

NHS BLOOD AND TRANSPLANT

CARDIOTHORACIC ADVISORY GROUP – HEART

PAEDIATRIC LONG-TERM CONDITIONAL SURVIVAL POST-HEART TRANSPLANT

INTRODUCTION

1. NHSBT publishes patient survival rates post-heart transplantation up to a maximum of 10 years on a national basis and 5 years on a centre-specific basis post-transplant. There is interest in presenting longer-term survival rates, beyond 10 years, for the UK paediatric heart transplant population.
2. There is also interest in examining conditional survival rates, which represent the probability of surviving to a given time point on the condition that the patient has survived beyond the initial post-transplant period. **Appendix A** shows the equivalent analysis from the International Society for Heart and Lung Transplantation.
3. This paper reports on long-term survival post-heart transplant both nationally and on a centre-specific basis. It also presents survival conditional on surviving the first year post-transplant. Transplants performed between April 1996 and March 2016 were included in the analysis.

DATA AND METHODS

4. Paediatric (age<16) first time heart only transplants performed at Newcastle Centre and Great Ormond Street Hospital between 1 April 1996 and 31 March 2016 were extracted from the UK Transplant Registry. Patient survival was defined as time from transplant to death or last known survival date recorded as of 15 August 2023.
5. The Kaplan-Meier estimation method was used to calculate survival probabilities at 10 years and beyond, both nationally and on a centre-specific basis. Median survival times were also estimated, by selecting the time when 50% of patients were still alive. Conditional survival was calculated by excluding patients who died within 1 year of transplant.
6. Survival rates were also stratified by transplant era (April 1996 – March 2001, April 2001 – March 2006, April 2006 – March 2011, April 2011 – March 2016) to examine changes in survival rates over time. Differences across eras were examined using the log-rank test.

RESULTS

7. **Figure 1a** shows long-term national survival post-heart transplant and **Figure 1b** shows survival conditional on surviving the first year. **Figures 2a** and **2b** show the same information, stratified by era. **Table 1** presents 10, 15 and 20 year survival rates by era (not conditional on surviving the first year).

Figure 1a Long-term survival of the paediatric patient after heart transplantation, for transplants performed 1 April 1996 - 31 March 2016

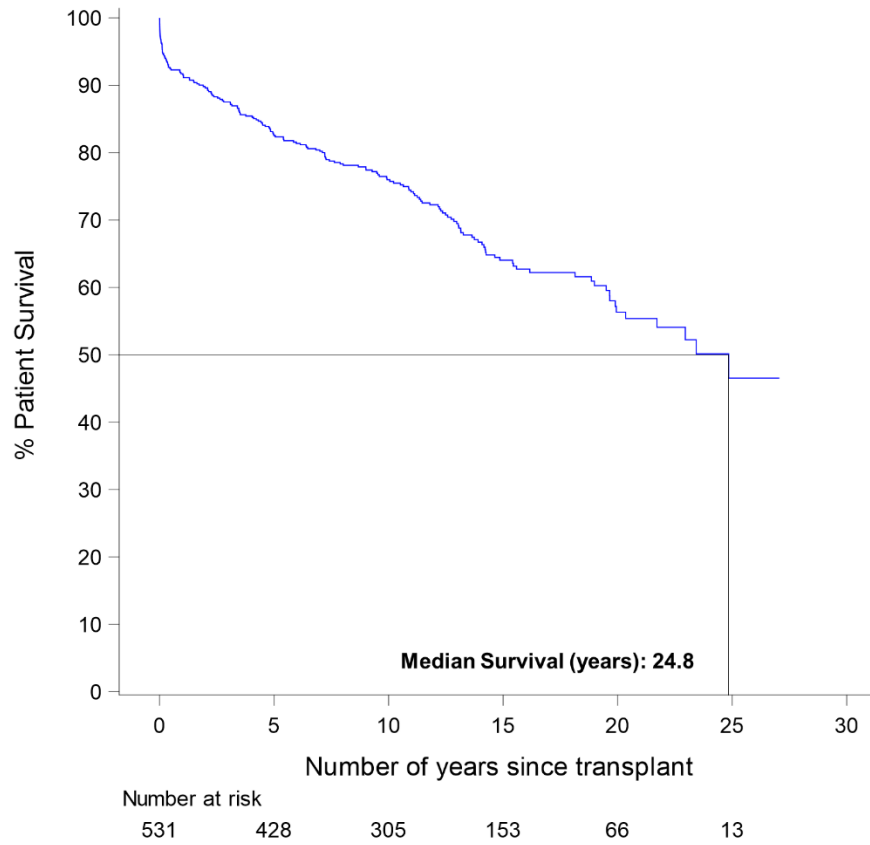


Figure 1b Long-term survival of the paediatric patient after heart transplantation, conditional on surviving the first year, for transplants performed 1 April 1996 - 31 March 2016

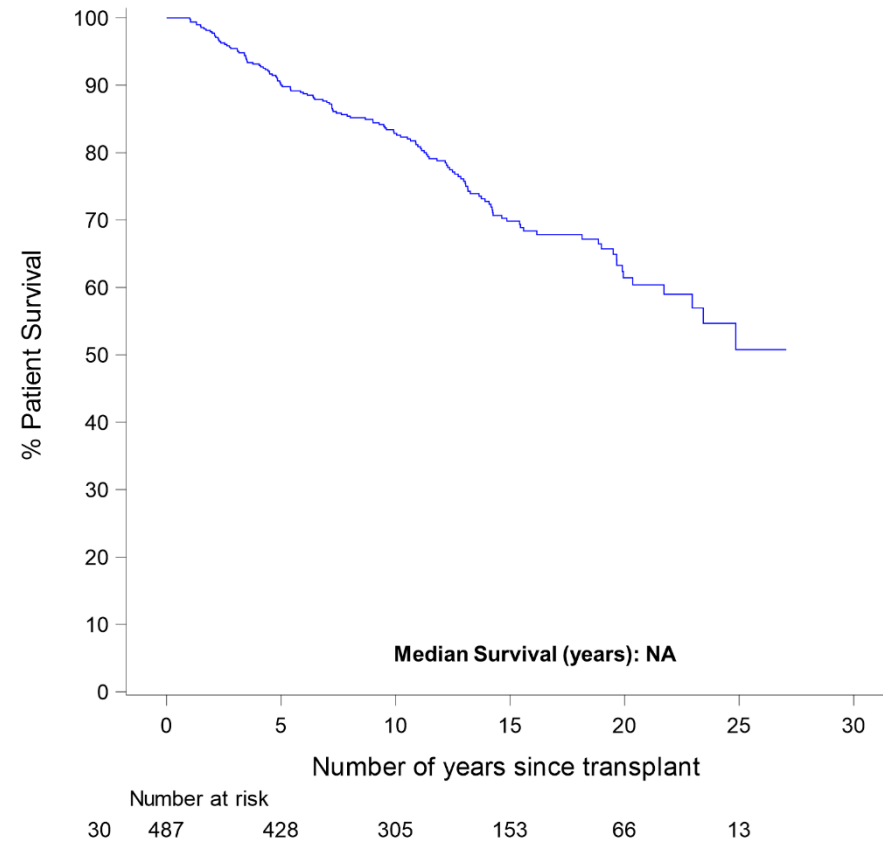
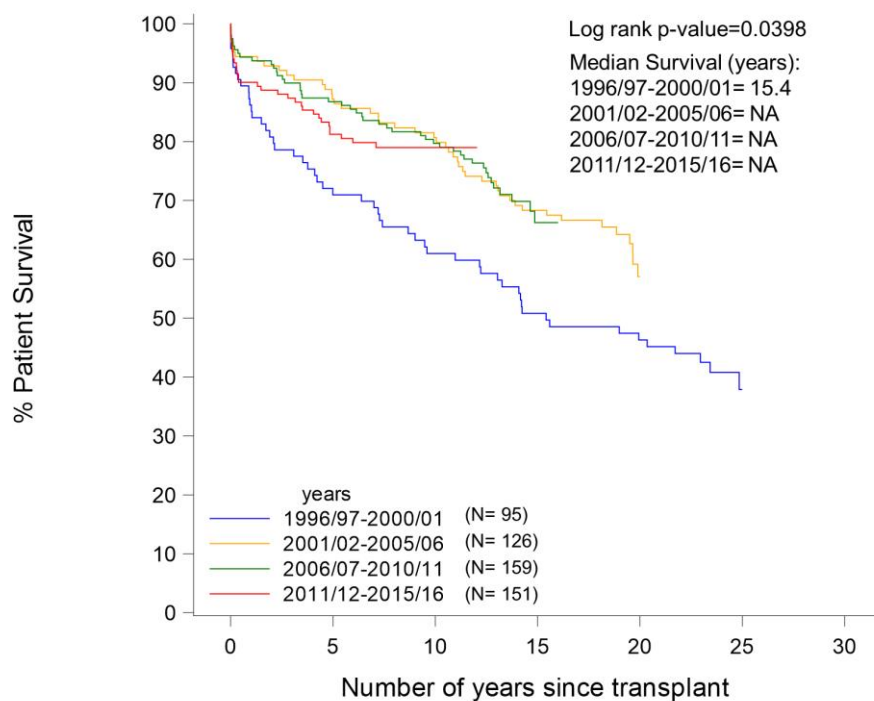
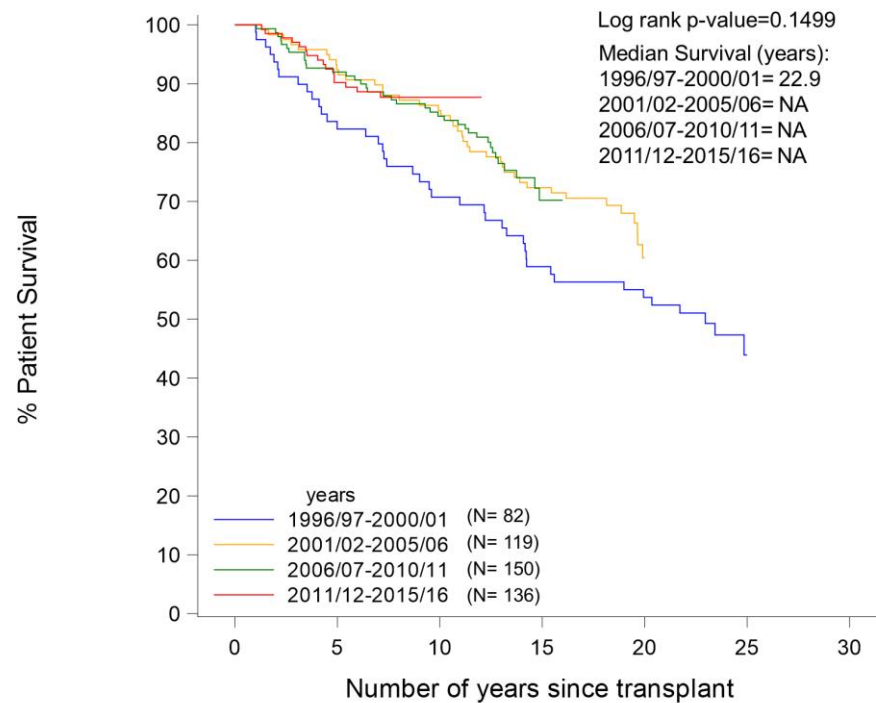


Figure 2a Long-term survival of the paediatric patient after heart transplantation stratified by era, for transplants performed 1 April 1996 - 31 March 2016



	Number at risk				
	0	5	10	15	20
1996/97-2000/01	95	65	54	45	41
2001/02-2005/06	126	108	98	82	25
2006/07-2010/11	159	137	121	26	
2011/12-2015/16	151	118	32		

Figure 2b Long-term survival of the paediatric patient after heart transplantation, stratified by era and conditional on surviving the first year, for transplants performed 1 April 1996 - 31 March 2016

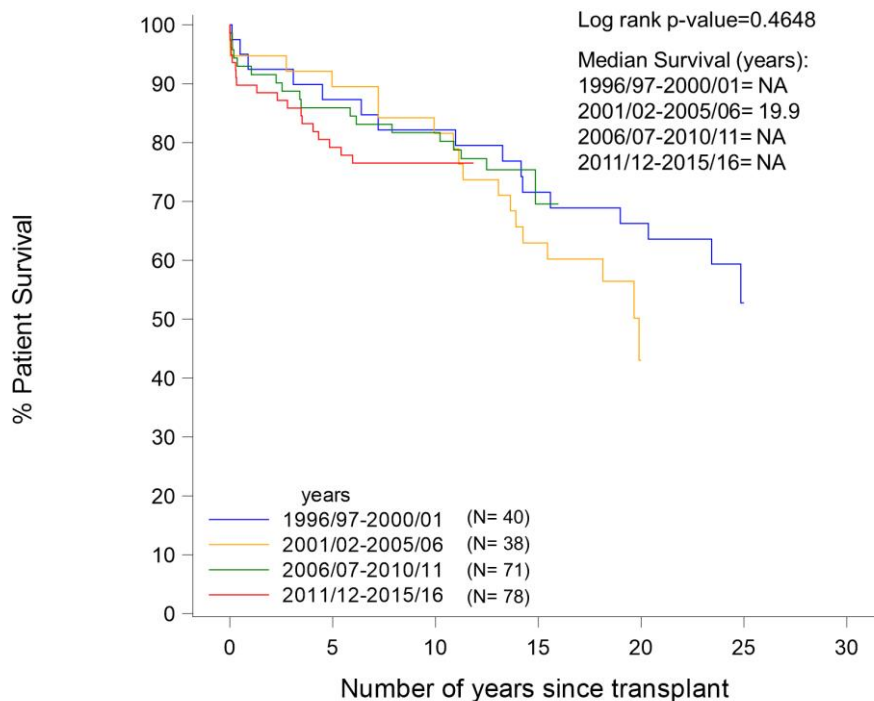


	Number at risk				
	0	5	10	15	20
1996/97-2000/01	82	65	54	45	41
2001/02-2005/06	119	108	98	82	25
2006/07-2010/11	150	137	121	26	
2011/12-2015/16	136	118	32		

Era of transplant	Number of transplants performed	10 year survival		15 year survival		20 year survival	
		%	95% CI	%	95% CI	%	95% CI
1996/97-2000/01	95	61	50 - 70	51	40 - 61	46	36 - 56
2001/02-2005/06	126	81	73 - 87	68	59 - 76	57	46 - 67
2006/07-2010/11	159	80	73 - 85	66	57 - 74	-	-
2011/12-2015/16	151	79	71 - 85	-	-	-	-
Total	531	76	72 - 79	64	59 - 69	56	50 - 62

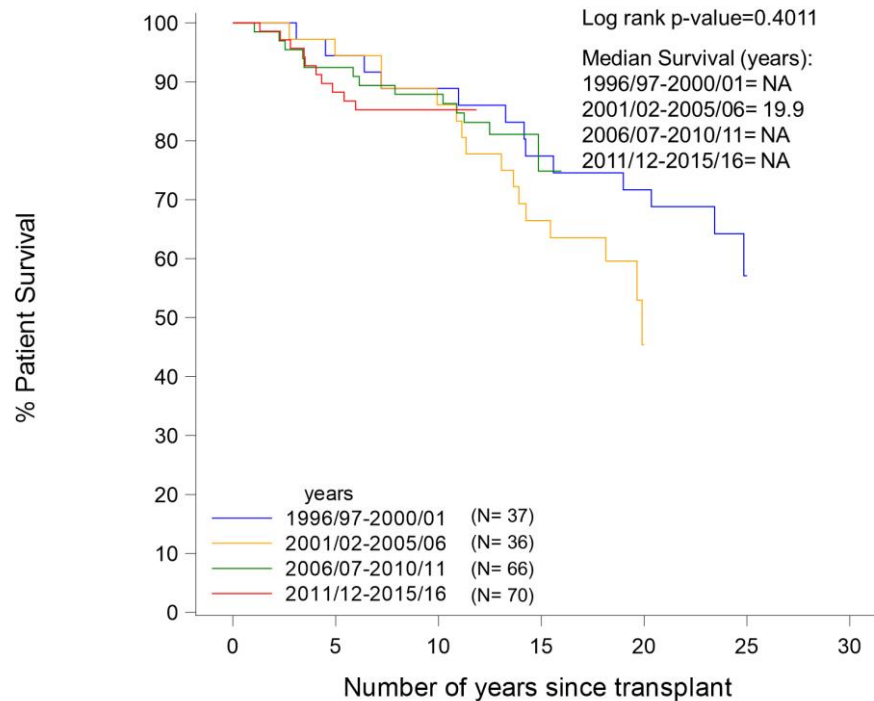
8. **Figures 3a and 3b and 4a and 4b**, show centre specific survival plots of long-term survival and conditional survival, by era.

Figure 3a Newcastle long-term survival of the paediatric patient after heart transplantation stratified by era, for transplants performed 1 April 1996 - 31 March 2016



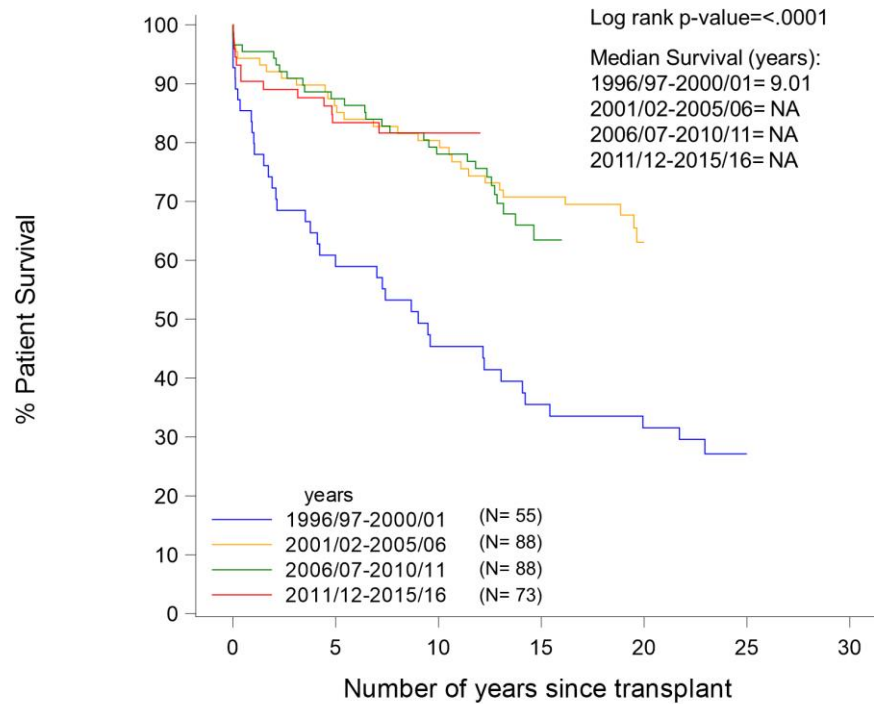
	Number at risk				
	0	5	10	15	20
1996/97-2000/01	40	34	31	27	25
2001/02-2005/06	38	34	31	23	4
2006/07-2010/11	71	61	56	7	
2011/12-2015/16	78	59	13		

Figure 3b Newcastle long-term survival of the paediatric patient after heart transplantation, stratified by era and conditional on surviving the first year, for transplants performed 1 April 1996 - 31 March 2016



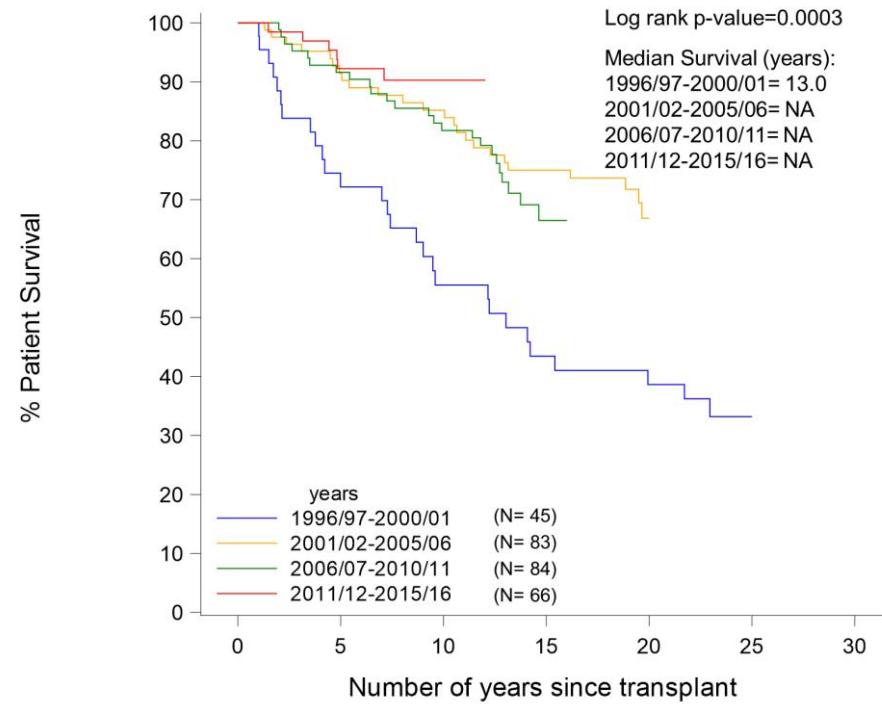
	Number at risk				
	0	5	10	15	20
1996/97-2000/01	37	34	31	27	25
2001/02-2005/06	36	34	31	23	4
2006/07-2010/11	66	61	56	7	
2011/12-2015/16	70	59	13		

Figure 4a London, Great Ormond Street long-term survival of the paediatric patient after heart transplantation stratified by era, for transplants performed 1 April 1996 - 31 March 2016



	Number at risk				
	0	5	10	15	20
1996/97-2000/01	55	31	23	18	16
2001/02-2005/06	88	74	67	59	21
2006/07-2010/11	88	76	65	19	
2011/12-2015/16	73	59	19		

Figure 4b London, Great Ormond Street long-term survival of the paediatric patient after heart transplantation, stratified by era and conditional on surviving the first year, for transplants performed 1 April 1996 - 31 March 2016



	Number at risk				
	0	5	10	15	20
1996/97-2000/01	45	31	23	18	16
2001/02-2005/06	83	74	67	59	21
2006/07-2010/11	84	76	65	19	
2011/12-2015/16	66	59	19		

LIMITATIONS/POSSIBLE FUTURE WORK

9. These analyses do not adjust for possible changes in risk factors overtime or between centres. Transplants in the earlier eras may not provide accurate estimates for patients transplanted today and transplants in the most recent eras have not accrued enough follow-up time to produce medians.
10. There are more sophisticated statistical methods that can be used to generate estimates of median survival times, including Weibull models for life expectancy and period analysis. These could be explored as possible future work.

CONCLUSIONS

11. This analysis shows that the overall UK median survival time following paediatric heart transplantation is 24.8 years, but for conditional survival after the first year, the proportion of patients still alive is still above 50%, and so is not estimable. Considering just those patients transplanted in the most recent transplant era (2011/12-2015/16), the proportion of patients still alive is still above 50%.
12. The International Society for Heart and Lung Transplantation reported a median of 14.6 years for transplants performed between 1992-2001. In a comparable transplant era 1996/97-2000/01, the UK estimates are 15.4 years.
13. Centre-specific long-term survival curves, both conditional and non-conditional, are provided for interest.
14. Nationally, 13 patients survived beyond 25 years following heart transplantation.

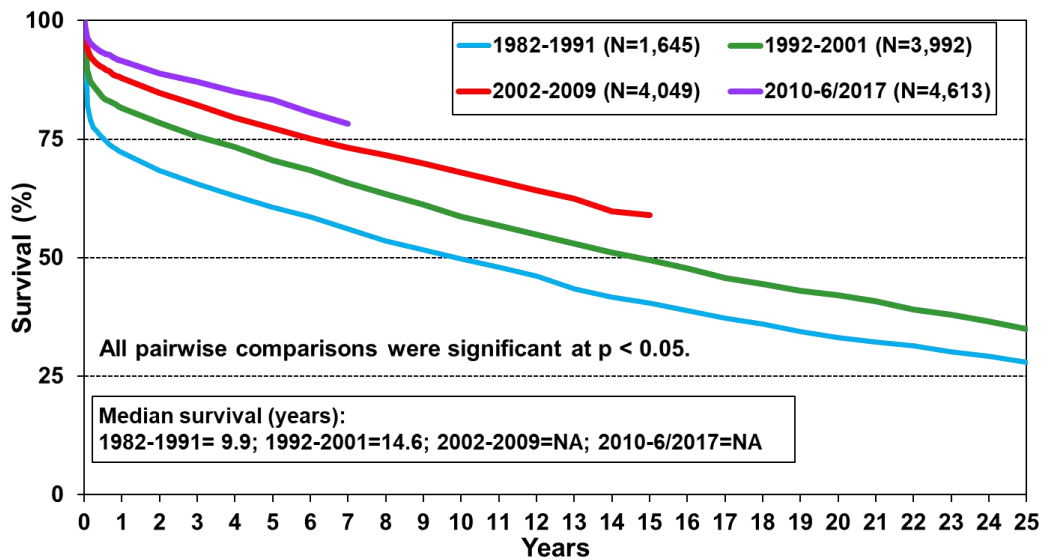
Miguel Angel Reyes Roque
Statistics and Clinical Research

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APPENDIX

Appendix A ISHLT: Long-term survival post-heart transplant, stratified by era of transplant

**Pediatric Heart Transplants
Kaplan-Meier Survival by Era
(Transplants: January 1982 – June 2017)**



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