

Australian and New Zealand  
Intensive Care Society



**ANZICS**  
Centre for Outcome  
and Resource Evaluation

ANZICS



2008  
ANNUAL  
REPORT

CENTRE FOR OUTCOME AND  
RESOURCE EVALUATION

## Acknowledgments

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

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

The First Annual Report for:  
The Australian and New Zealand Intensive Care Society (ANZICS)  
Centre for Outcome and Resource Evaluation (CORE)

Funded by:

Australian Capital Territory Health

Department of Health and Community Services—Northern Territory

Department of Health and Human Services – Tasmania

Department of Health—South Australia

Department of Health—Victoria

Health Department of Western Australia

Ministry of Health (New Zealand)

New South Wales Health

Queensland Health



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## Foreword from ANZICS CORE Chairman

The Australian and New Zealand Intensive Care Society (ANZICS) Centre for Outcome Resource and Evaluation (CORE) came into existence in 2008, creating a banner under which the Adult Patient Database (APD), the Critical Care Resources (CCR) and the Australian and New Zealand Paediatric Intensive Care (ANZPIC) Registry now operate. This was formerly known as the ANZICS Data Management Committee (ADMC) which was formed in 1992. With a staff of seven and a budget in excess of \$750,000 pa, CORE is a proud contributor to clinical quality assurance, epidemiological and outcomes research. CORE works closely with the Clinical Trials Group (CTG), ANZICS Safety and Quality Committee, Paediatric Study Group and the Australian and New Zealand Intensive Care Research Centre (ANZIC RC). I would like to acknowledge the staff and ANZICS members in each of these organisations for their support and collaboration.

At the end of 2008, our longstanding Manager, Carol George, resigned to pursue a career in Government and during the interim period we received great assistance from Dr Michael Bailey of the ANZIC-RC and Monash Department of Epidemiology and Preventive Medicine. This relationship has developed and is now supported through a Memorandum of Understanding between CORE and ANZIC RC.

Another very important relationship has been with the Australian Commission for Safety and Quality in Healthcare through the CEO, Prof Chris Baggoley, and Dr Niall Johnson. The Commission has been supportive of our role and Prof Baggoley agreed to Chair the Governance Body formed in response to the most recent triennial funding agreement with the jurisdictions. The National Intensive Care Registry Steering Committee (NICRSC) meets twice a year to facilitate CORE relations with the jurisdictions. This enables ongoing dialogue supporting quality outcomes, governance processes and funding.

CORE and Safety and Quality Committee jointly sponsor the Annual Safety Quality Audit and Outcomes Research Conference. This is a means of developing the Intensive Care community understanding of and participation in, improvement of methods and measurement of quality activities.

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

Although CORE activities and findings have been widely published, the Annual Report will become a concise document regularly outlining our aims, activities, Governance, people and findings. It will thus provide an overview of the State of Critical Care in Australia and New Zealand.

**Associate Professor Graeme Hart**

Chair, CORE Management Committee

ANZICS CORE comprises three clinical registries that collect de-identified data from contributing intensive care units in Australia and New Zealand. The Adult Patient Database (APD) collects data on all admissions to adult intensive care units, the Australian and New Zealand Paediatric Intensive Care (ANZPIC) Registry collects data on ICU admissions under the age of 16, and the Critical Care Resources (CCR) registry collects data via an annual survey on ICU infrastructure, staffing and processes. They report back to each ICU with comparative data for benchmarking, and to Jurisdictional Liaison Committees for review.

## Clinical Registries

Clinical registries collect a standardised set of information. As data management is independent of the represented providers, clinical registries are able to monitor and provide benchmark data to potentially improve healthcare performance across institutions and providers. Registries also assist in the accurate interpretation of results from raw data to outcome. Benchmarking information provided by registries provides a 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 Australian Commission for Safety and Quality in Healthcare (ACSQHC) as a key method for quality assurance<sup>1</sup>.

## ANZICS CORE

ANZICS CORE comprises the APD, CCR and the ANZPIC Registry. CORE is unique in that it offers an overview across regional, state, federal and international jurisdictions. Over time, the datasets held by the CORE registries have developed into an expansive and invaluable resource for the intensive care community and other health care sectors. It has enabled research, service delivery and more informed resource planning, as well as benchmarking performance. The APD, now one of the largest single datasets in intensive care in the world, contains data from over 900,000 patient episodes, while the ANZPIC Registry holds over 83,000 paediatric ICU admissions. The CCR database contains information on critical care resources dating from 1993 to 2007.

<sup>1</sup> 'Windows into Safety & Quality in healthcare in 2009', pg 89; <http://www.health.gov.au/internet/safety/publishing.nsf/content/windows-into-safety-and-quality-in-health-care-2008>, accessed 12/04/2010

## ANZICS CORE

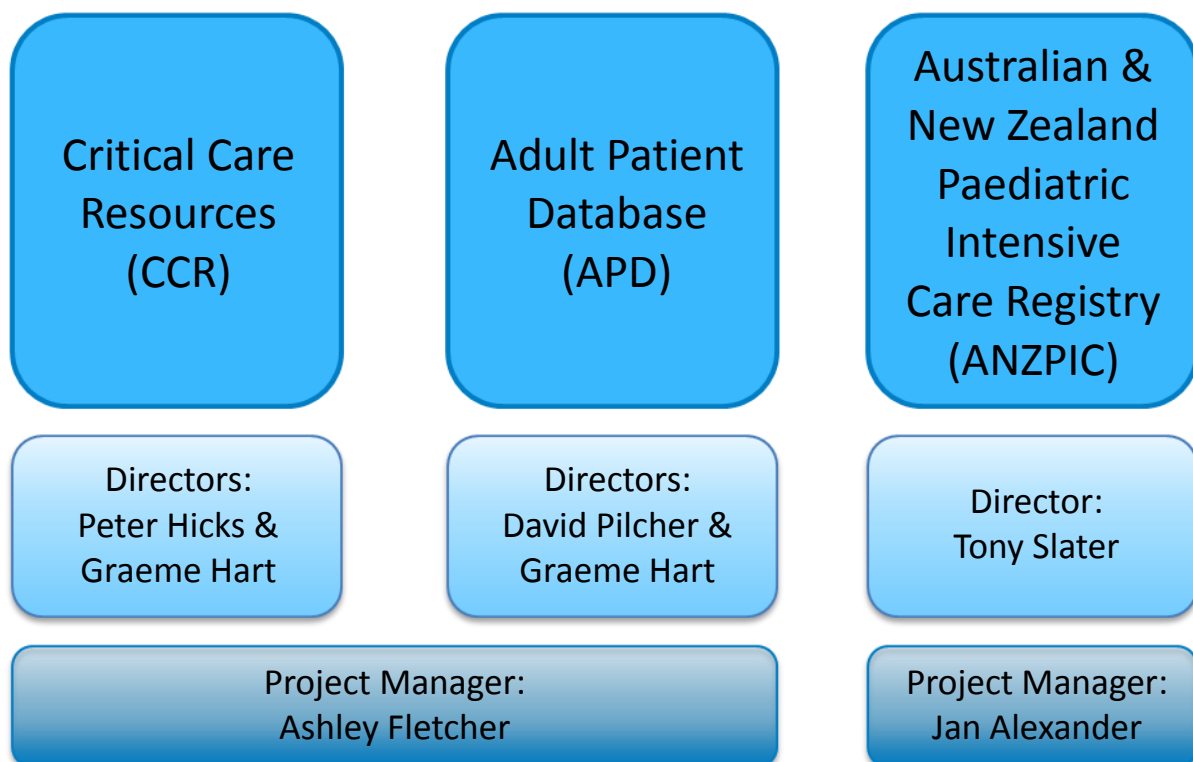


Figure 1: Organisational Structure of ANZICS CORE

Together these databases allow research into the availability and utilisation of critical care resources, patient outcomes, disease patterns and the effectiveness of critical care interventions. The Mission of CORE is to provide, and continuously develop, a quality assurance and information resource that facilitates informed decision making and implementation of strategies to improve intensive care services delivery in Australia and New Zealand.

Under the direction of the CORE Management Committee, CORE aims to:

- Provide a peer review mechanism for contributing adult and paediatric intensive care units by providing data processing and reporting facilities.

- Develop, collect, analyse and publish data on the state of critical care resources. This is achieved via the annual CCR survey.
- Enable appropriate epidemiological research of intensive care by providing a comprehensive database.
- Ensure optimal compatibility with other databases, particularly those held by the Australian Institute of Health and Welfare.
- Liaise with the intensive care community in order to determine national research and peer review strategies.
- Develop the research focus and activities of the ANZICS CORE through local, national and international collaborations.
- Promote internal and external research activities directed at greater understanding of critical illness, its management and outcome.
- Become a resource centre for intensive care research activities through the dissemination of research reports, provision of information from the ANZICS CORE databases and the reference collection.

Initial funding of the database was sporadic, with stable funding only being achieved in 2001 with all jurisdictions (Australian States and Territories and New Zealand) agreeing to triennially fund the registry. Two more triennia of funding have since been agreed to. Consistent funding has resulted in an increase in research output and participation by clinicians and other key stakeholders.

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 databases, 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.

The CORE Management Committee is comprised of jurisdictional representation and co-opted members with particular interests and skills to offer. The Chair is a permanent member of the Board. Operational reports are submitted to the ANZICS Board Executive Committee on a monthly basis.

For 2008, the CORE Management Committee membership was as follows:

<b>Member</b>	<b>Representing</b>
A/Professor Graeme Hart	Chair
Dr David Pilcher	Victoria and Director APD
Dr Peter Hicks	New Zealand and Director CCR
Dr Janet Liang	New Zealand (until March 2008)
Dr Tony Slater	Director ANZPIC Registry
Dr Dan Mullany	Queensland
Dr Tony Burrell	New South Wales
Dr Steve Webb	Western Australia and Clinical Trials Group
Dr Alan Rouse	Tasmania
Dr John Moran	South Australia
<b>Co-opted Members</b>	
Dr Michael Bailey	Dr David Cook
Dr Arthas Flabouris	Dr John Lambert
Dr Imogen Mitchell	Dr Ranald Pascoe
Dr Michael Reade	Dr Dianne Stephens

The National Intensive Care Registry Steering Committee (NICRSC) was formed with State, Territory and NZ health departments to assist the Management Committee in achieving mutually agreed deliverables under Jurisdictional Agreements. NICRSC provides a platform to promote collaboration between ANZICS, NZ, State and Territory health departments in the effective monitoring of intensive care service delivery in Australia and New Zealand.

Each jurisdiction has agreed to establish and maintain a Jurisdictional Liaison Committee (JLC) comprising representatives of the intensive care medical community and health department representatives. JLCs meet quarterly to review the data reports provided by CORE in their local context and manage any potential outlier issues. The NICRSC is also responsible for establishing periodic external reviews of the CORE infrastructure and activities to ensure compliance with national registry standards.

## Activities of CORE

### Defining Data

- Production and refining of a data dictionary, as data definitions are under continual review and development

### Collecting Data

- Collation of locally collected data about intensive care admissions, practices, resources and outcomes
- Provision, development and support of free software to collect data

### Data Quality

- Education for data collectors, managers and intensive care staff
- Audit of data collection quality

### Reporting Data

- Production of reports provided to submitting units and jurisdictions
- Outlier identification and management process
- Ad hoc reporting of data on request

### Research

- Development, research and assessment of intensive care key performance indicators
- Production of multiple research papers studying all aspects of intensive care practice
- Ad hoc surveys in response to specific situations
- Epidemiological studies on which to base multi-centre prospective interventional studies

## Critical Care in Australia and New Zealand

In 2008:

- There were 189 ICUs in Australia and New Zealand <sup>#</sup>
- 180 units submitted data to the CCR <sup>#</sup>
- 128 units submitted data to the APD <sup>\*</sup>
- 23 units submitted data to the ANZPIC Registry <sup>^</sup>
- Over 145,000 patients were treated in intensive care units <sup>#</sup>
- The predicted risk of death of ICU patients by APACHE III-J was 14% in Australia and 16% in New Zealand for 2008, predicted risk of death by APACHE II was 22% and 24% respectively <sup>\*</sup>
- The hospital mortality of patients admitted to ICU was 11.1% in Australia and 13.4% in New Zealand for 2008 <sup>\*</sup>
- 2.4% of adult patients were discharged from one ICU and transferred to another <sup>\*</sup>
- ICU mortality in paediatric patients was 3% <sup>^</sup>
- The predicted risk of death by PIM2 for paediatric patients was 3.6% <sup>^</sup>
- There were 10,106 registered nurses working in permanent/rostered positions in Australia and New Zealand. Actual hours worked translates to a full time equivalent of 7,852 full-time nursing positions <sup>#</sup>
- Senior Medical Staff worked a total of 605.2 full time equivalent positions, with 82.5% being worked by Intensivists. The remaining 105.8 full time equivalents are performed by non-intensive care specialists <sup>#</sup>
- There were 121 medical emergency teams operating in Australia and New Zealand <sup>#</sup>
- There were 2,108 physical ICU beds in Australia & NZ, and 1,821 are funded and available for use. <sup>#</sup>
- At sites reporting invasive ventilation, 40.7% of patients received mechanical ventilation <sup>#</sup>
- 5.2% of patients were readmitted to ICU during their hospital admission <sup>\*</sup>
- Over 5,400 patients were affected by inadequate bed or staff resources. There were 1,936 cancelled or deferred elective cases, representing 1.8% of patients. 3,538 (3.4%) appropriately referred non-elective patients were refused admission <sup>#</sup>
- 11.9% (13,102) of patients were discharged to a ward after 1800 and before 0600 <sup>#</sup>
- 2.8% of patients were admitted to ICU with a treatment limitation order (53% mortality), 0.3% for palliative care (92% mortality) and 0.05% as a potential organ donor (99% mortality) <sup>\*</sup>

\* **APD** (2008 calendar year) <sup>^</sup> **ANZPIC** (2008 calendar year) <sup>#</sup> **CCR** (2007/8 financial year)

The APD collects data on individual episodes of care in critical care units. To assist hospitals in collecting and submitting data required by ANZICS CORE, software has been made available to ICUs throughout Australia and New Zealand. This free software program is called AORTIC. Data is collected and entered in quarterly intervals, based on date of ICU admission. It is then submitted to the APD during the month that follows the quarterly interval. Data undergoes extensive validation checks and reports are published on the ANZICS CORE secure web portal the following month. 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 type and jurisdiction.

Data from CORE registries supports four risk adjusted physiological scoring systems, each giving a slightly different estimation for severity of illness score and predictive risk of death. The adult patient database uses APACHE III-J, APACHE II and SAPS 2 systems, while PIM2 is used for paediatric patients. These scoring systems have developed over time as older systems lose calibration due to changing clinical practices and case-mix, making it essential to use the most recently calibrated system to be able to predict mortality. See Appendix for details.

The SMR is then calculated from the risk of death of each patient compared to the observed number of deaths:

$$\frac{\text{Number of observed deaths} \times 100}{\text{Number of predicted deaths (sum of risks of death)}}$$

At December 2008, 172 hospitals have contributed to the database at some point: 34 tertiary hospitals (four in New Zealand), 42 metropolitan (four in New Zealand), 42 rural or remote (five in New Zealand) and 54 private hospitals (one in New Zealand). In the 2008 calendar year a total of 128 of a potential 189 hospitals contributed data to the APD (almost 70%). Table 1 indicates the number of hospitals contributing to the APD by type in 2008; it also shows the number of admissions recorded. Of the 93,360 admissions reported to the APD, 4,858 (5.2%) were readmitted to ICU during the same hospital stay.

# Adult Patient Database

Table 1 - Number of contributing hospitals and admissions to the APD in Australia and New Zealand in 2008

Hospital Type	Australia		New Zealand	
	Number	Number of Admissions	Number	Number of Admissions
Tertiary	29	39,853	4	1,118
Metropolitan	26	15,272	3	785
Regional/Rural	28	11,638	3	1,119
Private	35	21,708	0	0
<b>Total</b>	<b>118</b>	<b>88,471</b>	<b>10</b>	<b>4,889</b>

Figure 2 shows the increase in the number of sites submitting data and the number of admissions recorded each year since the start of the database in the early 1990's. It includes data submissions from pilot sites in 1991. 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.

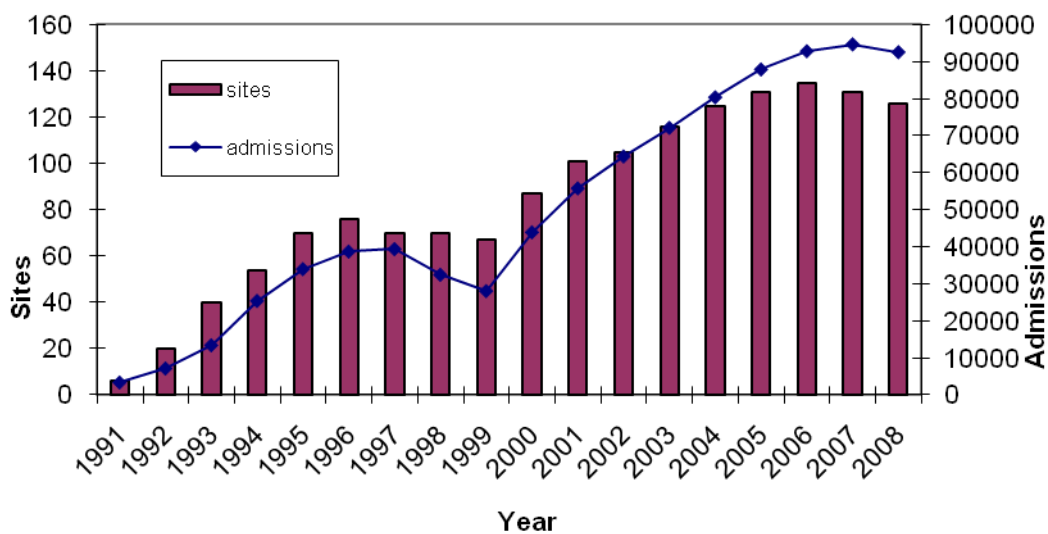


Figure 2 - Contribution Rate to APD between 1991 and 2008

## AORTIC Software

AORTIC is an intensive care database program to support the APD; it also collects some CCR and ANZPIC Registry data. 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. CORE supplies full support for the database and the software can be downloaded from the CORE website at <http://www.anzics.com.au/core/aortic-software>.

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.

## Web Portal and Web Report Studio

The 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. Latest regional reports summarising the APACHE outcomes and some descriptive statistics of the Australian States & Territories as well as New Zealand are available for end users.

Web Report Studio (WRS) is used as a business reporting tool for non-technical users to find, interact with, create and share reports based on available data. WRS can be used to build reports or to interact with existing reports. Both the Web Portal and WRS can be accessed by contributing units at <http://www.anzics.com.au/core/sas-portal>, with logon details being available to the ICU Director of contributing units.

## Adult Intensive Care Outcomes

From the 128 hospitals that contributed data to the APD in 2008, 93,360 admissions were submitted (5.2% readmissions). Table 2 shows hospital mortality, risk of death scores and length of stay of admitted patients in Australian and New Zealand ICUs in 2008.

Table 2 - Hospital mortality, risk scores and length of stay in Australia and New Zealand in 2008

	Australia	New Zealand	Total
Hospital Mortality (excluding readmissions)	11.1%	13.4%	11.2%
APACHE II predicted risk of death - Mean (SD)	22% (23%)	24% (24%)	22% (23%)
APACHE II predicted risk of death - Median (SD)	13% (5% - 31%)	15% (6% - 35%)	13% (5% - 31%)
APACHE III-J predicted risk of death - Mean (SD)	14% (22%)	16% (23%)	14% (22%)
APACHE III-J predicted risk of death - Median (IQR)	4% (1%- 16%)	5% (1% - 20%)	4% (1% - 16%)
SAPS II score - Mean (SD)	30.34 (16.33)	32.73 (16.69)	30.47 (16.35)
SAPS II score - Median (IQR)	27 (19-39)	29 (21 - 42)	27 (19 - 35)
Length of stay in ICU (days) - Median (IQR)	1.77(0.91 - 3.42)	1.10 (0.79 - 2.65)	1.75 (0.9 - 3.34)

Tables 3 and 4 show the most common causes for admission to ICU in Australia and New Zealand. (Figures based on APD data.)

Table 3 - Top Five APACHE III-J Diagnoses in Australia in 2008

Coronary artery bypass surgery	7,825 (8.84%)
GI surgery for neoplasm	3,649 (4.12%)
Valvular heart surgery	3,256 (3.68%)
Drug overdose	3,040 (3.44%)
Orthopaedic surgery	3,023 (3.42%)

Table 4 - Top Five APACHE III-J Diagnoses in New Zealand in 2008

Coronary artery bypass surgery	453 (9.27%)
Drug overdose	224 (4.58%)
Valvular heart surgery	202 (4.13%)
Bacterial Pneumonia	201 (4.11%)
Head Trauma +/- multi trauma	198 (4.05%)

## Outlier Management Plan

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.

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 will liaise with the hospital management and the ICU Director and assume responsibility for correcting factors leading to outlier performance. CORE will continue to monitor the site and report back to the ICU Director and the Jurisdictional Liaison Committee regarding on-going performance. This process has been endorsed by the NICRSC. In 2008, one contributing hospital was identified as having the potential to be a statistical negative performance outlier and the Outlier Management Plan was successfully implemented with high satisfaction levels at unit, hospital and jurisdictional level.

## Risk Adjusted Hospital Outcomes

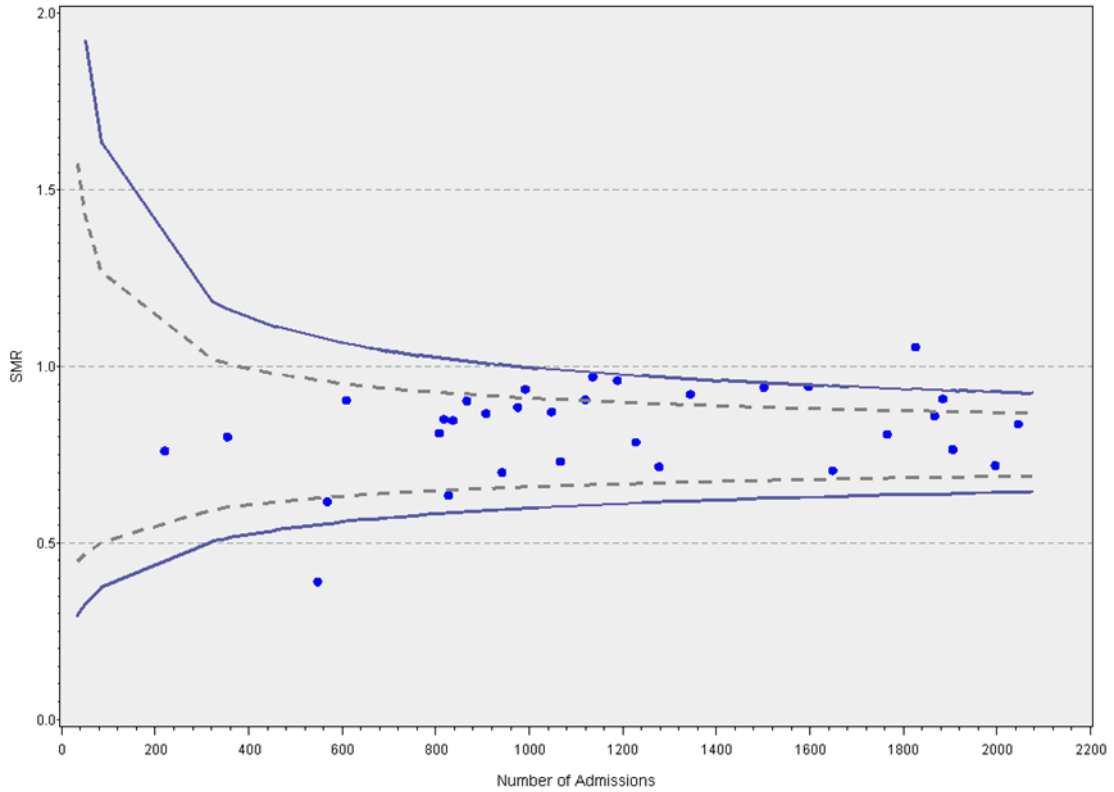
Assessing hospital performance is dependent on appropriate risk adjustment for case-mix, severity of illness and hospital sector. Differences in the number of cases submitted can influence the interpretation of outcomes. Figure 3 presents funnel plots as a visual representation of hospitals by type (tertiary, metropolitan, regional/rural and private). The funnel plots are based on the APACHE III-J SMR. The SMRs for all units within the same level are plotted against the number of admissions for each site during the reporting period. 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.

NOTE: Units are specified by dots. 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.

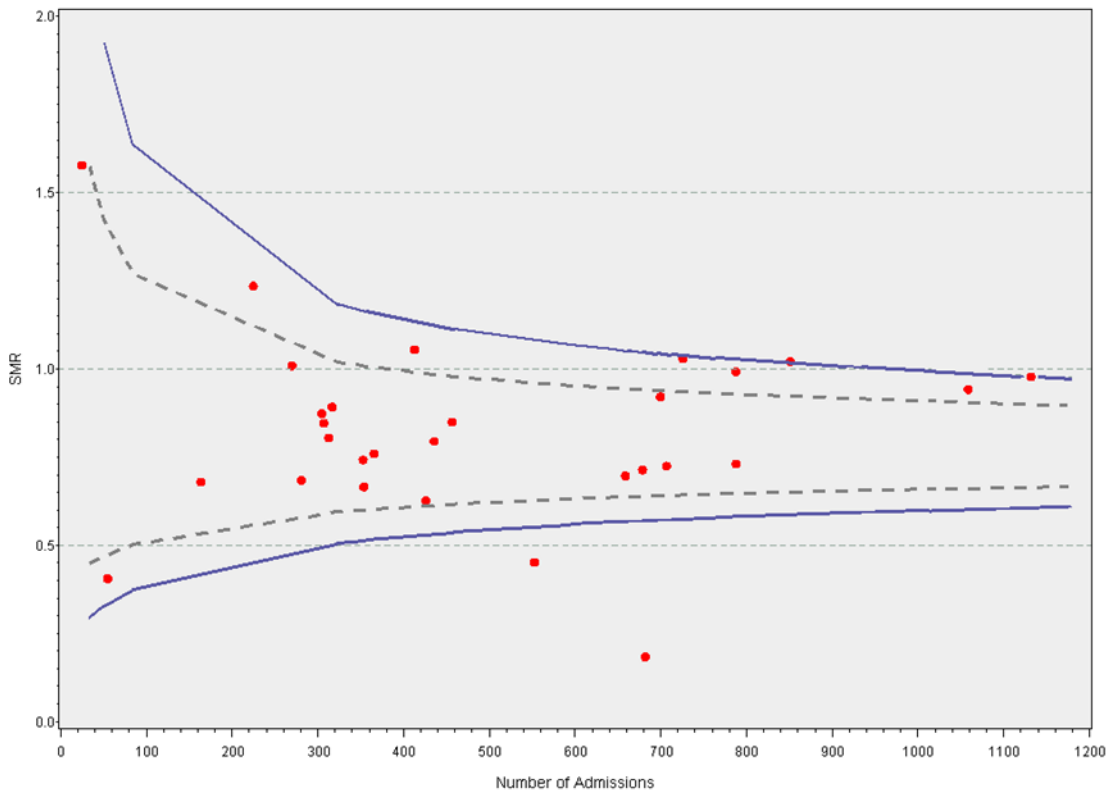
# Adult Patient Database

Figure 3 - Funnel Plot of APACHE III-J SMR in 2008 by Hospital Type

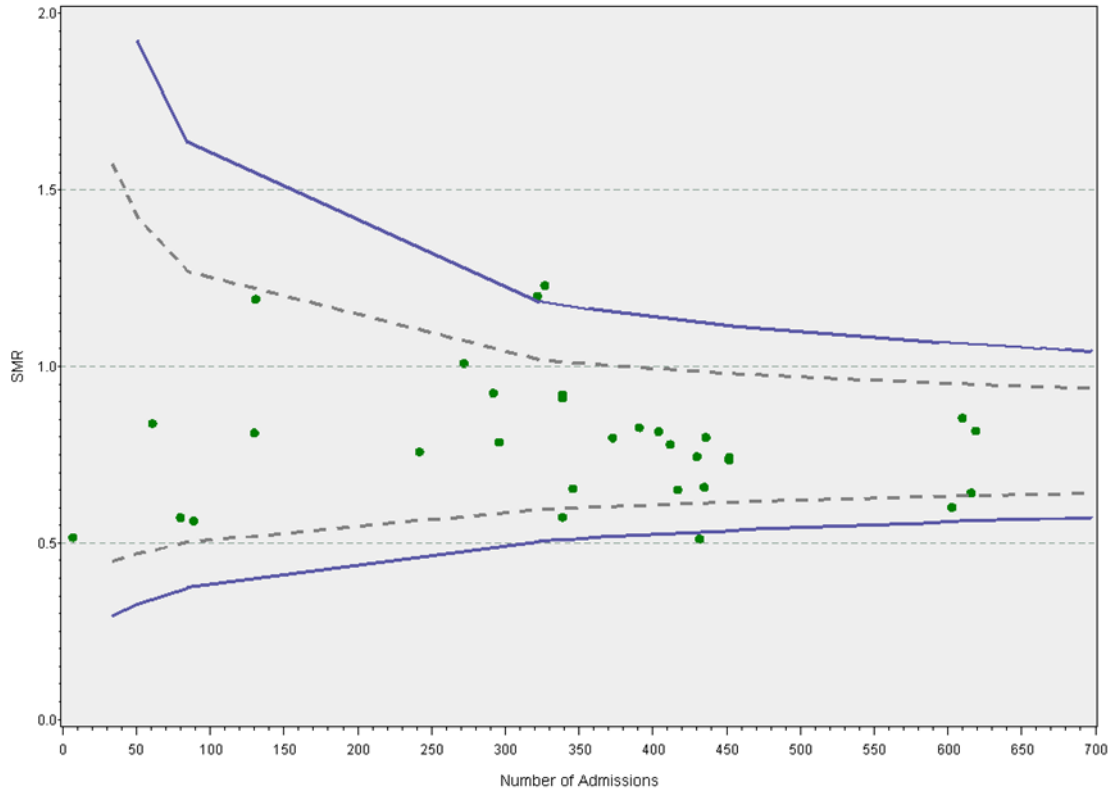
## Tertiary Hospitals



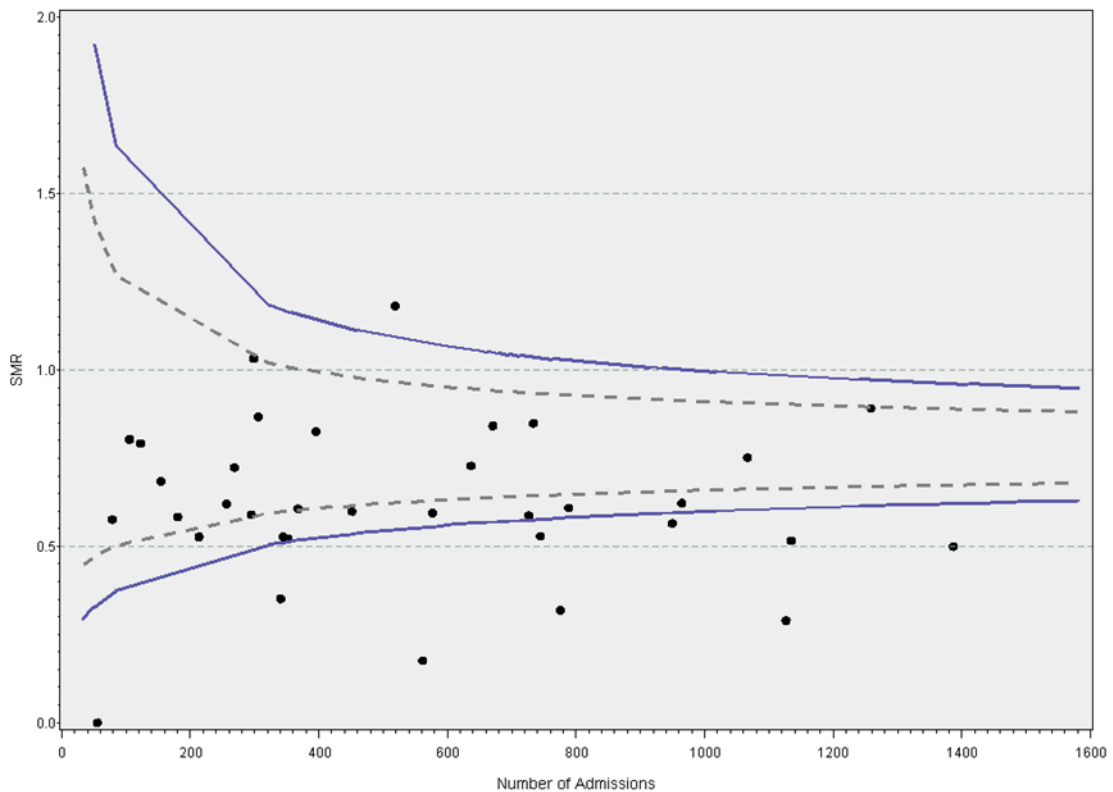
## Metropolitan Hospitals



## Regional/Rural Hospitals



## Private Hospitals



## Adult Patient Database Data Audit

The APD Data Audit Program was initiated in 2007 with the purpose of measuring the reliability of data held in the APD. The program is based around audits of individual ICUs and the data they collect. For each audit, a random set of 25 admissions that have previously been submitted to the APD are selected. A CORE-trained auditor then re-extracts the data required to generate an APACHE II severity of illness score and predicted risk of death for these 25 admissions. 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 II 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 individual sites data collection methods
5. Implementing procedures to improve data quality for the future through the training of data collectors

The Data Audit Program is structured in such a way that the audits fall into a 3 year cycle, with each jurisdiction visited once during a cycle and a total of 50 sites audited over the 3 year period. The first audit cycle was due to reach completion at the end of 2009. Table 5 shows the number of sites within each jurisdiction that were audited in 2007 and 2008.

Table 5 - Number of Sites Audited by Jurisdiction (2007 and 2008)

Jurisdiction	Number	% of contributing
New South Wales	10	23
South Australia	4	40
Victoria	9	29
Western Australia	4	100

Overall the results so far indicate that the submitted data is of good quality and fit for a first pass at outlier identification. A summary of audit findings for those sites audited during 2007 and 2008 is as follows:

- 671 admissions from 27 different hospitals have been audited
- The average APACHE II score for the original data was 17.03, while for the re-extracted audit data it was 17.32 (a difference of 0.29)
- The original data predicted 26.4% mortality while the audited data predicted 25.9% mortality, a difference of only 0.5%
- Glasgow Coma Scores and Chronic Health Status have been identified as the variables most prone to data collection error across audited sites, with Chronic Health Status producing the greatest variability in APACHE II scores and predicted risk of death; this has made these variables a target for future APD data collection training.

The remaining jurisdictions to be audited during this cycle were visited by the data audit program in 2009, with a report detailing the findings of the 2007-2009 Data Audit cycle planned for early 2010.

# Critical Care Resources

The Critical Care Resources (CCR) survey is conducted 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 from the published reports section of the CORE website (<http://www.anzics.com.au/core/reports>).

The survey collects a variety of information regarding the infrastructure, staffing and processes of ICUs. It enumerates:

- Critical care beds, admissions, refusals, ventilation requirements and bed utilisation
- Workforce data for senior medical officers, registrars and nursing staff
- Services including medical emergency teams (METs), Outreach, Echocardiography
- Clinical indicators and processes in ICU care

The survey for the 2007/08 financial year had a participation rate of 96.2%, which comprised 154 Australian ICUs and 27 New Zealand ICUs; a total of 181 out of 188 units. One Australian site was excluded as it was ineligible based on the minimum criteria of ventilating 20 patients per annum over three consecutive years. The participation rate of contributing units and their ICU classifications are detailed respectively in Table 6.

Table 6 - Participation and distribution: sites contributing to the CCR in 2007/08

	Australia		New Zealand		Total
	Public	Private	Public	Private	
Number of units contributing	103	50	24	3	180
Number of units invited to participate	105	56	25	3	189
Participation Rate	98.1%	89.2%	96.0%	100.0%	95.2%

There were 46 Rural ICUs submitting data, 36 each of Tertiary and Metropolitan units, 9 paediatric and 53 private ICUs.

Based on the contributing 180 hospitals in Australia and New Zealand, there were 6.9 available beds per 100,000 population, and 11.7 beds per 1,000 patient admissions over the 2007/08 CCR financial year (shown in Table 7). Not all sites are able to provide information where requested. The number of contributing units are shown in brackets (n=) and the denominator is tailored accordingly.

40.7% of patients had invasive ventilation requirements, while 7.7% of patients received non-invasive ventilation only. Unit occupancy based on available beds was a mean 68% and median 70.2% of capacity level (in 166 contributing ICUs). Occupancy was calculated by dividing available beds by the yearly bed hours provided and 365 (days in a year) to create a percentage of occupied days from total possible bed days.

Eight Australian Paediatric ICUs (PICUs) and 1 New Zealand PICU reported a total 129 physical beds and 98 available beds. PICUs treated 76.3% of all patients < 16 years of age requiring critical care.

Table 7 - Participation, population, beds, admissions and summary of activity 2007/08

	Australia	New Zealand	Total
Number of contributing units	153	27	180
Population *	22,010,040 <sup>1</sup>	4,333,075 <sup>2</sup>	26,343,115
Available beds per 100,000 population	7.4	4.6	6.9
Physical beds (a)	1,856	252	2,108
Available beds (b)	1,622	199	1,821
Ventilator Beds (c)	1,313	174	1,487
Total Admission	127,074 (n=151)	18,919 (n=27)	145,993 (n=178)
Readmission	5,457 (n=133)	540 (n=21)	5,997 (n=154)
Readmission rate (mean)	4.7%	3.5%	4.5%
Invasively ventilated patients (no.)	47,748	7,867	56,615
Pts invasively ventilated (mean)	40.6%	41.5%	40.7%
Occupancy rate (mean)	70.8%	52.7%	68.9%

Notes:

(a) *PHYSICAL BEDS* 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) *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.

(n=) Number of contributing hospitals

<sup>1</sup> Australia Bureau of Statistics 'Population Clock' <http://www.abs.gov.au>; accessed 16/10/09

<sup>2</sup> Statistics New Zealand 'Estimated Resident Population Of New Zealand' <http://www.stats.govt.nz>, accessed 16/10/09

Table 8 presents a summary of medical and nursing staff head count and full time equivalent (FTE) reported to CORE via the CCR in 2007/08. An FTE is the number of paid hours which is expressed as a ratio of the agreed hours for a full time employee ( $\geq 35$  hours per week of paid employment, worked at an individual site).

The total senior medical officer (SMO) FTE is comprised predominately of Intensivists rather than non-intensive care specialists. There is an SMO vacancy rate of 8.1% overall and a registered nurse (RN) vacancy rate of 10.9%.

Table 8 - Medical and nursing staff levels 2007/08

	Australia	New Zealand	Total
Number of contributing units	153	27	180
Total SMO Specialist FTE	527.5 (n=152)	77.8 (n=27)	605.2 (n=179)
Proportion of Intensivists to total Specialists in FTE	86.2%	59.5%	82.5%
Vacant Specialist FTE %	7.6% (n=143)	11.6% (n=25)	8.1% (n=168)
RN Headcount	8,975	1,131	10,106
RN FTE	6,967.7 (n=152)	884.9 (n=27)	7,852.5 (n=179)
RN vacancies FTE%	11.0% (n=146)	10.4% (n=23)	11.0% (n=169)
RN FTE resignations	857.7 (n=151)	124.4 (n=26)	982.5 (n=177)

(n=) Number of contributing units

## MET

There were 121 medical emergency teams (METs) in operation in 2007/08; of these 15.7% received full funding and they received an average of 30 calls per month.

## Echocardiography

Echocardiography use was one of the questions posed for the 2007/08 period. It was found 48% of units perform echocardiography on their patients, and two thirds of these units possess their own echocardiography machine.



CORE also facilitates and collaborates on external surveys. In 2008, these included:

Mechanical Ventilation Weaning Practices in Adult Intensive Care Units: An International Survey. Karen E. A. Burns & St Michael's Hospital, Canada.

Safety Culture in Australian ICUs: The Australian College of Critical Care Nurses (ACCCN) and the Safety and Quality Committee (SQC) of the Australian and New Zealand Intensive Care Society (ANZICS) jointly funded study.

Further information and all data can be found in the detailed report "Intensive Care Resources & Activity: Australia and New Zealand 2006/2007". This report and reports from previous years can be obtained for the CORE website: <http://www.anzics.com.au/core/reports>.

# Australian and New Zealand Paediatric Intensive Care 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. Comprehensive annual reports are available 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 only from the specialist paediatric ICUs located in tertiary teaching children's hospitals. Over recent years there has been increased participation by some of the general ICUs which provide intensive care to both adults and children (defined as less than 16 years of age). This participation has been facilitated by modification of CORE's AORTIC software to enable an ANZPIC compliant dataset to be collected. This allows continuing assessment of outcomes for children cared for in regional settings where children are at times managed in general ICUs as well as the specialist paediatric centres.

Contributing units receive individual site reports detailing patient demographics, bed usage, indicators of case-mix, as well as performance indicators such as SMRs. Comparative registry figures are also included in the site reports. Table 9 shows the number of contributing hospitals, number of admissions and deaths, and length of stay for the 2008 calendar year.

# Australian and New Zealand Paediatric Intensive Care Registry

Table 9 - Hospitals Contributing to the ANZPIC Registry and Outcomes for 2008

<b>Number of Contributing Hospitals</b>	
Australia	19
New Zealand	4
Number of ICU admissions submitted	8,356
Number of ICU patients	7,301
ICU Mortality	245 deaths - crude mortality of 3%
<b>Age specific mortality rates (95% CI)</b>	
Neonates <28days	5.7 (4.0 - 7.3)
>28 days - <1 year	2.7 (2.1 - 3.4)
1 - 4 years	2.9 (2.2 - 3.6)
5 - 9 years	2.2 (1.4 - 3.1)
10 - 14 years	2.6 (1.7 - 3.5)
>= 15 years	3.1 (1.6 - 4.6)
PIM2 SMR (95% CI)	1.01 (0.91 - 1.11)
<b>Median length of stay (days) in ICU (95% CI)</b>	
All admissions	1.3 (0.8 - 3.4)
Elective admissions	1.0 (0.8 - 2.1)
Non-elective admissions	1.7 (0.8 - 4.4)
Intubated admissions	2.6 (1.0 - 5.9)
Non-intubated admissions	0.9 (0.6 - 1.7)

# Australian and New Zealand Paediatric Intensive Care Registry

Table 10 - Top Five Elective and Non-Elective Diagnoses for the ANZPIC Registry in 2008

<b>Non-Elective</b>	
Bronchiolitis	556 (11.5%)
Seizures	383 (7.9%)
Asthma	288 (5.9%)
Trauma - Head	273 (5.6%)
Pneumonia or Pneumonitis	243 (5.0%)
<b>Elective</b>	
Spinal Instrumentation	226 (6.4%)
Adenoidectomy and/or Tonsillectomy	193 (5.5%)
VSD Repair	133 (3.6%)
General Surgery - Other	125 (3.6%)
ICU Procedure (e.g. CVC Insertion)	112 (3.2%)

Table 11 - ICU Admission Source for the ANZPIC Registry in 2008

<b>ICU Admission Source (%)</b>	<b>Non-Elective</b>	<b>Elective</b>
Direct ICU Admission	19.9	1.6
Emergency Department	16.9	0.4
Operating Theatre or Recovery	6.6	37.4
Other ICU or NICU	0.3	0.3
Ward	14.2	2.4

# Australian and New Zealand Paediatric Intensive Care Registry

## ANZPIC Registry Audit Process

As part of ensuring the integrity and uniformity of all ANZPIC Registry data, site audits are routinely performed every two years. 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, 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 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.

## Risk Adjusted Outcomes

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 2008. Comprehensive details of the recalibration and the new variable coefficients are presented in the full 2008 ANZPIC Registry Annual Report.

A funnel plot of the Paediatric Index of Mortality (PIM) risk of death for admissions to contributing hospitals in 2007 and 2008 is presented in Figure 4.

# Australian and New Zealand Paediatric Intensive Care Registry

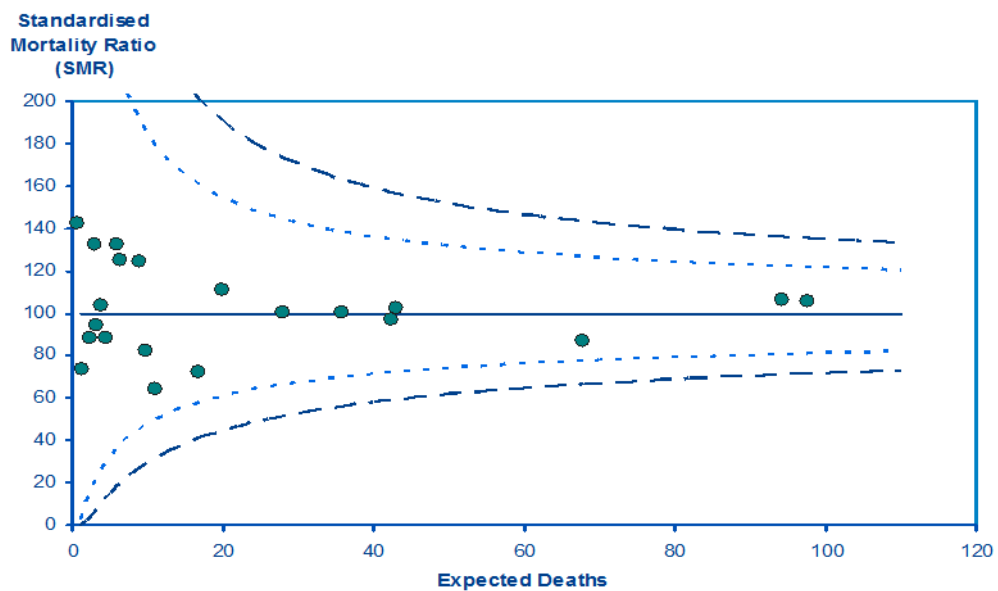


Figure 4 - PIM Funnel Plot for Hospitals Contributing to the ANZPIC Registry in 2007 and 2008

ANZICS CORE engages in and supports a number of research projects not only using data collected in the Adult Patient Database and the CCR survey, but also through the work of PhD students and collaboration with research bodies such as the ANZICS Clinical Trials Group and ANZIC-RC. Requests for data and analyses are welcomed and encouraged from all ANZICS members and indeed anyone interested in epidemiological research into the practices and outcomes of intensive care medicine in Australia and New Zealand.

## Requests for Information

Medical professionals, researchers and other interested parties may apply for access to specific sets of data collected and held by the APD, CCR and/or ANZPIC Registry. The ANZICS CORE Publication Policy must be followed and publications must be approved prior to submission.

In 2008, 36 of 40 applications for data were approved. Of these, 19 can be broadly classified as research requests ranging from background data for large studies to full research projects or contributions to post graduate research. The other 17 can be classified as service assessment requests ranging from national surveys, to jurisdictional assessments and requests for individual hospitals to use data in benchmarking exercises. Further information and request forms are available on the CORE website at <http://www.anzics.com.au/core/information-requests>.

## Research Publications for 2008

Below is a list of journal articles published in collaboration with CORE. Abstracts for these articles can be found on the ANZICS CORE website under Scientific Publications at <http://www.anzics.com.au/core/core-publications>.

A comparison of the RIFLE and AKIN criteria for acute kidney injury in critically ill patients. Bagshaw, S.M., George, C., and Bellomo, R. (2008). *Nephrology, dialysis, transplantation: official publication of the European Dialysis and Transplant Association*, 23, 1569-1574.

A multi-center evaluation of early acute kidney injury in critically ill trauma patients. Bagshaw, S.M., George, C., Gibney, R.T., and Bellomo, R. (2008). *Renal Failure*, 30, 581-589.

A multi-centre evaluation of the RIFLE criteria for early acute kidney injury in critically ill patients. Bagshaw,

S.M., George, C., Dinu, I., and Bellomo, R. (2008). Nephrology, dialysis, transplantation: official publication of the European Dialysis and Transplant Association, 23, 1203-1210.

Critical care outcome prediction equation (COPE) for adult intensive care. Duke, G.J., Santamaria, J., Shann, F., Stow, P., Pilcher, D., Ernest, D., and George, C. (2008). Critical Care and Resuscitation: Journal of the Australasian Academy of Critical Care Medicine, 10, 41.

Early acute kidney injury and sepsis: a multicentre evaluation. Bagshaw, S.M., George, C., and Bellomo, R. (2008). Critical Care, 12, R47.

Glucose control, organ failure, and mortality in pediatric intensive care. Yung, M., Wilkins, B., Norton, L., and Slater, A. (2008). Pediatric Critical Care Medicine, 9, 147-152.

Introduction of medical emergency teams in Australia and New Zealand: a multi-centre study. Jones, D., George, C., Hart, G.K., Bellomo, R., and Martin, J. (2008). Critical Care, 12, R46.

Mortality and length-of-stay outcomes, 1993-2003, in the binational Australian and New Zealand intensive care adult patient database. Moran, J.L., Bristow, P., Solomon, P.J., George, C., and Hart, G.K. (2008). Critical Care Medicine, 36, 46-61.

Observational study of patients admitted to intensive care units in Australia and New Zealand after interhospital transfer. Flabouris, A., Hart, G.K., and George, C. (2008). Critical Care and Resuscitation: Journal of the Australasian Academy of Critical Care Medicine, 10, 90-96.

Outcomes of patients admitted to tertiary intensive care units after interhospital transfer: comparison with patients admitted from emergency departments. Flabouris, A., Hart, G.K., and George, C. (2008). Critical Care and Resuscitation: Journal of the Australasian Academy of Critical Care Medicine, 10, 97-105.

Review of the application of risk-adjusted charts to analyse mortality outcomes in critical care. Cook, D.A., Duke, G., Hart, G.K., Pilcher, D., and Mullany, D. (2008). *Critical Care and Resuscitation: journal of the Australasian Academy of Critical Care Medicine*, 10, 239-251.

The ANZICS CORE: an evolution in registry activities for intensive care in Australia and New Zealand. Hart, G.K. (2008). *Critical Care and Resuscitation: Journal of the Australasian Academy of Critical Care Medicine*, 10, 83-88.

The application of risk-adjusted control charts using the Paediatric Index of Mortality 2 for monitoring paediatric intensive care performance in Australia and New Zealand. Baghurst, P.A., Norton, L., and Slater, A. (2008). *Intensive Care Medicine*, 34, 1281-1288.

## Research Projects commenced in 2008

Factors associated with increasing risk of readmission to intensive care in Australia. Renton, J., Pilcher, D., Santamaria, J., Stow, P., Bailey, M., Hart, G.K., Duke, G.

Is Emergency Department length of stay prior to ICU admission related to patient mortality? Carter, A., Pilcher, P., Bailey, M., Cameron, P., Duke, G., Cooper, J.

Is PaO<sub>2</sub>/FIO<sub>2</sub> a predictor of death in the immunosuppressed ICU patient? Miles, L., Pilcher, D., Bailey, M., Butt, W.

Risk-adjusted continuous outcome monitoring with an "EWMA" chart: could it have detected excess mortality among intensive care patients at Bundaberg Base Hospital? Pilcher, D., Hoffman, T., Thomas, C., Ernest, D., Hart, G.

## 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 databases for their research. The student must be full time with a minimum four days dedicated to their research work.

In 2008 there are two students engaged in PhDs researching CORE data. Lahn Straney was funded by both ANZICS CORE and the University of Queensland. Megan Bohensky was funded by Monash University, Melbourne with additional support from ANZICS CORE.

Lahn Straney (University of Queensland)

*Measuring Quality and Performance in the Pediatric Intensive Care Unit (ICU)*

Working with ANZPIC, my research focuses on developing paediatric ICU risk-adjustment methods for objectively comparing performance among units and over time. The research makes use of over 10 years of ICU admission data from all paediatric ICUs in Australia and New Zealand, and data obtained from 31 units in the United Kingdom to examine the relationships between patient characteristics and patient outcomes and to facilitate objective interpretations of performance.

This PhD research comprises an important body of research that provides more robust methods for assessing efficiency and clinical performance in the PICU. The research is significant in two ways. Firstly the methods described provide novel methods for comparing ICU outcomes, including length of stay (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.

The skewed distribution and heterogeneity of LoS poses difficulty for statistical modelling. The paper 'Quantifying variation of paediatric length of stay among intensive care units in Australia and New Zealand' provides a statistical method for describing unit performance and provides insights into the variation in resource use among Australian and New Zealand ICUs that accept paediatric admissions. While the model is statistically complex, the use of random effects to measure the unit level effect on LoS provides an intuitive and relatively straight forward measure of ICU performance.

One of the challenges of comparing resource use using length of stay is that it may be easily confounded by bed block or the availability of appropriate step down facilities – such as high dependency units. The examination of LoS concurrent with duration of respiratory support helped to contextualise the variation seen among units and is the subject of the publication 'Variation in duration of respiratory support among Australian and New Zealand pediatric intensive care units'. The requirement for respiratory support is often considered the distinguishing characteristic of critically ill patients and thus cessation of RS is an important clinical endpoint; potentially representing the end of the critical phase of illness. This study showed that the variation in LoS may be partly explained by the site effect on duration of respiratory support.



Compartmental approaches to predicting LoS are the subject of current research. The compartmental model for predicting duration of ICU stay among children admitted to ICU uses two gamma distributions to describe short and long stay patients respectively. A random effect is used to account for the clustering of patients within each site and provides a measure of site effect for each of the compartments; namely short stay and long stay.

While resource use is undoubtedly an important consideration in the effective management of ICU, it needs to be considered in the context of clinical outcomes. This means to say that low resource use is not considered ideal if it is at the cost of poor patient outcomes. Further research provided a simple graphical representation of unit performance that characterised units as efficient, effective at the expense of high resource use, least efficient, and poorly performing. The study was significant in that it revealed two units which were designated as inefficient and one which had good clinical outcomes but high resource use.

The method described in this paper built on the work of Rapoport and Teres, however offers several technical advantages. Most notably the differing use of measures for clinical performance and resource use permitted the construction of confidence intervals permitting statistical inferences to be made. Interestingly, the study also revealed that there was a tendency for units with good clinical performance, as designated by low SMR, to also have low resource use, while those with poor clinical performance tended to have higher resource use. This suggested that complications such as infection may lead to prolonged LoS and increased risk of mortality however, due to the low unit numbers, this could not be tested empirically.

Finally an updated model for predicting mortality risk, the paediatric index of mortality 3 (PIM3), is the subject of ongoing collaboration with the United Kingdom's PICANet. PIM3 presents many critical improvements over previous iterations; in particular, the use of interaction terms to distinguish patients with a very low risk of death.

**Megan Bohensky (Monash University)**

### *Linking Clinical and Administrative Data to Evaluate Intensive Care Outcomes*

Performance reporting is an important aspect of monitoring the quality of healthcare and improving it, as it allows for the identification of systemic issues that can lead to poor quality care. The Institute of Medicine has recommended that hospitals and organizations set up information systems to enable continuous monitoring and improvement to study and prevent problems that can lead to poor patient outcomes. One way to measure the quality of healthcare is to use data obtained from secondary sources, such as financial databases or insurance databases (e.g. administrative data).

The scientific rigour of assessing hospitals' care quality using administrative data obtained from secondary sources has been questioned in the past. The reservations mainly relate to a lack clinical accuracy, inadequate clinical detail to enable robust statistical risk-adjustment models, incomplete coding of data variables and coding inconsistencies (of the International Classification of Diseases codes) across states. All of these factors can obscure the measurement of a hospital's performance leading to either the under or over-representation of the actual quality of care provided.

One proposal for enhancing quality reports based on administrative data is to use data from existing clinical registries. These registries, which are created for research into specific clinical or disease areas, have been shown to have a greater level of clinical detail, which can enhance the accuracy of risk-adjustment models to allow benchmarking of patient outcomes. Additionally, the clinical focus of these data sources may increase the acceptance of reports based on these data by other clinicians.

This project involves linking two data-sets. These are:

1. The ANZICS APD
2. The DHS Victorian Admitted Episodes Data-set (VAED), which is an administrative database.

As the APD and DHS data do not contain shared patient identifiers, a probabilistic matching technique is used by staff at the DHS (based on the patient's date of birth, hospital, sex, medical record number, date of hospital admission, date of hospital discharge). The merged data-sets include data on a range of intensive care patient factors (e.g. age, sex, co-morbidities, illness acuity scores) and hospital episode information (e.g. length of stay, treatments/procedures). The merged data-set will be analysed to identify various factors that are associated with patient mortality post-discharge.

The aims of this project are as follows:

1. To evaluate the utility and validity of administrative and clinical registry data for measuring ICU performance on post-hospital mortality.
2. To establish methods of linkage of relevant datasets, to aid in quality measurement.
3. To apply different statistical models for monitoring (e.g. risk-adjustment models) and interpreting (e.g. data display) data sources.

### Operating Standards and Technical Design for Australian Clinical Quality Registries

A collaboration between the Australian Commission on Safety and Quality in Health (ACSQH), the National Health & Medical Research Council Centre for Research Excellence in Patient Safety (NHMRC CREPS) at Monash University and the National E-Health Transition Authority (NEHTA) led to the development of draft Operating Standards and Technical Design for Australian Clinical Quality Registries in late 2008. This project is aimed at developing a set of guidelines for the establishment and management of clinical registries. The draft document described the role of registries and the attributes that would identify a registry as one applicable for monitoring quality of care. It also provided a list of principles that should be observed. A mapping of technical standards and the description of infrastructure and architecture design complemented the operating guidelines. ANZICS CORE contributed significantly to the development of the Operating Standards and Technical Design for Australian Clinical Quality Registries by providing valuable advice and insights gained from the experience of operating the ANZICS registries.

The draft Operating Standards and Technical Design for Australian Clinical Quality Registries have undergone further testing and validation with six registries and it is expected the final version will be released in 2010.

### Improved Data Processing and Reporting

CORE transitioned to a new reporting system, SAS Strategic Performance Management (SPM), made possible by the donation of new server from Intel and an upgraded internet connection. Portal users found that the time required to display the individual site reports was shortened and they were able to download a zip file of a number of new standard reports for convenient use in other applications such as PowerPoint for presentations. Individual user log-ins were replaced by single hospital site log-ins to allow the number of users in the new SAS implementation to be trimmed to 200.

The SPM upgrade also involved the automation of internal data cleaning processes from data submissions. This meant improvement in data quality with a number of data validity checks being sent back to units to decrease missing values errors in coding.

Disaster recovery software and the new backup system were put in place to avoid data loss.

### Adult Patient Database Training Workshops

CORE provides education for data collectors, managers & intensive care staff with two day training workshops as an introduction to the ANZICS Adult Patient Database. They are designed to introduce participants to the collection and management of ICU data while developing their skills. Participants will also be given training on how to navigate, extract and create customised reports using AORTIC and web reports via the web portal and WRS. They are usually held three to four times per year in different jurisdictions; in 2008 only one was held in Melbourne due to staff shortages.

### Safety Quality Audit and Outcomes Research Meeting

CORE and the Safety and Quality Committee jointly sponsor the Annual International Safety Quality Audit and Outcomes (SQAQO) Research Conference as a means of improving the intensive care community's understanding of and participation in improving the methods and measurement of quality activities.

The 2nd International SQAQO Conference was held at the Millennium Hotel, Christchurch, New Zealand on 27 and 28 August, 2008. Although this conference series is based on intensive care, the topics covered are applicable to a wide range of health related personnel as the methods explored are broadly based and designed to bring rigour to the many initiatives aiming to improve the safety and quality of our work. The conference is theoretically grounded but practically oriented to develop new safety and outcomes initiatives. Sessions covered Central Line Associated Bacteraemia, Transforming Care at the Bedside, Clinical Registries and Performance Reporting.

Among the speakers were Professor John McNeil (Ethical and Privacy Issues Surrounding Clinical Registries and Data Linkage), Dr Niall Johnson (ACSQHC Initiatives), Mr Steven McConchie (Hospital Based KPIs From Administrative Data Sets), Ms Bernadette Grealy (Quality KPIs for Critical Care Nursing), Dr Steve Webb (WA Data Linkage Project), Dr Mary Seddon (Human Error), Prof Ian Baldwin (ICU Based Incident Monitoring Programs) and Dr Tony Burrell (Incidents Monitoring in NSW ICUs).

The 3rd International Conference on Safety, Quality, Audit and Outcomes Research in Intensive Care will be held at the Millennium Hotel, Queenstown on 6 and 7 August, 2009. The 4th will be held on the 10 and 11 of August, 2010 in the Daylesford/Hepburn Springs area of Victoria, in conjunction with the first Clinical Trials Group (CTG) Winter Conference. Updates are available at the conference website [www.sgao2010.com](http://www.sgao2010.com).

# The Future of CORE

## Reporting improvements

Plans to develop new displays for reporting ICU performance are underway. These include funnel plots, EWMA graphs and a multidimensional assessment of the overall unit activities comprising a balanced scorecard and dashboard presentation of information. Changes to WRS to increase the range of comparative reports are also planned.

## Research aims

With a set of quality databases, it is possible to provide evidence for research into practice. The ability to answer novel or topical questions that will inform policy requires a combination of clinical knowledge and the ability to get the data needed to answer the questions. This requires collaboration with clinicians with an interest in research and flexible data collection tools to collect the data. Further research collaboration is planned.

## Development of Key Performance Indicators for Intensive Care

CORE has been investigating the potential benchmarking indices that could rationally add value to the assessment and management of intensive care activities using comparative information on Structure, Process, Culture and Outcome. Figure 5 shows the patient flow through the ICU and the areas where key performance indicators (KPIs) could be applied. Common CORE KPIs are mortality, risk adjusted mortality, length of stay and after hours discharge from ICU. With the large amount of data collected across the registries, additional KPIs could be developed that incorporate hospital resources such as bed and staffing availability, readmission rates, bed block and transfer rates or data collection resources. Data elements are currently available within the resources of the CCR, ANZPIC or APD databases, or can be derived from these sources, to extend the KPIs. Additional data may need to be collected either by the databases or by linking to other data sources such as other registries. Other elements may be derived from snapshot studies, periodic studies which could be loaded into the database in batch files or over the web through direct data entry.

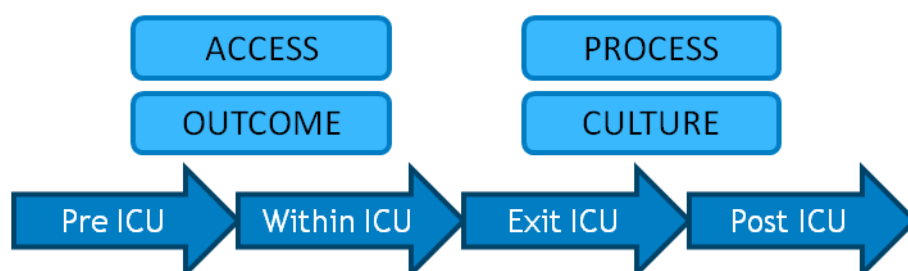


Figure 5 - Key Performance Indicator Classes and Patient Flow Map for ICUs

## CORE Staff in 2008

Carol George	Project Manager
Kim Bingham	Project Officer (Communications and Administration)
Jessica Andrews	Project Officer (Data Quality and Education ) (Shaila Chavan on maternity leave)
Chris Jacobs	Computer Programmer
Marcela Forero	Project Officer (Information Systems Management)
Kelly Drennan	Project Officer (Critical Care Resources)
Jan Alexander	ANZPIC Registry Manager

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# Glossary

ACCCN	Australian College of Critical Care Nurses	NHMRC CREPS	National Health & Medical Research Council Centre for Research Excellence in Patient Safety
ACSQHC	Australian Commission for Safety and Quality in Healthcare	NICRSC	National Intensive Care Registry Steering Committee
AKIN	Acute Kidney Injury Network	PAO2	Partial Pressure of Oxygen in Arterial Blood
ANZICS	Australian and New Zealand Intensive Care Society	PICU	Paediatric intensive care unit
ANZPIC	Australian and New Zealand Paediatric Intensive Care	PIM	Paediatric Index of Mortality
APACHE	Acute Physiological and Chronic Health Evaluation	RIFLE	Risk, Injury, Failure, Loss, End-stage kidney disease
APD	Adult Patient Database	RN	Registered Nurse
CCR	Critical Care Resources	SAPS	Simplified Acute Physiological Score
COPE	Critical Outcome Prediction Equation	SD	Standard Deviation
CORE	Centre for Outcome and Resource Evaluations	SMO	Senior medical officer
DSS	Decision Support Systems	SMR	Standard Mortality Ratio
FIO2	Fraction of Inspired Oxygen in a gas mixture	SPM	Strategic Performance Management
FTE	Full time equivalent	SQC	Safety and Quality Committee
CTG	Clinical Trials Group	SQAO	Safety Quality Audit and Outcomes (annual conference)
ICU	Intensive care unit	WRS	Web Report Studio
IQR	Interquartile Range		
JLC	Jurisdictional Liaison Committee		
KPI	Key Performance Indicator		
LoS	Length of stay		
MC	Management committee		
MET	Medical emergency teams		
NEHTA	National E-Health Transition Authority		

## 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

## Acute Physiological and Chronic Health Evaluation (APACHE)

### 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

## 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.

## Paediatric index of mortality (PIM)

PIM is a mortality prediction model for children in intensive care and is used by the ANZPIC Registry. The PIM model is based on eight variables collected at the time of admission to intensive care.







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