Chapter 12: Survival of Incident RRT Patients in the UK

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Summary

- This analysis presents the survival of patients starting RRT in UK renal units ('centres'), and includes an analysis of survival by centre. Data from 59 of the 70 UK centres are included. This is the first year that UK centre anonymity has been removed from analysis of patient survival by centre. Survival after adjustment for co-morbidity is also reported for the first time although this analysis is restricted to those centres returning data on co-morbidity in at least 85% of incident patients.

- The importance of adjusting for co-morbidity can be seen in that for one centre, after adjustment of survival for age and diagnosis, the adjusted 1 year after 90 day survival was 84.6%. After adjusting to the average co-morbidity present across centres, survival increased to 90.4%. Improved co-morbidity data returns by renal units may require investment in informatics staff and creating structural process at renal unit level for clinicians to support these data returns.

- From the date of first RRT, the 1 year survival of all patients (unadjusted for age) is 79%. From the 90th day of RRT (to allow comparison with other countries' 1 year survival), the 1 year survival is 83%. The age adjusted (60 years) survival for the 1 year after 90 day period is 86%. There is a high death rate in the first 90 days on RRT (6% of all patients starting RRT), a period not included in reports by many registries and other studies.

- The 5 year survival (including deaths within the first 90 days) rates are 58%, 53%, 44%, 28%, 19% and 12% respectively for patients aged 18–34, 35–44, 45–54, 55–64, 65–74 and >75 years.

- The 'vintage effect' of increasing hazard of death with length of time on RRT, prominent in data from the US, is only noted in older age groups (65–75 and 75+ years) at 5–6 years after starting RRT.

- Six centres had a figure for the 1 year after 90 day survival which was outside 2 standard deviations from the mean for the UK: in three cases this was better survival, and in three, poorer survival, than expected. Poor reporting by renal units of patient co-morbidity makes interpretation of these apparent differences in patient survival between centres difficult and a relationship to clinical performance cannot yet be inferred.

Introduction

The analyses presented in this chapter examine survival from the start of renal replacement therapy (RRT), they encompass the outcomes from the total incident UK dialysis population reported to the Registry since its inception, including the 21% who start on peritoneal dialysis and the 3% who receive a pre-emptive transplant and are not censored for transplantation. The results therefore show a true reflection of the whole UK RRT population. The incident survival figures reported here are better than those reported for the UK by the iDOPPS study[1] (which only includes a haemodialysis cohort). Additionally, 1st year UK survival data includes patients that have died within the first 90 days of starting RRT, a period excluded from most other countries' registry data.

As shown in Chapters 3 and 6[2,3], patients starting haemodialysis in the UK have higher levels of co-morbidity and tend to be older than those starting RRT on PD or those pre-emptively transplanted.

The dataset includes patients from England, Scotland and Wales. Northern Ireland has only recently joined the Registry and so there is not sufficient follow-up data available to enable survival analyses to be done. Patients returning to dialysis after a failed transplant are not included in this cohort.

Many of the survival figures quoted in this chapter are from the first day of renal replacement therapy. In many instances survival from day 90 is also presented, as this allows comparison with many other registries, including the US, which record data only from day 90 onwards. The distinction is important, as there is a high death rate in the first 90 days which would distort comparisons; in many other countries, patients are not reported to the national registry or considered to have established renal failure until they have completed 90 days on RRT, whereas in the UK all patients starting RRT are included from the date of the first RRT treatment unless they recover renal function within 90 days. The UK data therefore include patients who develop acute irreversible renal failure in the context of an acute illness, for instance.

To allow comparisons between centres with differing age distributions, survival analyses are statistically adjusted for age and reported as survival adjusted to age 60. This age was chosen because it was approximately the average age of patients starting RRT 8 years ago at the start of the Registry's data collection. The average age of patients commencing RRT in the UK in 2005 is now closer to 65 years, but the Registry has maintained age adjustment to 60 years for comparability with previous years' analyses.

Survival rates in different centres contributing to the UK Renal Registry are reported here and this year, with the agreement of all UK clinical directors, centre anonymity has been removed. These are raw data that require very cautious interpretation if legitimate centre comparisons are to be attempted. The Registry can adjust for the effects of the different age distributions of the patients in different centres, but lacks sufficient data from many participating centres to enable adjustment for co-morbidity and ethnic origin, which have been demonstrated to have a major impact on outcome. With this lack of information on case mix, it is difficult to interpret any apparent difference in survival between centres. Using data only from those centres with greater than 85% complete data returns on co-morbidity, an analysis has been undertaken to highlight the impact of changes in estimates of survival rates by centre after adjusting for age, primary renal diagnosis and co-morbidity. It is hoped this will encourage all centres to allocate the resources to return the co-morbidity data.

Despite the uncertainty about any apparent differences in outcome for centres which appear to be outliers, the Registry will follow the clinical governance procedures as set out in Chapter 2.

Statistical methodology

The take-on population in a year included patients who recover from ERF after 90 days from the start of RRT, but excludes those that recover within 90 days. Patients newly transferred into a centre who were already on RRT were **excluded** from the take-on population for that centre. Patients restarting dialysis after a failed transplant were also excluded (unless they started RRT in that current year).

Patients who started treatment at a centre and then transferred out soon after starting RRT treatment were counted at the original centre.

For patients who recovered renal function for a period of time and then went back into ERF, the length of time on RRT was calculated from the day on which the patient re-started RRT. If recovery was for less than 90 days, the start of renal replacement therapy was calculated from the date of the first episode and the recovery period ignored.

Patients who transferred out of their initial treatment centre were censored on the day they transferred out if there was no further information in the timeline.

The one year incident survival for patients in 2004 were for those who had all been followed for 1 full year through 2005. The 2005 incident patients were excluded from this year's incident

survival analysis as they had not been followed for a sufficient length of time.

For analysis of 1 year after 90 day survival, patients who started RRT in October through December 2004, were censored in the analysis, as 2006 data on these patients were not yet available. Analyses in previous UK Registry Reports have used the previous year's patient cohort (eg 2003) starting October. A comparison of these two methods has shown no difference between them for any but the smallest centres (who will have wide 95% confidence intervals), so for simplicity of understanding the cohort the Registry will now use, will be the previous year's data with censoring.

Adjustment of 1 year after 90 day survival for co-morbidity was undertaken using the combined incident cohort from 2000–2004. Twelve centres had returned >85% of co-morbidity data for patients. Adjustment was first performed to a mean age of 60 years, then to the average primary diagnosis mix for all the 12 centres. The individual centre data were then further adjusted for average co-morbidity mix present at these centres.

Survival of new patients on RRT

Comparison with Audit Standards

The 2002 UK Renal Standards document (www.renal.org) concluded that:

It is hard to set survival standards at present because these should be age, gender and co-morbidity adjusted and this is not yet possible from Registry data. The last Standards document (1998) recommended at least 90% one year survival for patients aged 18–55 years with standard primary renal disease. This may have been too low as the rate in participating centres in the Registry was 97%, though numbers were small.

Table 12.1: One-year patient survival, patients aged 18–54, 2004 cohort

First treatment	Standard primary renal disease	All primary renal diseases except diabetes
All %	95.7	94.3
95% CI	*94.3–97.1*	*92.9–95.6*
HD %	94.1	92.6
95% CI	*92.1–96.1*	*90.7–94.5*
PD %	98.6	97.6
95% CI	*97.2–99.9*	*96.1–99.1*

The Renal Standards document defines Standard Primary Renal Disease using the EDTA-ERA diagnosis codes (including only codes 0–49), this excludes patients with renal disease due to diabetes and other systemic diseases. It is more widespread practice to simply exclude patients with diabetes, so these figures are included in this report to allow comparison with reports from other registries. The results are shown in Table 12.1 and are similar to the previous year.

Between country

Two years incident data have been combined to increase the size of the patient cohort, so that any differences between the three UK countries are more likely to be identified (Table 12.2). These data have not been adjusted for primary renal diagnosis, ethnicity or comorbidity.

Modality

The age-adjusted one year survival estimates on HD and PD are 85.3% and 90.2% respectively with the improvement in HD survival from 2002 to 2003 appearing to have been maintained. There appears to be better survival on

Table 12.2: Incident patient percentage survival across the UK, combined 2 year cohort (2003–2004), adjusted to age 60

	England	Wales	Scotland	UK
% 90 day	93.7	93.4	93.8	93.7
95% CI	*92.9–94.5*	*91.3–95.5*	*92.1–95.5*	*92.9–94.5*
% 1 year after 90 days	87.2	85.1	83.6	86.6
95% CI	*86.1–88.4*	*81.6–88.7*	*80.6–86.7*	*85.5–87.8*

Table 12.3: One-year after day 90 survival by first established treatment modality (adjusted to age 60)

Year		HD	PD
2004	Adjusted 1 year after 90 days %	85.3	90.2
	95% CI	*83.9–86.6*	*88.6–92.0*
2003	Adjusted 1 year after 90 days %	85.7	92.5
	95% CI	*84.3–87.2*	*90.9–94.1*
2002	Adjusted 1 year after 90 days %	83.8	89.6
	95% CI	*82.0–85.5*	*87.6–91.7*

PD compared with HD (Table 12.3) after age adjustment, similar to data from the USRDS and Australasian (ANZDATA) Registries. However, a straightforward comparison of the modalities in this way is not valid, as there are significant factors in selection for the modalities and the patients in the two groups are not comparable[2,3].

Age

Tables 12.4 to 12.9 show survival of all patients and those above and below 65 years of age, for up to eight years after initiation of renal replacement therapy. The UK data show a steep age related decline in survival over all time periods (see also Figures 12.1, 12.2).

If the survival data in Tables 12.7 to 12.9 are calculated from day 90 (1 year after day 90 survival, 2 year after day 90 survival, etc) the survival in all cases increases by an additional 3–4% across both age bands. These are the results most comparable to the figures quoted by the USRDS from the USA and most other national registries[4,5] (see Chapter 17 on international comparisons).

Table 12.4: Unadjusted 90 day survival of new patients, 2004 cohort, by age

Age	KM* survival (%)	KM 95% CI	N
18–64	96.3	95.6–97.1	2,653
⩾65	85.5	84.2–86.8	2,707
All ages	90.8	90.1–91.6	5,360

*KM = Kaplan-Meier.

Table 12.5: Unadjusted 1 year after day 90 survival of new patients, 2004 cohort, by age

Age	KM survival (%)	KM 95% CI	N
18–64	90.8	89.7–92.0	2,533
⩾65	75.1	73.3–77.0	2,298
All ages	83.4	82.3–84.4	4,831

Table 12.6: Increase in proportional hazard of death for each 10 year increase in age, at 90 days and for 1 year thereafter

Interval	Hazard of death for 10 year age increase	95% CI
First 90 days	1.58	1.50–1.66
1 year after first 90 days	1.47	1.41–1.53

The 8-year KM survival from the start of renal replacement therapy (from day 0) is shown in Figure 12.2. The 5 year survival (including deaths within the first 90 days) is 58%, 53%, 44%, 28%, 19% and 12% respectively for patients aged 18–34, 35–44, 45–54, 55–64, 65–74 and >75 years.

It should be noted that any 50% life expectancy estimates obtained from this graph will include diabetic patients. Also, if these estimates were to be compared with other countries, deaths in the first 3 months should be excluded and this would add approximately 6 months to the average life expectancy figures. It is also important to remember that the Figure shows survival from the start of renal replacement therapy and so cannot be used for example, to estimate the life expectancy of a patient aged 50 who has been on dialysis for 10 years.

When the monthly hazard of death (for the following month) is analysed by age (Figure 12.3), a rapid fall in monthly hazard of death is seen in the first 3–4 months specifically in the older age groups.

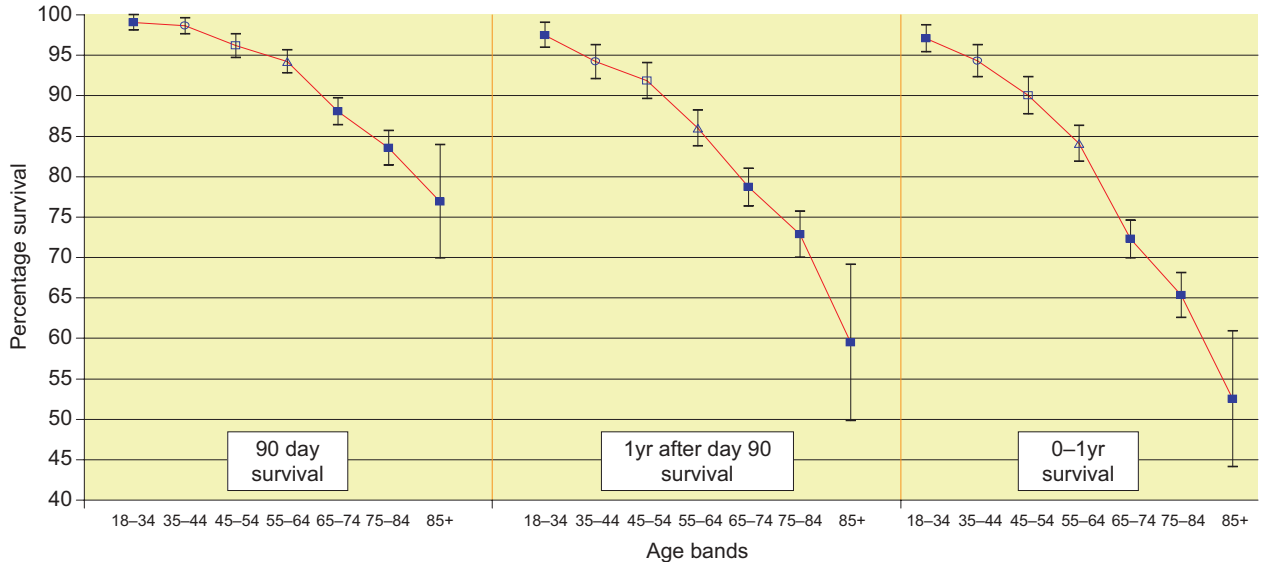

Figure 12.1: Unadjusted survival of all incident patients 2004 by age band

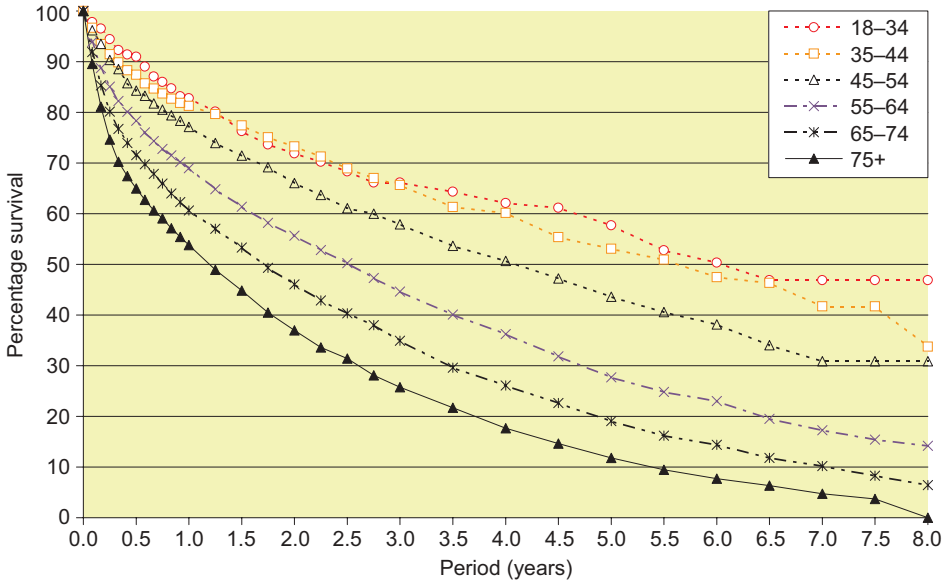

Figure 12.2: Kaplan-Meier 8-year survival of incident patients 1997–2004 cohort (from day 0)

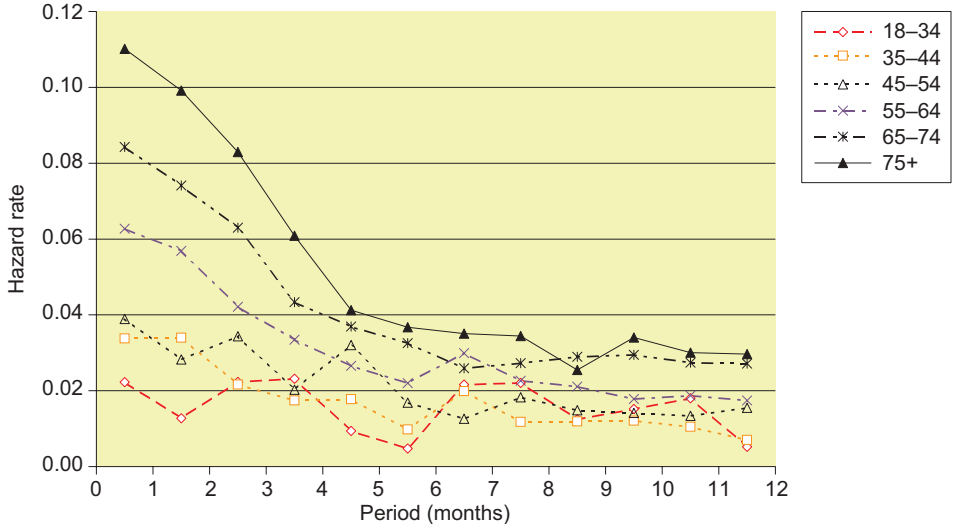

Figure 12.3: 1st-year monthly hazard of death, by age band 1997–2004 cohort

Table 12.7: Unadjusted KM survival of new patients 1997–2004 cohort for patients aged 18–64

Cohort	1 year	2 year	3 year	4 year	5 year	6 year	7 year	8 year	95% CI for last available year	N
2004	89.5	–	–	–	–	–	–	–	88.3–90.7	2,653
2003	89.1	81.9	–	–	–	–	–	–	80.3–83.4	2,361
2002	88.2	81.0	75.5	–	–	–	–	–	73.6–77.4	2,079
2001	87.4	79.8	74.1	68.5	–	–	–	–	66.4–70.7	1,866
2000	89.4	81.7	75.1	70.3	65.1	–	–	–	62.7–67.4	1,578
1999	87.6	81.3	73.9	67.9	62.9	58.8	–	–	56.1–61.4	1,350
1998	86.7	79.4	72.8	67.6	61.2	56.2	52.3	–	49.5–55.1	1,286
1997	85.9	78.2	70.9	65.3	60.2	55.3	52.0	50.0	46.5–53.5	793

Table 12.8: Unadjusted KM survival of new patients 1997–2004 cohort for patients aged >65

Cohort	1 year	2 year	3 year	4 year	5 year	6 year	7 year	8 year	95% CI for last available year	N
2004	68.1	–	–	–	–	–	–	–	66.4–69.9	2,707
2003	68.4	52.6	–	–	–	–	–	–	50.6–54.7	2,362
2002	65.5	50.4	39.8	–	–	–	–	–	37.7–41.8	2,174
2001	67.1	51.8	39.5	30.5	–	–	–	–	28.4–32.6	1,871
2000	66.8	53.2	39.9	28.8	22.6	–	–	–	20.5–24.7	1,514
1999	66.1	50.5	38.3	28.8	21.4	15.0	–	–	13.1–17.0	1,272
1998	63.9	46.9	36.3	27.4	20.6	14.8	10.6	–	8.8–12.4	1,140
1997	63.8	46.1	33.3	23.9	16.6	11.8	8.1	6.2	4.2–8.2	583

Table 12.9: Unadjusted survival of new patients 1997–2004 cohort for patients of all ages

Cohort	1 year	2 year	3 year	4 year	5 year	6 year	7 year	8 year	95% CI for last available year	N
2004	78.7	–	–	–	–	–	–	–	77.6–79.8	5,360
2003	78.7	67.2	–	–	–	–	–	–	65.8–68.5	4,723
2002	76.5	65.3	57.1	–	–	–	–	–	55.6–58.6	4,253
2001	77.2	65.8	56.7	49.4	–	–	–	–	47.8–51.1	3,737
2000	78.3	67.7	57.9	50.1	44.3	–	–	–	42.5–46.1	3,092
1999	77.2	66.3	56.6	48.9	42.8	37.6	–	–	35.7–39.4	2,622
1998	76.0	64.1	55.7	48.7	42.1	36.8	32.7	–	30.8–34.5	2,426
1997	76.6	64.7	55.0	47.8	41.8	36.9	33.5	31.5	29.0–33.9	1,376

Table 12.6 demonstrates that the age related increase in hazard of death is different between the two time periods.

It should be noted that the data in Tables 12.7 to 12.9 are not adjusted for age. The median age of incident patients has increased over the period 1997–2004 and so an apparent decrease in patient survival could have been expected.

Change in survival on renal replacement therapy by vintage

Data from the USA[4] (USRDS Report 2006) has demonstrated a worsening prognosis on renal replacement therapy with increase in years on dialysis (vintage) and this effect has not been demonstrated in previous analyses of UK data[6].

Survival analysis of younger patients that have been censored at the time of transplantation, censors out those with better prognosis, leaving a biased subgroup of patients on dialysis. The analysis has therefore not been censored at transplantation.

The hazard of death was calculated for 6 monthly periods as the hazard at the mid point within that time period. The first 3 month period has been excluded from this analysis.

Analysis of patients in older age groups (65–75 and 75+ years) shows an increasing 6 monthly hazard of death at 5–6 years after starting renal replacement therapy (Figure 12.4). This contrasts with data from the USA where this increasing hazard is seen beyond 2 years for all age groups. Previous Registry analyses have demonstrated that survival on RRT in the UK is better than in the USA[7] across all age ranges even though there are similar rates of co-morbidity[8]. The reasons for this are unknown, but may also partly explain why there are also differences seen in the effect of vintage.

Analysis of the same data after excluding diabetic patients shows an even clearer trend (Figure 12.5). Figure 12.6 for diabetic patients shows no vintage effect and this may be related to the higher risk of death in this group of patients, overwhelming small changes from a vintage effect.

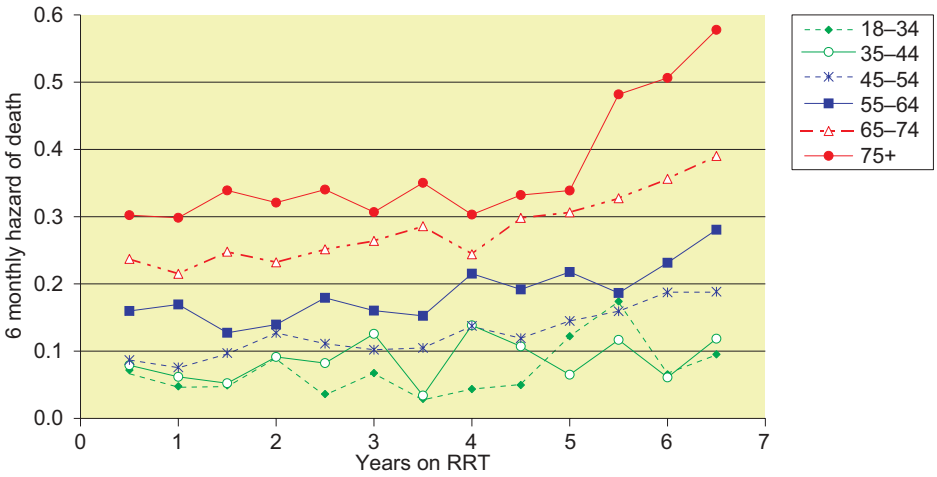

Figure 12.4: Six monthly hazard of death, by vintage and age band, 1997–2004 incident cohort after day 90

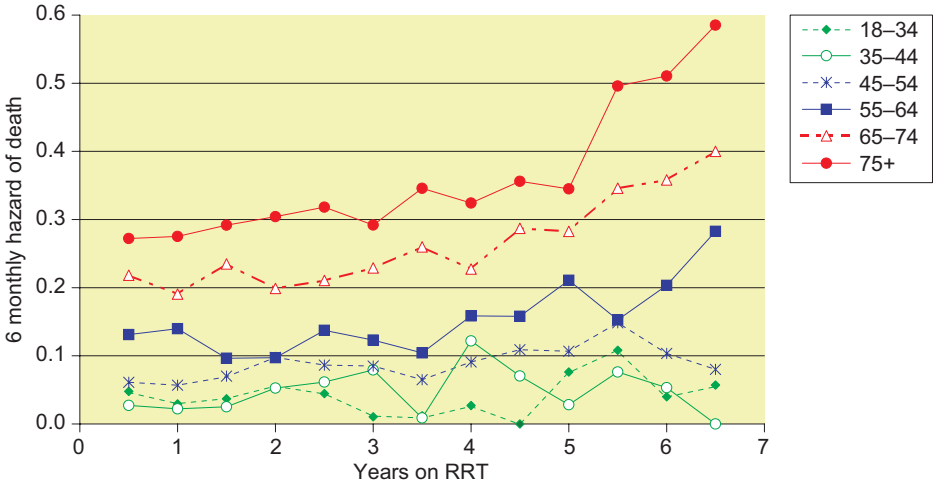

Figure 12.5: Six monthly hazard of death, by vintage and age band, 1997–2004 non-diabetic incident cohort

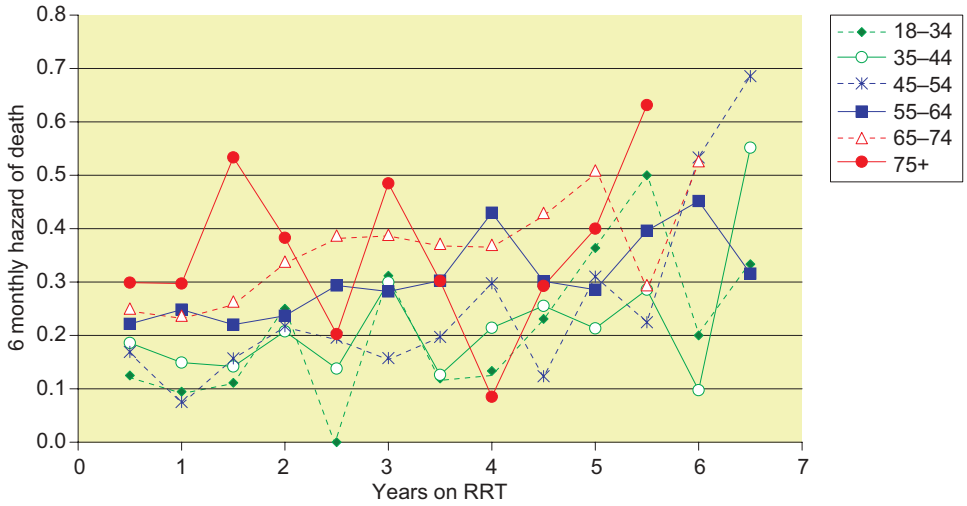

Figure 12.6: Six monthly hazard of death, by vintage and age band, 1997–2004 diabetic incident cohort

Time trend changes in incident patient survival, 1999–2004

Figure 12.7 shows the change over 5 years in incident patient survival. As the Registry does not currently cover the whole of the UK, any improvement in survival could be confounded by the effect of newer centres with lower mortality, reporting data for the first time. To allow for this, the left hand graph shows survival for the original 1999 Registry sites, which very closely follow the 'all sites' UK change in survival. This also indicates that the 1999 Registry data was very representative of the UK as a whole. All previous UK Registry reports have compared survival using the much smaller 1997 cohort.

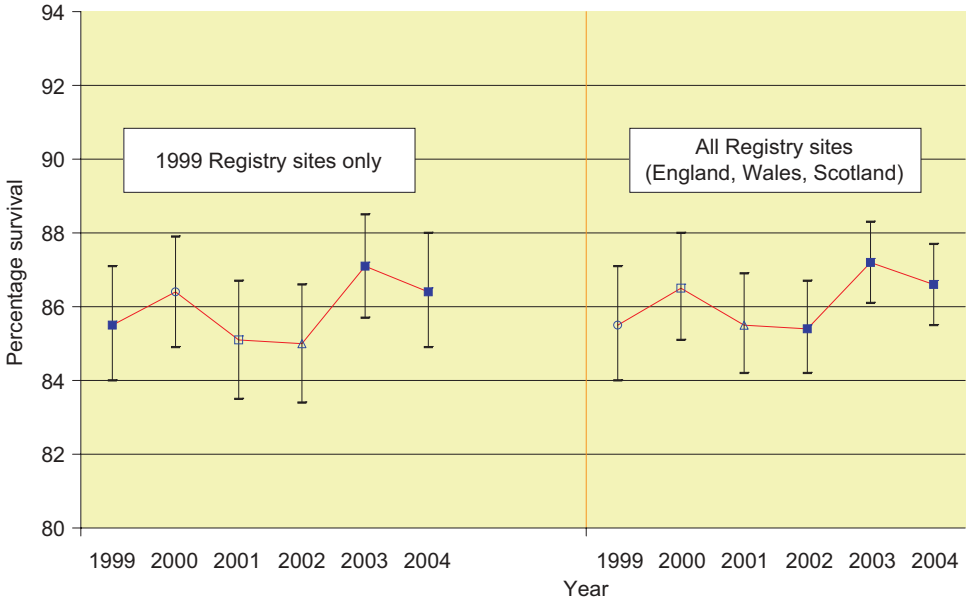

Figure 12.7: Change in one-year after 90 day adjusted (age 60) survival, 1999–2004
Showing 95% confidence intervals

Analysis of centre variability in 1 year after 90 days survival

The one year after 90 day survival for the 2004 incident cohort is shown in Figure 12.8 for each renal unit. The tables for these data and for 90 day survival are in Appendix 1 at the end of this chapter (Tables 12.12 and 12.13).

In the analysis of 2004 survival data, some of the smaller centres have wide confidence intervals (Figure 12.8). This can be addressed by including a larger cohort, from all patients starting RRT 2001–2004, which also assesses sustained performance. A few centres have been contributing data to the Renal Registry for only part of this period so will have fewer years included. The survival results are shown for this larger cohort, using funnel plots to identify possible outliers (Figure 12.9). From Figure 12.9, for any size of incident cohort (X axis) one can identify whether any given survival rate

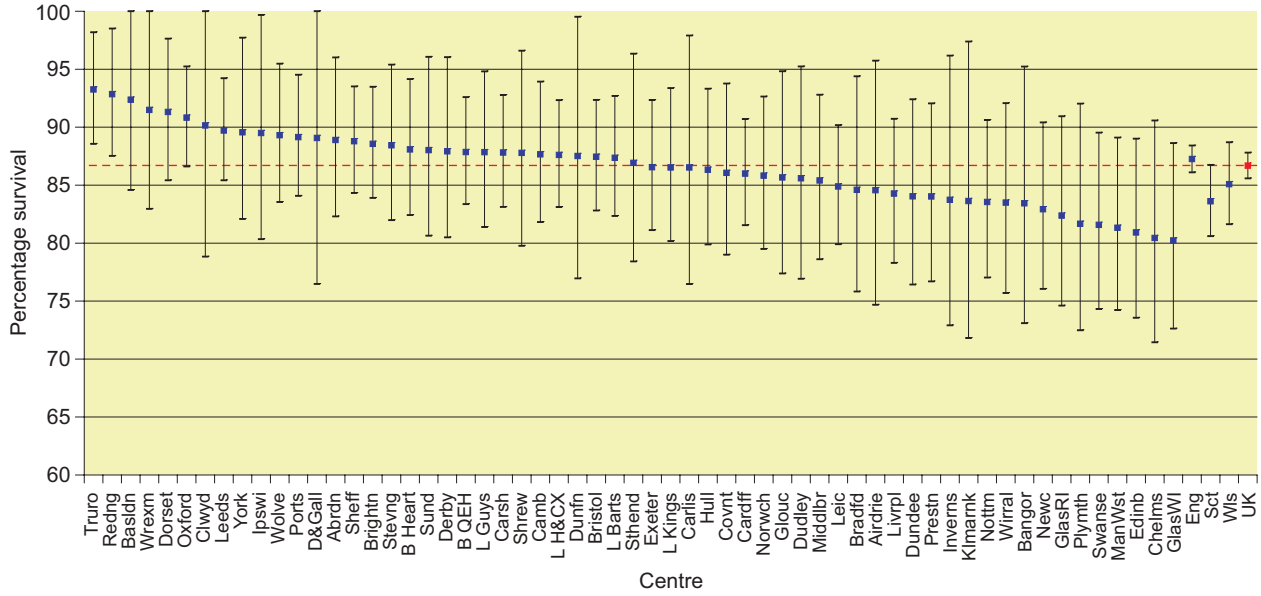

Figure 12.8: Survival one-year after 90 days, adjusted to age 60, 2004 cohort

Showing 95% confidence intervals

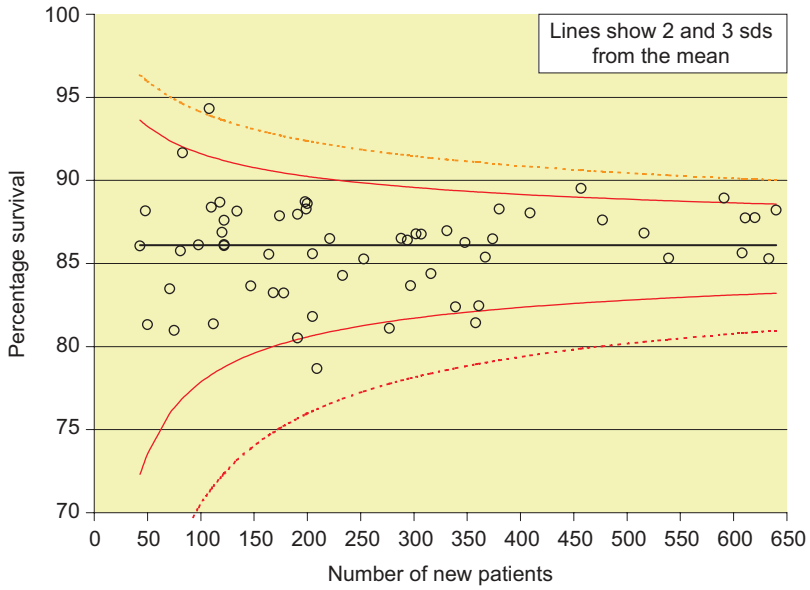

Figure 12.9: Funnel plot for age adjusted 1 year after 90 days survival; 2001–2004 cohorts

(patients who died within the first 90 days have been excluded)

From 2000, the Glasgow Western Infirmary and Glasgow Royal Infirmary have been a single NHS Trust operating on two sites. To date, statistics from these units have been reported separately. The 1-year after day 90 survival rate for the combined Glasgow units (n = 655) was 82.5%

Table 12.10: Adjusted 1 year after 90 day survival 2001–2004

Centre	No of incident pts	1 year after 90 day survival	Centre	No of incident pts	1 year after 90 day survival
Abrdn	199	88.3	Klmarnk	122	86.1
Airdrie	205	81.8	L Barts	174	87.9
B Heart	294	86.4	L Guys	409	88.0
B QEH	191	88.0	L H&CX	457	89.5
Bangor	71	83.5	L Kings	307	86.8
Basldn	83	91.7	Leeds	640	88.2
Bradfd	221	86.5	Leic	620	87.8
Brightn	118	88.7	Livrpl	539	85.3
Bristol	516	86.8	ManWst	233	84.3
Camb	331	87.0	Middlbr	339	82.4
Cardff	633	85.3	Newc	253	85.3
Carlis	98	86.1	Norwch	81	85.8
Carsh	608	85.6	Nottm	374	86.5
Chelms	50	81.3	Oxford	611	87.7
Clwyd	43	86.1	Plymth	209	78.7
Covnt	288	86.5	Ports	477	87.6
D&Gall	75	81.0	Prestn	367	85.4
Derby	164	85.6	Redng	198	88.7
Dorset	110	88.4	Sheff	591	88.9
Dudley	134	88.2	Shrew	48	88.2
Dundee	205	85.6	Stevng	380	88.3
Dunfn	112	81.4	Sthend	122	86.1
Edinb	277	81.1	Sund	191	80.5
Exeter	348	86.3	Swanse	361	82.5
GlasRI	297	83.7	Truro	200	88.6
GlasWI	358	81.4	Wirral	147	83.7
Glouc	178	83.2	Wolve	316	84.4
Hull	302	86.8	Wrexm	122	87.6
Inverns	120	86.9	York	168	83.2
Ipswi	108	94.3			

(Y axis) falls within plus or minus 2 standard deviations (SDs) from the national mean (solid lines, 95% confidence interval) or 3 standard deviations (dotted lines, 99.8% confidence interval). Table 12.10 helps centres to identify themselves on this graph by finding their number of patients and then looking up this number on the X axis. There are 3 centres that fall between 2–3 sds below average (Plymouth, Glasgow Western and Edinburgh), one centre outside 3 sds above average (Ipswich) and 2 other centres between 2–3 sds above average (Sheffield and Hammersmith & Charing Cross). These data have not been adjusted for any patient related factor except age (not co-morbidity or primary renal disease or ethnicity) with both Plymouth and the Scottish centres returning no data on co-morbidity. There is no censoring at transplantation, so the effect of differing unit rates of transplantation is not taken into account.

As discussed in an earlier Report[8], the general population of Scotland is known to have more ill health than England & Wales, reflected in 16% higher all cause mortality[9] and particularly cardio-vascular disease mortality[10,11,13]. Table 12.11 below shows differences in life expectancy between the UK countries[12]. Thus a slightly higher dialysis mortality in Scotland may reflect the increased mortality in the population from which the dialysis patients are drawn. This emphasises the need to consider the characteristics of the general population from which patients come when considering or comparing outcomes of treatment.

Table 12.11: Life expectancy 2003–2005 in UK countries (source ONS)

	At Birth		At age 65	
	Male	Female	Male	Female
England	76.9	81.2	16.8	19.6
Wales	76.3	80.7	16.4	19.2
Scotland	74.2	79.3	15.5	18.4
Northern Ireland	76.0	80.8	16.4	19.3
UK	76.6	81.0	16.6	19.4

Analysis of the impact of adjustment for co-morbidity on the 1 year after 90 day survival

Co-morbidity returns to the Registry have been slowly increasing (Chapter 6). With the de-anonymisation of centre names in this Report, it is essential to show what the importance is of adjusting patient survival for co-morbidity.

Using the combined incident cohort from 2000–2004, 12 centres had returned co-morbidity data for more than 85% of patients. Adjustment was first performed to age 60, then to the average primary diagnosis mix for all the 12 centres. Further adjustment was then made to the average co-morbidity mix present at these centres (Figure 12.10).

The importance of adjusting for co-morbidity can be seen for Swansea. After adjustment of survival for age and diagnosis, the 1 year after 90 day survival increased from 77% to 84.6%; after adjusting to the average co-morbidity present in the 12 centres, survival increased to 90.4%. This indicates that patients starting RRT at the Swansea renal unit have more co-morbidities present than average for E&W. This contrasts with Wolverhampton where there is little change (85.5% to 85.6%). In both Dorset and Chelmsford the adjusted survival falls indicating that patients at these centres have fewer co-morbidities present.

This highlights the importance of improving co-morbidity returns to the Renal Registry.

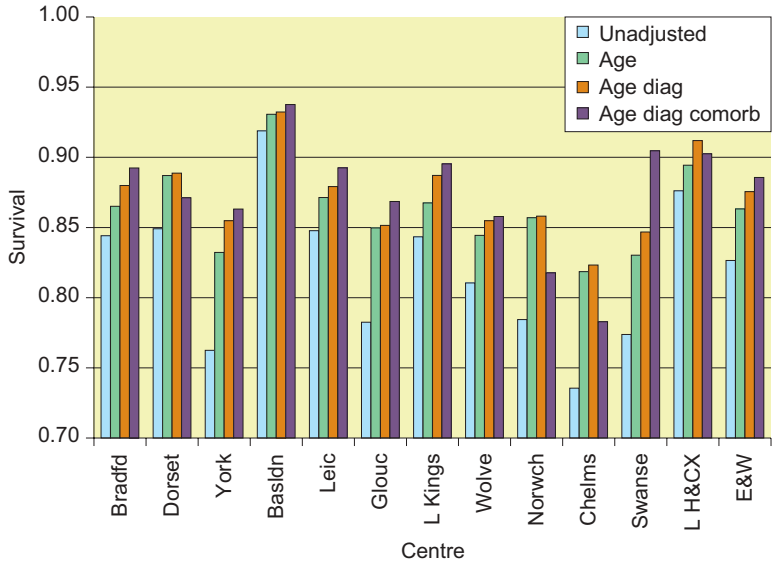

Figure 12.10: Change in 1 year after 90 day survival after adjustment for age, diagnosis and co-morbidity

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Appendix 1: Survival tables

Table 12.12: 1 year after 90-day survival by centre for 2004 unadjusted and adjusted to age 60

Centre	Unadjusted 1yr + 90d survival	Adjusted 1yr + 90d survival	Adjusted 1yr + 90d 95% CI
Abrdn	85.0	88.9	82.3–96.0
Airdrie	83.3	84.6	74.7–95.7
B Heart	83.3	88.1	82.4–94.1
B QEH	86.5	87.9	83.4–92.6
Bangor	74.4	83.4	73.1–95.2
Basldn	91.4	92.4	84.6–100
Bradfd	82.1	84.6	75.8–94.4
Brightn	82.5	88.6	83.9–93.5
Bristol	83.0	87.5	82.8–92.4
Camb	85.9	87.7	81.8–93.9
Cardff	81.3	86.0	81.5–90.7
Carlis	82.1	86.5	76.5–97.9
Carsh	85.4	87.8	83.1–92.8
Chelms	71.7	80.4	71.4–90.6
Clwyd	83.3	90.2	78.8–100
Covnt	83.1	86.1	79.0–93.8
D&Gall	85.7	89.1	76.5–100
Derby	85.4	87.9	80.5–96.0
Dorset	87.4	91.3	85.4–97.6
Dudley	82.9	85.6	76.9–95.2
Dundee	76.3	84.0	76.4–92.4
Dunfn	84.3	87.5	77.0–99.5
Edinb	78.5	80.9	73.6–89.0
Exeter	79.3	86.6	81.1–92.3
GlasRI	77.9	82.4	74.6–90.9
GlasWI	78.2	80.2	72.6–88.6
Glouc	78.1	85.7	77.4–94.8
Hull	81.6	86.3	79.9–93.3
Inverns	81.8	83.7	72.9–96.2
Ipswi	87.2	89.5	80.3–99.7
Klmarnk	79.2	83.6	71.8–97.4
L Barts	88.0	87.4	82.3–92.7
L Guys	88.4	87.8	81.4–94.8
L H&CX	84.8	87.6	83.1–92.3
L Kings	85.2	86.5	80.2–93.4
Leeds	87.3	89.7	85.4–94.2
Leic	81.3	84.9	79.9–90.2
Livrpl	83.0	84.3	78.3–90.7
ManWst	80.0	81.3	74.2–89.1
Middlbr	82.8	85.4	78.6–92.8
Newc	80.8	82.9	76.1–90.4
Norwch	78.1	85.8	79.5–92.6
Nottm	78.6	83.6	77.0–90.6
Oxford	89.1	90.8	86.6–95.2
Plymth	76.1	81.7	72.5–92.0
Ports	85.9	89.1	84.1–94.5
Prestn	80.7	84.0	76.7–92.1
Redng	91.0	92.9	87.5–98.5
Sheff	86.0	88.8	84.3–93.5
Shrew	84.0	87.8	79.8–96.6
Stevng	86.7	88.4	82.0–95.4
Sthend	79.4	86.9	78.4–96.3
Sund	83.7	88.0	80.6–96.1
Swanse	73.6	81.6	74.3–89.5
Truro	89.3	93.3	88.6–98.2
Wirral	78.5	83.5	75.7–92.1
Wolve	86.6	89.3	83.6–95.5
Wrexm	88.0	91.5	83.0–100
York	83.8	89.6	82.1–97.7
Eng	**84.1**	**87.3**	**86.1–88.4**
Scot	**80.1**	**83.6**	**80.6–86.7**
Wls	**79.4**	**85.1**	**81.6–88.7**
UK	**83.4**	**86.7**	**85.6–87.8**

Table 12.13: 90-day survival by centre for 2004 unadjusted and adjusted to age 60

Centre	90 day unadjusted survival	90 day adjusted survival	90 day adjusted 95% CI
Abrdn	94.1	96.2	92.7–99.9
Airdrie	92.2	93.9	88.4–99.7
B Heart	84.9	90.9	86.5–95.5
B QEH	89.5	92.1	88.9–95.4
Bangor	84.9	92.3	86.1–98.9
Basldn	79.6	85.1	76.7–94.5
Bradfd	92.9	94.9	90.2–99.9
Brightn	94.3	96.9	94.7–99.2
Bristol	87.0	91.9	88.6–95.3
Camb	92.8	94.6	91.0–98.3
Cardff	91.5	94.7	92.1–97.3
Carlis	100.0	n/a	n/a
Carsh	90.2	93.0	89.8–96.3
Chelms	90.2	94.8	90.4–99.3
Clwyd	85.7	93.6	85.7–100
Covnt	93.8	95.7	92.0–99.4
D&Gall	87.5	92.5	83.6–100
Derby	85.9	89.9	83.8–96.4
Dorset	93.3	96.0	92.2–99.9
Dudley	87.0	90.7	84.5–97.4
Dundee	88.9	93.9	89.7–98.4
Dunfn	93.1	95.5	89.8–100
Edinb	91.8	94.0	90.1–98.1
Exeter	90.3	94.8	91.8–97.9
GlasRI	87.7	91.6	86.7–96.7
GlasWI	88.2	91.2	86.5–96.1
Glouc	88.0	93.4	88.4–98.6
Hull	77.5	86.2	80.9–91.7
Inverns	94.3	95.8	90.3–100
Ipswi	88.1	91.1	84.1–98.7
Klmarnk	100.0	n/a	n/a
L Barts	92.3	92.8	89.2–96.5
L Guys	95.1	95.6	91.9–99.4
L H&CX	92.4	94.6	91.8–97.4
L Kings	93.3	94.7	90.9–98.6
Leeds	86.9	91.0	87.5–94.7
Leic	94.1	95.9	93.4–98.4
Livrpl	94.8	96.0	93.2–99.0
ManWst	97.2	97.7	95.2–100
Middlbr	86.0	89.7	84.8–95.0
Newc	87.9	90.8	86.2–95.7
Norwch	92.7	96.1	93.1–99.2
Nottm	86.5	91.2	86.8–95.7
Oxford	94.9	96.4	94.0–98.9
Plymth	75.8	85.6	79.0–92.8
Ports	94.8	96.4	93.6–99.3
Prestn	94.9	96.3	92.9–99.9
Redng	98.5	98.9	96.9–100
Sheff	95.2	96.7	94.5–99.0
Shrew	84.6	90.0	83.7–96.8
Stevng	96.2	97.1	93.9–100
Sthend	89.5	94.5	89.4–99.9
Sund	96.1	97.8	94.7–100
Swanse	84.3	91.0	86.6–95.7
Truro	98.5	99.2	97.7–100
Wirral	91.2	94.3	89.9–98.8
Wolve	85.4	89.6	84.6–95.0
Wrexm	92.6	95.6	89.9–100
York	84.4	91.9	86.3–97.8
Eng	**90.8**	**93.8**	**93.0–94.6**
Scot	**91.0**	**93.8**	**92.1–95.6**
Wls	**88.9**	**93.4**	**91.3–95.6**
UK	**90.7**	**93.8**	**93.0–94.6**

Appendix 2: Statistical methods

The unadjusted survival probabilities (with 95% confidence intervals) were calculated using the Kaplan–Meier method, in which the probability of surviving more than a given time can be estimated for members of a cohort of patients, without accounting for the characteristics of the members of that cohort. Where centres are small, or the survival probabilities are greater than 90%, the confidence intervals are only approximate.

In order to estimate the difference in survival of different subgroups of patients within the cohort, a stratified proportional hazards model (Cox) was used where appropriate. The results from the Cox model are interpreted using a hazard ratio. When comparing two groups, the hazard ratio is the ratio of the estimated hazards for group A relative to group B, where the hazard is the risk of dying at time t given that the individual has survived until this time. The underlying assumption of a proportional hazards model is that this ratio remains constant throughout the period under consideration. Whenever

used, the proportional hazards model was tested for validity.

Validity of the centre adjustment for proportional hazards

For the Cox model to be used to adjust centre survival to a specific age (eg 60 years), the assumption of constant proportionality means that the relationship of survival (hazard of death) to age is similar in all centres within the time period studied. If one centre had a relationship of survival with age different from the other centres, the adjustment would not be valid. Testing showed the relationship to be similar for all centres.