

Chapter 9: Survival of incident adult patients

Summary

The first year survival from day 0 of renal replacement therapy was 96%, 94%, 90%, 84%, 72%, 65% for patients aged 18-34, 35- 44, 45-54, 55-64, 65- 74, 85+ respectively.

There was no relationship between a centre's 90 day or 1 year after 90 day survival and the mortality rate of the local population for all cause mortality or only cardiac mortality

There are marked differences between centres in survival rates, but these are not consistent. Serial studies on one year survival rates for individual centres from 1997 – 1999, after adjustment to a standard age, showed wide variation

Introduction

The 'Renal Registry' database enables analysis of the influence of different factors on patient survival. These factors are related to patient case mix [e.g. age, gender, ethnicity, underlying diagnosis & other co-morbidity] or are dependent on treatment [e.g. haemoglobin, mode of dialysis, serum phosphate]. For individual renal units such analysis allows comparison with performance in previous years, and with other centres.

Survival rates can either be looked at in relation to:

- (a) An '*incident cohort*' in which patients who started renal replacement therapy in a particular year are included
- or
- (b) A '*prevalent cohort*' in which all (or a defined group) of patients undergoing renal replacement therapy at a particular time are included

The analyses presented in this chapter examine survival whilst on renal replacement therapy, including transplantation, of incident patients. Patients are censored when moving to a centre which does not report to the Registry.

Death rates in different centres contributing to the UK Renal Registry are reported here. These are very crude data. Adjustment can be made between centres on the basis of age, but there is need for more detailed information relating to co-morbidity and ethnic origin. With this lack of information about case-mix, no significance can currently be attributed to any apparent differences in survival between centres.

Statistical Methods

The 'number of days at risk ' was calculated for each patient and the sum of these values for all patients divided by 365 represents the 'number of patient years at risk'. The mortality rate was defined as :

$$\frac{\text{Number of deaths on dialysis}}{\text{Number of patient years at risk}}$$

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 greater than 90% the confidence intervals are only approximate.

In order to estimate the differences 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. For example, for diabetics when compared with non-diabetics, the hazard ratio is the ratio of the estimated hazards for diabetics relative to non-diabetics, 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 time period under consideration. The proportional hazards model was tested for validity in all cases.

Survival patterns

This analysis relates primarily to the 1999 cohort of patients, with earlier patients studied for the longer-term survival analysis. Analysis of the survival of incident patients reveals a complex picture. As shown in chapter 4, the death rate in the first 90 days is much higher than in the rest of the first year (table 9.1). The high early risk of death may also vary by age and diagnosis.

Age	90 day KM Survival	1 yr KM Survival
< 65	95	86
≥ 65	83	66
All	89	76

Table 9.1 90 day & 1 yr survival

The number of deaths per 100 live patients in each 30-day time interval was plotted. Figure 9.1 shows that the death rate levels not at day 90, but at day 150. Thereafter the death rate appears fairly constant.

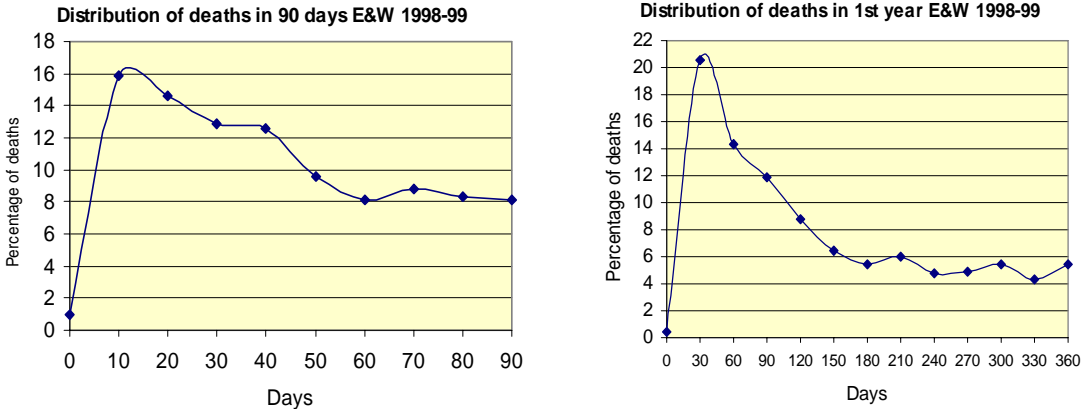


Figure 9.1 Distribution of deaths in the 1st year

Fig. 9.1 shows the distribution of deaths as a percentage of all deaths within the 90-day and 360 day time period. When analysed as a percentage of total deaths in the 1st year, 20% occur within the first 30 days and 47% within 90 days for England & Wales.

Figure 9.2 shows the difference between Scotland (with a generally higher mortality) and England & Wales. There is an apparent greater variation in the Scottish data due to smaller numbers of patients in this group.

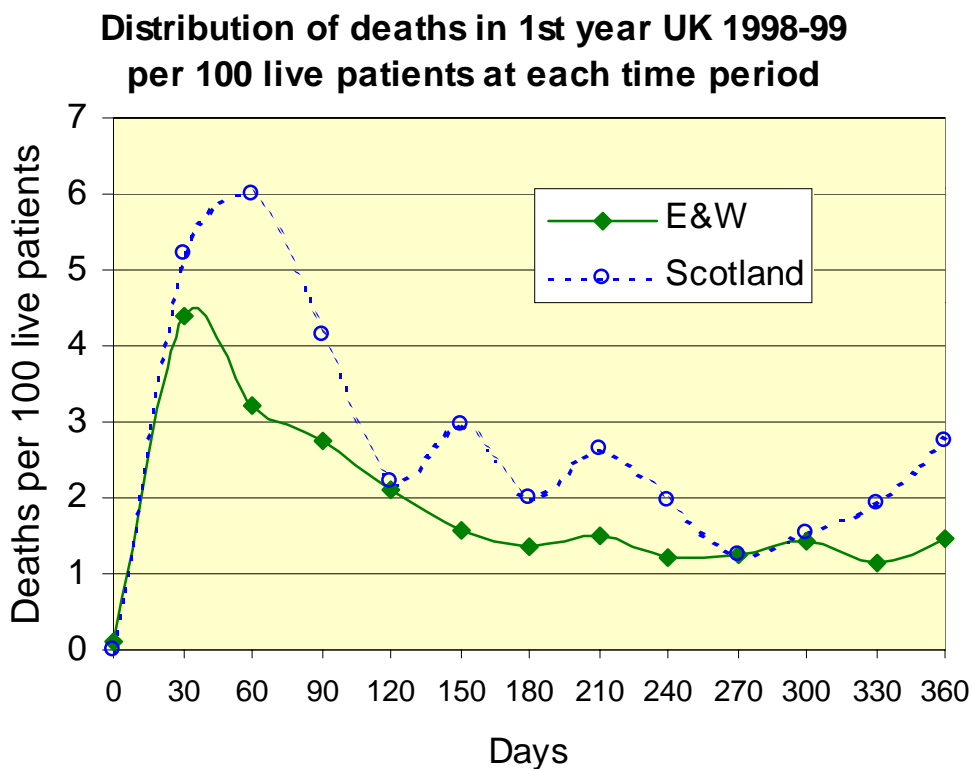


Figure 9.2 Distribution of deaths in 1st year UK 98 – 99 per 100 live patients at each time period

The distribution of deaths in the first few months may also show differences between units, even where overall survival is similar. Different distribution patterns may give an indication of differences in practice.

The “hazard function”

The hazard function is the probability of dying in a short time interval. The hazards expressed below are the probability of dying on any single day

Survival within the first 90 days

Analysis of the hazard of death within the first 90 days shows that for patients aged over 65 there is a large hazard of death at the start of renal replacement therapy, which then falls rapidly. This compares with the risk for those aged less than 65 years, which decreases to day 60 and then rises. By day 90 the 95% confidence intervals for these two groups overlap.

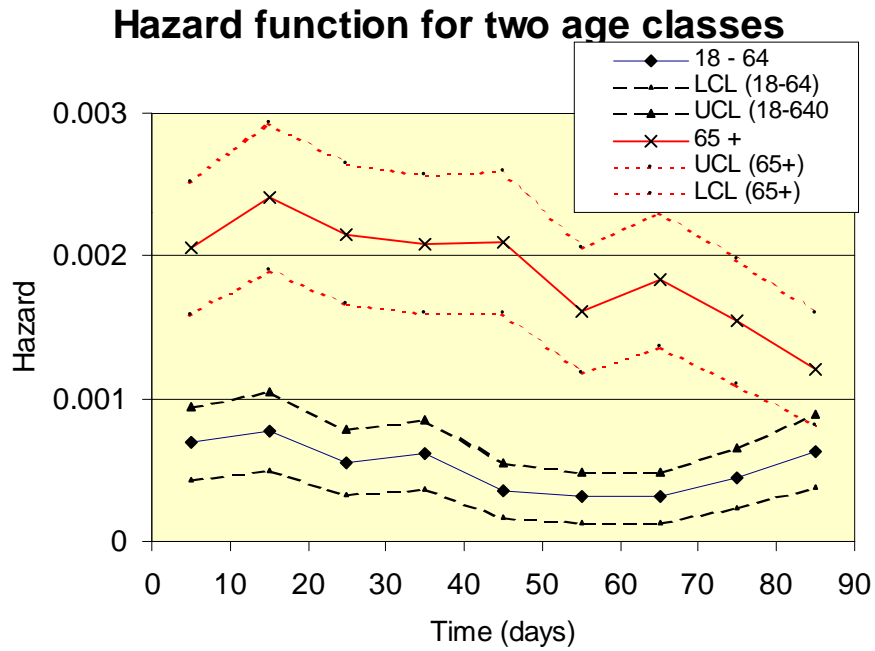


Figure 9.3 The hazard function for incident adults aged above and below 65 years

Calculation of the ratio of the hazard of death for those aged over 65: aged less than 65, confirms that the ratio between these two groups is not constant throughout the first 90 days (figure 9.4).

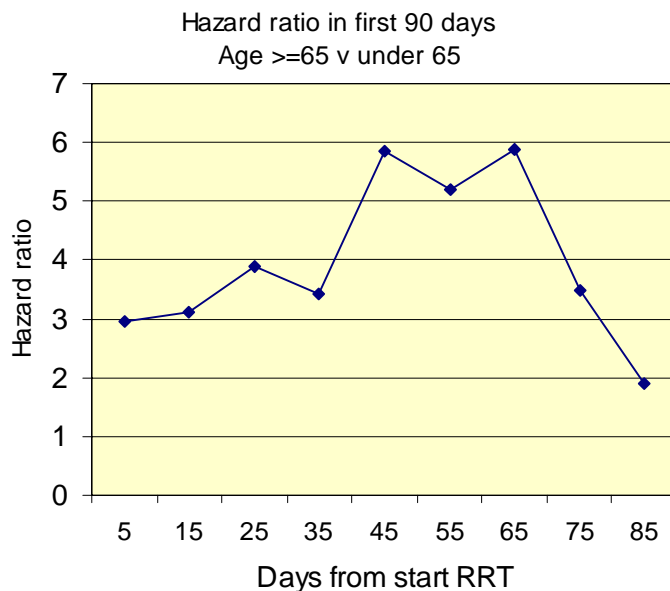


Figure 9.4 The ratio of the hazard of death for aged >65 : aged <65 , in the first 90 days.

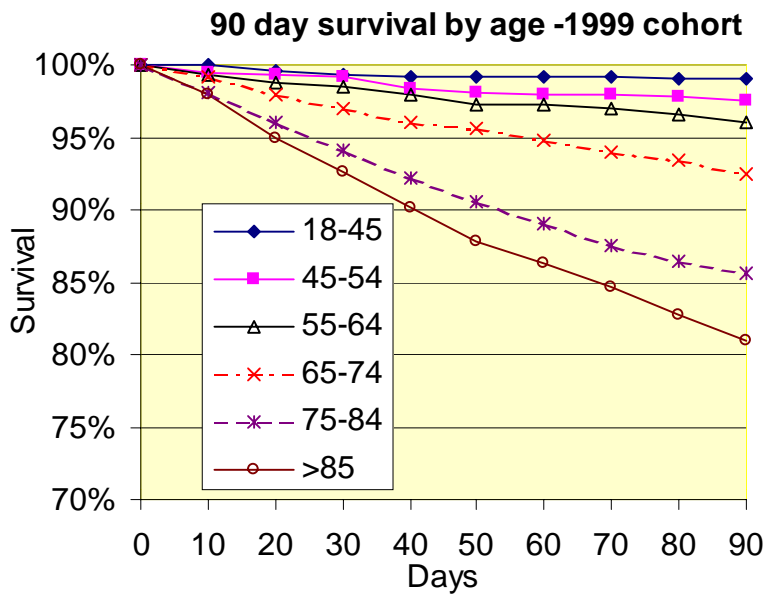


Figure 9.5 Kaplan-Meier survival curves by age band for 90 days

The figure above shows the Kaplan-Meier survival curves and indicates the different mortality rates between the different age bands in the first 90 days for those patients starting Renal Replacement Therapy in 1999.

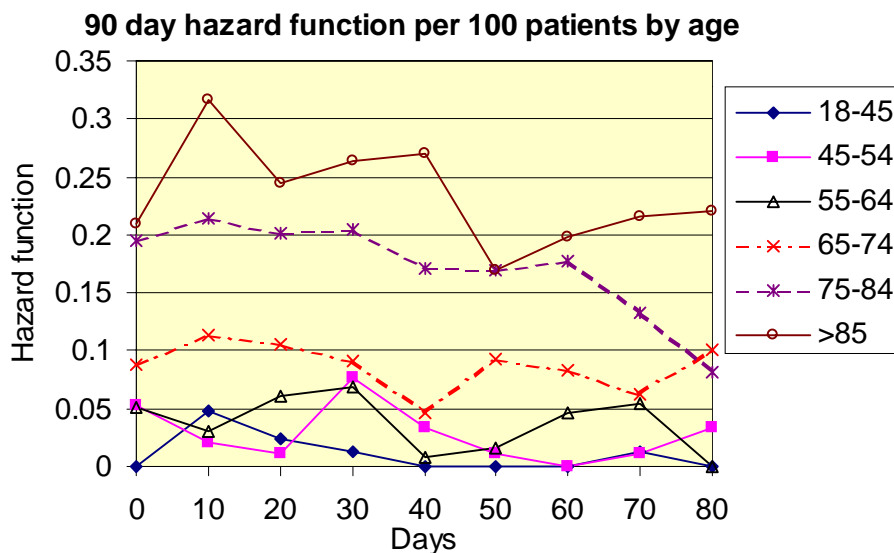


Figure 9.6 Hazard function by age band for the 1st 90 days

The hazard functions shown in figure 9.6 indicate that the hazard of death is not of a constant proportionality between the different age bands during the first 90 days. Thus the Cox proportional hazard model cannot be used on this untransformed data to adjust survival by centre to the same age for all centres. Through the use of a standard statistical method of log, log transformation, it is possible to obtain proportionality between the age bands, for use in

the application of a proportional hazards model (Figure 9.7). These methods were used in making age adjustments in the individual centre data shown later.

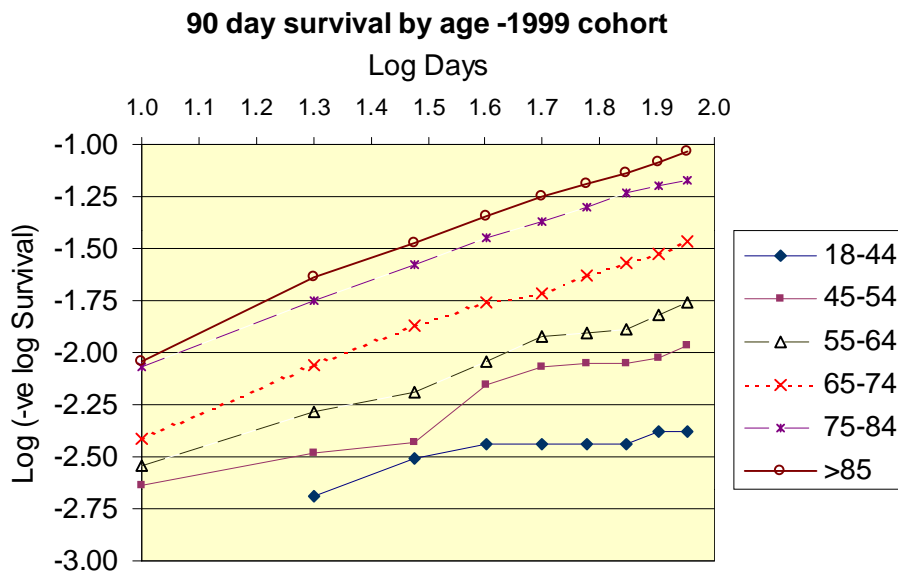


Figure 9.7 Log log transformation of Survival function over 90 days by age

Survival over 360 days from start of Renal Replacement therapy

Kaplan-Meier survival curves over 360 days from the first renal replacement therapy for the same age bands are shown in figure 9.8. There is a marked variation from 96% survival in the 18-44 age group to 65% in those over 85.

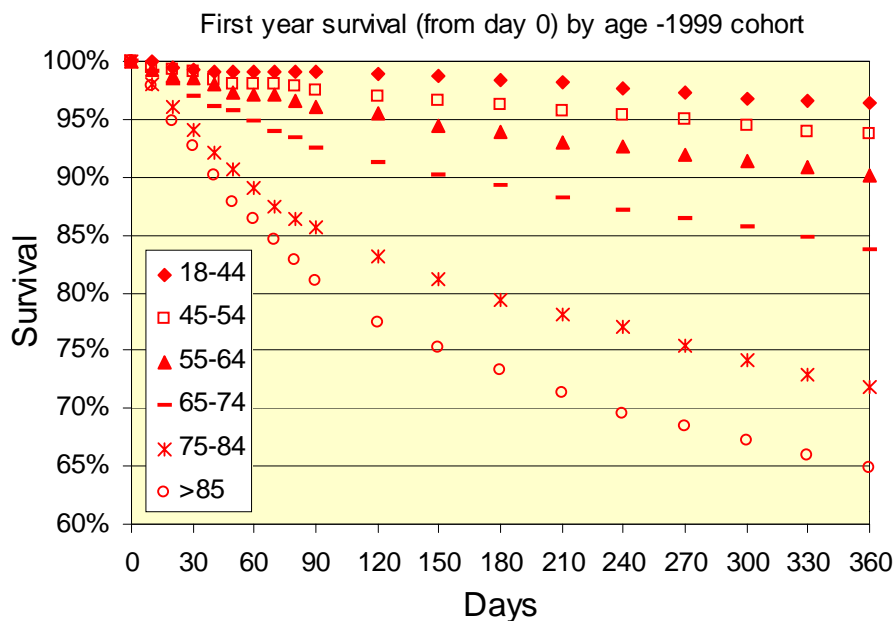


Figure 9.8 Survival in the first year of renal replacement therapy

Death within three years from start of Renal Replacement therapy

Figure 9.9 shows that the hazard of death falls dramatically in the early months, and by 4 months is half that at the start of renal replacement therapy.

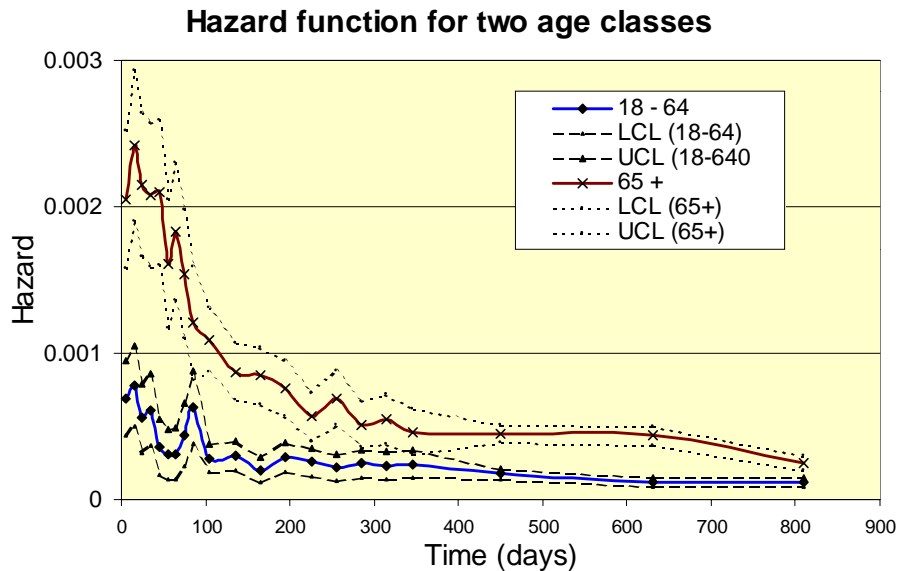


Figure 9.9 Hazard of death over three years from starting renal replacement therapy

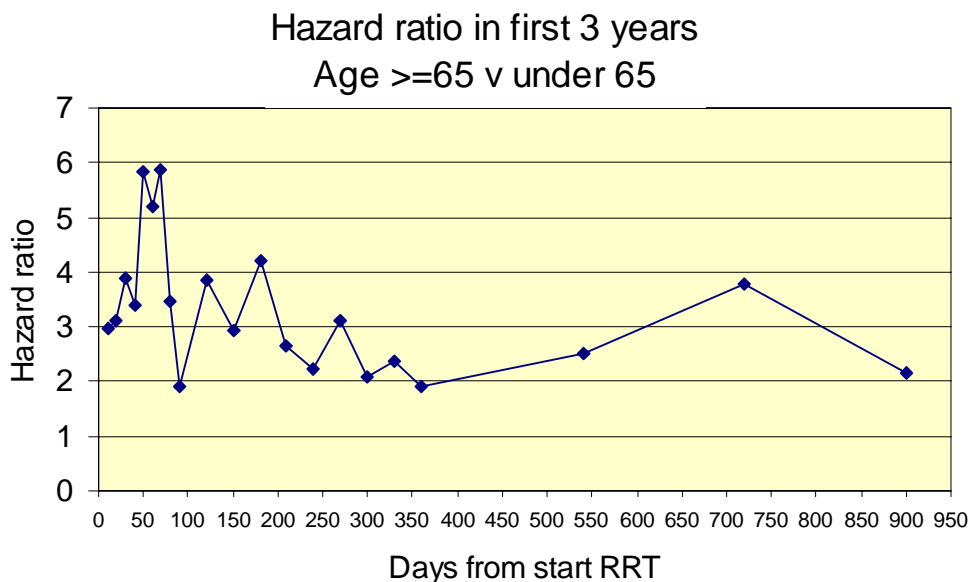


Figure 9.10 Ratio of hazard of death over 3 years, above and below age 65

The ratio of hazard of death shown between those above and below age 65 is shown in figure 9.10. The number of patients in the later periods is small and the confidence intervals wide. Beyond 150 – 200 days the hazard ratio does not change significantly.

Survival in individual centres

The survival of incident patients in individual centres is shown in figures 9.11 and 9.12. The results are age adjusted. As already discussed, the different hazard ratio between different age groups in the first 90 days and subsequent time renders it invalid to use the Cox proportional hazard method to make adjustments throughout the first year. Thus periods of 90 days and one year after 90 days have been used. In the absence of good co-morbidity data no adjustment can be made for co-morbidity. It thus not possible to attach significance to any apparent differences between centres.

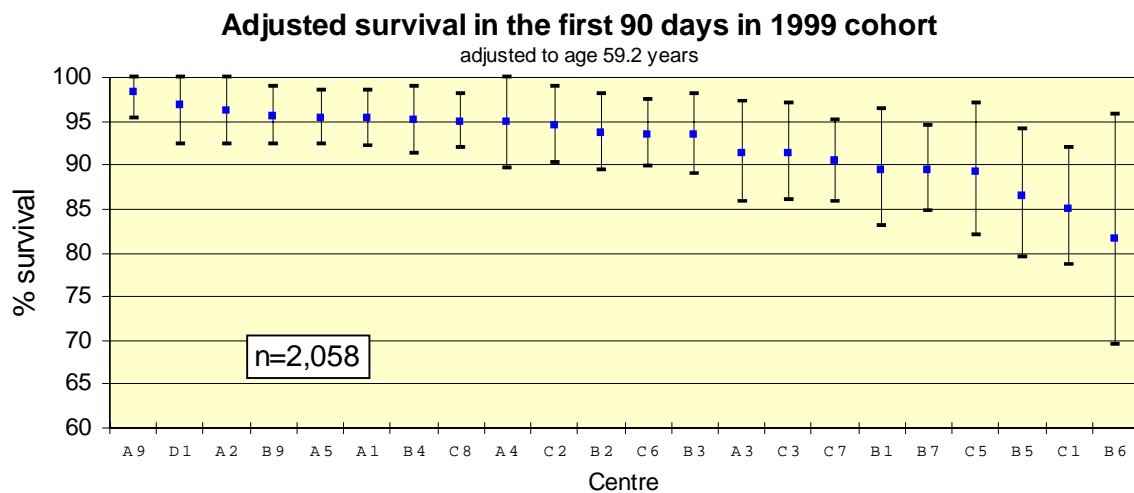


Figure 9.11: Adjusted survival in the first 90 days in 1999 cohort

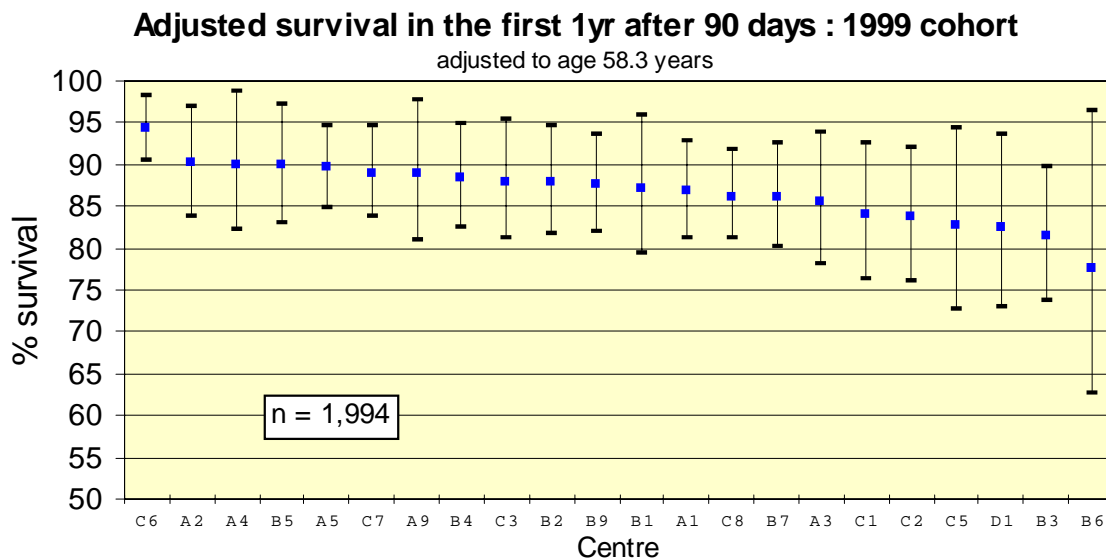


Figure 9.12: Adjusted survival in the first 1yr after 90 days in the 1999 cohort

First year survival by centre aged <65 and >65 years

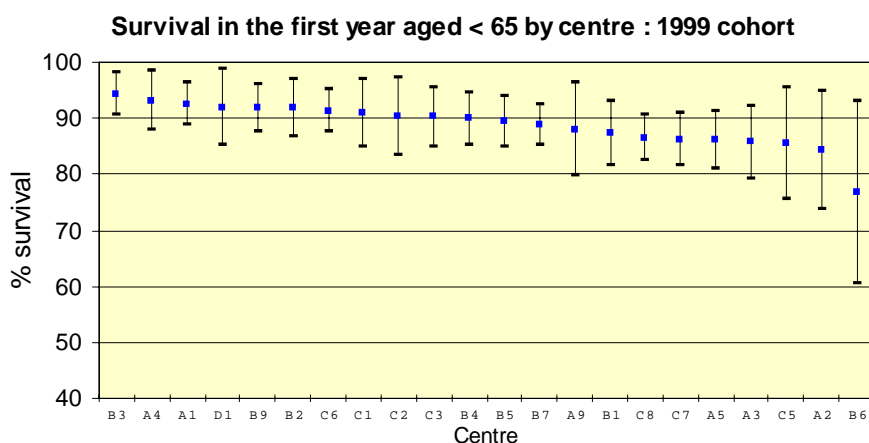


Figure 9.13 First year survival patients aged <65 by centre

The first year survival by centre from day 0 of starting renal replacement therapy is shown below. By showing survival separately for those aged under 65 and over 65 years it has not required an adjustment for age.

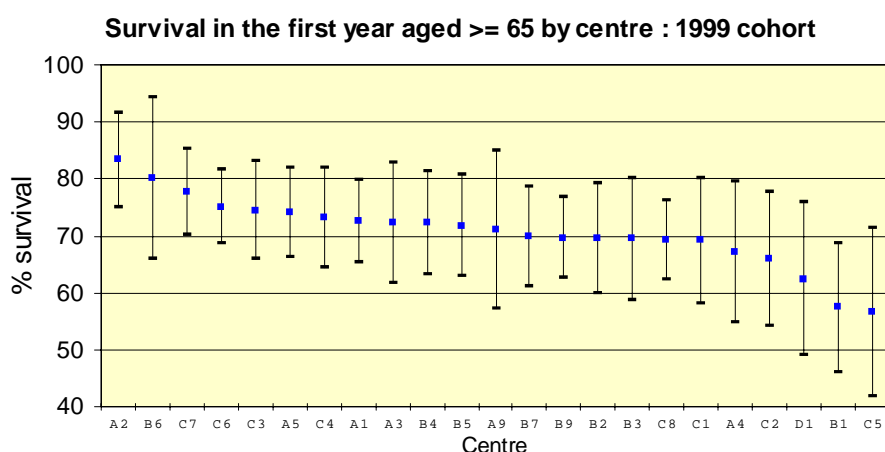


Figure 9.14 First year survival patients aged ≥ 65 by centre

Changes in survival 1997 – 1999 by centre

The 90-day survival for each individual centre was originally adjusted using the Cox proportional hazards model, to a standard age of 59.2 years. This was chosen as it was the median age of the patients starting RRT in England and Wales during 1997. This median age varies on a year-by-year basis. In addition the median age in 1997 of those surviving 1 year after 90 days is slightly younger at 58.3 years, as more of the older patients die within the first 90 days. This produced a separate age to adjust survival to for the 1 year after 90 days. This year in the 1999 data we have kept to this method, although for the serial data we have adjusted both the 90 day and 1 year after 90 days data to the same age of 60 years. The age of 60 has been reached in agreement with several other international registries to standardise survival adjustment for comparative purposes. In future reports all comparative survival will be adjusted to this figure. Direct international comparison is still limited, as countries vary in the percentage of diabetic patients with poorer survival and ethnic minorities with better survival.

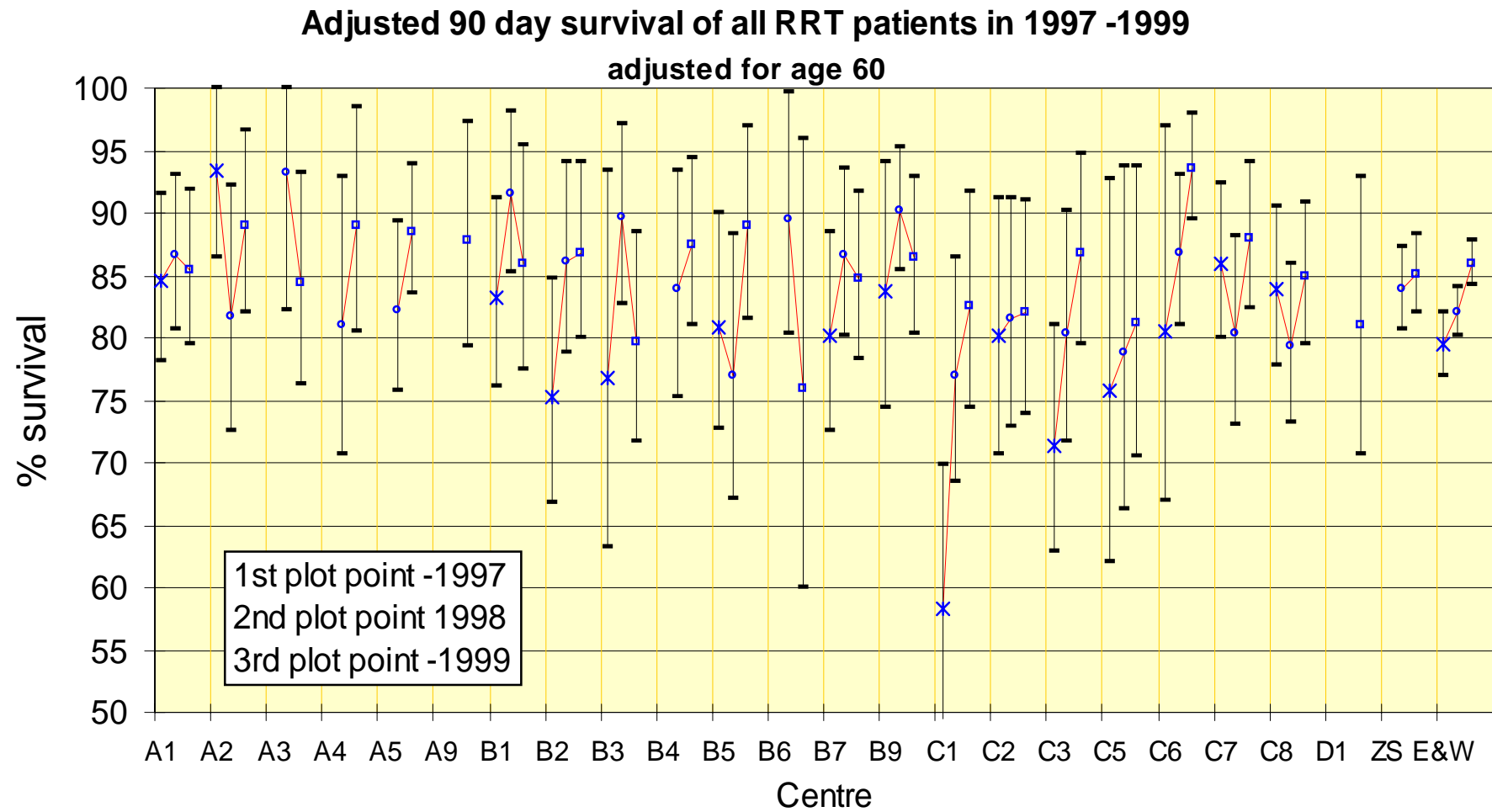


Figure 9.15 Survival 90 day 1997 -1999

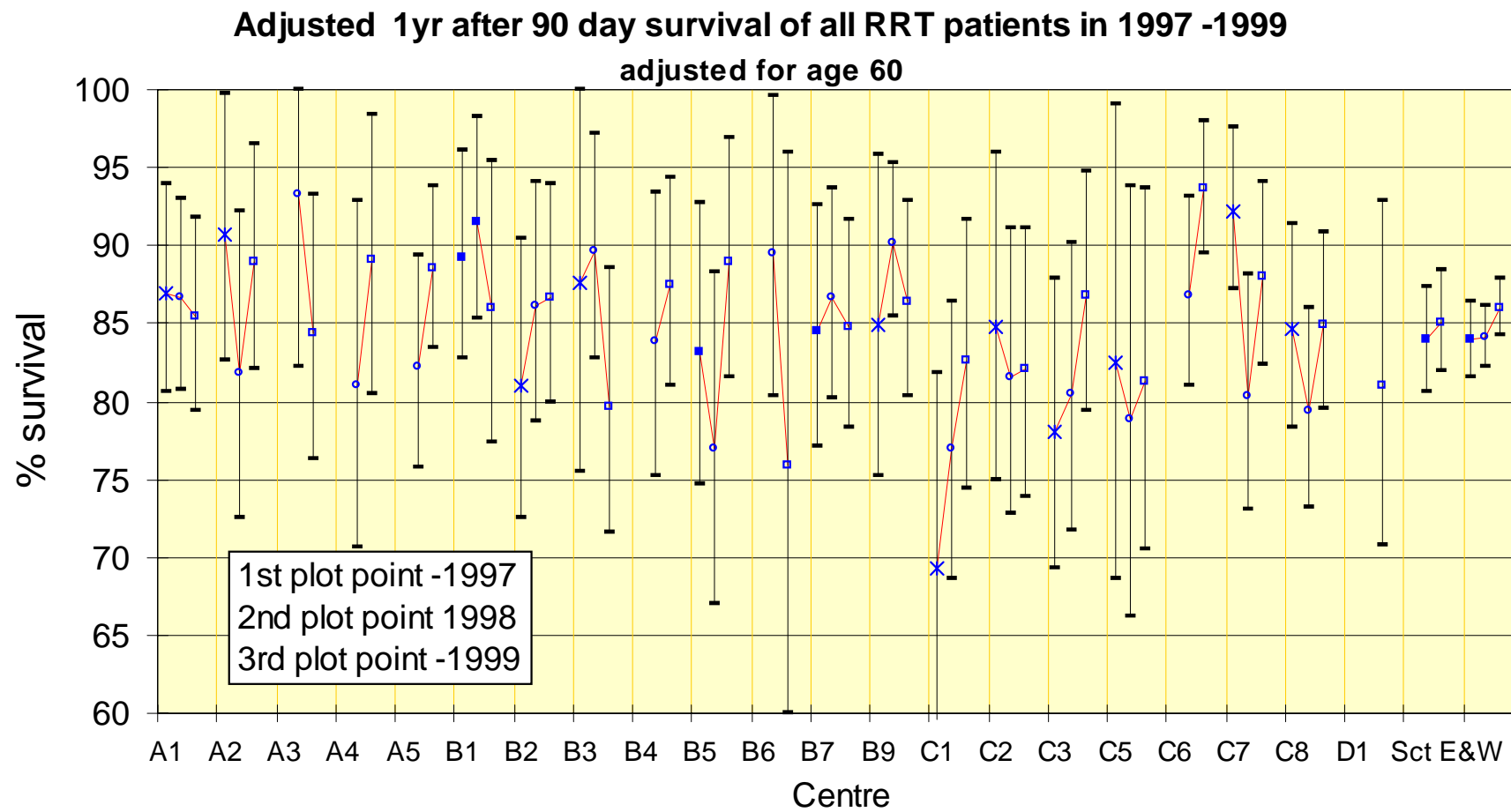


Figure 9.16 Survival 1 year after 90 days 1997-99

Relationship of centre survival to population mortality

To investigate whether the low 90 day survival rate was related to increased ‘local’ co-morbidity factors, data on ‘all cause mortality’ was obtained from the Office for National Statistics (ONS). The death rate for the local population by health authority was plotted against the 90-day and one year after 90 days survival of patients starting renal replacement therapy.

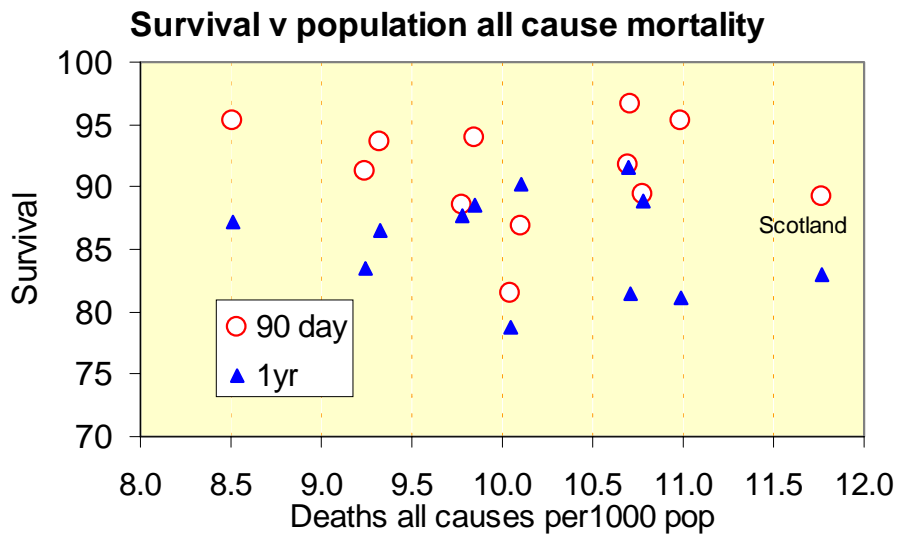


Figure 9.17 All cause population mortality v RRT survival

There appeared to be no correlation between local population mortality rates and mortality rate on renal replacement therapy either at 90 days or 1 year after 90 days (figure 9.17).

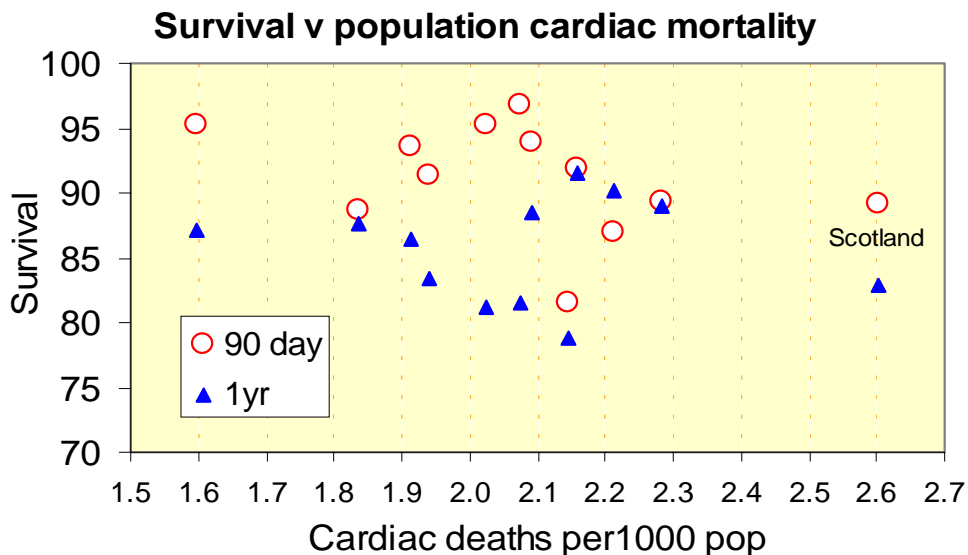


Figure 9.18 Population cardiac mortality v RRT survival

Figure 9.18 demonstrates no relation between the population cardiac mortality and survival at 90 days or 1 year after 90 days.