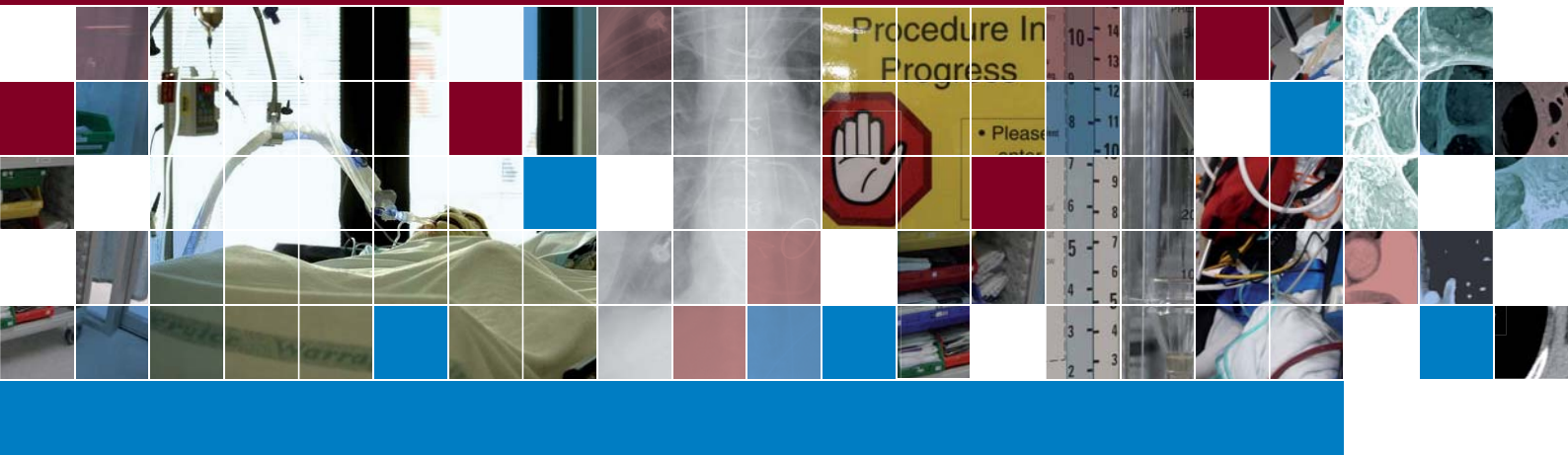




Australian and New Zealand Intensive Care Society



Centre for Outcome and Resource Evaluation
Annual Report 2010



Acknowledgements

This report would not have been possible without the efforts of doctors, nurses, ward clerks, data managers and data collectors who have contributed data to the Adult Patient Database (APD), Critical Care Resources (CCR) Registry and the Australian and New Zealand Paediatric Intensive Care (ANZPIC) Registry. Their contributions are gratefully acknowledged.

Thanks are also extended to the contributing authors of this report.

CORE is funded by:

Australian Capital Territory Health
Department of Health and Community Services – Northern Territory
Department of Health and Human Services – Tasmania
Department of Health – New South Wales
Department of Health – South Australia
Department of Health – Victoria
Health Department of Western Australia
Ministry of Health (New Zealand)
Queensland Health

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Foreword from the ANZICS CORE Chair

With great thanks to the ANZICS President and Board, to the CORE staff and CORE Management Committee members, I am proud to write this foreword to the Annual Report.

Intensive care units typically look after the most severely ill, most complex and most demanding patients in a hospital. The provision of safe and timely care of the highest quality is of utmost importance. The Australian and New Zealand Intensive Care Society (ANZICS) through the ANZICS Centre for Outcome and Resource Evaluation (CORE) provides a bi-national peer review process and quality assurance program, which allows audit and benchmarking of intensive care outcomes across Australia and New Zealand.

ANZICS CORE is funded through agreements with jurisdictional health departments throughout Australia and New Zealand. ANZICS CORE in its present form came into being in 2008, creating a single organisation to oversee the operation of the Adult Patient Database (APD), the Critical Care Resources (CCR) Registry and the Australian and New Zealand Paediatric Intensive Care (ANZPIC) Registry. This replaced the ANZICS Database Management Committee, which had overseen the activities of the three separate registries since 1992. CORE now manages one of the largest repositories of intensive care patient episodes in the world (over one million). It is the only quality assurance program in the field of intensive care medicine that spans international borders. The audit and training program run by CORE is one of the most extensive and complete of any throughout the world. CORE works closely with the ANZICS Clinical Trials Group (CTG), the ANZICS Safety and Quality Committee (SQC), the Paediatric Study Group (PSG) and the Australian and New Zealand Intensive Care Research Centre (ANZIC-RC) based at the School of Public Health and Preventive Medicine (SPHPM), Monash University.

Many organisations have supported CORE's activities in recent years. Foremost among these are the Australian Commission for Safety and Quality in Health Care (ACSQHC) through the CEO, Professor Chris Baggoey, and The Australian Council on Healthcare Standards (ACHS). The National Intensive Care Registry Steering Committee (NICRSC) meets twice a year to facilitate CORE's relationship with the jurisdictions. This enables ongoing dialogue supporting quality outcomes, governance processes and funding.

This report is the result of the work of many individuals whose achievements are in turn founded on others before them. Most notable is Associate Professor Graeme Hart, who stepped down as Chair of ANZICS CORE in 2010. His ability to guide CORE's development and engage with clinicians and jurisdictional governments alike has allowed CORE to achieve its position as one of the foremost bodies for monitoring of clinical outcomes. This report is dedicated to Graeme and his contribution to the field of intensive care medicine through his leadership of ANZICS CORE over the past 15 years.

Yours,



Associate Professor David Pilcher
Chair, ANZICS CORE

Structure and Governance of ANZICS CORE

ANZICS Centre for Outcome and Resource Evaluation

Clinical registries collect a standardised set of information, monitor and benchmark health care performance across institutions, assist in accurate interpretation of results from raw data to outcome and provide strong impetus for clinicians and institutions to reach their maximum potential in providing quality care. There are now numerous clinical registries in Australia and around the world supporting clinical outcomes monitoring. In Australia these have been listed by the ACSQHC as a key method for quality assurance¹.

ANZICS CORE comprises the APD, the CCR Registry and the ANZPIC Registry. CORE is unique in that it offers an overview across regional, state, federal and international jurisdictions. The APD, now one of the largest single datasets in intensive care in the world, contains data from over 1.2 million patient episodes, while the ANZPIC Registry holds over 100,000 paediatric ICU admissions. The CCR Registry contains information on critical care resources dating from 1993 to 2010.

The NICRSC was formed with state, territory and New Zealand health departments to assist the CORE Management Committee in achieving mutually agreed deliverables under jurisdictional agreements. The

NICRSC provides a platform to promote collaboration between ANZICS and health departments to ensure effective monitoring of intensive care service delivery in Australia and New Zealand. Jurisdictions have agreed to establish and maintain Jurisdictional Liaison Committees (JLCs), comprising representatives of the intensive care medical community and health departments. Presently these committees meet regularly in New South Wales, Victoria, Queensland and South Australia to review the reports from ANZICS CORE, examining outcome data from local intensive care units.

The CORE Management Committee is a sub-committee of the ANZICS Board. The Committee operates according to the Terms of Reference and Policies of the Board by providing management and financial oversight of the activities of the three registries, liaising with the intensive care community, promoting research activities and ensuring the efficient use of personnel, facilities and research expertise. It reports to the Board on activity, intended publications and financial statements on a regular basis, enters negotiations with relevant governmental and non-governmental bodies, and operates according to the direction of the Board.

¹Australian Commission on Safety and Quality in Health Care (2009), Windows into Safety and Quality in Health Care 2009, ACSQHC, Sydney. page 89.

Structure and Governance of ANZICS CORE

Personnel

The ANZICS CORE Management Committee

Associate Professor David Pilcher (Chair)
APD Director/Intensivist, the Alfred Hospital,
Melbourne, Australia

Dr Peter Hicks
CCR Director/Intensivist, Wellington Hospital,
Wellington, New Zealand

Dr Anthony Slater
ANZPIC Director/PICU Director,
Royal Children's Hospital, Brisbane, Australia

Erin O'Sullivan
General Manager, ANZICS

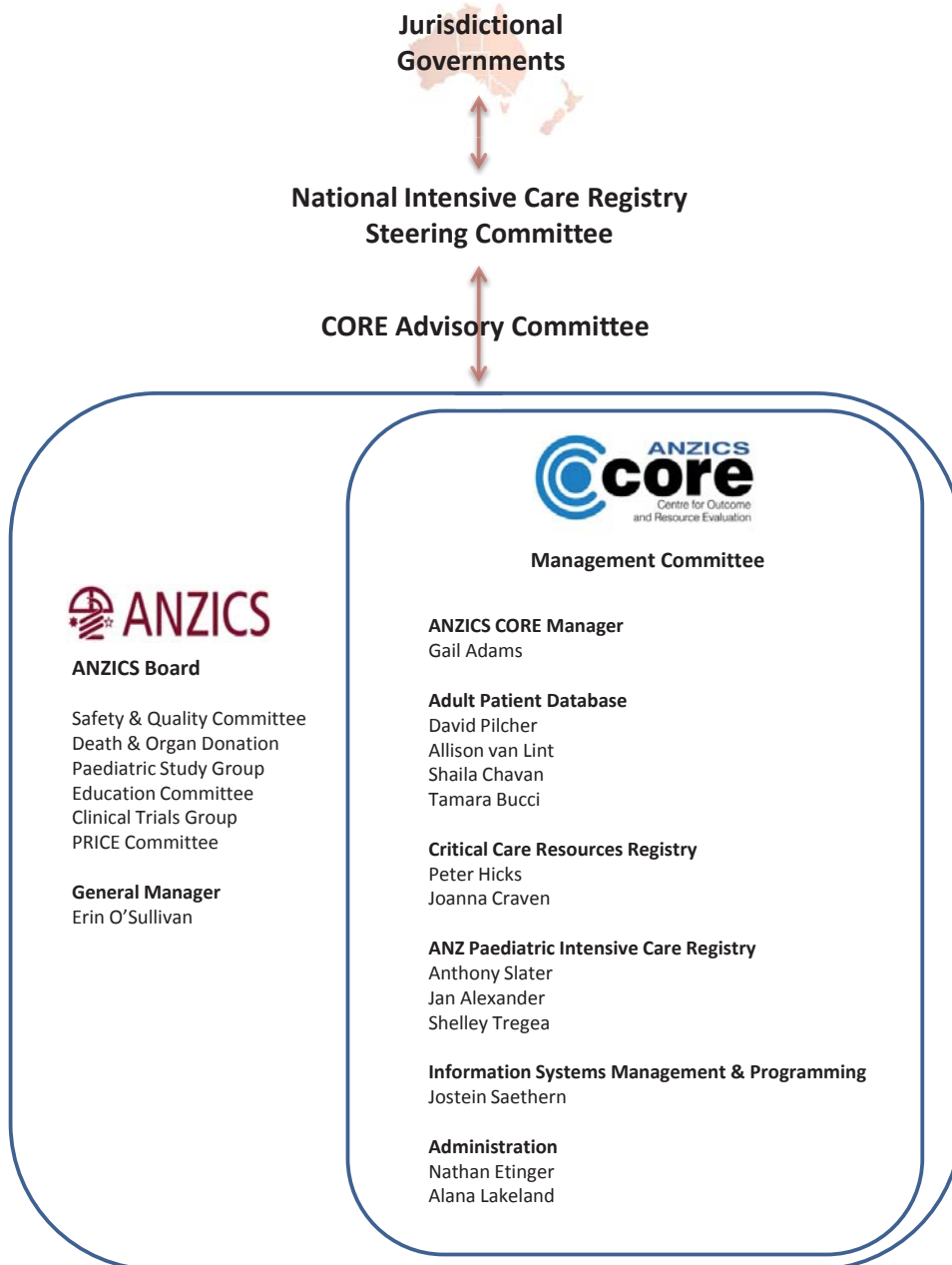
Gail Adams
Manager, ANZICS CORE

ANZICS CORE Staff

Jan Alexander
Shelley Tregoe
Allison van Lint
Joanna Craven
Jostein Saethern
Tamara Bucci
Nathan Etinger
Alana Lakeland
Shaila Chavan (currently on maternity leave)

Organisational Structure

Figure 1: Organisational Structure of ANZICS CORE



Critical Care in Australia and New Zealand



The State of Intensive Care Practice across Two Nations in 2010

- There were 186 ICUs in Australia and New Zealand[#]
- 167 units submitted data to the CCR Registry[#]
- 144 units submitted data to the APD^{*}
- 25 units submitted data to the ANZPIC Registry[^]
- Over 140,000 patients were treated in Australian and New Zealand ICUs[#]
- 75.0% of patients were treated in public hospital ICUs^{*}
- There were 1,990 physical ICU beds[#]
- 1,754 ICU beds were funded and available for use[#]
- There were 6.8 available beds per 100,000 population in Australia and 4.7 in New Zealand[#]
- 1,048 senior medical staff from 161 units were employed in a total of 575.5 full time equivalent positions[#]
- 514 (76.4%) senior medical staff in 104 units were intensivists[#]
- 10,429 registered nurses from 155 units were employed in a total of 7,827 full time equivalent positions[#]
- 5,390 (52.9%) registered nurses in 149 units had critical care training[#]
- The predicted risk of death for adult patients was 13.2% in Australia and 15.1% in New Zealand (estimated using the APACHE III-J mortality prediction algorithm)^{*}
- The observed hospital mortality for adult patients was 10.1% in Australia and 11.9% in New Zealand^{*}
- The predicted risk of death for paediatric patients was 3.0% (estimated using the PIM2 mortality prediction algorithm recalibrated – ANZ08)[^]
- The observed ICU mortality for paediatric patients was 3.1%[^]
- 43,330 (41.6%) patients at 125 units received invasive ventilation[#]
- 4,769 (5%) patients who survived their initial admission to ICU, were subsequently readmitted to ICU at least once during the same hospital stay^{*}
- 14,701 (11.5%) patients at 145 units were discharged to ward after 1800 hours and before 0600 hours[#]
- 1,595 (1.5%) patients from 122 sites had elective surgery cancelled or deferred due to inadequate resources such as beds or staff[#]
- 2385 (2.2%) patients admitted to ICU were then transferred to an ICU at another hospital^{*}
- 4292 (4.3%) patients were admitted to ICU with some form of treatment limitation order^{*}
- 83 patients were admitted to ICU for potential organ donation^{*}

^{*} APD (2010) [^] ANZPIC (2010) [#] CCR (2009/2010 financial year)

ANZICS CORE Registries

ANZICS CORE is comprised of three registries:

- Critical Care Resources (CCR) Registry
- Adult Patient Database (APD)
- Australian and New Zealand Paediatric Intensive Care (ANZPIC) Registry

In 2009/2010 there were 159 adult units and eight paediatric units that contributed data to the CCR, while in 2010, 144 adult units contributed to the APD and 16 adult units and nine paediatric units contributed to the ANZPIC Registry. There were 129 adult units that contributed to both the CCR and APD and 25 paediatric/adult units that contributed to both the CCR and ANZPIC Registry. A full list of contributing units for each registry can be found in Appendix A.

The ANZICS CORE Critical Care Resources Registry

The CCR Registry surveys ICUs annually on resources and activity. Data is collected to identify the distribution

and attributes of intensive care services in Australian and New Zealand adult and paediatric ICUs and HDUs under ICU management. The survey was first conducted in 1993 as the ANZICS ICU Registry. Annual reports are available on the CORE website and report data on a financial year basis (<http://www.anzics.com.au/core/reports>).

The survey collects a variety of information regarding the infrastructure, staffing and processes of ICUs, including critical care beds, admissions, refusals, ventilation requirements and bed utilisation, workforce data for senior medical officers, registrars and nursing staff, together with clinical indicators and processes in ICU care.

The survey for the 2009/2010 financial year had a participation rate of 90%, which comprised 142 Australian ICUs and 25 New Zealand ICUs; a total of 167 out of 186 units. The participation rate according to hospital classification is detailed in Table 1. Participation and admission numbers as reported to the CCR Registry between 2006 and 2010 are detailed in Table 2.

Table 1: Participation in the CCR Registry by Australian and New Zealand ICUs in 2009/2010

Hospital Classification	Australia		New Zealand	
	Invited	Participation Rate	Invited	Participation Rate
Tertiary	29	96.6%	7	85.7%
Metropolitan	30	86.7%	6	100.0%
Rural/Regional	36	94.4%	11	81.8%
Private	56	83.9%	4	75.0%
PICU	7	100.0%	1	100.0%
TOTAL	158	89.9%	29	86.2%

Data Source: CCR Registry

ANZICS CORE Registries

Table 2: Contributing ICUs and Admissions reported to the CCR Registry by Australian and New Zealand units from 2006 to 2010 by Hospital Classification

Hospital Classification	Australia		New Zealand	
	Number of Hospitals	Number of ICU Admissions	Number of Hospitals	Number of ICU Admissions
2009/2010				
Tertiary	28	43,900	6	10,001
Metropolitan	26	18,071	6	2,317
Rural/Regional	34	17,434	9	4,158
Private	47	39,247	3	1,040
PICU	7	6,339	1	942
Total	142	124,991	25	18,458
2007/2008				
Tertiary	29	48,508	7	9,624
Metropolitan	30	19,323	6	2,627
Rural/Regional	36	17,511	10	4,744
Private	50	35,439	3	1,075
PICU	8	6,293	1	849
Total	153	127,074	27	18,919
2006/2007				
Tertiary	29	47,017	7	9,451
Metropolitan	29	19,327	6	2,235
Rural/Regional	32	16,561	10	4,650
Private	52	35,581	2	1,028
PICU	7	5,509	1	869
Total	149	123,995	26	18,233

Data Source: CCR Registry

ANZICS CORE Registries

The ANZICS CORE Adult Patient Database

The APD collects patient episode information from adult ICUs across Australia and New Zealand. As of December 2010, 183 hospitals had contributed to the APD, although participation has varied over time for some units. The contributing sites have included 35 tertiary hospitals (five in New Zealand); 41 metropolitan hospitals (four in New Zealand); 47 rural or regional hospitals (five in New Zealand) and 60 private hospitals (three in New Zealand). Figure 2 shows the increase in both the number of sites submitting data and the number of admissions recorded each year since the start of the database in the early 1990s. It includes data submissions from pilot sites in 1991.

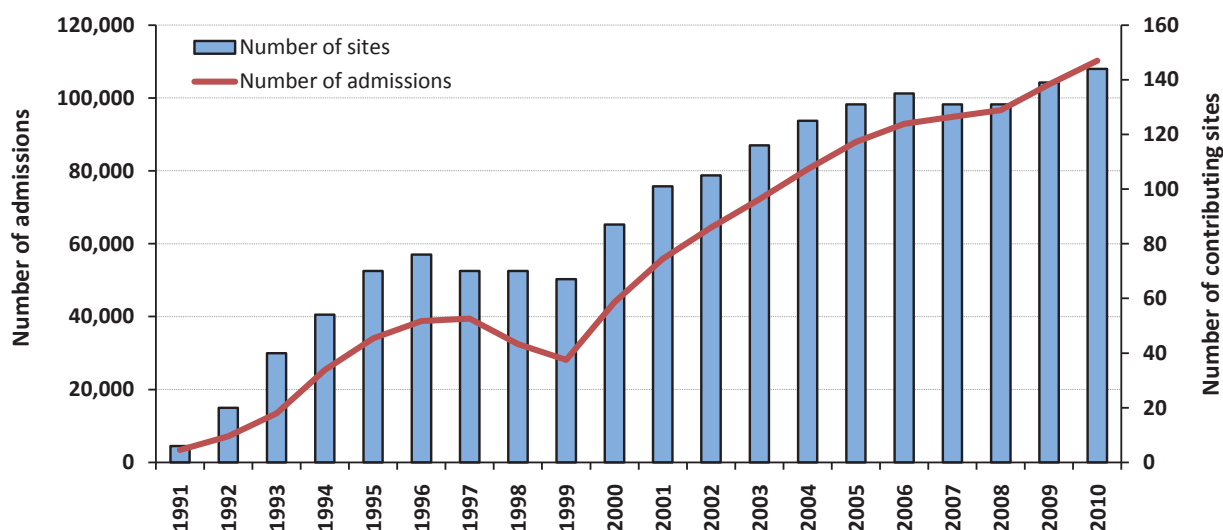
APD Data is collected and entered into a local database and then submitted to the APD at quarterly intervals. The submitted data undergoes extensive validation checks and reports are published on the ANZICS CORE secure web portal the following week. The reports are comparative based on age distribution, length of stay distribution, APACHE III-J score distribution, APACHE III-J predicted risk of death and Standardised Mortality Ratio (SMR) for the reporting period, and are grouped by hospital classification. Individual hospital reports are sent directly to units and are available online at: <http://sasspm.anzics.com.au/Portal/displayLogon.do>. Regional reports

are provided separately to JLCs to review their local hospitals' outcomes.

Feedback from contributing sites indicates that APD data is collected by a range of people within the ICU: clinicians, nurses, registrars, ward clerks and administrative staff. Results from the ongoing APD data audit program have indicated that the most reliable data is collected by trained, dedicated data collectors, and, as such, this is the recommended model for collection of APD data. Submission of data to the APD is supported by jurisdictional health departments and is also recognised as a clinical indicator by the ACHS. Queensland Health has taken this a step further by including timely submission of data to the APD in their Clinical Practice Improvement Payment (CPIP) Program, whereby units can receive up to \$10,000 per year for timely submission to the APD.

During the 2010 calendar year a total of 144 of a potential 178 hospitals contributed data to the APD (81%). Table 3 shows the number of hospitals contributing to the APD by hospital classification in 2008, 2009 and 2010; it also shows the number of admissions recorded each year. It is estimated that approximately 82% of ICU admissions in Australia and 41% in New Zealand were submitted to the APD in 2010.

Figure 2: Contributions to the APD by Australian and New Zealand ICUs between 1991 and 2010



Data Source: APD

Note: The low participation seen between 1999 and 2000 corresponds with a period of lost funding for the Registry, together with data issues related to Y2K software changes.

ANZICS CORE Registries

Table 3: Contributing ICUs and Admissions reported to the APD by Australian and New Zealand units from 2008 to 2010 by Hospital Classification

Hospital Classification	Australia		New Zealand	
	Number of Hospitals	Number of ICU Admissions	Number of Hospitals	Number of ICU Admissions
2010				
Tertiary	29	44,003	5	5,439
Metropolitan	27	17,233	3	866
Rural/Regional	34	13,784	3	1,467
Private	41	27,357	2	42
Total	131	102,377	13	7,814
2009				
Tertiary	29	42,039	4	3,573
Metropolitan	26	16,912	3	545
Rural/Regional	32	12,684	3	1,645
Private	41	26,334	1	29
Total	128	97,969	11	5,792
2008				
Tertiary	29	39,858	4	3,430
Metropolitan	27	15,930	3	785
Rural/Regional	27	11,849	3	1,118
Private	37	23,655	0	0
Total	121	91,292	10	5,333

Data Source: APD

ANZICS CORE Registries

The ANZICS CORE ANZPIC Registry

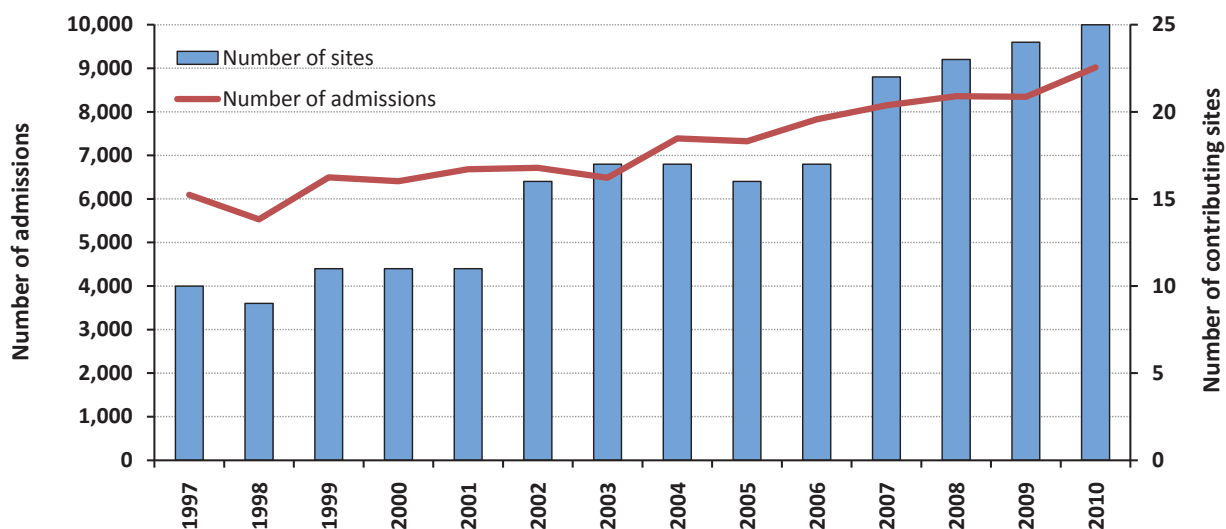
The ANZPIC Registry provides a paediatric intensive care overview through the collection of patient episode information, risk-adjusted audit and research via regular six-monthly data submissions. The Registry produces a comprehensive standalone annual report, which can be accessed from the published reports section of the CORE website: <http://www.anzics.com.au/core/reports>.

The ANZPIC Registry was established in 1997 with contributions coming from the specialist paediatric ICUs (PICUs) located in tertiary teaching children's hospitals. As data entry software has been developed and disseminated to sites, there has been increased participation by many of the general ICUs throughout Australia and New Zealand that provide intensive care to both adults and children (defined as less than 16 years of age). This allows continuing assessment of outcomes for children cared for in regional settings as well as the specialist paediatric centres.

Following the finalisation of 2010 data, the total number of admissions held within the Registry was over 100,000 (actual 100,832), with admission numbers for the year being over 9,000 for the first time. Figure 3 shows the steady increase of both admissions and number of contributing sites since inception.

In Australia and New Zealand in 2010, all eight specialist PICUs, one specialist neonatal intensive care unit (NICU)/PICU, and 16 general ICUs contributed their admission data to the ANZPIC Registry. The submitted data represents approximately 92% of all paediatric ICU admissions in the region, with PICU admissions totalling 80%. A further 8% of paediatric admissions from other general ICUs were not captured by the Registry, and were predominantly from sites admitting very small numbers of children annually. Table 4 gives a breakdown of the types of ICUs contributing their admission data to the Registry in 2010.

Figure 3: Contributions to the ANZPIC Registry by Australian and New Zealand ICUs between 1997 and 2010



Data Source: ANZPIC Registry

ANZICS CORE Registries

Table 4: Contributing ICUs and Admissions reported to the ANZPIC Registry by Australian and New Zealand units in 2010

ICU Classification	Australian Contributing Sites	New Zealand Contributing Sites	Total Admission Numbers
PICU	7	1	7782
NICU/PICU	1	-	
ICU	12	4	1238
Total	20	5	9019

Data Source: ANZPIC Registry

Explanation of Variation in Unit Number and ICU Admissions Presented in This Report

The data presented in the adult and paediatric sections of this report combine data from these three sources. Some data elements are collected by all three registries and differences in reported numbers for these (e.g. number of admissions to ICU) are a result of slightly different numbers of participating units and different reporting time periods. The APD and ANZPIC Registry report on a calendar year basis, while the CCR Registry reports on a financial year basis.

Adult Intensive Care Medicine in Australia and New Zealand

Resources, Workforce, Patients and Outcomes

This section relates to data submitted by 174 adult ICUs, keeping in mind that there were 15 units which contributed only to the APD and 30 units which contributed only to the CCR, and that the reporting periods for the two registries are different. Table 5 is based on the 159 adult units contributing to the CCR Registry. It shows that across Australia and New Zealand there were 7.8 available beds

per 100,000 population and 136,168 total admissions over the financial year 2009/2010. The overall occupancy across the 159 contributing ICUs was 67.7% (based on available beds). Occupancy was calculated by dividing total patient hours by the number of available beds to create a percentage of occupied days from total possible bed days.

Table 5: Summary of Resources and Activity in Adult Units in Australia and New Zealand in 2009/2010

	Australia	New Zealand	Total
Population > 16 yrs	17,819,818*	3,449,740**	21,269,558
Contributing Units	135	24	159
Total Admissions	118,652 (n=134)	17,516 (n=24)	136,168 (n=158)
Physical Beds ^(a)	1,627	238	1,865
Available Beds ^(b)	1,469	191	1,660
Available Beds per 100,000 Population	8.2	5.5	7.8
Occupancy Rate	69.9%	50.8%	67.7%

Data Source: CCR Registry (2009/2010) unless otherwise stated

*<http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3201.0Jun%202010?OpenDocument>

**http://www.stats.govt.nz/browse_for_stats/population/estimates_and_projections/national-pop-estimates.aspx

Notes:

(a) Physical bed refers to a single patient care location fully configured to ICU standards. It is an actual bed (or bed equivalent), not a bed space.

(b) An Available bed is a bed in use or immediately available, which has advanced life support capability and is fully staffed and funded. The number of available beds cannot exceed physical beds.

Adult Intensive Care Medicine in Australia and New Zealand

Table 6 presents a summary of adult units' medical and nursing workforce as reported to the CCR in 2009/2010. The total senior medical officer (SMO) full time equivalent (FTE) was comprised predominately (82.9%) of intensivists rather than non-intensive care specialists. In comparison, the total registrars FTE was comprised of only 48.5% College of Intensive Care Medicine (CICM) trained registrars. The proportion of registered nurses (RN) with critical care training in ICUs across Australia and New Zealand was 42.9%. There was an SMO vacancy rate of 7.1% overall and a RN vacancy rate of 6.8%.

When looking at data submitted to the APD in 2010, a total of 110,191 ICU admissions (5.0% readmissions) were submitted from 144 units. It is worth noting that the total number of ICU admissions in Australia and New

Zealand reported to the CCR Registry for the 2009/2010 financial year was 136,168 (reported by 158 adult units). Taking into account the ICUs that did not contribute to the CCR for 2009/2010, it is estimated that approximately 82% of ICU admissions were submitted to the APD from Australian units and 41% from New Zealand units.

Table 7 shows the admission characteristics, severity of illness scores and observed and predicted mortality for patients admitted to adult ICUs in Australia and New Zealand in 2010. Patients admitted to New Zealand ICUs in 2010 were younger than those admitted to Australian ICUs and stayed in ICU for a shorter period of time but had a higher predicted risk of death. Observed mortality and risk-adjusted mortality (using the APACHE III-J Standardised Mortality Ratio) were higher among ICU admissions reported from New Zealand.

Table 6: Medical and Nursing Workforce in Adult Units in Australia and New Zealand in 2009/2010

	Australia	New Zealand	Total
Total SMO FTE	452.0	85.3	537.3
Total Registrars FTE	677.5	78.5	756
Total RN FTE	6648.2	767.1	7415.3
SMO Vacancy %	6.1%	9.6%	7.1%
RN Vacancy %	7.0%	5.0%	6.8%
Intensivists to Non-Intensivists %	90.6%	42.6%	82.9%
CICM Registrars to non-CICM Registrars %	51.6%	21.7%	48.5%
CCN to Non-CCN %	42.9%	43.5%	42.9%

Data Source: CCR Registry (2009/2010)

SMO-Senior Medical Officer; RN-Registered Nurse; CCN-Critical Care Nurse; CICM-College of Intensive Care Medicine; FTE-Full-time Equivalent

Note: An FTE is the number of paid hours which is expressed as a ratio of the agreed hours for a full time employee (> 35 hours per week of paid employment, worked at an individual site).

Adult Intensive Care Medicine in Australia and New Zealand

Table 7: Admission Characteristics, Severity of Illness Scores and Mortality Outcomes for Admissions to Adult ICUs in Australia and New Zealand in 2010

	Australia	New Zealand	Total
Patient Characteristics			
Total Admissions (Contributing Sites)	102,337 (n=131)	7,814 (n=13)	110,191 (n=144)
Median Age in Years (IQR)	64.7 (49.8-75.8)	59.8 (40.0-71.8)	64.3 (49.0-75.5)
Percentage Male	58.1%	58.7%	58.2%
Proportion of Patients with Planned Admissions to ICU Following Elective Surgery	38.2%	25.4%	37.3%
Proportion Ventilated in First 24 Hours of ICU Admission	39.1%	49.0%	39.8%
Proportion Ventilated Overall*	38.0%	33.7%	37.4%
Median Length of Stay in ICU in Days (IQR)	1.8 (0.9-3.7)	1.3 (0.8-2.9)	1.8 (0.9-3.6)
Proportion Discharged to Ward After-Hours (18:00 – 05:59)	15.4%	12.1%	15.1%
Patients with at Least 1 Readmission During their Hospital Stay	5.1%	4.2%	5.0%
Severity of Illness – Scores**			
Median APACHE III-J Score (IQR)	46 (32-64)	49 (35-68)	46 (32-64)
Median APACHE II Score (IQR)	14 (10-19)	15 (11-20)	14 (10-19)
Median SAPS II Score (IQR)	27 (19-38)	29 (21-40)	27 (19-38)
Severity of Illness – Predicted Risk of Death			
Mean APACHE III-J Predicted Mortality	13.2%	15.1%	13.4%
Median APACHE III-J Predicted Mortality (IQR)	4.2% (1.3%-14.6%)	5.0% (1.3%-18.5%)	4.3% (1.3%-15.2%)
Mean APACHE II Predicted Mortality	21.0%	22.4%	21.1%
Median APACHE II Predicted Mortality (IQR)	12.6% (5.5%-28.9%)	14.0% (5.6%-32.1%)	12.9% (5.6%-30.0%)
Outcomes			
ICU Mortality (During First Admission to ICU)	6.5%	8.4%	6.6%
Hospital Mortality	10.1%	11.9%	10.2%
APACHE III-J SMR (95% CI)	0.74 (0.73 – 0.76)	0.81 (0.76 – 0.87)	0.75 (0.74 – 0.76)

Data Source – APD (2010) unless otherwise stated, * CCR Registry (2009/2010)

** Please see Appendix B for an explanation of the scoring systems used by ANZICS CORE

SMR= Standardised Mortality Ratio

All readmission episodes to ICU are excluded from calculation of predicted mortality, observed mortality (ICU and Hospital) and SMR

Adult Intensive Care Medicine in Australia and New Zealand

Table 8 shows the top five admitting diagnoses in 2010 in each country. Three out of the top five most common admitting diagnoses were common to both patient populations.

Table 8: Top Five Admission Diagnoses for Patients Admitted to Adult ICUs in Australia and New Zealand in 2010

Australia	Number	Percentage
Coronary Artery Bypass Surgery	6964	6.8%
GI Surgery for Neoplasm	4643	4.5%
Orthopaedic Surgery	4199	4.1%
Valvular Heart Surgery	3668	3.6%
Drug Overdose	3610	3.3%
New Zealand	Number	Percentage
Coronary Artery Bypass Surgery	728	9.2%
Drug Overdose	379	4.9%
Valvular Heart Surgery	341	4.4%
Bacterial Pneumonia	269	3.4%
Head Trauma +/- Multiple Trauma	263	3.4%

Data Source: APD (2010)

Adult Intensive Care Medicine in Australia and New Zealand

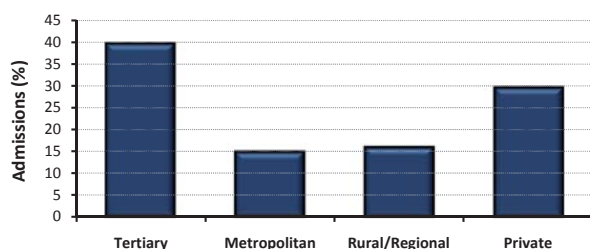
Admission and Outcome Characteristics by Hospital Classification

The demographics and outcomes of patients admitted to ICUs in Australia and New Zealand are generally reported according to the type of hospital. This ensures that hospitals with similar services and similar case-mix presenting to their ICUs are compared with appropriate peers wherever possible. Hospitals are classified as tertiary, metropolitan, rural/regional or private. These classifications are based on the location of the hospital and the level of care provided. The data presented in this section shows ICU admission and outcome characteristics based on hospital classification. A number

of alternative classifications exist, such as those used by CICM, the New South Wales Department of Health and the Australian Institute for Health and Welfare. These are not used for outcome reporting by ANZICS CORE.

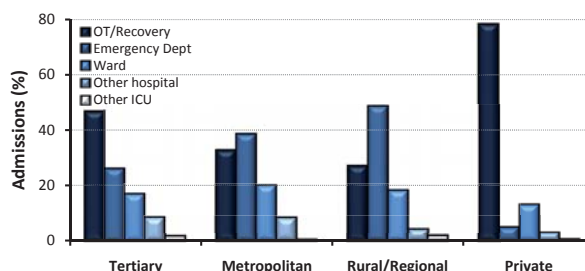
Tertiary hospitals account for the largest number of admissions to ICU and have the highest proportion of patients requiring mechanical ventilation. Private ICUs have a much higher proportion of patients who are planned admissions following elective surgery (and have a lower predicted risk of death than emergency admissions).

Figure 4: Percentage of Total Admissions to Adult ICUs in Australia and New Zealand in 2009/2010 by Hospital Classification



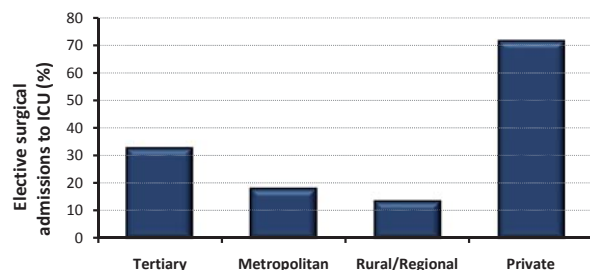
Data Source: CCR Registry (2009/2010)

Figure 5: Source of Admission to Australian and New Zealand ICUs in 2010 by Hospital Classification



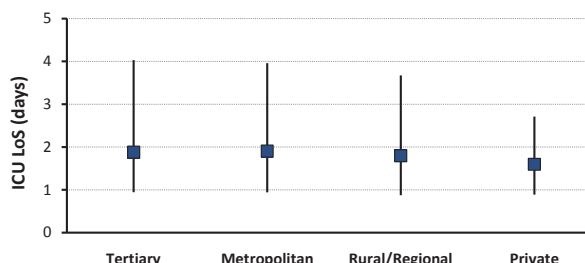
Data Source: APD (2010)

Figure 6: Percentage of Elective Surgical Admissions to Australian and New Zealand ICUs in 2010 by Hospital Classification



Data Source: APD (2010)

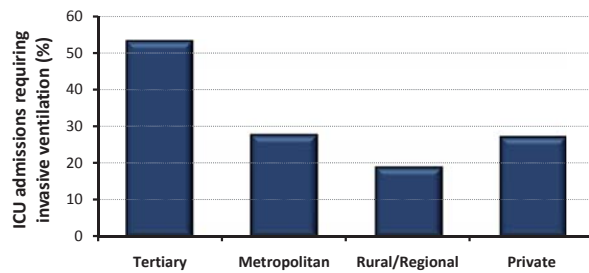
Figure 7: Median Length of Stay (days) in Australian and New Zealand ICUs in 2010 with Interquartile Range by Hospital Classification



Data Source: APD (2010)

Adult Intensive Care Medicine in Australia and New Zealand

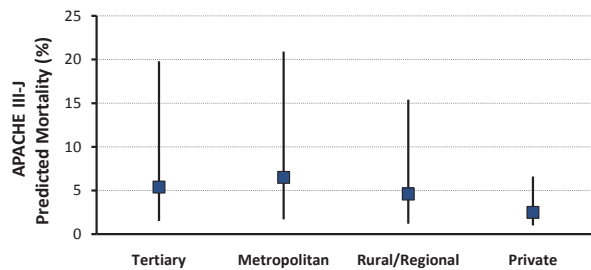
Figure 8: Percentage of Australian and New Zealand ICU Admissions Requiring Invasive Ventilation during the First 24 Hours of Admission in 2010 by Hospital Classification



Data Source: APD (2010)

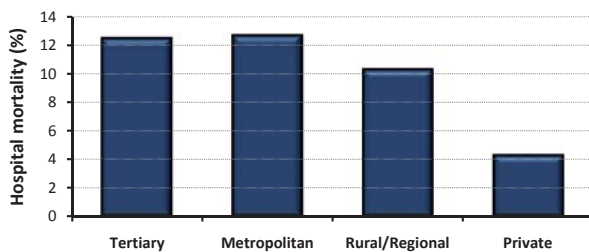
Note: The APD can identify a patient as invasively ventilated if an arterial blood gas is taken during the first 24 hours in ICU while the patient was invasively ventilated.

Figure 9: Median APACHE III-J Probability of Death in Australian and New Zealand ICUs in 2010 with Interquartile Range by Hospital Classification



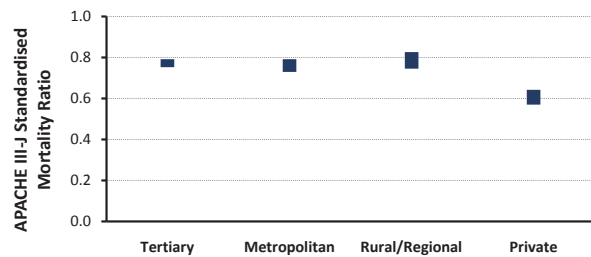
Data Source: APD (2010)

Figure 10: Observed Hospital Mortality of ICU Patients in Australia and New Zealand in 2010 by Hospital Classification



Data Source: APD (2010)

Figure 11: APACHE III-J Standardised Mortality Ratio 95% Confidence Intervals for Australian and New Zealand ICUs in 2010 by Hospital Classification



Data Source: APD (2010)

Adult Intensive Care Medicine in Australia and New Zealand

Risk-Adjusted Outcomes of Patients Admitted to ICU by Hospital Classification

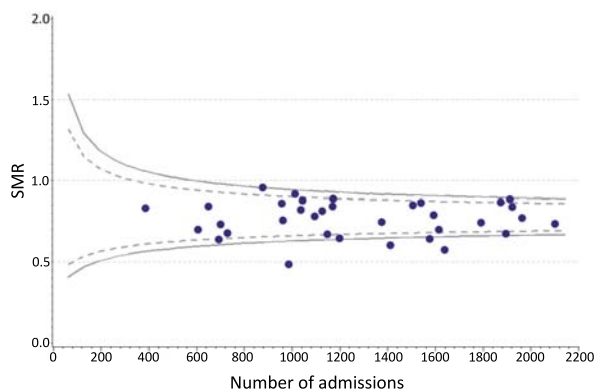
Assessing hospital performance is dependent on appropriate risk adjustment for case-mix, severity of illness and hospital sector. Differences in the number of cases submitted can influence the interpretation of outcomes. Figure 12 presents funnel plots as a visual representation of hospitals by classification (tertiary, metropolitan, rural/regional and private). The funnel plots are based on the APACHE III-J SMR. The SMRs for all units within the same classification are plotted against the number of admissions for each site during the reporting period. Confidence intervals for the plot are calculated around the mean SMR of the group shown. As the statistical confidence limits of the plots are dependent on the number of cases (represented on the vertical axis),

the upper and lower control limits for the SMRs take the shape of a funnel, hence the chart's name.

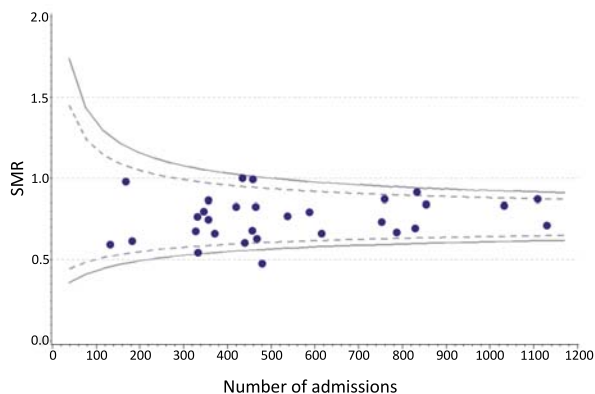
As a comparative report, the funnel plot will quickly compare a unit's SMR against the SMRs of all units within the same category. This plot quickly identifies potential outliers, as they will fall outside the control lines. If an ICU shows up above the upper-most confidence interval then this indicates it is statistically likely that this ICU's calculated SMR is higher than the others shown. There may be many reasons for this, which include data quality issues, case-mix variation and higher than expected mortality. The approach to dealing with an 'outlying ICU' is detailed under the Outlier Management Process in the next section.

Figure 12 (a)-(d): APACHE III-J SMR Funnel Plots with 95% and 99% Confidence Intervals for Australian and New Zealand ICUs in 2010 by Hospital Classification

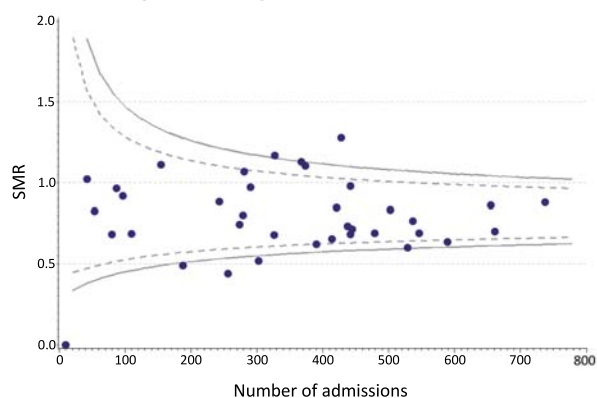
a) Tertiary Hospitals



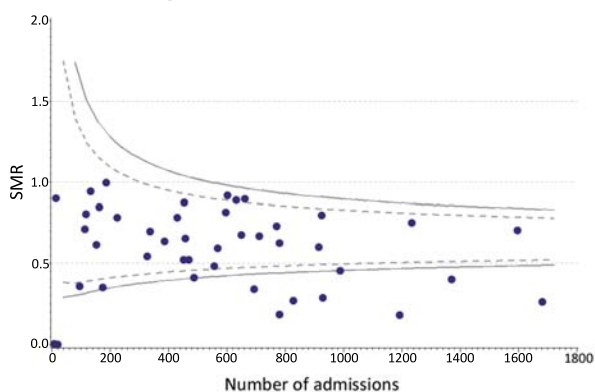
b) Metropolitan Hospitals



c) Rural/Regional Hospitals



d) Private Hospitals



Data Source: APD (2010)

Funnel chart explanation: Units are specified by closed circles. Control limits for the funnel plot are derived using 95% and 99% confidence intervals from the mean SMR of hospitals studied. The SMR is derived from the APACHE III-J predicted risk of death.

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Outlier Management Process

An 'outlier' is a contributing intensive care unit that has been identified, by analysis of data submitted to the APD or ANZPIC Registry, as having results which lie outside a predetermined range. This range is defined to indicate a high likelihood of being within the boundaries of standard or acceptable practice and may vary over time. CORE is responsible for reporting these analyses using agreed methods and within the known constraints of the data and statistical methodology.

As an example, in 2010 two units appeared above the 99% confidence intervals on their APACHE III-J funnel plot. Following further analysis, CORE was able to demonstrate that one unit was an outlier due to case-mix differences, while the second unit was an outlier due to data quality issues.

Routine internal data quality checks are performed on submitted data and reports sent back to each ICU. Units that appear to be outliers have supplementary reports run that give greater detail regarding data quality and case-mix in order to facilitate both internal and external evaluation. After further analysis, if the outlier is not due to data collection issues or case-mix, the regional jurisdictional authority (Jurisdictional Liaison Committee where there is one) and ICU Director are contacted and informed of the additional analyses. The jurisdictional authority liaises with the hospital management and the ICU Director to determine if the report requires further action, if it is an appropriate representation of local practices or outcomes and to assume responsibility for correcting factors leading to outlier performance. ANZICS CORE continues to monitor the site and report back to the ICU Director and the jurisdictional authority regarding ongoing performance. This process has been endorsed by the NICRSC. The current outlier management policy can be found at: <http://www.anzics.com.au/core?start=2>.

Additional Services Provided by ANZICS CORE to Adult ICUs

Free Data Collection Software – AORTIC

AORTIC is an intensive care database program to support the APD; it also collects some CCR and ANZPIC data. AORTIC is used by 80-85% of units that regularly contribute data to the APD. Its philosophy is to provide a tool for collecting a standardised data set to describe and compare intensive care practices across units. Although it is a Windows program, the AORTIC software has been carefully written to allow 'heads down', keyboard-only data entry, as well as providing the usual mouse-driven point-and-click Windows interface. AORTIC can collect data from multiple intensive care units in multiple hospitals in a single database. It has facilities for recording patient demographics, hospital and ICU admission data together with diagnostic, physiologic, intervention and outcome data related to intensive care. Physiology and intervention data can be collected for each day in ICU if required. It will produce simple reports on this data set and enable export of the data for more detailed analysis by the user as well as submission of de-identified data to the central ANZICS database for the production of comparative reports.

The current version of AORTIC, version 9.2.3, was released in March 2010 and has been widely implemented at contributing sites. CORE supplies full support for the database and the software can be downloaded free of charge by any contributing unit from the CORE website at: <http://www.anzics.com.au/core/aortic-software>.

Web Portal and Web Report Studio

The ANZICS CORE Web Portal is available to contributing units and is where they can view and download their quarterly standard reports one by one or all at once as a zip file. The latest regional reports summarising the APACHE outcomes and some descriptive statistics of the Australian states and territories as well as New Zealand are also available.

Web Report Studio is used as a business reporting tool for non-technical users to find, interact with, create and share reports based on available data. Web Report Studio can be used to build reports or to interact with existing reports.

Both the Web Portal and Web Report Studio can be accessed by contributing units with log-in details provided to the ICU Director: <http://sasspm.anzics.com.au/Portal/displayLogon.do>.

Adult Intensive Care Medicine in Australia and New Zealand

ANZICS Adult Patient Database Data Audit

The APD Data Audit Program was initiated in 2007 with the purpose of measuring the reliability of data held by the APD. The program, designed to run in three-year cycles, aims to visit every contributing jurisdiction and audit 50 sites each cycle. Cycle 1 of the audit program was run between 2007 and 2009 and audited APACHE II data collection at 44 sites. Cycle 2 of the audit program began in July 2010 and aims to audit the collection of APACHE III-J variables and outcomes; 14 sites have

been audited to date. All ICUs are invited to be audited but presently participation is voluntary. ICUs in the larger three states of Australia have so far been relatively under-represented and ANZICS CORE would welcome and encourage greater participation by hospitals in these regions. Information about the ANZICS APD Audit program can be found at <http://www.anzics.com.au/core/apd-data-audit-project>.

Table 9: Participation of Contributing Sites in Cycles 1 and 2 of the APD Data Audit Program

Cycle 1 (2007-2009)		
Jurisdiction	Number of Sites Audited	% Contributing Sites Audited
Victoria	9	29%
New South Wales	10	23%
Queensland	7	22%
Western Australia	4	100%
South Australia	4	40%
Tasmania	1	50%
Australian Capital Territory	2	100%
Northern Territory	2	100%
New Zealand	5	56%
Cycle 2 (2010-2012)		
Jurisdiction	Number of Sites Audited	Future Audits
Victoria	11	3 Additional audits planned 2011
New South Wales	3	6 Additional audits planned 2011
Queensland	Planned for 2011	
Western Australia		
South Australia	Planned for 2011-12	
Tasmania		
Australian Capital Territory		
Northern Territory	Planned for 2012-13	
New Zealand		

Data Source: APD audit program

Adult Intensive Care Medicine in Australia and New Zealand

The audit process involves a CORE-trained auditor re-extracting the APD data for a random set of 25 admissions previously submitted to the APD. Differences between the original and audit data are then analysed with the aim of improving the quality of submitted data by:

1. Assessing the inter-observer variation of the APACHE score and predicted risk of death at individual sites.
2. Identifying major systematic causes of variability and bias in the collection of data through analysis of the inter-observer variability.
3. Assigning an estimate of the impact of observed differences on the SMR of the contributing hospital.
4. Using the findings of the audit to recommend changes to data collection methods at individual sites.
5. Implementing procedures to improve data quality for the future.

Results from Cycle 1 of the APD Data Audit Program:

During Cycle 1 of the APD data audit program over 41,000 variables from 1102 ICU admissions to 44 hospitals were audited. While there was some bias in the collection of APD data, the submitted data was found to be of good quality and believed to be fit for purpose as a first pass at outlier identification.

The bias identified in the data submitted to the APD was predominantly caused by over coding of the chronic health variables for APACHE II. These variables proved to be the most problematic in terms of both unreliable collection and subsequent impact on APACHE II scores and predicted mortality. CORE will be targeting the coding of chronic conditions as a priority in the future to further improve the quality of the ANZICS APD.

Of great interest was the finding that units with APD-trained data collection and entry staff showed significantly less variation in both APACHE II scores and predicted mortality when compared with units where staff hadn't attended training. These units also showed less significant bias in their collection of individual variables. Further to this, those units with trained staff and a dedicated data collector were able to completely eliminate significant bias in their collection of individual variables. This highlights the importance of both APD training and the use of dedicated data collectors within units.

A report detailing the results of the first cycle of the APD Data Audit Program was released in June 2010 and can be found at <http://www.anzics.com.au/core/apd-data-audit-project>.

These results have been used to inform the redesign of APD Workshops, the redevelopment of the APD data dictionary and the upgrade of APD data quality reporting; with the aim of enhancing local data collection knowledge, increasing feedback to contributing sites and improving the reliability of those variables identified as problematic during the first cycle of the audit program.

Cycle 2 of the audit program is currently underway. Victoria and New South Wales were audited during 2010, with Queensland, Tasmania, South Australia and Western Australia the next jurisdictions to be visited.

Adult Patient Database Training Workshops

CORE provides education for data collectors, managers and intensive care staff with two-day training workshops as an introduction to the ANZICS APD. They are designed to introduce participants to the collection and management of ICU data while developing their skills. Participants are also given training on how to navigate, extract and create customised reports using AORTIC and web reports via the web portal and Web Report Studio. The APD usually holds three to four workshops per year. In 2010 there were two workshops held in Brisbane and additional workshops held in Melbourne, Wellington and Sydney. The Brisbane workshops were supported by the Queensland Statewide Intensive Care Clinical Network (SICCN), the Wellington workshop was supported by ANZICS-New Zealand, and the Sydney workshop was run in collaboration with the NSW Intensive Care Coordination and Monitoring Unit (ICCMU).

Further information about training provided by ANZICS CORE for data collection can be found at: <http://www.anzics.com.au/core/apd-education>.

Paediatric Intensive Care in Australia and New Zealand

Resources, Workforce, Patients and Outcomes

Paediatric Intensive Care in Australia and New Zealand is primarily provided by the eight specialist paediatric intensive care units (PICUs) in children's hospitals in the two countries. Approximately 80% of all paediatric ICU admissions are cared for in the eight PICUs and one combined NICU/PICU. In 2010, there was a total of 9,805 paediatric admissions reported to ANZICS CORE, of which 7,782 were treated in these nine units.

Information about resources and workforce in the specialist PICUs is obtained through submissions to

the CCR Registry from the seven PICUs in Australia and one PICU in New Zealand. Table 10 shows the overall resources and occupancy for the eight contributing PICUs as reported to the CCR Registry in 2009/2010. Occupancy was calculated by dividing the total patient hours by the available beds to create a percentage of occupied days from total possible bed days.

Table 11 shows the 2009/2010 medical and nursing PICU workforce data from the CCR Registry. Not all PICUs provided workforce data.

Table 10: Summary of Resources and Activity in Specialist Paediatric ICUs in Australia and New Zealand in 2009/2010

Resources & Activity	Australia & New Zealand
No. Contributing PICUs	8
Population < 16yrs*	5,478,757
Available Beds per 100,000 pop.	1.72
Physical Beds ^(a)	125
Available Beds ^(b)	94
Ventilator Beds ^(c)	101
Total PICU Admissions ^(d)	7594 (n=8)
Occupancy Rate	81.2%

Data Source: CCR Registry (2009/2010), unless otherwise stated
 * <http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3201.0Jun%202010?OpenDocument> and http://www.stats.govt.nz/browse_for_stats/population/estimates_and_projections/national-pop-estimates.aspx

Notes:

(a) Physical bed refers to a single patient care location fully configured to ICU standards. It is an actual bed (or bed equivalent), not a bed space.

(b) An Available bed is a bed in use or immediately available, which has advanced life support capability and is fully staffed and funded. The number of available beds cannot exceed physical beds.

(c) Ventilator bed refers to a physical ICU bed plus a ventilator.

(d) Admissions from 8 PICUs only (excludes the NICU/PICU)

Table 11: Medical and Nursing Workforce in Specialist Paediatric ICUs in Australia and New Zealand in 2009/2010

Country	Contributing PICUs
Australia	7
New Zealand	1
Workforce measures	Australia and New Zealand
Total SMO FTE ^(a)	38.1
Total Registrars FTE ^(a)	77.0
Total RN FTE ^(b)	487.4
SMO Vacancy % ^(c)	5.7%
RN Vacancy % ^(d)	6.0%
Intensivists to Non-Intensivists % ^(a)	100%
CICM Registrars to Non-CICM Registrars % ^(a)	31.2%
CCN to Non-CCN % ^(b)	57.0%

Data Source: CCR Registry (2009/2010)

(a) CCR 2009/2010 – responses from 7 PICUs only

(b) CCR 2009/2010 – responses from 6 PICUs only

(c) CCR 2009/2010 – responses from 4 PICUs only

(d) CCR 2009/2010 – responses from 5 PICUs only

SMO-Senior Medical Officer; RN-Registered Nurse; CCN-Critical Care Nurse; CICM-College of Intensive Care Medicine; FTE-Full-time Equivalent

Paediatric Intensive Care in Australia and New Zealand

The ANZPIC Registry receives data related to all admissions to PICUs in Australia and New Zealand, as well as paediatric (<16 years old) admissions from many general ICUs that are providing care to both adults and children. An agreed minimum dataset is collected at the site level and submitted to the Registry at six-monthly intervals. In 2010, the ANZPIC Registry received data on 9,019 paediatric ICU admissions from 25 contributing sites, which is approximately 92% of all paediatric admissions across Australia and New Zealand. Table 12 shows more detailed admission and mortality information for these sites.

Information such as patient demographics, hospital and ICU admission and discharge data, diagnoses, treatments, physiological, intervention and outcome data related to the intensive care episode are submitted as de-identified data. These data are subjected to rigorous

validation and completeness checks before being able to be uploaded into the main Registry data set for reporting.

Contributing units receive six-monthly and 12-monthly individual site reports detailing patient demographics, bed usage, indicators of case mix, as well as outcome measures such as SMRs and funnel plots. Comparative total Registry figures are also included in the site reports. Additionally, PICUs are provided with 12-month performance indicators, including risk-adjusted cumulative sum charts (cusums) and comparative unit efficiency. The Paediatric Index of Mortality, PIM2, is the mortality prediction model used by the ANZPIC Registry and is based on eight variables collected at the time of a child's admission to intensive care. A recalibrated PIM2 (PIM2_ANZ08) has been used in the figures presented for 2010. The PIM2 model is recalibrated every two years by the Registry.

Table 12: Admission and Mortality Data for Paediatric ICU Admissions in Australia and New Zealand in 2010

Contributing units	
Australia	20 (7 PICUs, 1 NICU/PICU, 12 ICUs)
New Zealand	5 (1 PICU, 4 ICUs)
Admission numbers	
PICUs*	7782
ICUs	1238
Total	9019
Mortality	
ICU mortality	268 deaths – crude mortality of 3.0%
Predicted mortality (PIM2 risk of death**)	3.1%

Data Source: ANZPIC Registry (2010)

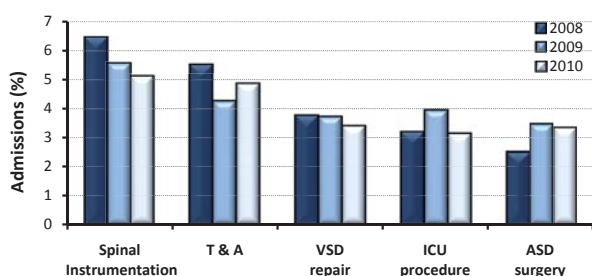
* Includes 8 PICUs & 1 NICU/PICU

**PIM2_ANZ08 - recalibrated PIM2

Paediatric Intensive Care in Australia and New Zealand

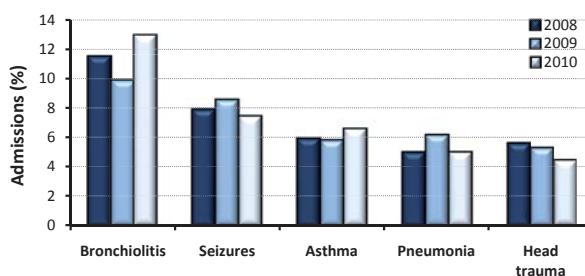
Figure 13 and Figure 14 show the top five elective and non-elective reasons for paediatric admission to ICU for the years 2008 to 2010 as a percentage of all admissions.

Figure 13: Top Five Elective Reasons for Paediatric Admissions to ICU in Australia and New Zealand from 2008 to 2010



Data Source: ANZPIC Registry (2008-2010)

Figure 14: Top Five Non-Elective Reasons for Paediatric Admissions to ICU in Australia and New Zealand from 2008 to 2010



Data Source: ANZPIC Registry (2008-2010)

Table 13 shows the different percentages of elective and non-elective admissions being admitted from various sources in 2010.

Table 13: Source of Admission for Paediatric ICU Admissions in Australia and New Zealand in 2010 by Admission Type

ICU Admission Source (%)	Non-Elective	Elective
Direct ICU Admission	18.9	1.4
Emergency Department	20.2	0.4
Operating Theatre or Recovery	6.6	34.6
Other ICU or NICU	0.2	0.2
Ward	15.5	2.0

Data Source: ANZPIC Registry (2010)

Paediatric Intensive Care in Australia and New Zealand

Monitoring Performance of Paediatric Intensive Care Outcomes

Table 14 shows basic age specific outcomes with number of deaths, Registry SMR, and length of stay for the 2010 calendar year.

Table 14: Paediatric ICU outcomes for Australia and New Zealand in 2010

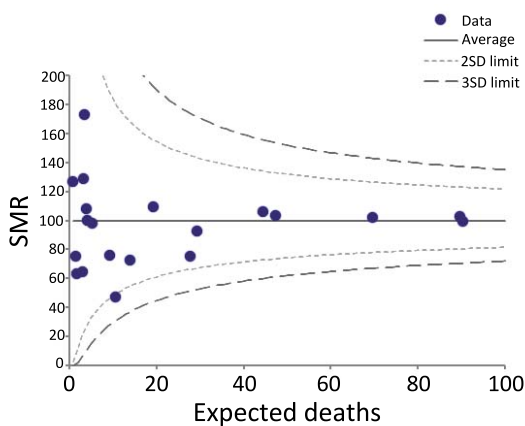
Age specific mortality rates (95% CI)	
Neonates <28 days	6.4 (4.7 - 8.1)
>28 days - <1 year	2.9 (2.2 - 3.6)
1 - 4 years	2.1 (1.5 - 2.7)
5 - 9 years	2.8 (1.9 - 3.8)
10 - 14 years	2.5 (1.6 - 3.4)
>= 15 years	2.8 (1.3 - 4.3)
Registry SMR (95% CI) based on PIM2 _{ANZ08}	0.96 (0.87 - 1.06)
Median (IQR) length of stay (days) in ICU	
All Admissions	1.5 (0.8 - 3.5)
Elective Admissions	1.0 (0.8 - 2.8)
Non-Elective Admissions	1.7 (0.8 - 4.1)
Intubated Admissions	2.6 (1.0 - 5.8)
Non-Intubated Admissions	1.0 (0.7 - 2.1)

Data Source: ANZPIC Registry (2010)

Paediatric Intensive Care in Australia and New Zealand

Since 2008 innovative risk-adjusted measures of quality and performance of contributing PICUs have been developed and reported on. Methods for risk adjusting mortality have been available for many years. For example, the funnel plot in Figure 15 and Registry-generated sequential control charts represent the results of analysis of risk-adjusted mortality reported back to sites.

Figure 15: PIM2_{ANZ08} Funnel Plot for Australian and New Zealand ICUs Contributing to the ANZPIC Registry in 2008 and 2009



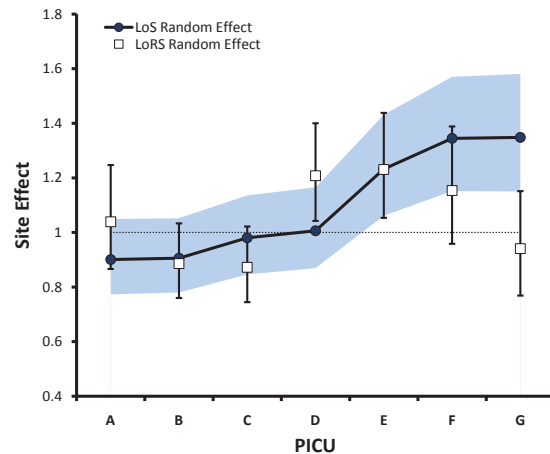
Data Source: ANZPIC Registry (2008 and 2009)

Please note although similar to the funnel plots used for monitoring adult intensive care practice, the following paediatric funnel plot plots expected deaths along the x-axis, not total ICU admissions.

However, as well as considering risk-adjusted mortality, new methods of assessing variation in patient outcomes among units have been developed for the Registry using risk-adjusted ICU length of stay (LoS) and length of respiratory support (LoRS), as well as a visual representation of unit efficiency.

Figure 16 illustrates the results of the LoS/LoRS analysis for seven PICUs in 2009; one PICU was excluded from the analysis as the unit did not collect data on LoRS. The figure illustrates that units E, 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 D had a risk-adjusted mean LoRS that was significantly longer than the population overall, however, this was not associated with prolonged LoS.

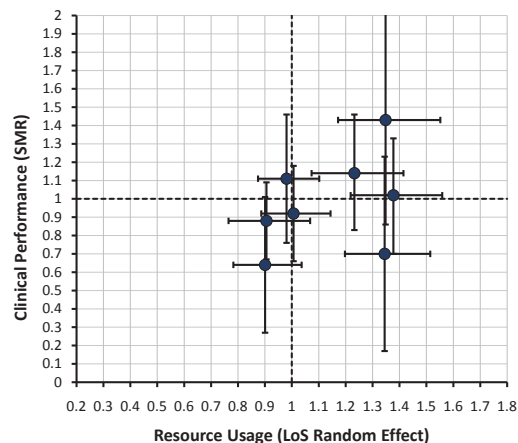
Figure 16: Risk-Adjusted Mean Length of Stay and Length of Respiratory Support for Australian and New Zealand PICUs in 2009



Data Source: ANZPIC Registry (2009)

Figure 17, a modified Rapoport-Teres plot, provides a simple visual representation of PICU efficiency. For intensive care, a unit can be considered efficient if optimum clinical outcomes are achieved with low resource use. The site 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. The quadrants of the plot can be designated as most efficient (bottom left), least efficient (top right), effective but at the expense of high resource use (bottom right) and poor performance (top left).

Figure 17: Rapoport-Teres Plot of Efficiency for Australian and New Zealand PICUs in 2009



Data Source: ANZPIC Registry (2009)

Paediatric Intensive Care in Australia and New Zealand

Data Quality

Data quality assurance for ANZPIC Registry data submissions includes internal consistency checking, site data query reports, completeness and accuracy restrictions on uploaded data, and biennial site audits. Study days are organised by the Registry and held annually for site staff involved in data collection and coding, in an effort to ensure consistency and accuracy of submitted data.

ANZPIC Registry Audit Process

As part of ensuring the integrity and uniformity of all ANZPIC Registry data, site audits on all specialist paediatric ICUs are routinely performed every two years. During 2010, seven of the eight PICUs had an audit completed on their 2009 data, with the final site being completed in 2011 on 2010 data. The audit process is based on a random sample of 50 records stratified by the risk of death, predicted by PIM2, to ensure that the sample includes patients with a representative range of mortality risk. An independent and experienced data manager from another PICU then re-extracted information from hospital medical records and submitted the audited data back to the Registry.

Statistical software was used to compare the two sources of data and comparison reports were centrally generated and sent to each site for feedback. The reports included measures of agreement on all fields required for the calculation of PIM2, as well as Bland-Altman plots displaying the agreement between the PIM2 risk of death calculated from the original and re-extracted data. Sites were requested to examine discrepancies and provide feedback. Following the completion of this process, the original data submitted by sites showed very few and minor errors, although some sites acknowledged the need to provide more comprehensive documentation in support of their coding. Auditing of sites will occur again in the second quarter of 2012.

ANZICS CORE

Collaborations and Research

ANZICS CORE engages in and supports a number of research projects, not only using data collected by the three ANZICS CORE Registries, but also through the work of PhD students and collaborations with research bodies such as the ANZICS CTG and ANZIC-RC. Requests for data and analyses are welcomed and encouraged from all ANZICS member and indeed anyone interested in epidemiological research into the practices and outcomes of intensive care medicine in Australia and New Zealand.

Requests for Information

In 2010 there were 20 requests for data from the CCR Registry and 34 requests for data from both the APD and ANZPIC Registry.

ANZICS CORE Research Publications for 2009 and 2010

Bohensky MA, Jolley, Sundararajan V, Evans S, Pilcher DV, Scott I, Brand CA. **Data Linkage: a powerful tool with potential problems.** *BMC Health Serv Res* 2010; 10:346

Carter AW, Pilcher D, Bailey M, Cameron P, Duke GJ, Cooper J. **Is ED length of stay before ICU admission related to patient mortality?** *Emerg Med Australas* 2010; 22:145

Drennan K, Hicks P, Hart GK. **Impact of pandemic (H1N1) 2009 on Australasian critical care units.** *Crit Care Resusc* 2010; 12:223

Martin JM, Hart GK, Hicks P. **A unique snapshot of intensive care resources in Australia and New Zealand.** *Anaesth Intensive Care* 2010; 38:149

McNamee JJ, Pilcher DV, Bailey MJ, Moore E, Cleland H. **Mortality prediction among burns patients in Australian and New Zealand intensive care units.** *Crit Care Resusc* 2010; 12:196

Moran JL, Solomon PJ. **Global quantitative indices reflecting provider process-of-care: data-base derivation.** *BMC Med Res Methodol* 2010; 10:32

Pilcher DV, Hoffman T, Thomas C, Ernest D, Hart GK. **Risk-adjusted continuous outcome monitoring with a EWMA chart: could it have detected excess mortality among intensive care patients at Bundaberg Base Hospital?** *Crit Care Resusc* 2010; 12:36

Straney L, Clements A, Alexander J, Slater A for the ANZICS Paediatric Study Group. **Measuring efficiency in Australian and New Zealand paediatric intensive care units.** *Intensive Care Med* 2010; 36: 1410

Straney L, Clements A, Alexander J, Slater A for the ANZICS Paediatric Study Group. **Quantifying variation of paediatric length of stay among intensive care units in Australia and New Zealand.** *Qual Saf Health Care* 2010; 19:e5

Straney L, Clements A, Alexander J, Slater A for the ANZICS Paediatric Study Group. **Variation in duration of respiratory support among Australian and New Zealand pediatric intensive care units.** *Pediatr Crit Care Med* 2010; 12:9

Bagshaw SM, Bellomo R, Jacka MJ, Egi M, Hart GK and George C. **The impact of early hypoglycemia and blood glucose variability on outcome in critical illness.** *Crit Care* 2009; 13:R91

Bagshaw SM, Egi M, George C and Bellomo R. **Early blood glucose control and mortality in critically ill patients in Australia.** *Crit Care Med* 2009; 37: 463

Bagshaw SM, Webb SA, Delaney A, George C, Pilcher D, Hart GK and Bellomo R. **Very old patients admitted to intensive care in Australia and New Zealand: a multi-centre cohort analysis.** *Crit Care* 2009; 13: R45

Corke C, Leeuw E, LO SK, George C. **Predicting future intensive care demand in Australia.** *Crit Care Resusc* 2009; 11:257

Duke GJ, Buist MD, Pilcher D, Scheinkestel CD, Santamaria JD, Gutteridge GA, et al. **Interventions to circumvent intensive care access block: a retrospective 2-year study across metropolitan Melbourne.** *Med J Aust* 2009; 190:375

Martin J, Hicks P, Norrish C, Chavan S, George C, Stow P, et al. **Designing and implementing an Australian and New Zealand intensive care data audit study.** *Int J Health Care Qual Assur* 2009; 22:572

Taori G, Ho KM, George C, Bellomo R, Webb SA, Hart GK, et al. **Landmark survival as an end-point for trials in critically ill patients--comparison of alternative durations of follow-up: an exploratory analysis.** *Crit Care* 2009; 13:R128

ANZICS CORE

Collaborations and Research

ANZICS PhD Scholarships

A limited number of scholarships are available for PhD students to work in conjunction with ANZICS CORE, using data from the three registries for their research.

Current Scholarships

Development of a New Mortality Prediction Tool for Australia and New Zealand

Eldho Paul (Monash University)

ANZICS CORE collects data for the calculation of three mortality prediction models (APACHE II, APACHE III and SAPS II). APACHE III was developed in the USA and released into the public domain in 2002. At the time it provided reasonable overall prediction of outcomes in Australia and New Zealand. Although APACHE III still provides the best available mortality prediction, at present it performs increasingly poorly for certain diagnostic groups. It tends to over-predict mortality for the majority of diagnoses, including elective surgical patients, and under-predict mortality for a few, e.g. sub-arachnoid haemorrhage.

In collaboration with ANZICS CORE, the Department of Epidemiology at Monash University and the ANZIC-RC, Eldho Paul began his PhD studies in 2010 with the aim of developing a new mortality prediction model specific to Australian and New Zealand intensive care units.

Linking Clinical and Administrative Data to Evaluate Intensive Care Outcomes

Megan Bohensky (Monash University)

Performance reporting is an important aspect of monitoring and improving the quality of healthcare. One method of measuring the quality of healthcare is to obtain data from administrative databases, however, the scientific rigour of assessing a hospital's care quality using administrative data obtained from secondary sources has been questioned in the past. One proposal for enhancing the quality reports based on administrative data is to link this data to that held by existing clinical registries.

This project involves linking two datasets, the ANZICS CORE APD and the Victorian Department of Health Victorian Admitted Episodes Data Set (VAED). The aims of the project are as follows:

- To evaluate the utility and validity of administrative and clinical registry data for measuring ICU performance and post-hospital mortality
- To establish methods of linkage of relevant data sets, to aid in quality measurements
- To apply different statistical models for monitoring and interpreting data sources

Completed Scholarships

Measuring Quality and Performance in the Paediatric Intensive Care Unit

Lahn Straney (University of Queensland)

This PhD focused on developing paediatric ICU risk-adjustment methods for objectively comparing performance among units and over time. The research used over 10 years of ICU admission data from all PICUs in Australia and New Zealand to examine the relationships between patient characteristics and patient outcomes and to facilitate objective interpretations of performance.

The results of the research now provide more robust methods for assessing efficiency and clinical performance in the PICU. This is significant in two ways. Firstly, the methods provide novel methods for comparing ICU outcomes, including LoS, which has posed difficulty for modelling. Secondly, the findings of this research provide practical insights into the performance of Australian and New Zealand PICUs and in doing so provide direction for potential quality improvement.

Lahn was awarded his PhD in December, 2010 and is now a post-doctoral research fellow at the Institute for Health Metrics and Evaluation, University of Washington, Seattle, USA.

ANZICS CORE

Future Directions

Main Aims

The main aims for ANZICS CORE over the coming three years are the:

- Redevelopment of data submission, analysis and reporting processes to integrate the APD, ANZPIC Registry and CCR Registry;
- Relocation within the Registries Group at the SPHPM, Monash University.

Redevelopment of Submission, Database Structure and Reporting Processes

The CORE Enterprise Reporting System (CERS)

With this project ANZICS CORE aims to provide secure submission of data via a web service without the need for contributing sites to email data submissions and survey responses. As data is currently de-identified at source, this has been acceptable until now, however, this approach has severely limited analysis and reporting on longer term outcomes of critical illness and is not compliant with new registry technical and operating standards. It will also reduce the current manual processes performed by ANZICS staff, such as uploading data for the APD and ANZPIC Registry and entering data for the CCR Registry. The three registries run by ANZICS CORE will be incorporated into one single data warehouse using modern database and reporting technologies which conform to industry standards. The use of Microsoft SQL technologies for database and reporting environments will allow more security, greater access to programming skills, and increased economies of scale (both financially and through use of personnel). It will provide greater scope for future development, should be associated with a reduction in programming costs, and will match standards and infrastructure already in place at other registries within The School of Public Health and Preventive Medicine (SPHPM) at Monash University.

Relocation within the Registries Group at the SPHPM, Monash University

A number of external drivers in governance, technology and scope of clinical practice have influenced the recent development of CORE. These include the recent *Towards National Arrangements for Clinical Quality Registries*, including the *Operating Principles and Technical Standards for Australian Clinical Quality Registries* developed by the ACSQHC, the evolving role of intensive care units in providing hospital-wide rapid response teams and outreach follow-up services and the *Report to NICRSC on CORE* by Professor Kathy Rowan from The United Kingdom's Intensive Care National Audit & Research Centre (ICNARC), following her visit to CORE in 2009. This report highlighted much strength but also identified areas where ANZICS CORE should develop (in management structure, information technology infrastructure, strategic direction and academic collaborations). Many of Professor Rowan's suggestions have already been introduced. However, her review also highlighted the potential benefit of greater collaboration between the Registries group at the SPHPM, Monash University. *The Strategic Principles for Clinical Quality Registries* developed by the ACSQHC also makes substantive arguments for consolidation or collocation to reach economies of scale and capability.

The SPHPM at Monash University has significant expertise, experience and resources for running clinical registries and currently houses 18 major clinical registries, of whom some of the largest include the Bi-National Burns Registry, The Victorian Trauma Registry, The Australian Orthopaedic and Joint Registry and The Australian Cardiothoracic Surgical Registry. Although run from within Monash University using common information technology and governance frameworks, these registries retain individual identities, are funded through agreements with external organisations, ensure performance monitoring to their respective craft groups and provide multiple avenues for research to improve patient outcomes. Recognition of the expertise of Monash University in running clinical registries has lead CORE to investigate the potential advantages of joining this group. In addition, The SPHPM at Monash University is also the site of the ANZIC-RC and the Australian and New Zealand Anaesthetists' CTG, with whom ANZICS CORE already cooperates on many projects.

ANZICS CORE

Future Directions



Additional Aims

In addition to the normal activities, each of the three CORE registries has a number of goals that will be achieved during the current triennial funding period (2011 - 2013):

The ANZICS Adult Patient Database

- Increase the number of sites submitting data
- Increase data quality through the data audit and education programs
- Develop a web audit tool to facilitate the APD audit program and self audits by units
- Target sites with questionable data quality and low submission numbers
- Develop standardised data quality reports
- Develop a new mortality risk model for adult admissions to ICU
- Develop new reports and reporting methods
- Redevelop data collection software
- Submission of identified patient data and linkage to other registries
- Long-term integration with CCR and ANZPIC Registries through IT infrastructure development

The ANZPIC Registry

- Recalibration of the Risk-Adjusted Congenital Heart Surgery Model (RACHS) for the Australian and New Zealand region
- Increase the number of sites submitting data
- Expand existing data audit program
- Long-term integration with APD and CCR Registries through IT infrastructure development
- Prospective development of updated version of PIM Model (PIM4)

The Critical Care Resource Registry

- Long-term integration with APD and ANZPIC Registries through IT infrastructure development
- Web-based data entry and reporting for units
- Develop enhanced comparative reports and feedback to sites
- Provide longitudinal reports of unit activity
- Work with colleges and government to support workforce planning
- Integrated use of APD and CCR data to enhance outlier analysis
- Integrated use of APD and CCR data to examine resources' relationship to outcomes
- Assist investigations of Medical Emergency Teams

ANZICS CORE Staff

ANZICS CORE Management Personnel

Chair

Associate Professor David Pilcher MBBS, MRCP, FRACP, FCICM

The Alfred Hospital

David has worked with ANZICS CORE since 2006, initially as the Victorian representative. He became Director of the APD in 2008 and Chair of ANZICS CORE in 2011. He has interests in mortality prediction modeling, epidemiology of ICU outcomes, and organ donation.

Dr Peter Hicks MBChB, FCICM

Wellington Hospital

Peter has worked with ANZICS CORE since 2000, initially as the NZ regional representative. He became the Co-Director of the CCR Registry in 2002 and has been the Director of the CCR Registry since 2011. His interests are in providing comparative information of intensive care units' activity and resources for units to use.

Dr Anthony Slater MBBS, BMedSci, FRACP, FCICM

Royal Children's Hospital, Brisbane

Tony has been the ANZPIC Registry Director since its inception in 1997 and is also the ICU Director at Royal Children's Hospital in Brisbane. He has been the principal investigator in the development of the PIM2 and PIM3 paediatric mortality prediction models.

Erin O'Sullivan BA, LLB

General Manager, ANZICS

Erin joined ANZICS in early 2009. As General Manager Erin is responsible for the management of the operational functions of the Society, including finance, governance, human resources, and communications.

Gail Adams BAppSci (MT)

ANZICS CORE Manager

Gail joined ANZICS CORE in October 2010. She oversees the technical aspects of managing the registries and is responsible for the management of CORE staff and projects.

ANZICS CORE Staff

ANZICS CORE Personnel

APD and CCR Staff (Based in Melbourne)

Allison van Lint BA, BSc (Hons), PhD

Senior Project Officer – Data Quality and Research

Allison has been with ANZICS CORE since early 2009, working with the Adult Patient Database. Her main roles include administering the APD data audit and outlier management programs, overseeing APD data submissions and jurisdictional reporting, and providing ongoing support to contributors through APD training workshops, data requests and query support.

Shailla Chavan BSc, MPH

*Project Officer – Data Quality and Education
(currently on maternity leave)*

Shailla has been with ANZICS CORE for six years, working with the Adult Patient Database. Shailla facilitates the extraction of APD data for external data requests, provides support to contributing units through APD training workshops and is involved in the redevelopment of APD reporting facilities.

Joanna Craven BAppSci, MPH

Project Officer – Core Registries

Joanna started with ANZICS CORE in 2011 and is responsible for the Critical Care Resources Registry. She facilitates the dissemination and collection of the annual CCR survey and the management and reporting of registry data.

Jostein Saethern MIT

Project Officer – Programming

Jostein has been with ANZICS CORE since late 2009 and is responsible for software development and looking after the IT infrastructure at CORE. He is also responsible for supporting CORE's data collection utility, AORTIC.

Tamara Bucci BSc

Project Support Officer

Tamara Bucci joined ANZICS CORE in 2010 working predominantly on the APD Audit Program and assisting with the cleaning/querying of data for the CCR Registry. Her role has since expanded and she is now responsible for coordinating the APD data submission and reporting of data to contributing sites.

ANZPIC Registry Staff (Based in Brisbane)

Jan Alexander

Research Manager

Jan commenced with ANZICS in mid 2007 and is responsible for the day-to-day running of the paediatric Registry and facilitating its future changes. She is responsible for maintaining the electronic registry, producing site and annual reports, and providing data management support for research and user requests, including the use of statistical and database software.

Shelley Tregoe

Research Assistant

Shelley has been with the ANZPIC Registry since the start of 2008 and her main role is the coordination of the data submission and cleaning/query resolution process for participating sites. She also contributes both technical expertise and administrative support in the production of the Registry's annual report and other documentation, and helps to run the annual training day for site staff.

Previous Personnel in 2010

Ashley Fletcher

CORE Manager

Kelly Drennan

Senior Research Officer (CCR Registry)

Marcela Forero

Project Officer: Information and Systems Management

Glossary

ACHS	Australian Council on Healthcare Standards
ACSQHC	Australian Commission for Safety and Quality in Health Care
ANZICS	Australian and New Zealand Intensive Care Society
ANZIC-RC	Australian and New Zealand Intensive Care Research Centre
ANZPICR	Australian and New Zealand Paediatric Intensive Care Registry
APACHE	Acute Physiological and Chronic Health Evaluation
APD	Adult Patient Database
CCN	Critical Care Nurse
CCR	Critical Care Resources
CERS	Core Enterprise Reporting System
CICM	College of Intensive Care Medicine
CPIP	Clinical Practice Improvement Payment
CORE	Centre for Outcome and Resource Evaluation
CTG	Clinical Trials Group
CUSUM	Cumulative Sum Chart
FTE	Full Time Equivalent
ICCMU	Intensive Care Coordination and Monitoring Unit
ICNARC	Intensive Care National Audit and Research Centre
ICU	Intensive Care Unit
JLC	Jurisdictional Liaison Committee
LoRS	Length of Respiratory Support
LoS	Length of Stay
MET	Medical Emergency Team
NICU	Neonatal Intensive Care Unit
NICRSC	National Intensive Care Registry Steering Committee
PICU	Paediatric Intensive Care Unit
PIM	Paediatric Index of Mortality
PSG	Paediatric Study Group
RACHS	Risk-Adjusted Congenital Heart Surgery
RN	Registered Nurse
SICCN	Statewide Intensive Care Clinical Network
SMO	Senior Medical Officer
SMR	Standardised Mortality Ratio
SPHPM	School of Public Health and Preventive Medicine
SQC	Safety and Quality Committee
VAED	Victorian Admitted Episodes Dataset

Appendices

Appendix A: Contributing Units in 2010

New Zealand	APD	CCR	ANZPICR
Auckland City Hospital – DCCM		✓	
Auckland City Hospital – CVICU		✓	
Christchurch Hospital	✓		✓
Dunedin Hospital	✓	✓	
Gisborne Hospital		✓	
Grey Hospital		✓	
Health Waikato	✓	✓	✓
Hutt Hospital		✓	
John Fawcner Hospital		✓	
Mercy Hospital & Health Services		✓	
Middlemore Hospital	✓	✓	✓
Nelson Hospital	✓		
North Shore Hospital		✓	
Palmerston North Hospital		✓	
Rotorua Hospital		✓	
Southern Cross Hospital, Hamilton	✓	✓	
Southern Cross Hospital, Wellington	✓		
Southland Hospital		✓	
Starship Children's Hospital		✓	✓
Taranaki Base Hospital	✓	✓	✓
Tauranga Hospital	✓	✓	
Timaru Hospital	✓	✓	
Wairau Hospital		✓	
Wakefield Hospital		✓	
Wanganui Hospital		✓	
Wellington Hospital	✓	✓	
Whakatane Hospital		✓	
Whangarei Hospital	✓	✓	

Australian Capital Territory	APD	CCR	ANZPICR
Calvary Hospital	✓	✓	
Canberra Hospital	✓	✓	✓

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New South Wales	APD	CCR	ANZPICR
Albury Base Hospital	✓	✓	
Armidale Rural Referral Hospital		✓	
Bankstown-Lidcombe Hospital	✓	✓	
Bathurst Base Hospital	✓	✓	
Blacktown Hospital	✓		
Brisbane Waters Private Hospital	✓	✓	
Calvary Health Care Riverina		✓	
Calvary Mater Newcastle	✓	✓	
Campbelltown Hospital	✓		
Coffs Harbour Health Campus	✓	✓	
Concord Hospital	✓	✓	
Dalcross Adventist Hospital		✓	
Dubbo Base Hospital		✓	
Figtree Private Hospital	✓	✓	
Gosford Hospital	✓	✓	
Gosford Private Hospital	✓	✓	
Grafton Base Hospital	✓		
Griffith Base Hospital	✓	✓	✓
Hawkesbury District Health Service		✓	
Hornsby Ku-ring-gai Hospital	✓	✓	
John Hunter Hospital	✓	✓	✓
Kempsey District Hospital		✓	
Lake Macquarie Private Hospital		✓	
Lismore Base Hospital	✓	✓	
Liverpool Hospital	✓	✓	
Manly Hospital & Community Health	✓	✓	
Manning Rural Referral Hospital	✓	✓	
Mater Private Hospital, Sydney	✓		
Nepean Hospital	✓	✓	
Newcastle Private Hospital	✓		
North Shore Private Hospital	✓	✓	
Norwest Private Hospital	✓	✓	

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Orange Base Hospital	✓	✓	
Port Macquarie Base Hospital	✓		
Prince of Wales Hospital		✓	
Prince of Wales Private Hospital	✓	✓	
Royal North Shore Hospital	✓	✓	
Royal Prince Alfred Hospital	✓	✓	
Shoalhaven Hospital	✓	✓	
St George Hospital	✓	✓	
St George Private Hospital	✓	✓	
St Vincent's Hospital	✓	✓	
St Vincent's Private Hospital		✓	
Strathfield Private Hospital		✓	
Sutherland Hospital & Community Health Services	✓	✓	
Sydney Adventist Hospital	✓	✓	
Sydney Children's Hospital		✓	✓
Tamworth Base Hospital	✓	✓	✓
The Children's Hospital at Westmead		✓	✓
Tweed Heads District Hospital	✓	✓	
Wagga Wagga Base Hospital & District Health	✓	✓	
Westmead Hospital	✓	✓	
Westmead Private Hospital	✓	✓	
Wollongong Hospital	✓	✓	
Wyong Hospital	✓		

Northern Territory	APD	CCR	ANZPICR
Alice Springs Hospital	✓	✓	
Royal Darwin Hospital	✓	✓	✓

Queensland	APD	CCR	ANZPICR
Allamanda Private Hospital	✓	✓	
Brisbane Private Hospital	✓	✓	
Bundaberg Base Hospital	✓	✓	
Caboolture Hospital	✓		
Cairns Base Hospital	✓	✓	✓

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Gold Coast Hospital	✓	✓	
Greenslopes Private Hospital	✓	✓	
Hervey Bay Hospital	✓	✓	
Holy Spirit Northside Hospital	✓	✓	
Ipswich Hospital	✓	✓	
John Flynn Private Hospital	✓	✓	
Logan Hospital	✓	✓	
Mackay Base Hospital	✓	✓	✓
Mater Adult Hospital	✓	✓	
Mater Children's Hospital		✓	✓
Mater Private Hospital, Brisbane	✓	✓	
Mater Private Hospital, Townsville	✓		
Mount Isa Hospital	✓	✓	
Nambour General Hospital	✓	✓	
Noosa Hospital	✓	✓	
Pindara Private Hospital	✓	✓	
Princess Alexandra Hospital	✓	✓	
Queen Elizabeth II Jubilee Hospital	✓	✓	
Redcliffe Hospital	✓	✓	
Robina Hospital	✓	✓	
Rockhampton Hospital	✓	✓	
Royal Brisbane and Women's Hospital	✓	✓	
Royal Children's Hospital		✓	✓
St Andrew's Hospital, Toowoomba	✓	✓	
St Andrew's War Memorial Hospital	✓	✓	
St Vincent's Hospital, Toowoomba	✓	✓	
The Prince Charles Hospital	✓	✓	
The Sunshine Coast Private Hospital	✓	✓	
The Townsville Hospital	✓	✓	✓
The Wesley Hospital	✓	✓	
Toowoomba Hospital	✓	✓	

Appendices

South Australia	APD	CCR	ANZPICR
Ashford Community Hospital	✓	✓	
Calvary North Adelaide Hospital	✓	✓	
Calvary Wakefield Hospital	✓	✓	
Flinders Medical Centre	✓	✓	
Flinders Private Hospital	✓	✓	
Lyell McEwin Hospital	✓	✓	
Modbury Public Hospital	✓		
Repatriation General Hospital	✓	✓	
Royal Adelaide Hospital	✓	✓	
St Andrew's Hospital	✓	✓	
The Memorial Hospital	✓	✓	
The Queen Elizabeth Hospital	✓	✓	
Women's and Children's Hospital		✓	✓

Tasmania	APD	CCR	ANZPICR
Launceston General Hospital	✓	✓	✓
North West Regional Hospital	✓	✓	
Royal Hobart Hospital	✓	✓	
Royal Hobart NICU/PICU			✓

Victoria	APD	CCR	ANZPICR
Alfred Hospital	✓	✓	
Austin Hospital	✓	✓	✓
Ballarat Health Services	✓	✓	
Bendigo Health Care Group	✓	✓	
Box Hill Hospital	✓	✓	
Cabrini Hospital		✓	
Central Gippsland Health Service	✓	✓	
Dandenong Hospital	✓	✓	
Epworth Eastern Private Hospital	✓	✓	
Epworth Freemasons Hospital	✓	✓	
Epworth Hospital	✓	✓	
Frankston Hospital	✓	✓	

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Geelong Hospital	✓	✓	
Goulburn Valley Health	✓	✓	
Knox Private Hospital	✓	✓	
Latrobe Regional Hospital	✓	✓	
Maroondah Hospital	✓	✓	
Melbourne Private Hospital	✓	✓	
Mildura Base Hospital	✓	✓	✓
Monash Medical Centre Clayton	✓	✓	✓
Northeast Health Wangaratta	✓	✓	
Peter MacCallum Cancer Institute	✓	✓	
Royal Children's Hospital		✓	✓
Royal Melbourne Hospital	✓	✓	
South West Healthcare	✓	✓	
St John Of God Hospital, Ballarat	✓	✓	
St John of God Hospital, Bendigo	✓	✓	
St John Of God Hospital, Geelong	✓	✓	
St Vincent's Hospital	✓	✓	
The Northern Hospital	✓	✓	
The Valley Private Hospital	✓	✓	
Warringal Private Hospital		✓	
Western District Health Service	✓	✓	
Western Hospital		✓	
Wimmera Health Care Group	✓	✓	

Western Australia	APD	CCR	ANZPICR
Fremantle Hospital	✓	✓	
Hollywood Private Hospital	✓		
Mount Hospital	✓	✓	
Princess Margaret Hospital for Children		✓	✓
Royal Perth Hospital	✓		
Sir Charles Gairdner Hospital	✓	✓	
St John of God Health Care, Subiaco		✓	

Appendices

Appendix B: Scoring Systems

1. Acute Physiological and Chronic Health Evaluation (APACHE)

APACHE II (2nd revision)

The APACHE II predicted risk of death is calculated using the worst physiological values in the first 24 hours of ICU admission, age, type of admission (planned/unplanned), chronic health status prior to hospital admission, ICU source of admission and diagnostic reason for ICU admission.

The exclusion criteria for the APACHE II reports include:

- Length of stay < 8 hours
- Age < 16 years
- Unknown hospital outcome
- Missing or non-valid APACHE II diagnostic codes
- 12 physiological variables required for the APACHE II score calculation are all missing

APACHE III-J (3rd revision, 10th recalibration)

The APACHE III-J predicted risk of death is calculated using the worst physiological values in the first 24 hours, age, pre-ICU length of stay, type of admission (planned/unplanned), chronic health status prior to hospital admission, ICU source of admission and a more specific diagnostic reason for ICU admission (as compared to APACHE II). APACHE III-J takes into account whether Acute Myocardial Infarction (AMI)/heart attack patients have received thrombolytic therapy and also includes cardiac patients, taking into account whether these patients have received multiple grafts.

The exclusion criteria for the APACHE III-J reports include:

- Length of stay < 4 hours
- Age < 16 years
- Unknown hospital outcome
- Missing or non valid APACHE III diagnostic codes
- 16 physiological variables required for the APACHE III-J score calculation are all missing

2. Simplified Acute Physiological Score (2nd revision) (SAPS 2)

SAPS 2 is calculated using the worst physiological values in the first 24 hours of ICU admission, age, type of admission (planned/unplanned, medical/surgical) and some chronic health variables.

3. Paediatric Index of Mortality 2 (PIM2)

PIM2 is an internationally recognised mortality prediction model for children in intensive care and is used by the ANZPIC Registry. Data for PIM2 are collected within the first hour of admission, which avoids potential bias from the effects of treatment after admission. The PIM2 model is based on the combined effect of ten risk factors collected at the time of admission to intensive care, seven of which are associated with increased risk, and three associated with decreased risk.

While an estimated PIM2 probability of death is calculated for each patient, the aim of PIM2 is to estimate the expected mortality for a population (or unit) overall.





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