

Statistical Methodology and Risk-Adjustment for Survival Rate Estimation

Unadjusted and risk-adjusted estimates of patient and graft survival are given for each centre. Unadjusted rates give an estimate of what the survival rate at a centre is, assuming that all patients at the centre have the same chance of surviving a given length of time after transplant. In reality, patients differ and a risk-adjusted rate that allows for these differences would give a more meaningful estimate of survival.

Computing unadjusted survival rates

Unadjusted survival rates were calculated using the Kaplan-Meier method, which allows patients with incomplete follow-up information to be included in the computation. For example, in a cohort for estimating one-year patient survival rates, a patient was followed up for only nine months before they relocated. If we calculated a crude survival estimate using the number of patients who survived for at least a year, this patient would have to be excluded, as it is not known whether or not the patient was still alive one year after transplant. The Kaplan-Meier method allows information about such patients to be used for the length of time that they are followed-up, when this information would otherwise be discarded. Such instances of incomplete follow-up are not uncommon in the analysis of survival data and the Kaplan-Meier method therefore allows the computation of survival estimates that are more meaningful.

Computing risk-adjusted survival rates

A risk-adjusted survival rate is an estimate of what the survival rate at a centre would have been if they had had the same mix of patients as that seen nationally. The risk-adjusted rate therefore presents estimates in which differences in patient mix across centres have been removed as much as possible. For that reason, it is valid to only compare centres using risk-adjusted rather than unadjusted rates, as differences among the latter can be attributed to differences in patient mix.

Risk-adjusted survival estimates were obtained through indirect standardisation. A Cox Proportional Hazards model was used to determine the probability of survival for each patient based on their individual risk factor values. The sum of these probabilities for all patients at a centre gives the number, E , of patients or grafts expected to survive at least one year or five years after transplant at that centre. The number of patients who actually survive the given time period is given by O . The risk-adjusted estimate is then calculated by multiplying the ratio O/E by the overall unadjusted survival rate across all centres.

The risk-adjustment models used were based on results from previous studies that looked at factors affecting the survival rates of interest. The factors included in the models are shown in the table below.

Risk adjustment factors

Adult patient transplants

First transplants from deceased donors

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|-------------------------|--|
| 1 year graft survival | Donor age, donor type, donor cause of death, recipient age, waiting time to transplant, primary renal disease, HLA mismatch group, cold ischaemic time*, recipient ethnicity |
| 1 year patient survival | Donor age, recipient age, waiting time to transplant, primary renal disease, HLA mismatch group, cold ischaemic time* |
| 5 year graft survival | Graft year, donor age, donor type, donor cause of death, recipient age, waiting time to transplant, primary renal disease, HLA mismatch group, recipient ethnicity |
| 5 year patient survival | Graft year, donor age, recipient age, waiting time to transplant, primary renal disease |

Transplants from live donors

| | |
|-------------------------|---|
| 1 year graft survival | Donor age, recipient age, primary renal disease, number of HLA mismatches |
| 1 year patient survival | Recipient age |
| 5 year graft survival | Graft year, donor age, recipient age, primary renal disease, number of HLA mismatches |
| 5 year patient survival | Recipient age, primary renal disease |

Paediatric patient transplants

First transplants from deceased donors

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|-------------------------|--|
| 1 year graft survival | Donor age, recipient age, HLA mismatch group, cold ischaemic time* |
| 1 year patient survival | Recipient age |
| 5 year graft survival | Donor age, recipient age, HLA mismatch group |
| 5 year patient survival | Recipient age |

Transplants from live donors

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|-------------------------|--------------------------|
| 1 year graft survival | Donor age, recipient age |
| 1 year patient survival | Recipient age |
| 5 year graft survival | Donor age, recipient age |
| 5 year patient survival | Recipient age |

*Time between retrieval of kidney from the donor and time of transplant in the patient.