

NHS BLOOD AND TRANSPLANT

CARDIOTHORACIC ADVISORY GROUP – HEART

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 adult 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 B** 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 1995 and March 2015 were included in the analysis.

DATA AND METHODS

4. Adult (age \geq 16) first time heart only transplants performed across the UK between 1 April 1995 and 31 March 2015 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 16 October 2022. Seven patients (0.2%) had missing survival data and were excluded from the analysis. Data from two historic transplant centres (Sheffield and London, St George's) were included in the national rates but not in the centre-specific charts.
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 1995 – March 2000, April 2000 – March 2005, April 2005 – March 2010, April 2010 – March 2015) 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 patient survival post-heart transplant, for transplants performed 1 April 1995 - 31 March 2015

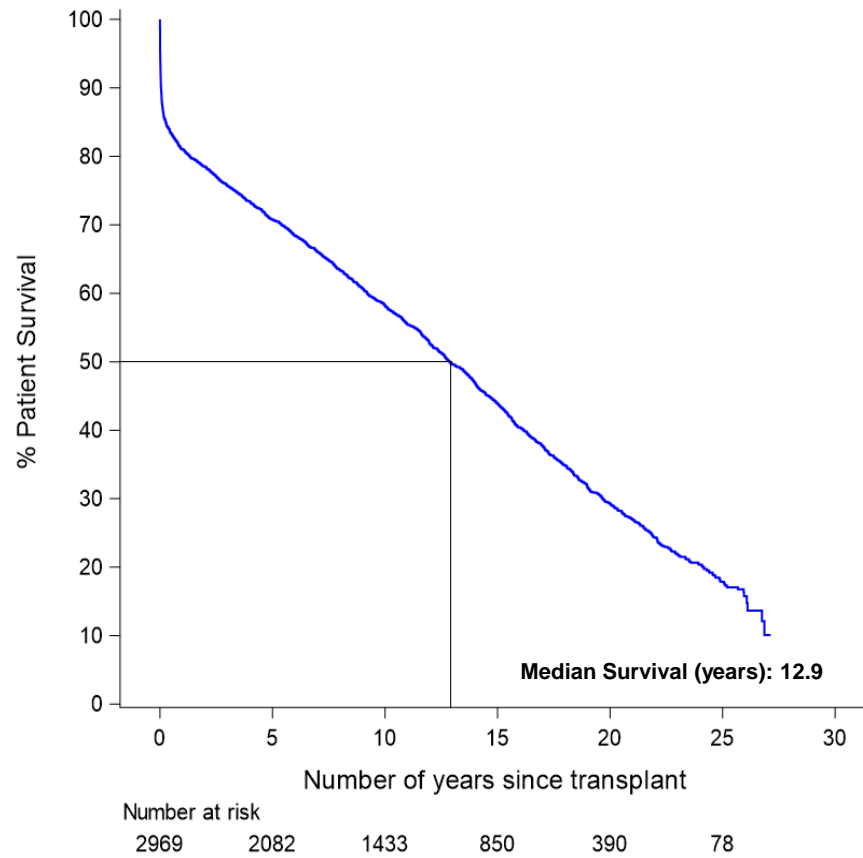


Figure 1b Long-term patient survival post-heart transplant, conditional on surviving the first year, for transplants performed 1 April 1995 - 31 March 2015

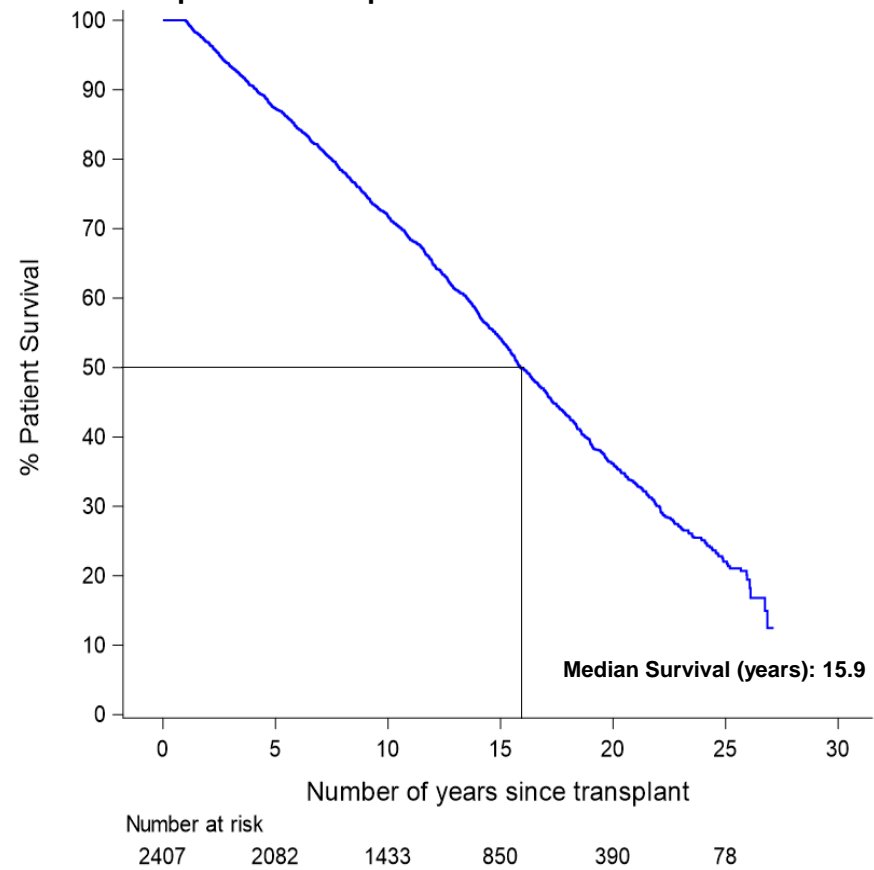
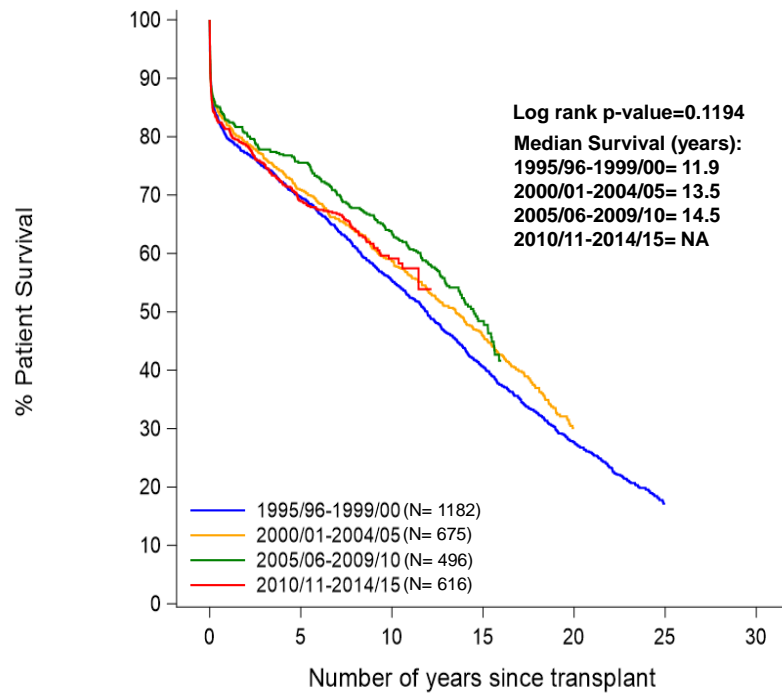
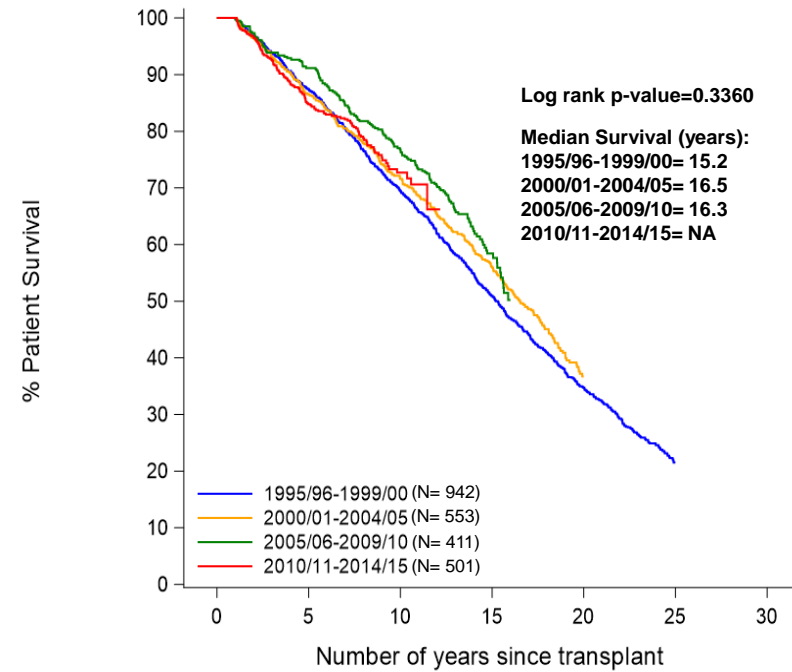


Figure 2a Long-term patient survival post-heart transplant stratified by era, for transplants performed 1 April 1995 - 31 March 2015



	Number at risk				
1995/96-1999/00	1182	821	648	471	319
2000/01-2004/05	675	472	384	298	71
2005/06-2009/10	496	369	305	81	
2010/11-2014/15	616	420	96		

Figure 2b Long-term patient survival post-heart transplant, stratified by era and conditional on surviving the first year, for transplants performed 1 April 1995 - 31 March 2015



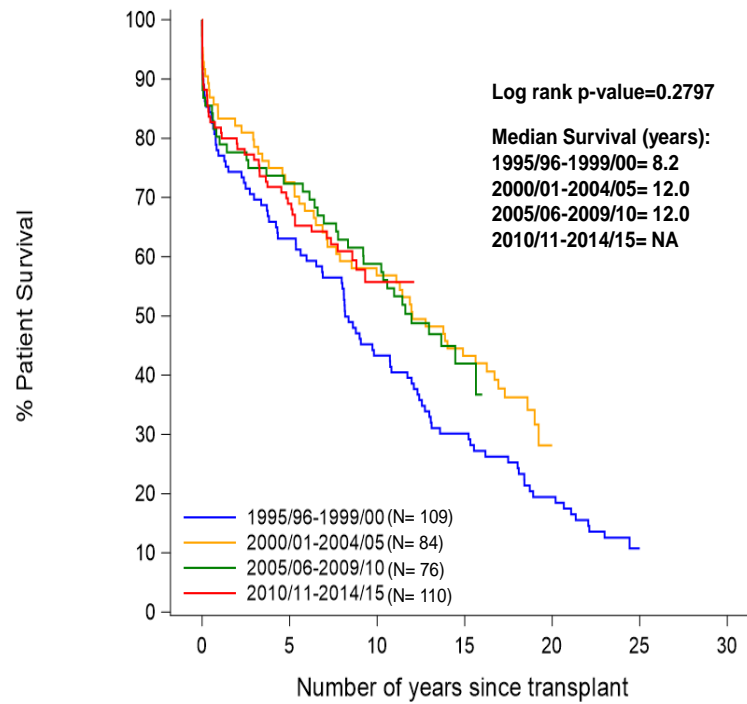
	Number at risk				
1995/96-1999/00	942	821	648	471	319
2000/01-2004/05	553	472	384	298	71
2005/06-2009/10	411	369	305	81	
2010/11-2014/15	501	420	96		

Table 1**Long-term survival rates post-heart transplant by transplant era**

Era of transplant	Number of transplants performed	10 year survival		15 year survival		20 year survival	
		%	95% CI	%	95% CI	%	95% CI
1995/96-1999/00	1182	55	52 – 58	41	38 – 43	28	25 – 30
2000/01-2004/05	675	59	55 – 62	46	42 – 50	30	26 – 34
2005/06-2009/10	496	64	59 – 68	48	43 – 53	-	-
2010/11-2014/15	616	59	55 - 63	-	-	-	-
Total	2969	58	56 - 60	44	42 - 46	29	27 - 31

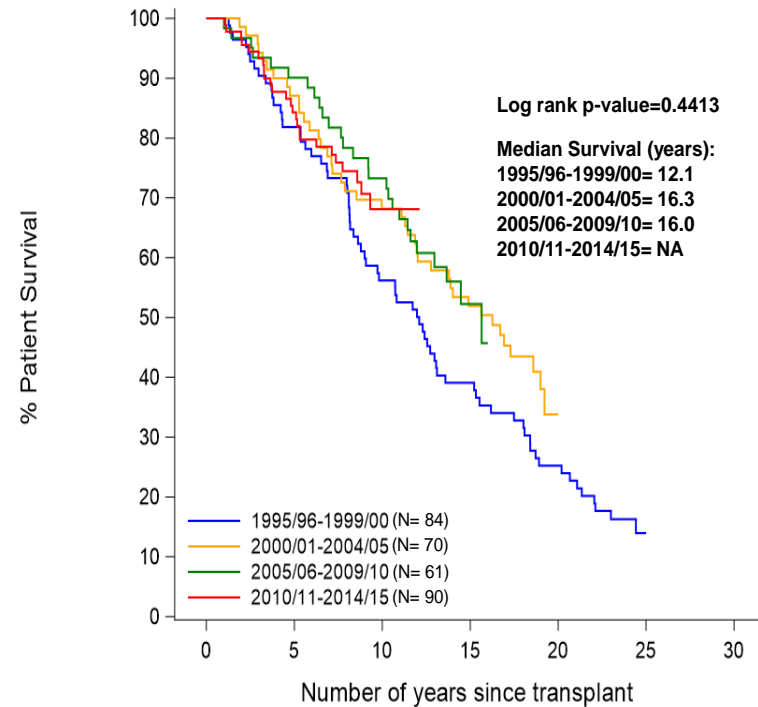
8. **Figures 3a** and **3b** through to **8a** and **8b**, show centre specific survival plots of long-term survival and conditional survival, by era.

Figure 3a Birmingham long-term patient survival post-heart transplant stratified by era, for transplants performed 1 April 1995 - 31 March 2015



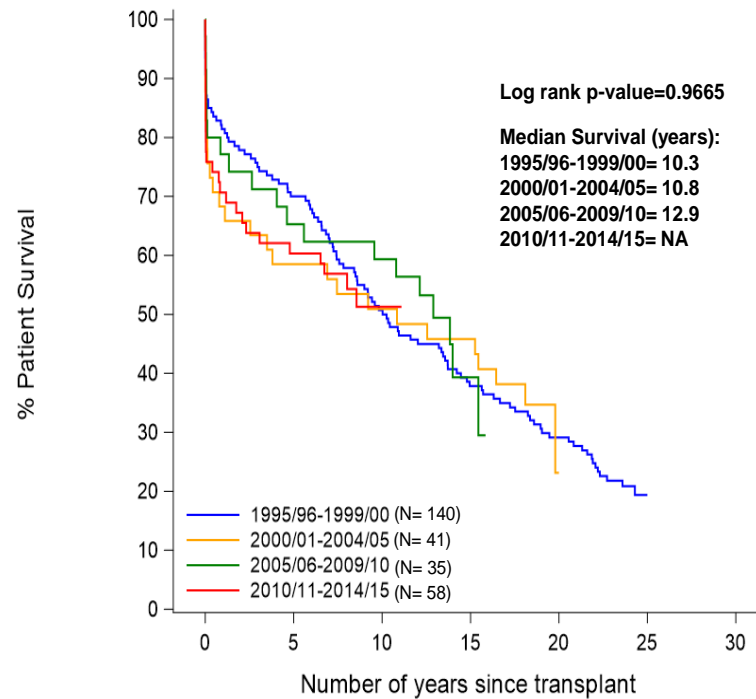
	Number at risk				
	0	5	10	15	20
1995/96-1999/00	109	67	46	32	20
2000/01-2004/05	84	60	47	35	6
2005/06-2009/10	76	54	43	11	
2010/11-2014/15	110	74	19		

Figure 3b Birmingham long-term patient survival post-heart transplant, stratified by era and conditional on surviving the first year, for transplants performed 1 April 1995 - 31 March 2015



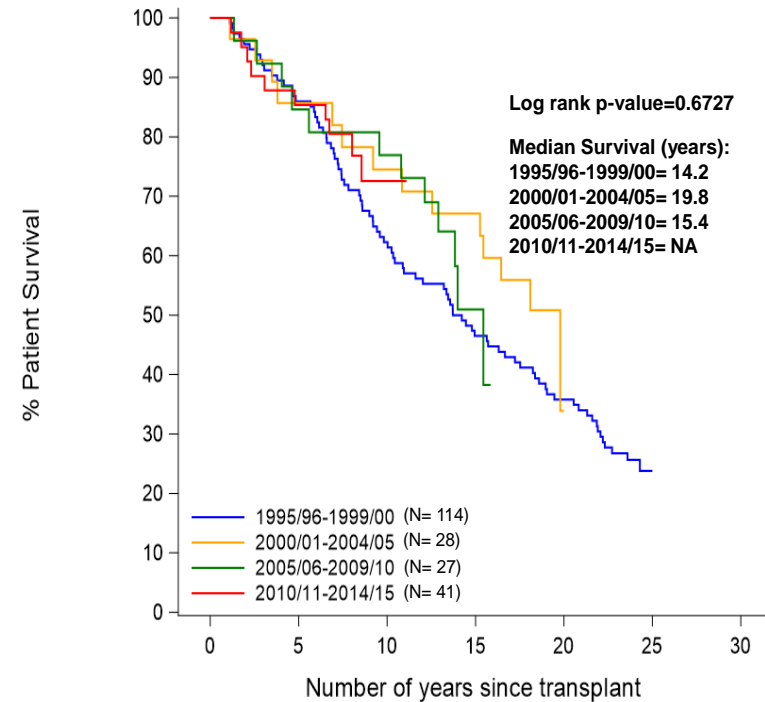
	Number at risk				
	0	5	10	15	20
1995/96-1999/00	84	67	46	32	20
2000/01-2004/05	70	60	47	35	6
2005/06-2009/10	61	54	43	11	
2010/11-2014/15	90	74	19		

Figure 4a Glasgow long-term patient survival post-heart transplant stratified by era, for transplants performed 1 April 1995 - 31 March 2015



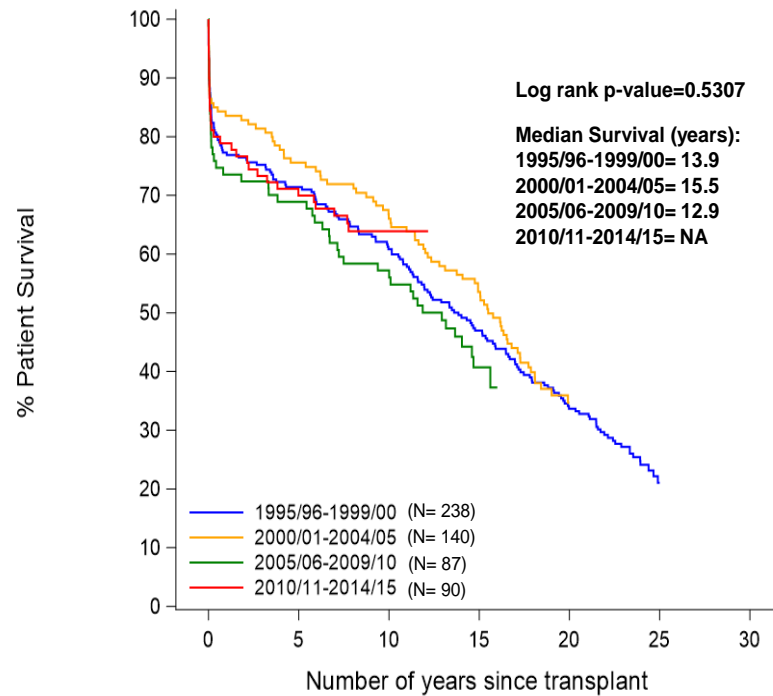
	Number at risk				
1995/96-1999/00	140	98	71	53	40
2000/01-2004/05	41	24	20	18	1
2005/06-2009/10	35	22	20	4	
2010/11-2014/15	58	35	5		

Figure 4b Glasgow long-term patient survival post-heart transplant, stratified by era and conditional on surviving the first year, for transplants performed 1 April 1995 - 31 March 2015



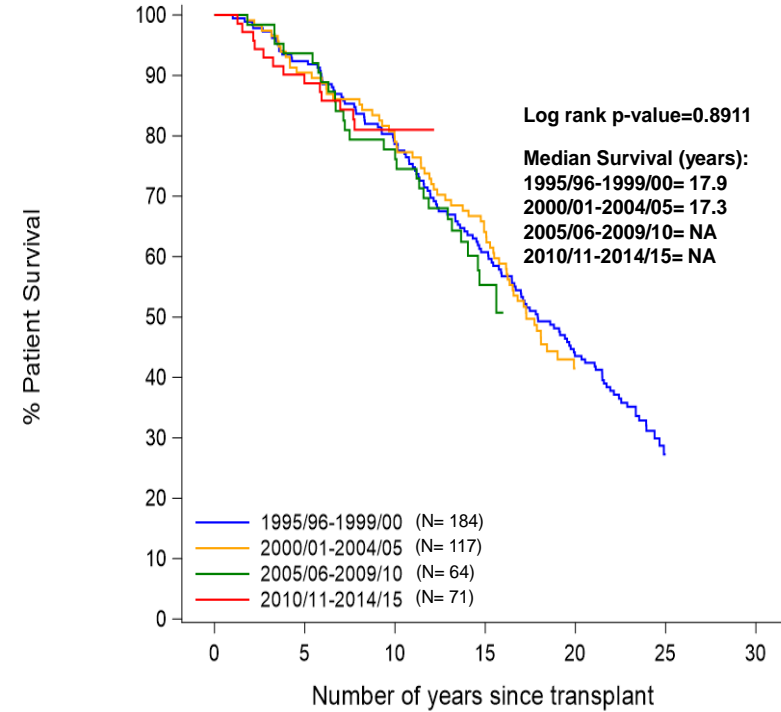
	Number at risk				
1995/96-1999/00	114	98	71	53	40
2000/01-2004/05	28	24	20	18	1
2005/06-2009/10	27	22	20	4	
2010/11-2014/15	41	35	5		

Figure 5a Harefield long-term patient survival post-heart transplant stratified by era, for transplants performed 1 April 1995 - 31 March 2015



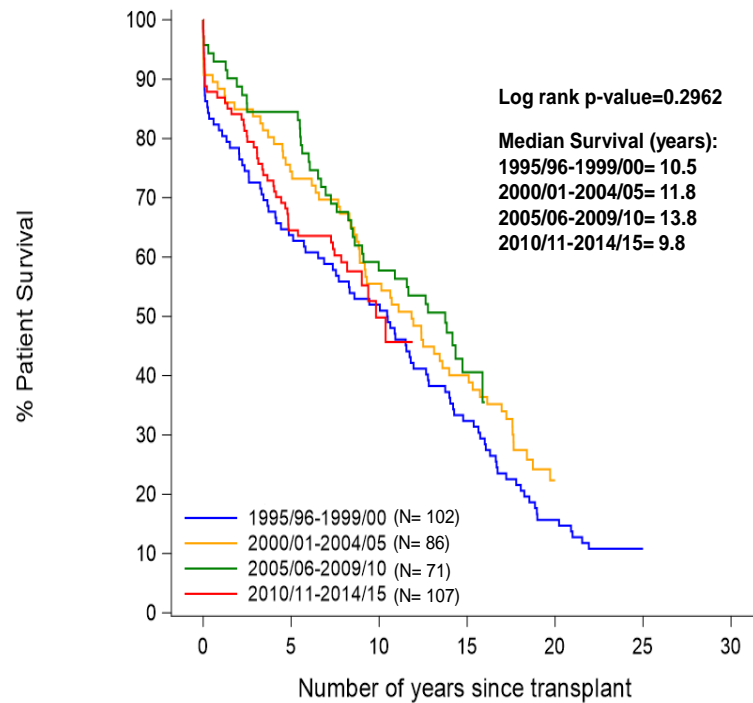
	Number at risk				
	0	5	10	15	20
1995/96-1999/00	238	170	142	107	76
2000/01-2004/05	140	103	90	73	25
2005/06-2009/10	87	59	48	16	
2010/11-2014/15	90	62	12		

Figure 5b Harefield long-term patient survival post-heart transplant, stratified by era and conditional on surviving the first year, for transplants performed 1 April 1995 - 31 March 2015



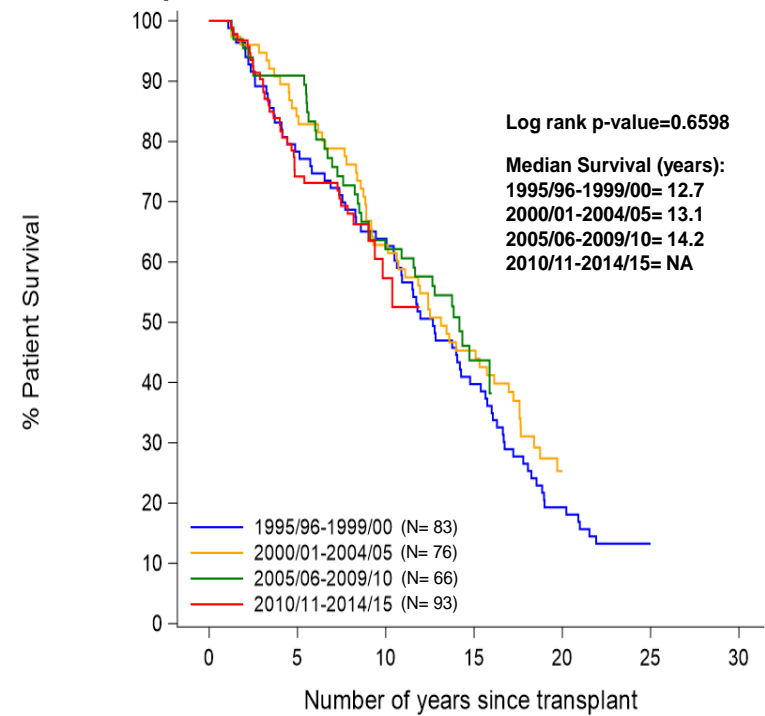
	Number at risk				
	0	5	10	15	20
1995/96-1999/00	184	170	142	107	76
2000/01-2004/05	117	103	90	73	25
2005/06-2009/10	64	59	48	16	
2010/11-2014/15	71	62	12		

Figure 6a Manchester long-term patient survival post-heart transplant stratified by era, for transplants performed 1 April 1995 - 31 March 2015



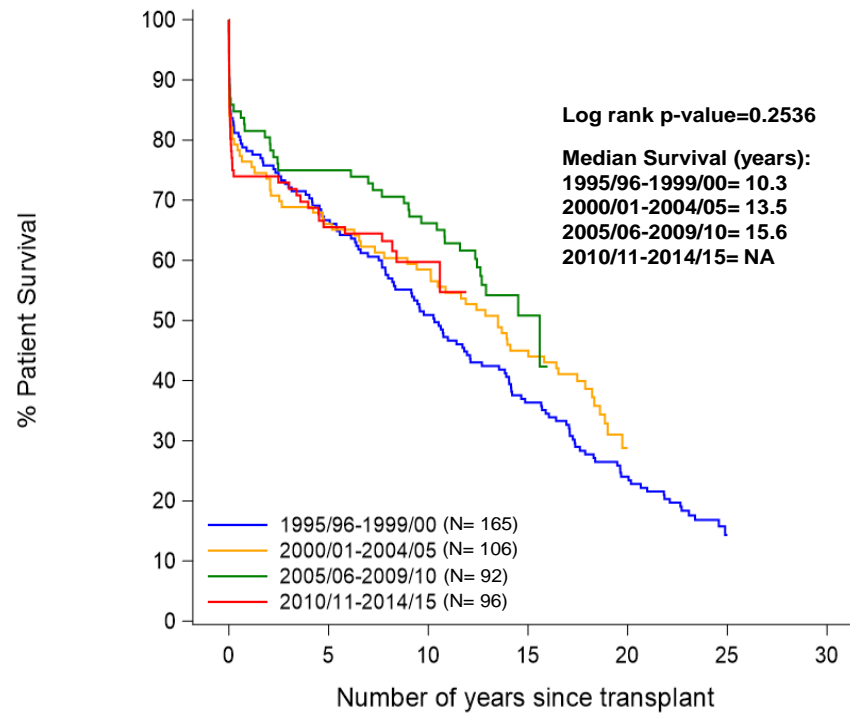
	Number at risk				
	0	5	10	15	20
1995/96-1999/00	102	65	53	33	16
2000/01-2004/05	86	63	47	33	7
2005/06-2009/10	71	60	41	12	
2010/11-2014/15	107	69	14		

Figure 6b Manchester long-term patient survival post-heart transplant, stratified by era and conditional on surviving the first year, for transplants performed 1 April 1995 - 31 March 2015



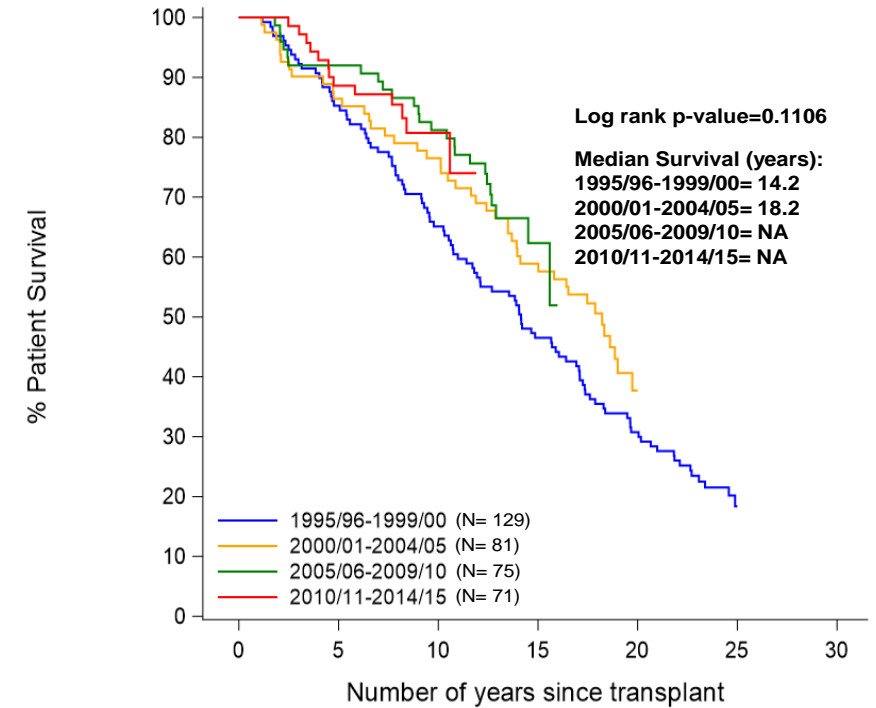
	Number at risk				
	0	5	10	15	20
1995/96-1999/00	83	65	53	33	16
2000/01-2004/05	76	63	47	33	7
2005/06-2009/10	66	60	41	12	
2010/11-2014/15	93	69	14		

Figure 7a Newcastle long-term patient survival post-heart transplant stratified by era, for transplants performed 1 April 1995 - 31 March 2015



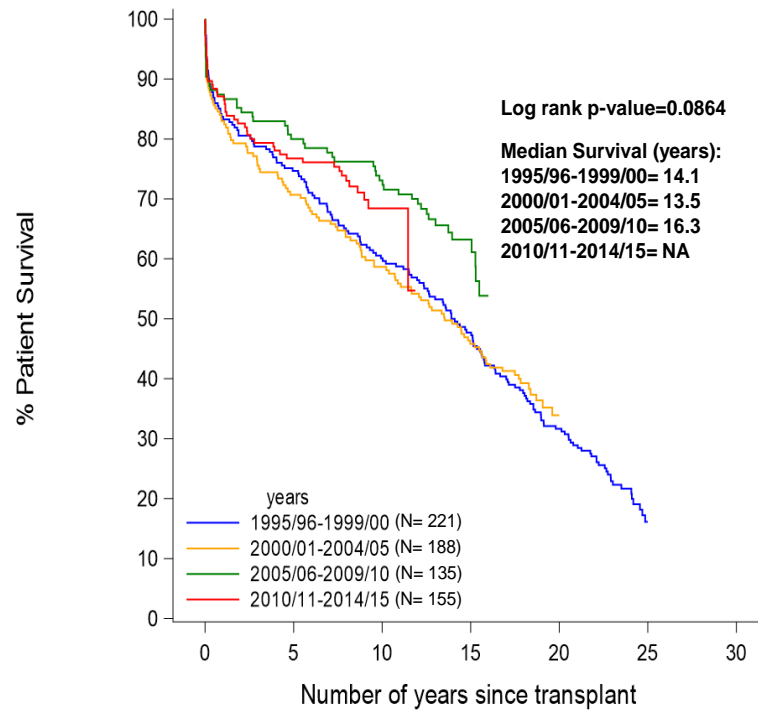
	Number at risk				
	0	5	10	15	20
1995/96-1999/00	165	110	84	59	39
2000/01-2004/05	106	70	61	46	8
2005/06-2009/10	92	68	59	6	
2010/11-2014/15	96	62	14		

Figure 7b Newcastle long-term patient survival post-heart transplant, stratified by era and conditional on surviving the first year, for transplants performed 1 April 1995 - 31 March 2015



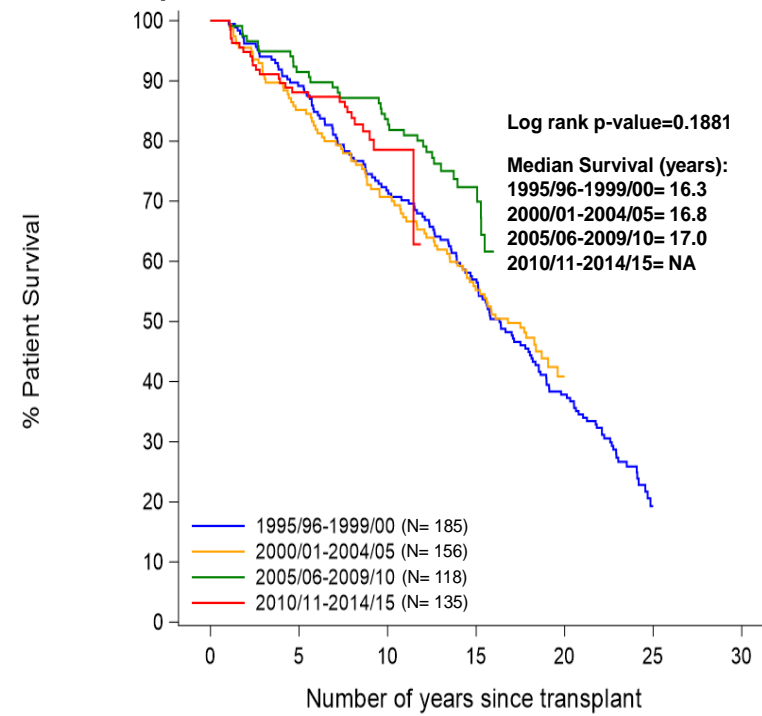
	Number at risk				
	0	5	10	15	20
1995/96-1999/00	129	110	84	59	39
2000/01-2004/05	81	70	61	46	8
2005/06-2009/10	75	68	59	6	
2010/11-2014/15	71	62	14		

Figure 8a Papworth long-term patient survival post-heart transplant stratified by era, for transplants performed 1 April 1995 - 31 March 2015



	Number at risk				
years	0	5	10	15	20
1995/96-1999/00	221	165	132	104	69
2000/01-2004/05	188	131	105	82	20
2005/06-2009/10	135	106	94	32	
2010/11-2014/15	155	118	32		

Figure 8b Papworth long-term patient survival post-heart transplant, stratified by era and conditional on surviving the first year, for transplants performed 1 April 1995 - 31 March 2015



	Number at risk				
years	0	5	10	15	20
1995/96-1999/00	185	165	132	104	69
2000/01-2004/05	156	131	105	82	20
2005/06-2009/10	118	106	94	32	
2010/11-2014/15	135	118	32		

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

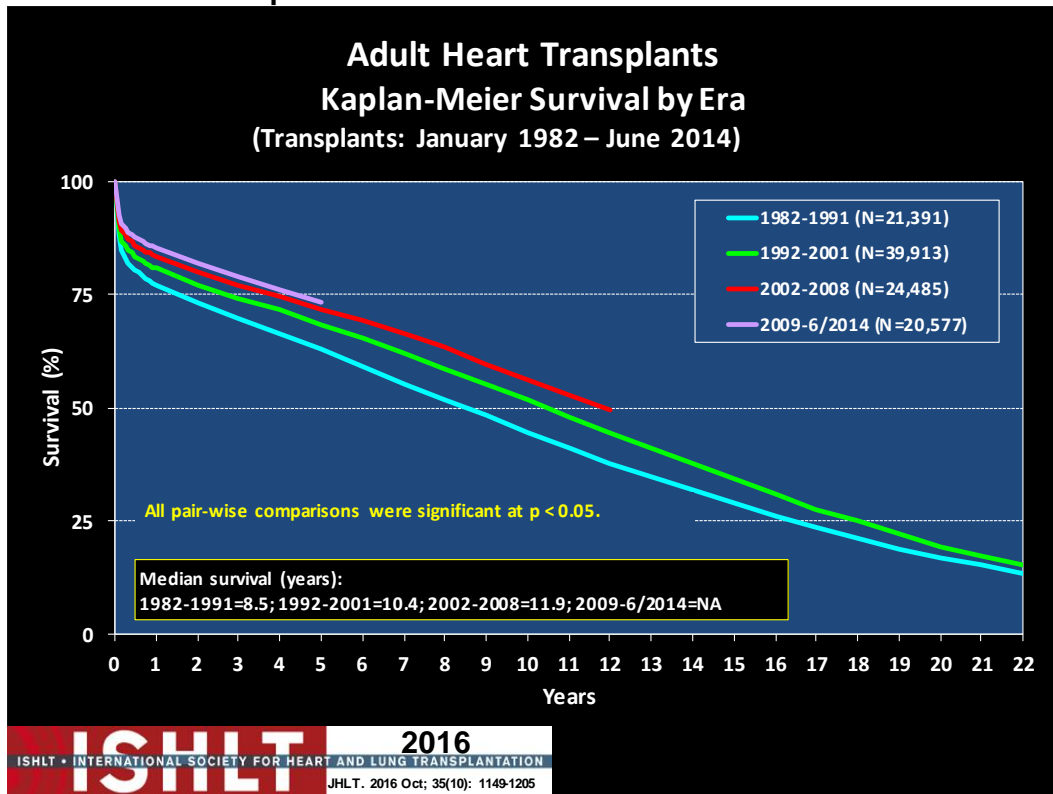
11. This analysis shows that the overall UK median survival time following adult heart transplantation is 12.9 years, but after excluding those patients who died within the first year post-transplant, the median is 15.9 years. Considering just those patients transplanted in the most recent transplant era (2005/06-2009/10), the median survival increases to 14.4 years and 16.3 years conditional on surviving the first year.
12. The International Society for Heart and Lung Transplantation report medians of 10.4 years, and 13.2 years conditional on surviving the first year, for transplants performed between 1992-2001. In a comparable transplant era, the UK estimates are 11.9 years and 15.2 years conditional on surviving the first year.
13. Centre-specific long-term survival curves, both conditional and non-conditional, are provided for interest.
14. Nationally, 78 patients survived beyond 25 years following heart transplantation.

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Statistics and Clinical Research

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APPENDIX

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



Appendix B ISHLT: Long-term survival post-heart transplant, stratified by era of transplant and conditional on surviving the first year

