Chapter 14: Survival of Incident RRT Patients in the UK

Summary

- 5 year survival of incident patients in the UK on RRT is 42.6%: 64% for those under 65 and 14.5% for older patients.
- The 2003 one-year incident patient survival, adjusted to age 60, on HD and PD was 85.7% and 92.5% respectively, compared with 83.8% and 89.6% for 2002.
- The hazard ratios confirm that the greatest hazard of death occurs in the first 120 days; thereafter the hazard ratio remains stable out to five years.
- For every 10-year increase in patient age, there is an increase in the hazard of death in the year after 90 days of 41% (95% CI 35–47%).
- Although from 1997 to 2001 there appeared to be an overall improvement in one year after 90-day survival from 84.0% to 88.0%, the trend has since levelled.
- The one year after 90 day survival for all renal units falls within 3 standard deviations from the national mean: 2 units have survival more than 2 standard deviations above the mean and 2 units lower than 2 standard deviations from the mean.
- Due to lack of co-morbidity data from many renal units, survival analysis has not been adjusted for co-morbid conditions, so the clinical significance of differences in survival between units is difficult to interpret. This highlights the importance of returning data on co-morbidity.
- In consultation with participating renal units it is hoped next year to remove anonymity from these analyses.

Introduction

The analyses presented in this chapter examine the survival from the start of renal replacement therapy: they encompass the outcomes from the total incident UK dialysis population, including the 31% who start on peritoneal dialysis and the 3% who receive a pre-emptive transplant. The results therefore show a true reflection of the whole UK RRT population. The survivals reported here are better than those reported for the UK by the IDOPPS study, which only includes haemodialysis patients. As shown in Chapter 4, the haemodialysis patients are a selected group with increased co-morbidity and higher death rates than those selected for PD or pre-emptive transplant.

The dataset includes patients from England, Scotland and Wales. 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 Registry, 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.

Survival rates in different centres contributing to the UK Renal Registry are reported here. These are raw data that require 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. It is for this reason that in this section the individual renal units are not identified. For the future it is most important that participating centres send more comprehensive data on co-morbidity and ethnic origin.

In consultation with participating renal units it is hoped next year to remove anonymity from these analyses. Patients with no co-morbidity recorded will be assumed to have none: in the adjusted analyses this may have the effect of making the survival in renal units with poor comorbidity returns look somewhat worse than they might if appropriate adjustments could be made.

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 methods

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

> Number of deaths on RRT 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 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.

Survival of new patients on RRT

The revised Renal Standards document 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 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.

The Renal Standards document defines Standard Primary Renal Disease using the EDTA 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 diabetics, so these figures are also included in this report to allow comparison with reports from other Registries. The results are shown in Table 14.1.

Table 14.2 contains 90 day adjusted patient survival for the UK countries showing the high initial death rates, and 1 year after 90-day adjusted patient survival.

Table 14.1:	One-year patient survival – patients
aged 18-55,	2003 cohort

First treatment	Standard primary renal disease	All diseases except diabetes
All %	95.5	95.2
95% CI	94.0–97.0	93.8–96.5
HD %	94.0	94.1
95% CI	91.9–96.1	92.3–95.9
PD %	98.1	97.1
95% CI	96.4–99.7	95.4–98.9

The age-adjusted survival by first established treatment modality is shown in Table 14.3.

The age adjusted one year survival on HD and PD at 85.7% and 92.5% respectively, has improved in 2003 when compared with the previous year of 83.8% and 89.6% respectively. There appears to be better survival on PD compared with HD (Tables 14.1 and 14.3) 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 (Chapter 4).

Tables 14.4 to 14.11 show survival of all patients, and those above and below 65 years of age, for up to seven 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 14.1 and 14.2).

Table 14.3: One-year survival by first establishedtreatment modality 2003 cohort (age adjusted)

	HD	PD
Adjusted 1 year after 90 days %	85.7	92.5
95% CI	84.3-87.2	90.9–94.1

Table 14.4: Unadjusted 90 day survival of newpatients, 2003 cohort by age

Age	KM ¹ survival analysis (%)	KM 95% CI	Ν
18–64	95.4	94.5-96.3	2,221
≥65	85.6	84.1-87.0	2,307
All ages	90.4	89.5-91.3	4,528

 1 KM = Kaplan-Meier.

Table 14.5: Unadjusted 1 year survival of newpatients, 2003 cohort by age

Age	KM survival analysis (%)	KM 95% CI	Ν
18–64	92.1	91.0-93.3	2,119
≥65	76.5	74.6-78.5	1,974
All ages	84.6	83.5-85.8	4,093

If the survival data in Tables 14.5 to 14.11 are calculated from day 90 (1 year after day 90 survival, 2 year after 90 day 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.

Table 14.2: Patient % survival across the UK, 2002- 2003 cohort*, adjusted to age 60

	England	Wales	Scotland	UK
% 90 day	93.3	91.4	93.8	93.2
95% CI	92.4–94.2	89.0–93.9	92.1–95.5	92.4–94.1
% 1 year after 90 days	88.3	86.4	86.0	87.8
95% CI	87.0-89.5	83.0-89.9	83.2–88.8	86.7-89.0
*D · · · · · DDTC	1 10 2002 / 20 0 2002			

*Patients starting RRT from 1.10.2002 to 30.9.2003.

	KM survival	analysis (%)			
Age	1 year	2 year	2 year 95% CI	Ν	
18–64	88.9	83.6	82.0-85.3	1,663	
≥65	67.0	57.0	54.7-59.3	1,806	
All ages	77.6	75.6	74.1–77.2	3,469	

Table 14.6: Unadjusted 2 year survival of new patients, 2002 cohort by age

Table 14.7: Unadjusted 3 year survival of new patients, 2001 cohort, by age

	KM				
Age	1 year	2 year	3 year	3 year 95% CI	Ν
18–64	88.5	81.3	76.4	74.4–78.4	1,524
≥65	66.8	53.2	44.6	42.1-47.1	1,540
All ages	78.4	67.4	65.8	64.0-67.7	3,064

		KM survival	Ι			
Age	1 year	2 year	3 year	4 year	4 year 95% CI	Ν
18-64	89.6	82.3	75.4	71.2	68.9–73.6	1,211
≥65	68.1	54.8	41.4	33.7	31.0-36.3	1,156
All ages	79.1	68.7	58.5	58.0	56.0-60.1	2,367

Table 14.9: Unadjusted 5 year survival of new patients, 1999 cohort by age

		KM su					
Age	1 year	2 year	3 year	4 year	5 year	5 year 95% CI	Ν
18–64	88.1	82.3	75.6	69.6	65.7	63.1-68.3	1,028
≥65	67.8	52.6	39.9	29.7	24.8	22.2-27.4	910
All ages	78.5	68.2	58.7	50.7	50.1	47.9-52.4	1,938

Table 14.10: Unadjusted 6 year survival of new patients, 1998 cohort by age

		K						
Age	1 year	2 year	3 year	4 year	5 year	6 year	6 year 95% CI	Ν
18–64	87.1	80.8	74.5	69.2	62.5	59.3	56.6-62.1	872
≥65	65.1	50.7	30.7	31.8	24.4	20.1	17.5-22.7	767
All ages	76.9	66.9	58.9	51.2	44.8	43.5	41.3-45.9	1,639

Table 14.11: Unadjusted 7 year survival of new patients, 1997 cohort by age

	KM survival analysis (%)								
Age	1 year	2 year	3 year	4 year	5 year	6 year	7 year	7 year 95% CI	Ν
18–64	87.4	80.4	74.4	68.3	64.0	59.7	54.8	51.2-58.4	454
≥65	65.8	45.2	33.6	23.9	14.5	10.8	9.1	6.5-11.8	345
All ages	78.1	65.2	56.8	49.1	42.6	38.6	37.2	34.4-39.9	799

Survival of new patients and age

The incident cohort included in this analysis is all those patients starting RRT in 2003. Patients who recovered function within 90 days (ie patients with acute rather than chronic renal failure) have been excluded.

In Figure 14.1, the unadjusted survival is shown for several age bands for the first 90 days, the first year from day 0 of RRT and the first year after day 90.

The UK Registry has been collecting data on incident patients since its inception in 1997,

enabling survival to be estimated for up to seven years after starting renal replacement therapy. The Kaplan-Meier survival curves by age for 7 years are shown in Figure 14.2. Only the older groups reach 50% mortality in a 7year period. For these, the 50% survival times with 95% CI are: aged 55–64, 66 months ± 2.8 m; aged 65–74, 33 months ± 1.8 m; over 75, 21 months ± 2.1 m. Patients with diabetes have been included in these survival figures. These data include the first 90-day period.

The hazard ratios confirm data previously shown by the Registry that the greatest hazard of death occurs in the first 120 days (Figure 14.3); thereafter the hazard ratio remains stable



Figure 14.1: Unadjusted survival of all incident patients, by age band



Figure 14.2: Kaplan-Meier 7-year survival of incident patients



Figure 14.3: 1st-year hazard of death, by age band



Figure 14.4: 5-year hazard of death, by age band (excluding the first 90 days) The results beyond 36 months for patients aged 75+ are not reliable as the numbers were very small

out to five years (Figure 14.4): patient numbers are too small for meaningful analysis for later years. These data contrast with the 'vintage effect' seen in data from the USRDS Registry (USA) which demonstrates a rising hazard of death with increasing length of time on renal replacement therapy. Cross sectional analysis of the one year hazard of death in prevalent UK patients also fails to show any effect of 'vintage'.

Age adjustment of survival in the first 90 days and thereafter

Analysing all the patients starting RRT between 1997 and 2000, the proportional hazards for

each 1-year increase in age of the patients for the two time intervals of the first 90 days and the subsequent 365 days are shown in Table 14.12.

These data show that in the first 90 days there is a greater risk of death for every 1 year increase in patient age than there is in the subsequent 1-year period. For every 10 year increase in patient age, there is an increase in the hazard of death of 58% (95% CI 50–65%) in the first 90 days, compared with 41% (95% CI 35–47%) in the subsequent 365 days.

These data on their own would not invalidate the proportional hazards model for age

Table 14.12: Increase in proportional hazard of death for each year increase in age, at 90 days and for 1 year thereafter

Interval	Hazard of death	95% CI
First 90 days	1.058	1.050-1.065
1 year after first 90 days	1.041	1.035-1.047

adjustment between centres for the single time period of 0-365 days. However analysis has shown that there are centre variations in the hazards that invalidate the model for this period due to the change over period between these two hazards varying between centres, with some earlier at 80 days and others later at 110 days. The model is valid if the period is divided into 0-90 days and any subsequent period. Analysed over longer periods (eg 3 years) the effect is lost as it becomes very small.

Changes in incident patient survival, 1997–2003

In Figure 14.5, the right-hand graph shows the adjusted one-year after 90-day survival for all incident patients on the Registry in the years 1997–2003. More centres have joined the Registry since 1997 and these centres may have had differing survival rates. The left-hand graph shows the same analysis just for those centres that reported in 1997. It shows that although in

the years up to 2001 there appeared to be an overall improvement in survival, from 84.0 to 88.0%, the trend has since levelled. Prevalent patients (see Chapter 4) show a similar trend. These data also demonstrate that the survival profile of the 1997 centres is similar to that of the newer centres.

Survival of incident patients in 2003 by centre

Comparability of figures for survival within the first 90 days is heavily dependent on consistency between renal units in ensuring that all early chronic renal failure deaths are included and that all acute renal failure patient deaths are excluded. The Registry has contacted renal units when apparent anomalies in data occur, and it is clear there is considerable variability between renal units in how these decisions are made, so one must be cautious when making comparative assessment of survival in the first 90 days. For this reason these data are not shown here. As the 1 year survival from day 0 of starting renal replacement therapy includes this time period, the more appropriate figure for comparing renal units is the 1 year after 90 days, which can also be adjusted for age: results are shown in Figure 14.6, adjusted to age 60. To enable this length of follow-up by 31.12.2004 the cohort is those starting RRT from 1.10.2002 to 30.9.2003.



Figure 14.5: Change in one-year after 90 day adjusted (age 60) survival, 1997-2003







Figure 14.7: Funnel plot for age adjusted 1 year after 90 days survival; 2001-2003 cohorts

Analysis of centre variability in survival in 1 year after 90 days

In the analysis of 2003 data alone, some of the smaller centres have wide confidence intervals. This can be addressed in part by including a larger cohort, including all patients starting RRT 2001-2003: this also assesses recently 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. These data on survival are shown using funnel plots to identify possible outliers (Figure 14.7). From Figure 14.7, for any size of incident cohort (X axis) one can identify whether any given survival rate (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).

This analysis has not been adjusted for comorbid conditions, so the clinical significance of differences in survival is difficult to interpret. This highlights the importance of all renal units needing to return data on co-morbidity. In addition there is a wide scatter of results from the different renal units such that a variation from the mean of 2 standard deviations may not be large enough to indicate statistical significance: 3 standard deviations may be more appropriate.

To adjust survival for case-mix needs better data return from renal units and requires improved methodologies and structure at renal unit level. This is likely to include investment in informatics staff within renal units who would form part of the renal team.

Appendix of survival tables

	U	Inadjusted	Adjusted to age 60		
Centre	1 year after 90	day survival & 95% CI	1 year after 90 day survival & 95% CI		
SA	85.5	75.5–95.5	90.4	83.9–97.5	
SB	78.7	66.9-90.4	82.2	72.9-92.7	
SC	76.9	57.0-96.9	84.6	72.2–99.2	
SD	81.1	73.6-88.6	84.2	78.1-90.8	
SE	80.5	68.4-92.6	82.9	73.0-94.2	
SF	84.3	72.7-95.9	87.1	78.1-97.1	
SG	95.0	85.4-100	96.3	89.5-100	
SH	80.5	72.0-89.1	84.5	77.7-91.8	
SI	80.3	64.8-95.8	85.9	75.4-97.9	
SJ	79.8	70.2-89.3	84.4	77.1-92.3	
SK	86.4	73.9-98.9	89.8	80.8-99.8	
Т0	87.6	82.2-93.0	89.9	85.5-94.5	
T1	85.5	79.9-91.1	88.3	83.8-93.1	
T2	80.7	69.8-91.5	85.0	76.8-94.0	
Т3	89.8	83.4-96.1	88.8	82.2-95.9	
T4	91.8	86.8-96.7	92.7	88.5-97.2	
T6	81.1	66.1-96.1	84.9	73.7-97.8	
T7	80.5	71.5-89.5	84.8	77.9-92.3	
Т8	94.0	88.8-99.2	94.4	89.7-99.3	
U0	85.0	78.0-92.0	87.6	82.0-93.7	
U1	82.9	75.5-90.3	83.6	76.8-91.0	
U2	83.9	76.7-91.2	87.8	82.4-93.6	
U3	83.3	66.1-100	86.8	74.5-100	
U4	86.4	77.7–95.2	89.8	83.4-96.7	
U5	76.1	68.1-84.2	83.1	77.3-89.4	
U6	78.8	69.2-88.4	82.4	74.6-90.9	
U7	88.8	84.0-93.5	90.8	87.0-94.9	
U8	85.1	74.8–95.3	90.2	83.6-97.3	
U9	68.3	54.3-82.3	77.2	67.2-88.7	
V 0	85.7	79.3-92.0	88.0	82.7–93.5	
V2	90.3	79.9–100	93.3	86.3-100	
V3	90.4	85.9-94.9	92.2	88.6-96.0	
V5	75.0	50.5-99.5	79.4	62.1–100	
V6	94.1	89.6-98.7	95.3	91.8-99.0	
V7	85.8	79.9–91.6	87.2	82.0-92.6	
V8	83.5	74.9-92.0	87.3	80.8-94.3	
V9	87.9	82.5-93.3	89.9	85.4-94.6	
W0	84.0	73.8-94.1	84.9	76.0-94.9	
W1	93.2	85.7-100	94.9	89.5-100	
W2	84.4	73.9–95.0	90.1	83.4–97.3	
W3	78.0	67.6-88.3	81.6	73.2–90.9	
W4	78.9	70.1-87.6	85.2	78.9–91.9	
W6	93.8	86.9–100	94.9	89.5-100	
W7	71.1	52.8-89.3	77.4	64.1–93.4	
W8	88.8	82.3-95.4	90.3	84.7–96.2	
W9	76.3	63.8-88.8	82.7	73.8–92.8	
X0	87.0	75.0-99.1	89.4	80.1-99.9	

 Table 14.13:
 1 year after 90-day survival by centre for 2003

Centre X1	U	nadjusted	Adjusted to age 60 1 year after 90 day survival & 95% CI		
	1 year after 90	day survival & 95% CI			
	81.8	68.7–95.0	88.2	79.8–97.5	
X5	87.0	81.0-93.0	88.2	82.9-93.8	
X6	76.2	63.8-88.5	85.3	77.6-93.7	
X8	83.3	77.1-89.6	87.7	83.0-92.6	
X9	79.5	69.6-89.5	83.8	76.1-92.3	
Y0	82.6	74.8-90.3	84.8	78.2-91.9	
Y1	79.7	71.0-88.3	86.8	81.1-92.9	
England	85.3	84.1-86.6	88.3	87.0-89.5	
Scotland	81.9	78.6-85.2	86.0	83.2-88.8	
Wales	82.3	78.0-86.5	86.4	83.0-89.9	
UK	84.6	83.5-85.8	87.8	86.7-89.0	

Fable 14.13: (continued)
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 Table 14.14:
 90-day survival by centre for 2003

	Unadjusted		Adjusted to age 60		
Centre	90 day survival & 95% CI		90 day survival & 95% C.		
SA	85.0	76.0–94.0	91.1	85.7–96.9	
SB	90.4	82.4–98.4	92.8	87.0-99.0	
SC	90.5	77.9-100.0	94.8	88.3-100.0	
SD	87.7	81.9-93.5	91.1	86.8-95.5	
SE	80.8	70.1-91.5	85.0	77.0-94.0	
SF	97.5	92.7-100.0	98.3	94.9-100.0	
SG	95.2	86.1-100.0	96.6	90.6-100.0	
SH	94.4	89.7–99.2	96.1	92.9–99.5	
SI	100.0	n/a	n/a	n/a	
SJ	94.8	89.8–99.8	96.4	93.0-99.9	
SK	94.1	86.2-100.0	96.1	91.0-100.0	
Т0	89.1	84.3–93.8	92.0	88.5-95.7	
T1	89.0	84.4–93.7	92.1	88.7-95.7	
T2	91.5	84.4–98.6	94.1	89.2-99.2	
T3	89.3	83.4–95.3	89.9	84.4-95.7	
T4	91.5	86.9-96.1	93.3	89.6-97.0	
T6	87.5	76.0–99.0	91.8	84.6-99.7	
T7	95.5	91.1–99.8	96.8	93.9–99.9	
T8	97.8	94.8-100.0	98.0	95.4-100.0	
U0	97.1	94.0-100.0	97.8	95.5-100.0	
U1	86.2	79.9–92.5	87.9	82.5-93.6	
U2	93.6	89.1–98.2	95.7	92.6-98.9	
U3	70.4	53.1-87.6	80.0	68.7–93.2	
U4	85.5	77.2–93.8	90.5	85.1-96.3	
U5	87.5	81.8-93.2	92.4	88.8-96.1	
U6	87.4	80.4–94.3	90.9	86.0-96.2	
U7	92.5	88.7–96.3	94.5	91.7-97.4	
U8	82.8	73.0–92.5	90.1	84.4-96.2	
U9	90.4	82.4–98.4	94.3	89.6-99.2	
V 0	89.0	83.7–94.2	91.7	87.7-95.9	
V2	93.9	85.8-100.0	96.2	91.3-100.0	
V3	93.9	90.3–97.4	95.5	92.9-98.1	

	U	nadjusted	Adjusted to age 60		
Centre	90 day su	rvival & 95% CI	90 day su	rvival & 95% CI	
V5	92.3	77.8-100.0	94.4	85.0-100.0	
V6	92.0	87.0-97.0	94.0	90.3-97.9	
V7	92.5	88.4–96.6	94.0	90.8-97.4	
V8	92.5	86.7-98.3	94.8	90.8-98.9	
V9	92.3	88.1-96.5	94.1	91.0-97.4	
W0	94.3	88.1-100.0	95.4	90.4-100.0	
W1	84.6	74.8-94.4	89.3	82.5-96.6	
W2	93.8	86.9-100.0	96.6	92.9-100.0	
W3	88.2	80.9-95.4	91.7	86.7-97.1	
W4	89.9	84.0-95.8	93.9	90.3-97.7	
W6	96.0	90.6-100.0	97.0	93.1-100.0	
W7	80.6	66.7–94.6	87.4	78.6-97.2	
W8	92.8	87.6-97.9	94.3	90.3-98.5	
W9	78.1	68.0-88.3	86.9	80.6-93.6	
X0	82.9	71.4–94.4	88.4	80.8-96.8	
X1	85.0	73.9–96.1	91.4	85.1-98.2	
X5	91.3	86.6-96.0	92.9	89.1-96.9	
X6	92.3	85.1-99.6	95.7	91.7-99.9	
X8	88.7	83.8–93.6	92.6	89.3-96.0	
X9	90.1	83.2-97.1	93.1	88.3-98.1	
Y0	88.5	82.3-94.6	90.8	86.0-95.9	
Y1	89.6	83.5-95.7	93.9	90.3-97.7	
England	90.6	89.7-91.6	93.3	92.4–94.2	
Scotland	90.9	88.6-93.2	93.8	92.1-95.5	
Wales	87.1	83.7-90.6	91.4	89.0-93.9	
UK	90.4	89.5–91.3	93.2	92.4–94.1	

Table	14.14:	(continued)	۱
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