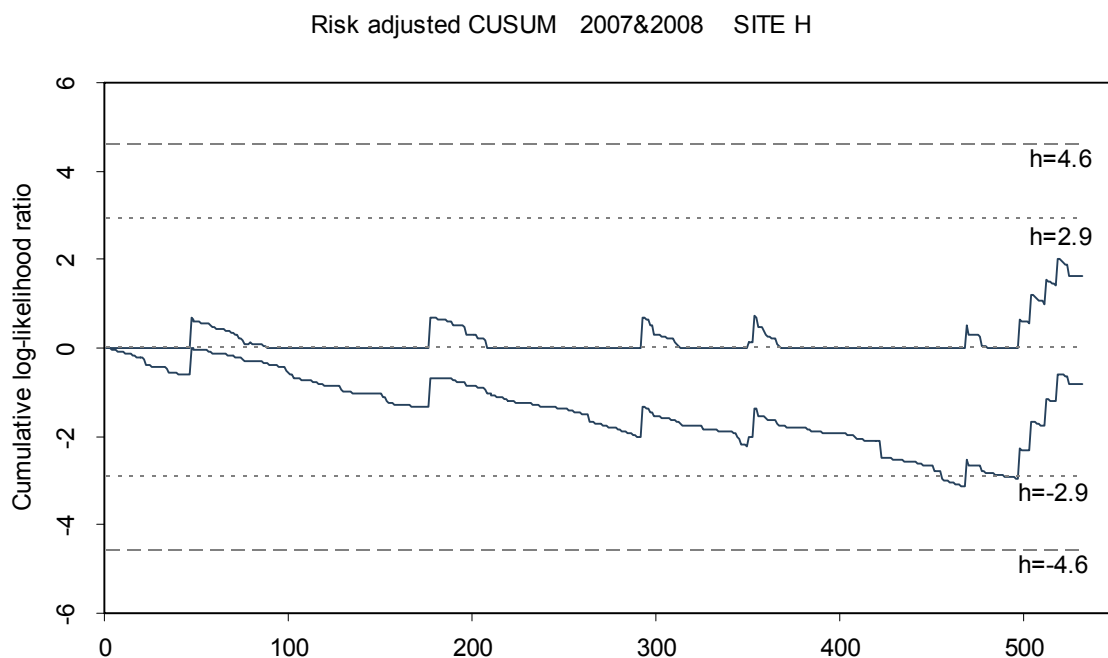
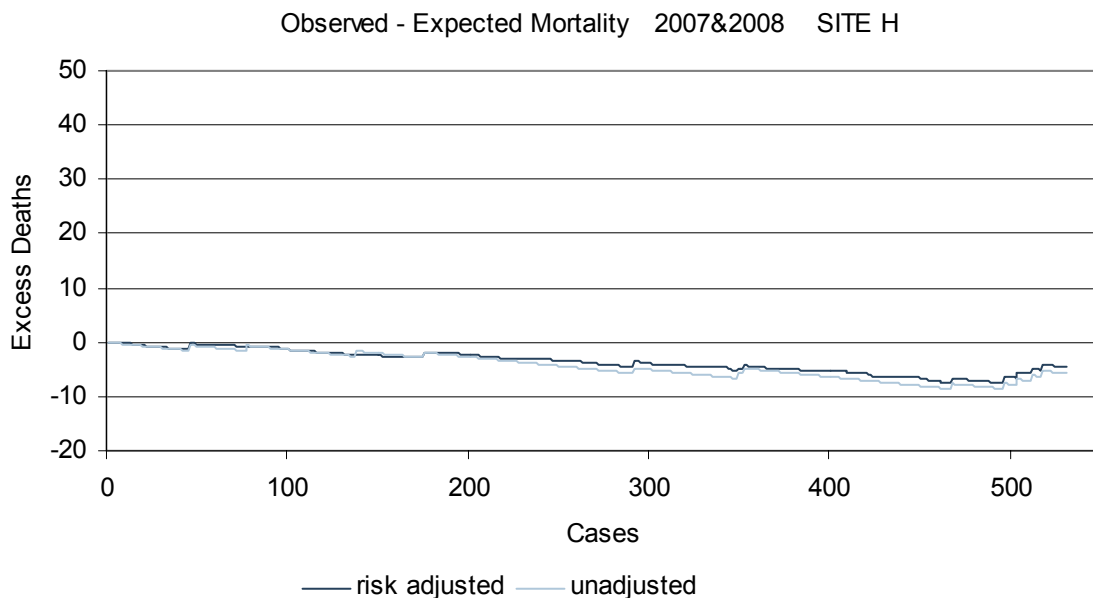
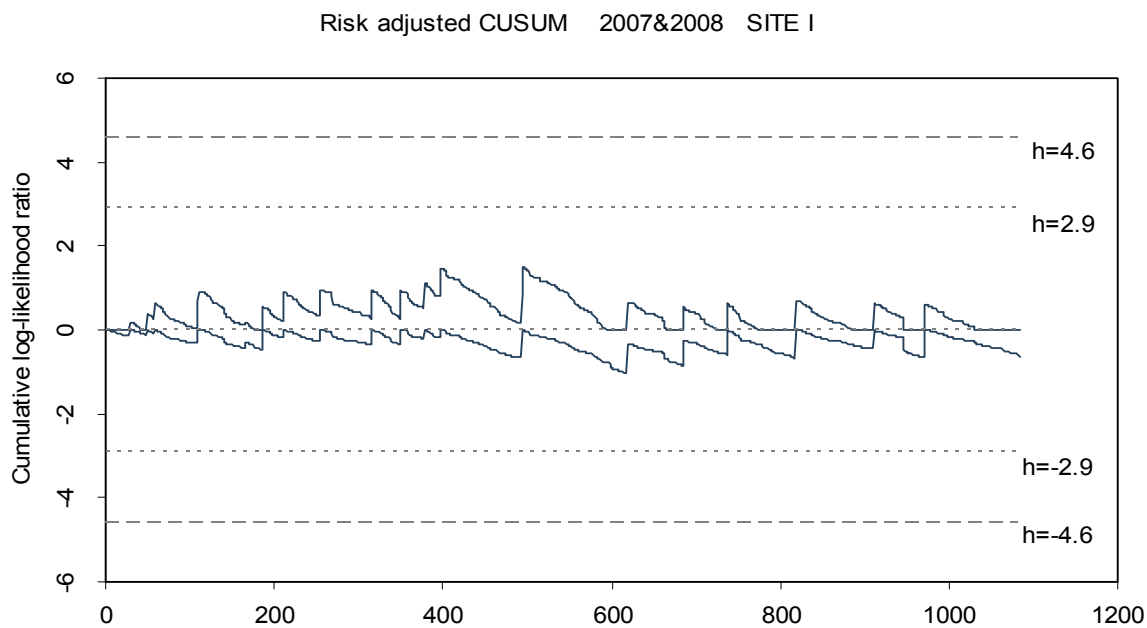


Figure 7.4.9 displays the cusum and excessive deaths representation for a ninth site (Site I) erroneously omitted and then subsequently included after finalisation of text on page 30 of this report.

Figure 7.4.9 Sequential cumulative sum control chart for doubling and halving the odds of death for PICU I, 2007 - 2008.



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- 11 Straney L, Clements A, Alexander J, Slater A, for the ANZICS Paediatric Study Group (2010) Measuring Efficiency in Australian and New Zealand Paediatric Intensive Care Units. *Intensive Care Medicine*. *submitted*
- 12 Rapoport J, Teres D, Zhao Y, Lemeshow S. (2003) Length of stay data as a guide to hospital economic performance for ICU patients. *Medical Care*, 41:386-397.
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## Appendix I

### Minimum data set variables

**Date of Birth** (field name DOB)

Date of Birth of the patient  
dd/mm/yyyy

**Gender** (field name GENDER)

Gender of the patient  
M Male  
F Female

**Indigenous Status** (field name IND\_STATUS)

The indigenous status of the patient, as identified by the patient next of kin

- 0 Not of Aboriginal or Torres Strait Islander (TI) descent
- 1 Aboriginal - of Aboriginal or Torres Strait Islander (TI) descent, who identifies as an Aboriginal or TI, and is accepted as such by the community with which the patient is associated

**Weight** (field name WT)

The weight of the patient on admission, measured in kilograms (Kg).

**Post Code** (field name POST)

Post Code of patient's home address.

**Hospital Admission Source** (field name HADM\_SC)

Patient's location prior to admission to hospital

- 1 Home/scene - admitted from home or the scene of an injury
- 2 Other Hospital - Emergency Department - patient transferred from the emergency department of another hospital
- 3 Other Hospital - OT/Recovery - patient transferred from the operating theatre or recovery room of another hospital
- 4 Other Hospital - ICU/NICU - patient transferred from the intensive care unit or the neonatal intensive care unit of another hospital
- 5 Other Hospital - Ward - patient transferred from any other in patient area of another hospital
- 6 Inborn - patient was born at this hospital

**Retrieval** (field name RETRIEV)

Describes the mechanism whereby a patient is transported to the hospital by a specialist paediatric IU transport team or equivalent

- 0 No
- 1 Yes

**ICU Admission Source** (field name IADM\_SC)

Patients location immediately prior to admission to the ICU

- 1 OT/Recovery - patient admitted to ICU from the operating theatre or recovery room
- 2 Emergency Department - patient admitted to ICU from the emergency department
- 3 Ward - patient admitted to ICU from any other inpatient area
- 4 Other ICU/NICU same Hospital - patient admitted to ICU from another ICU or NICU within the same hospital
- 5 Direct ICU Admission - patient admitted directly to ICU, for example following a retrieval

**Previous ICU Admission During this Hospital Admission** (field name PREV\_AD)

Has the patient been previously admitted to intensive care during this episode of care

- 0 No
- 1 Yes - Readmitted within 48 hours post ICU Discharge
- 2 Yes - Readmitted after 48 hours post ICU Discharge

**ICU Admission Date and Time** (field name ADM\_DT)

The date and time on which the patient commenced an episode of ICU care.  
dd/mm/yyyy hh:mm

**ICU Discharge Date and Time** (field name DIS\_DT)

The date and time on which the patient completes an episode of ICU care.  
dd/mm/yyyy hh:mm

**Principal ICU Diagnosis** (field name PDX)

Code the diagnosis most directly responsible for the ICU admission. Use the ANZPIC Registry diagnoses codes (Appendix II). For patients admitted primarily for recovery after a procedure, use a Post Procedural Diagnosis for the principal diagnosis. Do not use an infection code or mechanism of injury code for Principal Diagnosis

**Principal underlying diagnosis** (field name UDX)

The underlying diagnosis which has contributed to the need for ICU admission  
For example, an ex-premature infant with bronchiolitis will have a principal ICU diagnosis of bronchiolitis with an underlying diagnosis of prematurity

**Associated Diagnoses** (field names ADX1, ADX2, ADX3, ADX4, ADX5)

The presence of any other conditions in addition to that listed as the principal diagnosis (record up to five associated diagnoses). For patients having an operative procedure during the ICU admission, a Post Procedural Diagnosis should be listed as an associated diagnosis.

**Total Hours of Intubation During this Admission** (field name I\_ADHR)

Intubation refers to ETT or Tracheostomy

**Total Hours of Respiratory Support During this Admission** (field name RS\_ADHR)

Respiratory Support refers to ventilation, CPAP, BiPAP or NPV delivered by ETT, Tracheostomy, nasopharyngeal airway, mask, nasal prongs, or Curass (i.e.. any form of mechanical assistance).

**Outcome** (field name OUTCOME)

The patients destination on completion of the ICU episode of care.

- 1 Discharged to ward (includes transfer to another hospital ward) or home
- 2 Died in ICU
- 3 Transferred to another ICU (includes NICU)
- 4 Still in ICU

**ICU/NICU Transferred to** (field name ICU\_TRAN)

Code of the hospital to which the patient is transferred

## Paediatric Index of Mortality (PIM2) Variables

Record the first value of each variable measure at or about the time of first face to face contact between the patient and a doctor from your ICU (or a specialist paediatric retrieval team). Use the first values measured within the period from shortly before first contact to one hour after arrival in your own ICU. The first contact may be in the ICU, the emergency department, another inpatient area of the hospital, or in another hospital (for example on a retrieval). If the variable was not measured record 999.

**Elective** (field name ELECTIVE)

An ICU admission or an operation is considered elective if it could be postponed for more than six hours without an adverse effect.

- 0 Non-elective - all other admissions
- 1 Elective - includes booked ICU admission after elective surgery, for an ICU procedure (for example central line insertion), for diagnostic monitoring or review of a home ventilation patient.

**Recovery from surgery** (field name RECOVERY)

Includes a radiology procedure or cardiac catheter. Do not include patients admitted from the operating theatre where recovery from surgery is not the main reason for ICU admission (for example, a patient with a head injury who is admitted from theatre after insertion of an ICP monitor, in this patient the main reason for ICU admission is the head injury).

- 0 No
- 1 Yes

**Admitted following cardiac bypass** (field name BYPASS)

(Also code as recovery from surgery.)

- 0 No
- 1 Yes

**Mechanical ventilation** (field name RS\_HR124)

Record whether the patient was mechanically ventilated within the first hour of admission to ICU. Mechanical ventilation refers to both invasive (ETT or tracheostomy), and non-invasive (nasopharyngeal airway, mask or nasal prongs) methods of augmenting work of breathing. Using conventional mechanical ventilation (CVM), continuous positive airway pressure (CPAP), biphasic positive airway pressure (BiPAP), or negative pressure ventilation (NPV).

- 0 No
- 1 Yes

**Systolic Blood Pressure** (field name SBPA)

Measure in mmHg. If not measured within one hour of admission record 999.

**Pupillary Responses to bright light** (field name PUPILS)

Pupillary reactions to bright light are used as an index of brain function. Do not record abnormal findings due to drugs, toxins, or local eye injury.

- 0 All other responses including unknown
- 1 Both fixed and > 3mm

**PaO<sub>2</sub>** (field name PO2A)

The arterial oxygen tension, mmHg, as measured in an arterial blood gas sample. At time of PaO<sub>2</sub> if oxygen via ETT or headbox (unknown = 999)

**Base Excess** (field name BEA)

The base excess measured in arterial or capillary blood, in mmol/l. Unknown = 999.

**FiO<sub>2</sub>** (field name FIO2A)

The fraction of inspired oxygen being delivered to the patient via endotracheal tube (ETT) or headbox. Measure at the same time as the PaO<sub>2</sub>.

**PIM2 Low risk diagnosis** (field name PIM\_LR)

Specific conditions associated with reduced mortality risk

- 0 None
- 1 Asthma is the main reason for ICU admission
- 2 Bronchiolitis is the main reason for admission
- 3 Croup is the main reason for ICU admission
- 4 Obstructive sleep apnoea is the main reason for ICU admission include admissions following adenoidectomy &/or tonsillectomy in whom OSA is the main reason for ICU admission
- 5 Diabetic keto-acidosis is the main reason for ICU admission

**PIM2 High risk diagnosis** (field name PIM\_UC)

Specific conditions associated with increased mortality risk

- 0 None
- 1 Cardiac arrest out of hospital - requires either documented absent pulse or the requirement for external cardiac massage (do not include past history of cardiac arrest)
- 2 Severe combined immune deficiency - requires the documented diagnosis of SCID
- 3 Leukaemia or lymphoma after 1st induction
- 4 Spontaneous cerebral haemorrhage - haemorrhage must be spontaneous (for example, from an aneurysm or AVM). Do not include traumatic cerebral haemorrhage or intracranial haemorrhage that is not intracerebral.
- 5 Cardiomyopathy or myocarditis - requires the documented diagnosis of myocarditis or cardiomyopathy
- 6 Hypoplastic left heart syndrome - include only cases where a Norwood procedure, or equivalent is required to sustain life
- 7 HIV infection - requires the document diagnosis of HIV
- 8 IQ <35, (i.e. worse than Downs)

*(High risk diagnosis groups continued next page)*

***PIM2 High risk diagnosis (continued)***

- 9 Neurodegenerative disorder - requires a history of progressive loss of milestones or a diagnosis where this will inevitably occur
- 10 Liver failure - acute or chronic, include patients admitted for recovery following liver transplantation for acute or chronic liver failure
- 11 Cardiac arrest in hospital - preceding ICU admission requires either documented absent pulse or the requirement for external cardiac massage (do not include past history of cardiac arrest)

***(End of PIM2 variables)***

**Place of first face to face contact** (field name 1ST\_CONT)

Place of first face to face contact between the patient and a doctor from your ICU (or a doctor from a specialist paediatric transport team).

- 1 Your ICU
- 2 In your hospital but outside ICU
- 3 Outside your hospital

**First contact** (field name PIM\_VAL)

Are the values recorded above (i.e. those used in PIM2 calculations) made at or about the time of first face to face contact?

- 0 No
- 1 Yes

**Mode of Death** (field name DEATH\_MODE)

For patients who died, what was the mode of death of patient.

- 1 Brain death
- 2 Death with maximal support
- 3 Death with therapy limited but not withdrawn
- 4 Death with therapy withdrawn

**External Cardiac Massage** (field name ECM)

For patients who died, was external cardiac massage performed as the terminal event.

- 0 No
- 1 Yes

**Limitation of Therapy** (field name LIMIT)

For patients who died, was there a limitation of therapy order in the notes.

- 0 No
- 1 Yes

**Date of Limitation Order** (field name LIMIT\_D)

For patients who died and who had a limitation of therapy order in their notes, what was the date the order was documented in the patient's case notes. If more than one order, record date of first order; if order preceded ICU admission, record ICU admission date.  
dd/mm/yyyy.

**Organ Donation** (field name ORG\_DON)

For patients who died, what was their organ donation status.

- 1 Brain death not present (NBHD not considered)
- 2 Brain death, organ donor
- 3 Brain death, contraindication to organ donation
- 4 Brain death, consent not requested
- 5 Brain death, consent requested and refused
- 6 Non beating heart donor
- 7 Non beating heart donation consent requested and refused

**Specific Therapies**

To be completed at the time of patient discharge from ICU.

**CVVH or CVVHD** (field name CVVH)

Specifies whether the patient received renal therapy support in terms of continuous haemodialysis at any time during their admission to ICU.

0 No  
1 Yes

**Haemodialysis** (field name HD)

Specifies whether the patient received renal therapy support in terms of intermittent haemodialysis at any time during their admission to ICU.

0 No  
1 Yes

**Peritoneal dialysis** (field name PD)

Specifies whether the patient received renal therapy support in terms of peritoneal dialysis at any time during their admission to ICU.

0 No  
1 Yes

**Plasma filtration** (field name PF)

Specifies whether the patient received renal therapy support in terms of plasma filtration at any time during their admission to ICU.

0 No  
1 Yes

**High frequency oscillation** (field name HFO)

Specifies whether the patient received high frequency oscillation (HFO) therapy at any time during their admission to ICU.

0 No  
1 Yes

**Inhaled nitric oxide** (field name INO)

Specifies whether the patient received inhaled nitric oxide therapy at any time during their admission to ICU.

0 No  
1 Yes

**ECMO** (field name ECMO)

Specifies whether the patient received extra corporeal membrane oxygenation (ECMO) therapy at any time during their admission to ICU.

0 No  
1 Yes

**Ventricular assist device** (field name VAD)

Specifies whether the patient received support from a ventricular assist device (VAD) at any time during their admission to ICU.

0 No  
1 Yes

**ICP Monitoring** (field name ICPM)

Specifies whether the patient had an intra cranial pressure monitor inserted at any time during their admission to ICU.

0 No  
1 Yes. Complete specific therapy data at the time of ICU discharge

**Hospital Admission Date and Time** (field name HADM\_DT)

The date and time on which the patient commenced an episode of hospital care.  
dd/mm/yyyy hh:mm

**Hospital Discharge Date and Time** (field name HDIS\_DT)

The date and time on which the patient completes an episode of hospital care.  
dd/mm/yyyy hh:mm

**Hospital Outcome** (field name HOSP\_OUT)

The patients destination on completion of the hospital episode of care.

- 1 Still in hospital
- 2 Died
- 3 Discharged home
- 4 Transferred to a rehabilitation hospital
- 5 Transferred to other hospital—ICU/NICU
- 6 Transferred to other hospital—ward

**New fields added in 2007 to enable the calculation of a RACHS (risk adjustment for congenital heart surgery) score -**

**Gestation** (field name GESTATION)

If < 37 completed weeks and < 12 months of age, enter the number of completed weeks of gestation,  
If > 37 completed weeks or >12 months of age enter the number 40.

**Major Non Cardiac Structural Anomaly** (field name NC\_STAN)

- 0 No
- 1 Yes

**Combination of Cardiac Surgery Procedures at a Single Operation** (field name CP\_SOP)

- 0 No
- 1 Yes

**Antenatal Diagnosis of Major Structural Anomaly** (field name AD\_STAN)

- 0 No
- 1 Yes

**Cardiac Surgery During this Admission** (field name CARDIAC)

- 0 No
- 1 Yes

## Appendix II ANZPIC Diagnostic Codes

Australia and New Zealand Paediatric Intensive Care Registry, 2008

<b>INJURY</b>	214 PDA	320 Neuropathy
100 Injury - Other	215 Pulmonary Atresia or Stenosis	321 Seizures
101 Anaphylaxis	228 Pulmonary Insufficiency	322 Spinal Cord Lesion
102 Burns	229 RV Outflow Obstruction	327 Tetanus
103 Carbon Monoxide Poisoning	216 Single Ventricle	323 Venous Sinus Thrombosis
104 Drug Toxicity - Iatrogenic	217 TAPVD	
105 Electrocution	218 Tetralogy of Fallot	<b>RESPIRATORY</b>
106 Envenomation	219 Transposition of Great Arteries ( <i>d</i> TGA)	<i>UPPER AIRWAY</i>
107 Hanging or Strangulation	220 Tricuspid Atresia or Stenosis	400 Upper Airway – Other
108 Hyperthermia	221 Tricuspid Insufficiency	401 Choanal Atresia or Stenosis
109 Hypothermia	222 Truncus Arteriosus	402 Epiglottitis
110 Immersion (Near Drowning)	223 VSD	403 Foreign Body – Inhaled
111 Ingestion		414 Laryngomalacia
112 Smoke Inhalation	<i>AQUIRED</i>	404 Laryngotracheobronchitis (Croup)
113 Trauma - Other	250 Cardiovascular – Acquired – Other	405 Obstructive Sleep Apnoea
114 Trauma - Abdominal	251 Cardiac Failure	406 Pierre Robin Syndrome
115 Trauma - Chest	252 Cardiac Tumour	407 Retropharyngeal Abscess
116 Trauma - Facial	253 Cardiomyopathy/Myocarditis	413 Subglottic Haemangioma
117 Trauma - Head	254 Dysrhythmia – Supraventricular	408 Subglottic Stenosis
118 Trauma - Skeletal	255 Dysrhythmia – Ventricular	409 Tracheitis
119 Trauma - Spinal	256 Endocarditis	410 Upper Airway Obstruction – Other
	257 Hypertension – Pulmonary	411 Upper Respiratory Infection – Other
<i>INJURY MECHANISM</i>	258 Hypertension – Systemic	412 Vocal Cord Paresis
<i>(DO NOT USE FOR PRINCIPAL DIAGNOSIS)</i>	259 Kawasaki's Disease	<i>LOWER AIRWAY</i>
150 Injury Mechanism – Other	260 Pericardial Effusion or Tamponade	430 Lower Airway – Other
162 Crush Injury	263 Previous Heart Lung Transplant	431 Asthma
151 Cyclist	264 Previous Heart Transplant	432 Bronchiolitis
152 Fall	265 Rheumatic Heart Disease	433 Chronic Lung Disease (Includes BPD)
153 Farm Equipment	261 Vascular Thrombosis	434 Malacia - Trachea and/or Bronchi
154 Firearm Injury	262 Vasculitis	435 Mediastinal Mass
161 Motor Bike Rider / Passenger		436 Stenosis - Trachea and/or Bronchi
155 MVA – Passenger	<b>NEUROLOGICAL</b>	437 Tracheo-oesophageal Fistula
156 MVA – Pedestrian	300 Neurological – Other	438 Vascular Ring
157 Non Accidental Injury	328 Arnold Chiari Malformation	<i>OTHER</i>
158 Self Injury	301 Botulism	450 Respiratory – Other
159 Sports Injury	302 Brain Abscess	451 Air Leak Syndrome
160 Stab Injury	303 Brain AV Malformation	452 Apnoea – Central
	304 Brain Death	453 ARDS
<b>CARDIOVASCULAR</b>	305 Brain Infarction or Stroke	454 Aspiration
<i>CONGENITAL</i>	306 Brain Tumour	455 Chylothorax
200 Cardiovascular - Congenital - Other	324 Cerebral Aneurysm	456 Congenital Diaphragmatic Hernia
230 Cardiovascular - Congenital-Post Palliation	307 CSF Shunt Malfunction or Infection	457 Congenital Lung Anomaly
201 Absent Pulmonary Valve	308 Encephalitis	458 Cystic Fibrosis
202 Anomalous Coronary Artery	309 Encephalopathy, Acute – Hypoxic	459 Empyema
203 Aortic Insufficiency	Ischaemic	460 Hyaline Membrane Disease
204 Aortic Stenosis	310 Encephalopathy, Acute – Other	461 Hypoventilation – Central
224 AP Window	311 Encephalopathy, Chronic Degenerative	469 Lower Respiratory Infection – Other
205 ASD	(eg Leigh's Syndrome)	462 Lung Abscess
225 AV Malformation	312 Encephalopathy, Chronic Static	463 Meconium Aspiration Syndrome
206 AVSD (AV Canal)	(eg Cerebral Palsy)	470 Pertussis Syndrome
207 Coarctation	313 Guillain Barre Syndrome	464 Pleural Effusion
208 Cor triatriatum	314 Hydrocephalus	465 Pneumonia or Pneumonitis
226 Double Outlet Right Ventricle	315 Intracranial Haemorrhage – Spontaneous	471 Previous Lung Transplant
209 Ebstein's Anomaly	316 Intracranial Hypertension (Raised ICP)	466 Pulmonary Hypoplasia
210 Hypoplastic Left Heart Syndrome	317 Meningitis	467 Pulmonary Oedema
211 Interrupted or Hypoplastic Aortic Arch	318 Meningomyelocele or Spina Bifida	468 Respiratory Failure
227 LV Outflow Obstruction	325 Muscular Dystrophy	472 Transient Tachypnoea of the Newborn
212 Mitral Insufficiency	326 Myasthenia Gravis	
213 Mitral Stenosis	319 Myopathy	

## Australia and New Zealand Paediatric Intensive Care Registry, 2008

### RENAL

- 500 Renal - Other
- 501 Haemolytic Uraemic Syndrome
- 502 Nephrotic and/or Nephritic Syndrome
- 505 Previous Renal Transplant
- 503 Renal Failure - Acute
- 504 Renal Failure - Chronic
- 506 Urinary Tract Infection

### GASTROINTESTINAL

- 600 Gastrointestinal – Other
- 620 Biliary Atresia
- 601 Bowel Obstruction
- 621 Bowel Perforation
- 602 Colitis
- 603 Gastroenteritis
- 604 Gastrointestinal Haemorrhage
- 605 Gastroschisis or Exomphalos
- 606 Hepatitis
- 622 Hirschsprung's Disease
- 607 Intussusception
- 608 Liver Disorder – Other
- 609 Liver Failure – Acute
- 610 Liver Failure – Chronic
- 611 Necrotising Enterocolitis
- 623 Neonatal Jaundice
- 612 Oesophageal Atresia
- 624 Oesophageal Foreign Body
- 613 Pancreatitis
- 614 Peritonitis
- 625 Portal Hypertension
- 626 Previous Liver Transplant
- 615 Pyloric Stenosis
- 616 Short Gut Syndrome
- 617 Ulcer – Duodenal
- 618 Ulcer – Gastric or Gastritis
- 619 Varices – Oesophageal or Gastric
- 627 Volvulus

### INFECTION

*(DO NOT USE FOR PRINCIPAL DIAGNOSIS)*

- 700 Infection – Other
- 701 Adenovirus
- 702 Bacterium – Other
- 703 Bacterium – Gram Negative - Other
- 704 Bacterium – Gram Positive - Other
- 705 Candida
- 706 Clostridium
- 707 CMV
- 708 EBV
- 730 E Coli
- 709 Enterovirus
- 710 Fungus – Other
- 711 Haemophilus Influenzae Type b
- 712 Hepatitis – Viral
- 713 Herpes Simplex Virus
- 714 HIV

- 715 Influenza Virus
- 731 Klebsiella
- 716 Legionella
- 732 Malaria
- 735 Measles Virus
- 717 Meningococcus
- 718 Mycoplasma
- 719 Parainfluenzae Virus
- 720 Pertussis
- 721 Pneumococcus
- 722 Pneumocystis Carinii
- 733 Pseudomonas
- 723 Rotavirus
- 724 RSV
- 725 Salmonella
- 726 Staphylococcus
- 734 Streptococcus Group B
- 727 Streptococcus – Other
- 728 Varicella
- 729 Virus – Other
- 799 No Organism Identified

### MISCELLANEOUS

- 800 Miscellaneous – Other
- 801 Acute Life Threatening Event  
(Near Miss SIDS)
- 802 Cardiac Arrest - In Hospital
- 803 Cardiac Arrest – Out of Hospital
- 804 Chromosomal Anomaly
- 805 Coagulopathy
- 839 Craniosynostosis
- 850 Cystic Hygroma
- 806 Dehydration
- 807 Dermatological Disorder
- 808 Diabetes Insipidus
- 809 Diabetes Mellitus with Ketoacidosis
- 810 Diabetes Mellitus without Ketoacidosis
- 811 Electrolyte Disorder
- 812 Endocrine Disorder
- 813 Gas Gangrene
- 849 Graft vs Host Disease
- 847 Haematological Disorder
- 814 Home Ventilation Patient
- 815 Hypoglycaemia
- 816 ICU Diagnostic Monitoring - Elective
- 817 ICU Procedure (eg CVC Insertion)
- 818 Immunodeficiency - Congenital
- 819 Immunosuppression - Acquired
- 820 Inborn Error of Metabolism
- 821 Leukaemia or Lymphoma
- 822 Necrotising Fasciitis
- 840 Neonate – Hydrops Fetalis
- 841 Neonate – Infant of Diabetic Mother
- 842 Neonate – IUGR
- 823 Neutropenia
- 848 Organ Donor
- 824 Pancytopenia

- 825 Pheochromocytoma
- 826 Prematurity (<37/40 & <12mths of age)
- 843 Previous Bone Marrow Transplant
- 827 Respiratory Arrest - In Hospital
- 828 Respiratory Arrest - Out of Hospital
- 844 Scoliosis
- 829 Sepsis
- 830 Shock – Cardiogenic
- 831 Shock – Hypovolaemic
- 832 Shock – Septic
- 833 SIRS
- 834 Solid Neoplasm – Malignant (not Lymphoma)
- 835 Solid Neoplasm – Non Malignant
- 836 Syndrome or Malformation  
(not Chromosomal)
- 837 Toxic Shock Syndrome
- 838 Transplant - Bone Marrow
- 845 Tumor Lysis Syndrome
- 846 Wound Infection

### MISCELLANEOUS / ANAESTHETIC

- 1100 Post Procedure - Other
- 1101 Anaesthetic Complication
- 1106 Cardiac Catheter – Balloon Septostomy
- 1102 Cardiac Catheter – Diagnostic
- 1107 Cardiac Catheter – Interventional
- 1103 Ex-prem, Post GA
- 1104 Invasive Radiology Procedure
- 1105 Massive Intraop Transfn (> 1 blood vol)
- 1108 Post Operative Bleeding

### NEUROSURGERY

- 1300 Neurosurgery – Other
- 1301 Craniotomy – Anterior Fossa
- 1302 Craniotomy – Posterior Fossa
- 1303 CSF Shunt Insertion or Revision
- 1304 Decompression - Cranial
- 1310 Decompression - Craniocervical
- 1305 Decompression - Spinal Cord
- 1306 Hemispherectomy or Lobectomy
- 1307 ICP Monitor or Vent. Drain Insertion
- 1308 Intracranial Haematoma Evacuation
- 1309 Myelomeningocele Repair

### POST PROCEDURAL DIAGNOSES

#### THORACIC SURGERY

- 1400 Thoracic Surgery - Other
- 1401 Diaphragm Plication
- 1402 Diaphragm Repair
- 1403 Lung Biopsy
- 1404 Lung Decortication
- 1405 Oesophageal Atresia Repair
- 1406 Pneumonectomy or Lobectomy
- 1407 Thoracic Tumour Resection
- 1408 Tracheo-oesophageal Fistula Repair
- 1409 Tracheopexy

## Australia and New Zealand Paediatric Intensive Care Registry, 2008

<i>ENT SURGERY</i>		
1500 ENT - Other	1907 Subaortic stenosis resection	1948 Pulmonary artery banding
1501 Adenoidectomy and/or Tonsillectomy	1908 Pulmonary valvotomy - valvuloplasty	1949 Repair of tetralogy of Fallot with pulmonary atresia
1502 Choanal Atresia Repair	1909 Pulmonary valve replacement	1950 Repair of cor triatriatum
1503 Cricoid Split	1910 Right ventricular infundibulectomy	1951 Systemic to pulmonary artery shunt
1504 Laryngeal Reconstruction	1911 Pulmonary outflow tract augmentation	1952 Atrial switch operation
1505 Laryngobronchoscopy	1912 Repair of coronary AV fistula	1953 Arterial switch operation
1508 Laryngoplasty	1913 ASD and VSD repair	1954 Reimplantation of anomalous pulmonary artery
1507 Retropharyngeal Abscess Drainage	1914 ASD primum repair	1955 Annuloplasty
1506 Tracheostomy	1915 VSD repair	1956 Repair of coarction and VSD closure
<i>ABDOMINAL / GENERAL SURGERY</i>		
1600 General Surgery – Other	1916 VSD closure and pulmonary valvotomy or infundibular resection	1957 Excision of intracardiac tumour
1601 Abdominal Tumour Resection	1917 VSD closure and pulmonary artery band removal	<i>RISK CATEGORY 4</i>
1602 Appendicectomy	1918 Repair of unspecified septal defect	1958 Aortic valvotomy - valvuloplasty ≤30d of age
1603 Bladder Extrophy Repair	1919 Total repair of tetralogy of Fallot	1959 Konno procedure
1604 Burns Surgery	1920 Repair of total anomalous pulmonary veins >30d of age	1960 Repair of complex anomaly (single ventricle) by VSD enlargement
1605 Fundoplication	1921 Glenn shunt	1961 Total repair of anomalous pulmonary veins ≤30d of age
1606 Gastroschisis or Exomphalos Repair	1922 Vascular ring surgery	1962 Atrial septectomy
1607 GI Endoscopy and/or Sclerotherapy	1923 Repair of AP window	1963 Repair of transposition-VSD sub PS (Rastelli)
1608 Intussusception Repair	1924 Coarction repair ≤30d of age	1964 Atrial switch operation with VSD closure
1609 Kasai	1925 Repair of pulmonary artery stenosis	1965 Atrial switch operation with repair of sub PS
1610 Laparotomy	1926 Transection of pulmonary artery	1966 Arterial switch operation with pulmonary artery band removal
1615 Laparotomy – Bowel Obstruction	1927 Common atrium closure	1967 Arterial switch operation with VSD closure
1616 Laparotomy – Bowel Perforation	1928 Left ventricular to right atrial shunt repair	1968 Arterial switch operation with repair of sub PS
1617 Laparotomy – GI Haemorrhage	<i>RISK CATEGORY 3</i>	
1618 Laparotomy – Necrotising Enterocolitis	1929 Aortic valve replacement	1969 Repair of truncus arteriosus
1619 Laparotomy – Peritonitis	1930 Ross procedure	1970 Repair of hypoplastic or interrupted arch without VSD closure
1620 Laparotomy – Trauma	1931 Left ventricular outflow tract patch	1971 Repair of hypoplastic or interrupted arch with VSD closure
1611 Transplant – Kidney	1932 Ventriculomyotomy	1972 Transverse arch graft
1612 Transplant – Liver	1933 Aortoplasty (not arch repair or graft)	1973 Unifocalization for tetralogy of Fallot - pulmonary atresia
1613 Transplant - Small Bowel	1934 Mitral valvotomy - valvuloplasty	1974 Double switch
1614 Urogenital Surgery – Other	1935 Mitral valve replacement	<i>RISK CATEGORY 5</i>
<i>CRANIOFACIAL SURGERY</i>		
1700 Craniofacial Surgery – Other	1936 Valvectomy of tricuspid valve	1975 Tricuspid valve repositioning for neonatal Ebstein ≤30d of age
1706 Cleft Palate Repair	1937 Tricuspid valvotomy - valvuloplasty	1976 Repair of truncus arteriosus & interrupted arch
1701 Cranial Vault Reshaping	1938 Tricuspid valve replacement	<i>RISK CATEGORY 6</i>
1702 Dental Surgery	1939 Tricuspid valve repositioning for Ebstein anomaly >30d of age	1977 Stage 1 repair of hypoplastic left heart syndrome (Norwood)
1703 Facial Cleft Repair	1940 Repair of anomalous coronary artery without intrapulmonary tunnel	1978 Stage 1 repair of nonhypoplastic left heart syndrome conditions
1704 Mandibular Mobilisation	1941 Repair anomalous coronary art. with intrapulmonary tunnel (Takeuchi)	1979 Damus-Kaye-Stansel procedure
1705 Midface Mobilisation	1942 Closure of semilunar valve, aortic or pulmonary	<i>UNCLASSIFIED</i>
<i>ORTHOPAEDIC SURGERY</i>		
1800 Orthopaedic Surgery - Other	1943 Right ventricular to pulmonary artery conduit	1992 Pacemaker Insertion/Replacement
1801 Fracture Fixation	1944 Left ventricular to pulmonary artery conduit	1993 PDA surgery ≤ 30 days
1802 Spinal Instrumentation	1945 Repair of double-outlet right ventricle with or without repair of right ventricular obstruction	1994 Transplant – Heart
<b>RACHS CARDIAC CODES</b>		
<i>RISK CATEGORY 1</i>		
1901 ASD surgery (including ASD secundum, sinus venosus ASD, patent foramen ovale closure)	1946 Fontan procedure	1995 Transplant – Heart Lung
1902 Aortopexy	1947 Repair of transitional or complete atrioventricular canal with or without valve replacement	1996 Transplant – Lung
1903 PDA surgery >30d of age		1997 PA Plasty or Repair
1904 Coarction repair >30d of age		1998 Cardiac Surgery Closed – Other
1905 Partially anomalous pulmonary venous connection surgery		1999 Cardiac Surgery Open – Other
<i>RISK CATEGORY 2</i>		
1906 Aortic valvotomy—valvuloplasty >30d of age		

**Instructions for using the ANZPIC registry diagnostic codes**

- Code the reason most directly responsible for ICU admission as the *Principal Diagnosis*.
- Code up to 5 *Associated Diagnoses*.
- For patients admitted primarily for recovery after a procedure, use a *Post Procedural Diagnosis* for *Principal Diagnosis*.
- For patients having an operative procedure during the admission code the *Post Procedural Diagnosis* as an *Associated Diagnosis*.
- Do not use *Injury Mechanism* or *Infection* codes for the *Principal Diagnosis* (eg for RSV bronchiolitis code bronchiolitis as the *Principal Diagnosis* and RSV as an *Associated Diagnosis*).
- If new information (eg a test result) becomes available during the admission that allows more accurate coding, amend the original codes but ensure that the *Principal Diagnosis* still indicates the reason most directly responsible for ICU admission.

### **Appendix III**

#### **Diagnostic Groups used in Annual Report**

<b>Diagnostic group</b>	<b>ANZPIC Registry Diagnostic Codes</b>
Cardiovascular (incl post-op)	1900-1999, 200-299, 1102,1106,1107
Gastrointestinal/Renal	500-699
Injury	100-199
Neurological	300-399
Post-Operative (non-cardiac)	1300-1899, 1100,1101,1104,1105, 1103, 1108
Respiratory	400-499
Miscellaneous	700-799,800 - 899

*Please refer to Appendix II for definitions of diagnostic codes.*

## Appendix IV Participating ICUs Contact Details

ACT	The Canberra Hospital Intensive Care Unit PO Box 11 Woden, ACT, 2606 Ph. +61 2 6244 2222	Imogen Mitchell, Director Rebecca Millar, Data Manager	imogen.mitchell@act.gov.au rebecca.millar@act.gov.au
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	Royal Children's Hospital, Brisbane Level 2 Surgical Building Herston Road Herston, QLD, 4029 Ph. +61 7 3636 7957	Anthony Slater, Director Julie McEniery, Deputy Director Jane Hyne, Data Manager Julieta Woosley, Data Manager	anthony_slater@health.qld.gov.au julie_mcenery@health.qld.gov.au jane_hyne@health.qld.gov.au julieta_woosley@health.qld.gov.au
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Australia and New Zealand Paediatric Intensive Care Registry, 2008

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	Clayton, VIC, 3168		
	Ph. +61 3 9594 3196		
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	Perth, WA, 6840	Sue Muscat, Secretary	suzanne.muscat@health.wa.gov.au
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NZ	Christchurch Hospital	Seton Henderson, Director	seton.henderson@cdhb.govt.nz
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	Starship Children's Hospital	John Beca, Director	johnbeca@adhb.govt.nz
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	Auckland 1142 NZ		
	Ph. +64 9 307 4903		
	Waikato Hospital	Nicholas Barnes, Director	barnesn@waikatodhb.govt.nz
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	Hamilton, NZ		
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	PO Box 742	Michael Kalkoff, Consultant	michael.kalkoff@northlanddhd.org.nz
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