ANZ
DATA

AUSTRALIA & NEW ZEALAND
DIALYSIS & TRANSPLANT REGISTRY

TRANSPLANTING HOSPITAL REPORT

2011 - 2016

Contents

1 Introduction

This report is an abridged version of the transplant hospital report, prepared for general distribution. Individual hospital reports are also created, which contain more detailed information about the characteristics and outcomes within each hospital.

All Australian and New Zealand patients transplanted between 1 January 2011 and 31 December 2016 and who were aged ≥16 years at the time of operation were included. Both deceased and living donor transplants were included, but patients who received multi-organ grafts were excluded. Patients transplanted at a paediatric hospital were excluded. Recipients aged ≥18 years at the time of transplant were included for hospitals that provide transplantation services for all ages. Patients currently receiving RRT under the care of Canberra Hospital were excluded, as a result of delayed return of their 2016 ANZDATA survey data due to a data embargo by ACT Health.

The data are based on reports to the ANZDATA Registry. Interpretation of these results must take into account both the limitations of the methodology and the context. There is considerable literature about interpretation of results from many fields, and further information can be provided for those seeking to better understand the results.

The results presented here are estimates of true values and are subject to random variation. Confidence intervals are a common means of presenting this variability. For example, 95% confidence intervals illustrate a range which is expected to contain the true value 19 times out of 20. By definition, therefore, it is expected that 1 result in 20 will lie outside of 95% confidence intervals due to chance alone, if the assumptions of the model used to obtain the estimate are valid.

Another key limitation is the potential for factors other than those measured, which may be outside the control of treating hospitals, to affect results. This is known as residual confounding. Despite the inclusion of many factors related to patients and their care, most models predict only around 70% of the variation in transplant outcomes. ANZDATA results are consistent with international experience in this regard.

How then should results suggesting a hospital's results are inferior to expectation be interpreted? Perhaps the best approach is to consider them as signals for looking at a deeper level, bearing in mind that it may well be that the effects seen are driven by factors unrelated to the quality of care or beyond the control of individual hospitals (eg, chance, unmeasured confounders, or natural variation).

2 Methods

Random effects logistic regression was used to calculate the expected number of events (deaths or graft failures) at 1 year post-transplant for transplanting hospitals based on the patient and donor case-mix. Graft failure included return to dialysis or death. At this point, we have not included 3 year adjusted models due to technical issues with creating a suitably stable model while also including the key predictors.

Factors included in logistic regression models were recipient age, donor age, recipient gender, recipient race and country, presence of chronic lung disease and vascular disease (coronary artery disease, cerebrovascular disease and/or peripheral vascular disease) in the recipient, primary renal disease, number of HLA mismatches, donor type by cause of death (cerebrovascular accident (CVA), or other cause) and cold ischaemic time, time since commencing RRT, peak PRA and transplant year.

In addition, a random effect at the level of the transplanting hospital was included. This is a conservative assumption (i.e., this will reduce the chance of a false positive but will also reduce the chance of detecting a true positive). This term explicitly attempts to account for variation in hospital-specific performance due to chance; in doing so, it may also incorporate some elements of relevant hospital-specific outcomes. Following a similar philosophy we have included total ischaemic time in the model as a factor for adjustment; this assumption implies that this factor is not under the control of the transplanting hospital.

The logistic regression model was fitted to data from all transplant recipients to obtain the probability of an event occurring for each patient based upon their characteristics. Several changes to the methodology for the ratios have been made in this report, see the accompanying document for an explanation of these changes. The expected number of events was defined as the number of events expected if the patients treated at that hospital had instead been assigned at random to any hospital in Australia and New Zealand, with the random assignment weighted by hospital size. For each patient, predicted event probabilities had that patient been treated in each available hospital were calculated, then a weighted average was taken. These weighted average predicted probabilities were then summed over the patients within each hospital, resulting in the expected number of events. With the change in the definition of the expected events, the standard error of the ratios of observed to expected events are now estimated using 500 bootstrapped samples. We have indicated the number of missing patients for each hospital. Where this is large, then the potential exists to bias results if the pattern of missingness is not random.

For all models, the expected number of events predicted by the model within each category of covariates was consistent with the observed numbers. Additionally, the area under the receiver-operating characteristic (ROC) curves attributable to each model was also examined. For 1 year death and graft failure the area under the ROC curve were 76.0% (95% CI: 70.8-81.3) and 68.5% (95% CI: 64.5-72.4), respectively. These results indicate a model with moderate fit, and the degree of model fit is comparable with US and UK models.

This section contains the random effects logistic regression model results as odds ratios with 95% confidence intervals for the two outcomes. It also contains the number of transplants

performed by each hospital and the number of graft failure events (which includes death) and patient deaths within 1 year post-transplant. The expected number of events (graft failures or deaths) based on patient case-mix is presented as well as the ratio of observed to expected. The ratio of observed to expected is presented with a 95% false discovery rate (FDR) confidence interval, that accounts for the multiple comparisons made between centres. The probability of any single centre lying outside their confidence interval due to chance is 0.05. The rate of observed events per number of transplants is also presented with a 95% confidence interval.

The ratios of observed to expected for both outcomes are also presented in funnel plots. These show the ratios on a logarithmic scale (y-axis) plotted against the effective sample size (x-axis). Hospitals with a ratio of 0 are not shown. The red line indicates a ratio of 1, and the contours indicate 95% FDR confidence intervals. If a hospital lies within the confidence intervals then that hospital has an observed to expected ratio that is statistically consistent (at a 5% FDR level) with 1 (i.e. there is no statistical difference in the number of observed and expected events). If a hospital lies above the upper control lines, this indicates that the number of observed deaths is statistically greater than the number expected under the model. Conversely, if a hospital lies below the lines, this indicates statistically fewer observed deaths than expected under the model. The SMR is presented on a logarithmic scale as confidence intervals for the logarithm of the SMR (log-SMR) have better coverage properties. The effective sample size measures the variability of each log-SMR relative to the overall variability of all log-SMRs.

In interpreting the SMR and funnel plots it should be borne in mind that the precision of these estimates is strongly influenced by the number of patients in a hospital. As such, smaller hospitals will have less precise estimates and greater uncertainty about where the true effect lies. This is shown in wider confidence intervals for the SMR estimates and likely greater change in these estimates as they are updated over time.

One consequence of the modelling approach is that for small groups, the risk estimates have wide confidence intervals and can be "unstable". This is manifest in point estimates that can be large for example the odds ratio for the DD non-CVA $\geq$ 12 hours group for patient mortality is almost four-fold. We have examined alternative approaches to this issue, but in practice given the small numbers involved there is little effect on the overall unit ratios.

3 Graft Failure at 1 Year Post-transplant

3.1 Risk-adjusted Graft Failure Ratios

Table 1: Observed vs expected number of graft failures at 1 year post transplant

Code	Hospital	Grafts*	Observed	Expected	Observed Rate (95% CI)	Ratio (95% FDR CI)
ALFD	Alfred Hospital	112 (6)	9	5.5	0.080 (0.037-0.147)	1.63 (0.61-4.36)
AUCK	Auckland Hospital	332 (16)	10	13.3	0.033 (0.017-0.059)	0.75 (0.29-1.94)
AUST	Austin Hospital	204 (13)	4	10.1	0.020 (0.005-0.049)	0.40 (0.07-2.13)
CHCH	Christchurch Hospital	103 (11)	3	2.9	0.029 (0.006-0.083)	1.02 (0.19-5.57)
CNAR	Central Northern Adelaide Renal Service	403 (33)	22	16.8	0.055 (0.035-0.081)	1.31 (0.69-2.48)
FSTH	Fiona Stanley Hospital	36 (17)	2	0.8	0.056 (0.007-0.187)	2.40 (0.38-14.98)
HUNT	John Hunter Hospital	177 (13)	5	8.1	0.034 (0.013-0.072)	0.62 (0.13-2.98)
MMCA	Monash Medical (Adults)	358 (15)	21	16.8	0.061 (0.039-0.092)	1.25 (0.66-2.35)
POWH	Prince Of Wales Hospital	203 (9)	9	9.5	0.044 (0.020-0.082)	0.95 (0.33-2.75)
QRTS	Queensland Renal Transplant Service	686 (240)	14	19.7	0.032 (0.020-0.048)	0.71 (0.32-1.57)
RLPT	Royal Perth Hospital	141 (33)	9	4.6	0.085 (0.045-0.144)	1.94 (0.70-5.37)
RMBH	Royal Melbourne Hospital	531 (69)	21	21.9	0.047 (0.031-0.069)	0.96 (0.53-1.75)
RNSH	Royal North Shore Hospital	109 (40)	4	3.8	0.055 (0.020-0.116)	1.06 (0.18-6.17)
SCGH	Sir Charles Gairdner Hospital	231 (77)	8	6.6	0.061 (0.034-0.100)	1.22 (0.43-3.49)
STVI	St Vincent's Hospital (NSW)	14 (3)	0	0.3	0.000 (0.000-0.232)	0.00 (.-.)
SVIN	St Vincent's Hospital (VIC)	98 (19)	2	4.8	0.041 (0.011-0.101)	0.41 (0.05-3.14)
SWRS	Statewide Renal Services	326 (37)	18	13.6	0.058 (0.035-0.090)	1.33 (0.66-2.66)
WELN	Wellington Hospital	146 (11)	8	5.0	0.055 (0.024-0.105)	1.59 (0.62-4.12)
WEST	Western Renal Service	291 (38)	9	12.2	0.038 (0.019-0.067)	0.73 (0.24-2.23)

Transplant procedures performed 2011-2015

* The number in brackets is the number of grafts excluded from logistic regression due to missing data

3.2 Funnel Plot

Risk-adjusted Graft Failure Ratio at 1 Year
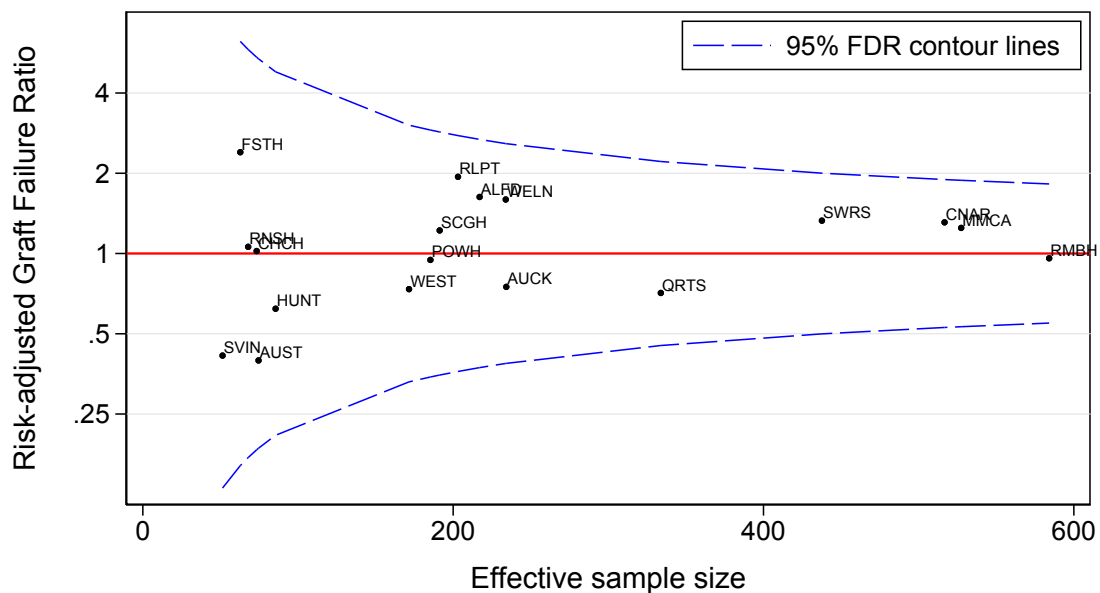
Observations with missing values are dropped from the model

3.3   Logistic Model Coefficients

Table 2: Logistic regression model odds ratios for graft failure at 1 year post transplant

	Odds Ratio	95% CI
Subsequent Graft	0.97	[0.55,1.73]
Age (years)	1.00	[0.98,1.01]
Male	1.33	[0.95,1.87]
Duration of ESKD		
Preemptive	1.09	[0.48,2.45]
<6 months	0.23	[0.06,0.98]
6-12 months	0.84	[0.44,1.63]
12-23 months	0.80	[0.50,1.29]
24+ months	ref.	
Peak PRA	1.00	[0.99,1.01]
Donor Age (years)	1.01	[1.00,1.03]
Country and Race		
Australian non-indigenous	ref.	
Australian Aboriginal/Torres Strait Islander	0.79	[0.35,1.80]
New Zealand non-indigenous	1.04	[0.55,1.97]
New Zealand Māori / Pacific	1.20	[0.50,2.85]
Lung Disease	1.07	[0.57,1.98]
Cardiac Disease	1.79	[1.23,2.59]
PRD		
GN	ref.	
Polycystic	0.65	[0.35,1.21]
Diabetes	1.31	[0.88,1.96]
Miscellaneous	1.47	[1.00,2.17]
Number of Mismatches	1.07	[0.97,1.18]
Year of Transplant	1.01	[0.91,1.13]
Donor Type / Cause of Death / Ischaemic Time		
LD	ref.	
DD CVA 0-11 hours	1.97	[1.07,3.65]
DD non-CVA 0-11 hours	2.25	[1.21,4.19]
DD CVA ≥12 hours	2.38	[1.30,4.33]
DD non-CVA ≥12 hours	2.79	[1.52,5.11]

4 Mortality at 1 Year Post-transplant

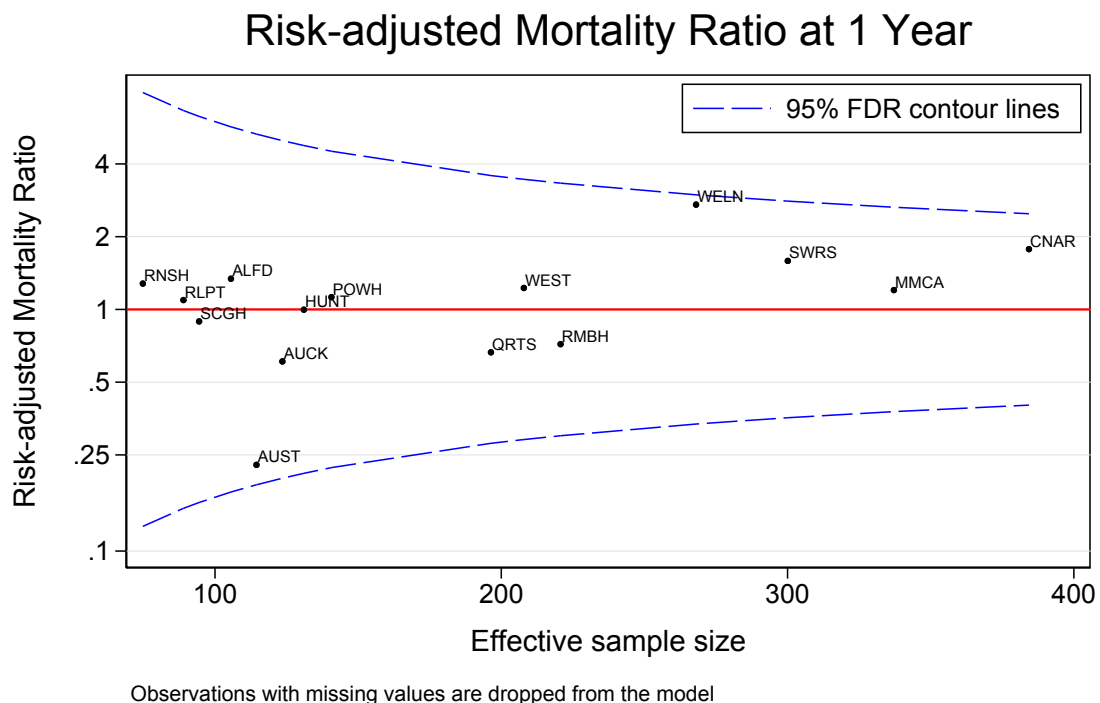## 4.1 Risk-adjusted Mortality Ratios

Table 3: Observed vs expected number of deaths at 1 year post transplant

Code	Hospital	Patients[*]	Observed	Expected	Observed Rate (95% CI)	Ratio (95% FDR CI)
ALFD	Alfred Hospital	100 (6)	3	2.2	0.030 (0.006-0.085)	1.34 (0.24-7.63)
AUCK	Auckland Hospital	308 (15)	4	6.6	0.013 (0.004-0.033)	0.61 (0.12-3.04)
AUST	Austin Hospital	192 (12)	1	4.4	0.005 (0.000-0.029)	0.23 (0.04-1.21)
CHCH	Christchurch Hospital	92 (10)	0	0.8	0.000 (0.000-0.039)	0.00 (.-.)
CNAR	Central Northern Adelaide Renal Service	346 (27)	12	6.8	0.035 (0.018-0.060)	1.78 (0.71-4.42)
FSTH	Fiona Stanley Hospital	31 (17)	0	0.3	0.000 (0.000-0.112)	0.00 (.-.)
HUNT	John Hunter Hospital	162 (12)	4	4.0	0.031 (0.010-0.071)	1.00 (0.21-4.75)
MMCA	Monash Medical (Adults)	310 (11)	8	6.7	0.026 (0.011-0.050)	1.20 (0.45-3.18)
POWH	Prince Of Wales Hospital	183 (8)	4	3.6	0.022 (0.006-0.055)	1.12 (0.25-5.07)
QRTS	Queensland Renal Transplant Service	621 (224)	5	7.5	0.008 (0.003-0.019)	0.66 (0.19-2.38)
RLPT	Royal Perth Hospital	129 (32)	2	1.8	0.016 (0.002-0.055)	1.09 (0.16-7.28)
RMBH	Royal Melbourne Hospital	443 (56)	6	8.4	0.018 (0.008-0.035)	0.72 (0.22-2.39)
RNSH	Royal North Shore Hospital	97 (35)	2	1.6	0.031 (0.006-0.088)	1.28 (0.16-10.11)
SCGH	Sir Charles Gairdner Hospital	193 (69)	2	2.2	0.021 (0.006-0.052)	0.89 (0.14-5.61)
STVI	St Vincent's Hospital (NSW)	13 (3)	0	0.1	0.000 (0.000-0.247)	0.00 (.-.)
SVIN	St Vincent's Hospital (VIC)	90 (17)	0	2.3	0.011 (0.000-0.060)	0.00 (.-.)
SWRS	Statewide Renal Services	293 (34)	8	5.0	0.027 (0.012-0.053)	1.59 (0.57-4.46)
WELN	Wellington Hospital	134 (10)	5	1.8	0.037 (0.012-0.085)	2.71 (0.91-8.09)
WEST	Western Renal Service	256 (34)	6	4.9	0.027 (0.011-0.056)	1.23 (0.36-4.24)

Patients transplanted 2011-2015 (primary grafts only)

[*] The number in brackets is the number of patients excluded from logistic regression due to missing data

4.2 Funnel Plot

Risk-adjusted Mortality Ratio at 1 Year

Observations with missing values are dropped from the model

4.3   Logistic Model Coefficients

Table 4: Logistic regression model odds ratios for mortality at 1 year post transplant

	Odds Ratio	95% CI
Age (years)	1.03	[1.00,1.05]
Male	0.92	[0.55,1.55]
Duration of ESKD		
Preemptive	0.34	[0.04,2.94]
<6 months	0.34	[0.05,2.63]
6-12 months	1.38	[0.59,3.24]
12-23 months	0.70	[0.33,1.46]
24+ months	ref.	
Peak PRA	1.00	[0.98,1.02]
Donor Age (years)	1.02	[1.00,1.03]
Country and Race		
Australian non-indigenous	ref.	
Australian Aboriginal/Torres Strait Islander	1.35	[0.44,4.12]
New Zealand non-indigenous	0.93	[0.31,2.83]
New Zealand Māori / Pacific	2.31	[0.78,6.85]
Lung Disease	1.50	[0.69,3.27]
Cardiac Disease	2.60	[1.53,4.41]
PRD		
GN	ref.	
Polycystic	0.40	[0.14,1.17]
Diabetes	1.00	[0.53,1.90]
Miscellaneous	1.35	[0.73,2.47]
Number of Mismatches	0.98	[0.84,1.13]
Year of Transplant	1.00	[0.84,1.19]
Donor Type / Cause of Death / Ischaemic Time		
LD	ref.	
DD CVA 0-11 hours	2.84	[1.00,8.10]
DD non-CVA 0-11 hours	2.66	[0.91,7.76]
DD CVA ≥12 hours	2.89	[1.03,8.08]
DD non-CVA ≥12 hours	3.64	[1.29,10.27]