

Bert J. van der Heijden · Paul C. W. van Dijk ·
Kate Verrier-Jones · Kitty J. Jager · J. Douglas Briggs

Renal replacement therapy in children: data from 12 registries in Europe

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Abstract In June 2000 the ERA-EDTA Registry office moved to Amsterdam and started collecting core data on renal replacement therapy (RRT) entirely through national and regional registries. This paper reports the pediatric data from 12 registries. The analysis comprised 3,184 patients aged less than 20 years and starting RRT between 1980 and the end of 2000. The incidence of RRT rose from 7.1 per million of age-related population (pmarp) in the 1980–1984 cohort to 9.9 pmarp in the 1985–1989 cohort, and remained stable thereafter. The prevalence increased from 22.9 pmarp in 1980 to 62.1 in 2000. Hemodialysis was the commonest form of treatment at the start of dialysis, but peritoneal dialysis gained popularity during the late 1980s. Pre-emptive transplantation accounted for 18% of the first treatment modality in the 1995–2000 cohort. The relative risk of death of patients starting dialysis in the period 1995–2000 was reduced by 36% {adjusted hazard ratio (AHR) 0.64 [95% confidence interval (CI) 0.41–1.00]} and that of those receiving a first allograft by 42% [AHR 0.58 (95% CI 0.34–1.00)], compared with patients in the period 1980–1984. The prevalence of RRT in children has continued to rise, while

its incidence has been stable for about 15 years. Patient survival has improved in both dialysis patients and transplant recipients. The development of this pediatric registry will form the basis for more-detailed and focused studies in the future.

Keywords Dialysis · Epidemiology · Europe · Registry · Renal transplantation

Introduction

When dialysis and renal transplantation were first established in the 1960s treatment was offered mainly to young adults, but once its success had been established treatment was extended to older children. Shortly thereafter, a few pioneering centers developed techniques for the treatment of very small children and infants. At that time the results of the treatment of children were less good in terms of patient and graft survival than for adults, reflecting some of the technical difficulties. Also the quality of life was often unsatisfactory. This initial phase was followed by the development of an increasing number of specialist pediatric nephrology centers with staff experienced in technical aspects of renal replacement therapy (RRT) as well as in the care of children in terms of growth, development, and emotional and psychosocial needs. In Europe the ERA-EDTA Registry used to gather data on RRT in children mainly from individual renal units by means of center and patient questionnaires, and the results were published as an annual report, the most recent of which was in 1996 [1].

In June 2000 the ERA-EDTA Registry office moved to the Academic Medical Center in Amsterdam and it was decided at this time that data would be collected exclusively from national and regional registries [2]. A new database was built in order to combine data from different countries and the first report was published the following year [3]. The European Society of Paediatric Nephrology decided to join this new registry. The aim of this paper is to describe the first results of data collection

B. J. van der Heijden
Sophia Children's Hospital,
PO Box 2060, 3000 CB Rotterdam, The Netherlands

P. C. W. van Dijk · K. J. Jager · J. D. Briggs
ERA-EDTA Registry, Department of Medical Informatics,
Academic Medical Center, University of Amsterdam,
Amsterdam, The Netherlands

K. Verrier-Jones
KRUF Children's Kidney Center for Wales,
University of Wales College of Medicine,
Heath Park, Wales, Cardiff CF4 4XN, UK

K. J. Jager (✉)
ERA-EDTA Registry, Department of Medical Informatics,
Academic Medical Center, University of Amsterdam,
J.2–254, PO Box 22700, 1100 DE Amsterdam, The Netherlands
e-mail: k.j.jager@amc.uva.nl
Tel.: +31-20-5667637
Fax: +31-20-6919840

in the pediatric population from 12 national and regional registries.

Materials and methods

Data collection

Data from the renal registries of Austria, Dutch-speaking Belgium, French-speaking Belgium, Catalonia (Spain), Denmark, Finland, Greece, Iceland, The Netherlands, Norway, Scotland (UK), and Sweden were chosen for inclusion in this report because of the quality and the availability of their data. Data from 7 of these registries were available for the years 1980–2000. Data from Dutch-speaking Belgium were available for 1994–2000, from French-speaking Belgium for 1985–2000, from Catalonia for the years 1985–2000, from Denmark for the years 1990–2000, and from Sweden for the years 1991–2000. The data consisted of a limited number of patient and treatment variables. This set included a meaningless national registry patient identifier, date of birth, gender, primary renal disease, date of start of first RRT, history of RRT with dates and changes of modality, treatment center, date and cause of death, and information concerning transfer from or to other renal registries. Details about data collection and data processing have been described previously [3].

Data analysis

The date of onset of end-stage renal disease (ESRD) was defined as the date of start of RRT. All children and young people less than 20 years at the start of RRT were included. We excluded patients not residing in the area of a contributing registry and patients with a missing start date. The incidence of RRT was defined as the number of new cases per year. The prevalence was defined as the number of patients alive and on RRT on 31 December. For both parameters the mid-year population was used as denominator. Renal diseases and causes of death were defined according to the ERA-EDTA coding systems, and subsequently classified into groups (see Appendix). To allow analysis of differences related to age, the data were analyzed in four equal age bands 0–4, 5–9, 10–14, and 15–19 years. These age bands were chosen because they correspond to widely available population statistics. The age group of 15–19 years was included because several important aspects of growth and development occur at this age. In order to evaluate the changes in patient characteristics, treatment, and outcome with time the data were analyzed in four cohorts 1980–1984, 1985–1989, 1990–1994, and 1995–2000.

Differences between groups were analyzed with chi-square tests for categorical variables. A two-sided *P* value less than 0.05 was considered statistically significant. Statistical analysis of mortality

was performed by the Kaplan-Meier method and by Cox proportional hazards regression. In the latter analysis, the relative risk of death was expressed as the adjusted hazard ratio (AHR). The 1st day on dialysis when this was the first form of RRT was taken as the starting point for the analysis of patient survival on dialysis. The death of the patient was the event studied. Transplantation, recovery of renal function, and loss to follow-up were censored observations. For the analysis of patient survival after transplantation, we took the date of the first renal transplant as the 1st day of follow-up. Death was the event, whereas the follow-up time was censored at loss of follow-up. The follow-up time of patients alive and on RRT as of 31 December 2000 was censored at that date.

Results

There were 3,184 patients from 12 registries who started RRT during the period 1980–2000 included in the study. Table 1 shows the general population statistics of these countries or regions, according to registry of origin. Figure 1 shows the incidence of RRT per million of age-related population (pmarp) by registry (upper panel) and by age group (lower panel). Overall, the incidence of RRT for patients aged 0–19 years was 7.1 pmarp in the period 1980–1984 and in the 15 years thereafter was relatively stable at 9 to 10 pmarp. The incidence was highest in the 15- to 19-year age group. In children aged 0–4 years there was an almost threefold increase with time from 2.4 pmarp in 1980–1984 to 6.2 pmarp in 1985–1989. There was a high incidence of RRT in these children aged 0–4 years in Finland (15.5 pmarp in 1995–2000) due to the large number of infants in this country with hereditary nephropathy. Figure 2 shows the increase in prevalence of RRT in children and adolescents from 22.9 pmarp in 1980 to 62.1 pmarp in 2000.

Table 2 shows the contribution in incident patients of the commonest conditions leading to chronic renal failure. Hypoplasia/dysplasia and hereditary diseases were the commonest in the 0- to 4-year age group, while glomerulonephritis and pyelonephritis became progressively more common with increasing age. There was little gender difference between the disease groups, apart from pyelonephritis, hypoplasia/dysplasia, and hereditary nephropathy, which were more common in males.

Table 1 General population statistics, according to registry of origin

	Millions of inhabitants, aged 0–19 years (2000)	Millions of inhabitants, all ages (2000)
Austria	1.8	8.1
Belgium, Dutch-speaking	1.4	5.9
Belgium, French-speaking	1.1	4.3
Denmark	1.3	5.3
Finland	1.3	5.2
Greece	2.3	10.6
Iceland	0.1	0.3
Norway	1.2	4.5
Spain, Catalonia	1.2	6.2
Sweden	2.1	8.9
The Netherlands	3.9	15.9
UK, Scotland	1.3	5.1
Total	18.8	80.3

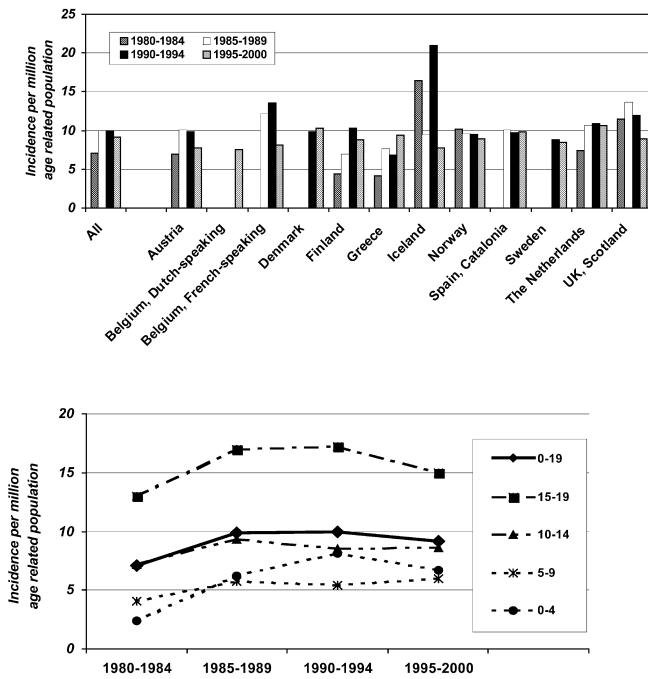


Fig. 1 Incidence of renal replacement therapy (RRT) per million age-related population in patients aged 0–19 years, by registry and cohort (upper panel) and by age group and cohort (lower panel)

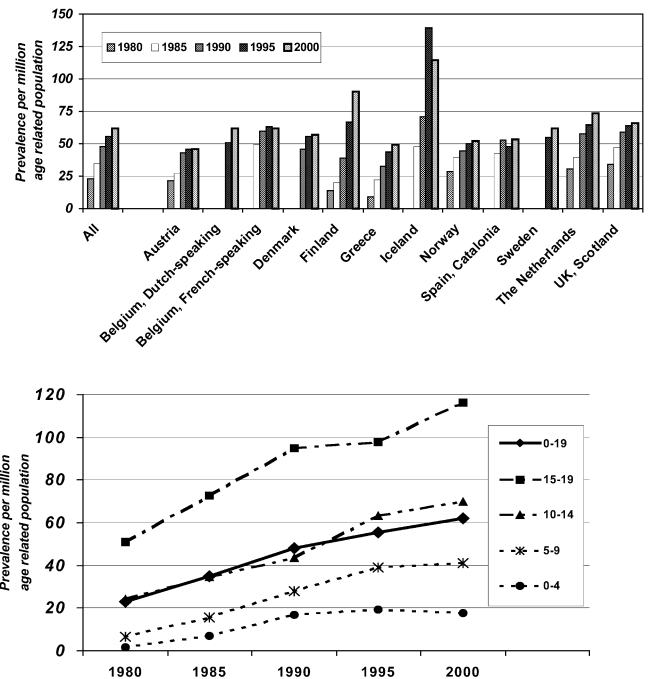


Fig. 2 Prevalence of RRT per million age-related population in patients 0–19 years, by registry and year (upper panel) and by age group and year (lower panel)

Table 2 Primary renal disease in incident patients per million age-related population, by age group and male to female ratio (period 1980–2000) (HUS hemolytic uremic syndrome)

Age group	0–19 years	0–4 years	5–9 years	10–14 years	15–19 years	M/F ratio
Glomerulonephritis	2.1	0.8	1.0	1.8	4.5	1.0
Pyelonephritis	1.9	0.8	0.7	2.1	3.8	1.7*
Cystic kidneys	0.7	0.4	0.7	1.0	0.8	0.9
Hypoplasia/dysplasia	1.0	1.3	1.0	1.0	0.9	2.0*
HUS	0.3	0.5	0.3	0.2	0.3	1.1
Hereditary nephropathy	0.9	1.2	0.5	0.5	1.1	2.0*
Miscellaneous	1.2	0.8	0.5	1.0	2.3	0.9
Unknown	1.0	0.5	0.6	0.8	1.9	1.3*

* $P < 0.05$

Table 3 First treatment modality (at day 1) per million age-related population for the different cohorts, by age group (HD hemodialysis, PD peritoneal dialysis, Tx pre-emptive renal transplantation)

Age group	0–19 years			0–4 years			5–9 years			10–14 years			15–19 years		
	HD	PD	Tx	HD	PD	Tx	HD	PD	Tx	HD	PD	Tx	HD	PD	Tx
1980–1984	5.2	1.3	0.5	0.6	1.6	0.1	2.7	1.3	0.1	5.4	1.2	0.7	10.5	1.1	0.9
1985–1989	6.2	2.6	1.1	0.9	4.8	0.5	2.5	2.0	1.2	6.5	1.8	1.0	13.4	2.1	1.5
1990–1994	4.9	3.6	1.4	1.4	5.5	1.0	2.3	2.3	0.8	4.4	2.7	1.3	10.9	4.0	2.2
1995–2000	4.4	3.1	1.6	1.6	4.2	0.9	1.8	2.7	1.4	3.6	2.8	2.1	10.1	2.7	2.0

Table 3 shows the changes with time of the first treatment modality in the different age groups. Overall, hemodialysis was the commonest form of treatment at the start (day 1) of RRT in the cohort 1995–2000 (48%), followed by peritoneal dialysis (34%), while pre-emptive transplantation accounted for the remaining 18%. Hemodialysis was used much more often in the older children, while peritoneal dialysis was the preferred therapy in

children below 5 years of age. Table 3 also shows that peritoneal dialysis and transplantation were more often the first treatment modality in recent years compared with the 1980–1984 time period. There was a large difference between countries in the initial form of RRT, as shown in Fig. 3. Pre-emptive transplantation was most commonly used in Norway, Sweden, and Denmark, while peritoneal dialysis was most popular in Finland, Scotland, and the

Table 4 Changes in transplant rate (number of transplants per million age-related population, period 1980–2000)

Age group	0–19 years	0–4 years	5–9 years	10–14 years	15–19 years
1980–1984	5.8	1.5	3.8	8.5	8.1
1985–1989	9.5	5.6	9.4	13.0	9.3
1990–1994	9.0	7.1	7.0	10.0	11.4
1995–2000	8.5	8.3	7.5	9.6	8.6

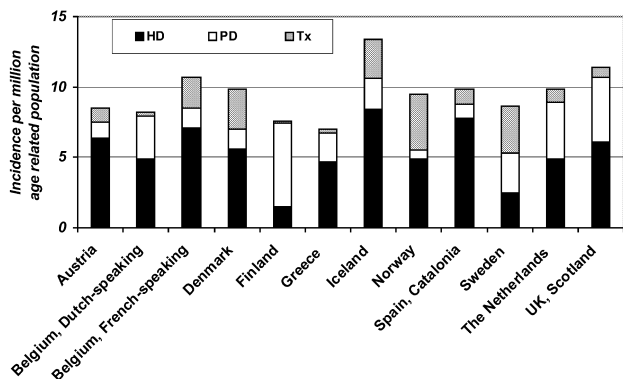


Fig. 3 First treatment modality by country per million age-related population at day 1, for period 1980–2000 (Tx pre-emptive renal transplantation, HD hemodialysis, PD peritoneal dialysis)

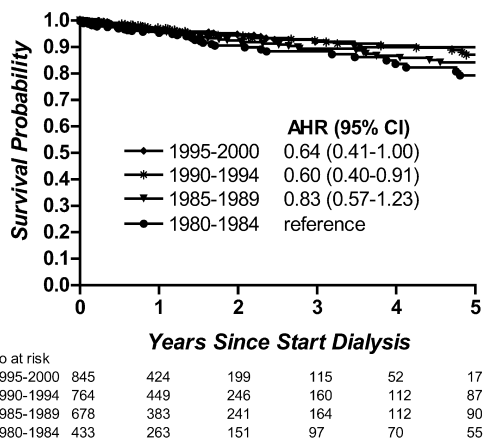
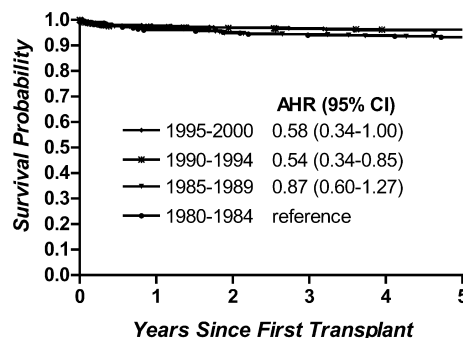


Fig. 4 Patient survival in dialysis patients aged 0–19 years, by cohort (adjusted for age and gender). The relative risk of death was expressed as adjusted hazard ratio (AHR)

Netherlands. The frequent use of peritoneal dialysis in Finland occurred in all age groups and was therefore not due to the high incidence of hereditary nephropathy alone. Table 4 shows that the number of transplants per million in children aged 0–4 years has now reached the level of that in the other pediatric age categories.

In dialysis patients the crude 2-year patient survival in the 0- to 19-year age group increased from 90.9% in 1980–1984 to 94.2% in 1995–2000, whereas in transplant recipients it rose from 95.2% to 96.9%. The greatest improvements have been achieved in the youngest age group. In these children aged 0–4 years the 2-year survival in dialysis patients increased from 71.3% in 1980–1984 to 87.9% in 1995–2000. Also in this age



no at risk	0	1	2	3	4	5
1995–2000	604	587	470	372	242	118
1990–1994	580	564	561	559	557	557
1985–1989	420	405	396	393	390	387
1980–1984	247	237	235	232	232	229

Fig. 5 Patient survival in recipients of a first renal transplant aged 0–19 years, by cohort (adjusted for age, gender, and donor type). The relative risk of death was expressed as AHR

group patient survival following renal transplantation rose from 93.6% in 1985–1989 (this time period was taken as a reference, as in 1980–1984 the number of transplant recipients in this age category was too low for statistical analysis) to 97.6% in 1995–2000. Figure 4 shows the improvement in survival in dialysis patients over time, adjusted for age and gender. In patients aged 0–19 years the relative risk of death of those patients starting dialysis in the period 1995–2000 was 0.64 [95% confidence interval (CI) 0.41–1.00] compared with patients starting dialysis in 1980–1984. The improvement was greatest in the subgroup of patients aged 0–4 years AHR 0.21, 95% CI 0.09–0.51. An even greater improvement was observed in the survival of transplant recipients (Fig. 5). Adjusted for age, gender, and donor type the relative risk of death of those aged 0–19 years receiving a first renal allograft in 1995–2000 was 0.58 (95% CI 0.34–1.00), compared with patients in the 1980–1984 period.

The causes of death are shown in Fig. 6. Infection and cardiac causes comprised the major categories, although almost one-quarter was classified as unknown. Cardiac causes of death predominated in those on hemodialysis, in contrast to infections in patients on peritoneal dialysis or those with a functioning graft. Of the separate codes, cerebrovascular accident, cardiac arrest, and septicemia were those most frequently reported in all modalities, accounting for respectively 8.0%, 7.4%, and 7.1% of all deaths in the entire group. Potentially preventable causes of death, such as hyperkalemia, hypertensive cardiac failure, fluid overload, and cerebrovascular accident, together accounted for 15.4% in the entire group, and for 21.1%, 10.3%, and 11.7% in the hemodialysis,

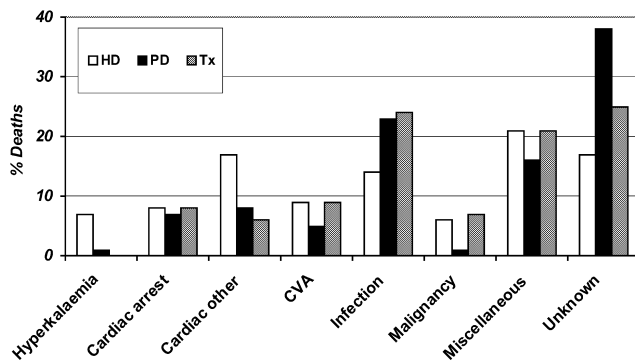


Fig. 6 Causes of death by treatment modality (1980–2000) (CVA cerebrovascular accident)

peritoneal dialysis, and transplant patients, respectively. In 2.0% of the 6.7% of hemodialysis patients who died of a malignancy, this malignancy had possibly been induced by immunosuppressive therapy after a previous transplant.

Discussion

These data are the first for children on RRT in Europe that have been produced by the ERA-EDTA Registry since its problems with data collection during the late 1990s. In June 2000, the ERA-EDTA Registry changed its policy of data collection, moved its office to Amsterdam, and started an entirely new database. The data are now obtained only from national or large regional registries that can provide complete and accurate data. Thus reliance can be placed on their quality. The development of this new ERA-EDTA database not only permits comparisons of pediatric RRT data between countries in Europe but also with registry data elsewhere in the world. The combined pediatric and adult database will enable it in future studies to look at the impact of renal failure in childhood on life expectancy and quality of life in adulthood.

There has been no major change among the countries surveyed in the number of older children accepted for RRT over the past 20 years. This contrasts with the large increase during the 1980s in the age group up to 5 years. The latter may reflect the improving skill and confidence of pediatric nephrologists in overcoming the technical problems associated with RRT among infants and very young children. The much higher incidence of RRT in children classified as having hereditary nephropathy in Finland is due to congenital nephrosis (Finnish type), which is currently the most-common cause of ESRD in that country among children below 15 years of age [4]. Our analysis shows that the incidence of RRT in children in Europe is similar to that reported in US whites below the age of 10 years, but lower than in US whites in the age groups 10–14 and 15–19 years [5]. The incidence of RRT in Australia, however, is quite similar to ours across all childhood age categories [6].

As one would expect, RRT prevalence rates have continued to rise as a consequence of improving patient survival together with the increase in RRT incidence which took place during the 1980s. The overall prevalence has more than doubled over the 20 years of the current analysis. Also there was a wide geographical variation in prevalence of RRT in children. One can at present only speculate as to the reasons for these differences between countries, but the aim of future analyses will be to answer this question. As with incidence, the prevalence of RRT in Europe was similar to that of Australia across all age categories [6], but compared with the United States the European prevalence was lower in the 10- to 14- and 15- to 19-year age groups [5].

This analysis confirmed what had been expected with regard to the types of primary renal disease, in that glomerulonephritis and pyelonephritis predominated in the older child, as in other parts of the world [5, 6]. Cystic kidneys, hypoplasia/dysplasia, and hemolytic uremic syndrome have contributed to a lesser degree throughout the pediatric age groups, while hereditary disease and hypoplasia/dysplasia, as elsewhere, have been the main causes of ESRD in the 0- to 4-year age group [6].

Our analysis has shown wide variations in first treatment modality with regard both to age group and country. Peritoneal dialysis has predominated in infancy, giving way to hemodialysis with increasing age. Pre-emptive transplantation has made a smaller but useful contribution, being used in 13%–25% of patients in 1995–2000 depending on age group, with little change with time over the last 15 years. A similar pattern of treatment modalities across age categories has been reported from Australia [6]. It is disappointing to note from our data the absence of any major increase in the rate of pre-emptive transplantation since the time period 1985–1990, in view of its advantages over dialysis. Norway has had the highest pre-emptive transplant rate, which is in line with the emphasis in that country on transplantation as the main form of RRT in all age groups. Hemodialysis was the commoner type of dialysis in all countries except Finland where peritoneal dialysis has predominated. The predominance of peritoneal dialysis in this country can be explained only to a limited extent by the large number of very young children on RRT.

Our data confirm the findings of others reporting a lower survival for younger children [5, 7]. As in other studies [8, 9, 10], we noted an improvement with time in patient survival among both dialysis and transplanted patients, although most of the improvement in the transplant recipients occurred prior to 1995. It is encouraging to note that in the most-difficult age group to treat, i.e., those under 5 years, the mortality has continued to fall in more-recent years. The improvement of patient survival among transplant recipients is at least in part explained by the better graft survival in the recent past [11].

In general, the pattern of the causes of death in this analysis was comparable to that in other countries, where

cardiac and infectious disease compete for the role of leading cause of death [5, 7, 12]. However, the high percentage of causes reported as unknown in our series complicates the interpretation of the data. The current high survival rates in pediatric RRT patients will make it difficult to achieve much further improvement over the next few years. Further efforts should however be made to reduce the number of potentially preventable cases of death, which now comprise up to 21.1% of deaths in hemodialysis patients.

In conclusion, this first analysis of pediatric data from the Amsterdam-based ERA-EDTA Registry has shown that the prevalence of RRT has continued to increase, while the rise in incidence has flattened out over the past 15 years. Peritoneal dialysis has tended to increase over time as a first treatment modality at the expense of hemodialysis, with considerable variation between countries. It is disappointing that the rate of pre-emptive transplantation has failed to increase since 1985. Overall, pediatric patient survival on RRT improved to an important extent, especially in children under 5 years. Over the next few years it is planned to extend our analyses as additional registries become affiliated to the ERA-EDTA Registry. This will increase the scope for further comparisons between European countries and other international registries.

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Appendix

ERA-EDTA codes for primary renal disease (Table 5) and cause of death (Table 6) in children.

Table 5 ERA-EDTA codes for primary renal disease (PRD) in children (I glomerulonephritis/sclerosis, II pyelonephritis, III cystic kidneys, IV hypoplasia/dysplasia, V hemolytic uremic syndrome, VI hereditary nephropathy, VII miscellaneous, VIII unknown)

PRD	Version 1994	Version 1995	PRD group
Glomerulonephritis, NOT examined histologically	10	10	I
Focal segmental glomerulosclerosis with nephrotic syndrome in children	11	11	I
IgA nephropathy (proven by immunofluorescence, not code 76 and not 85)	12	12	I
Dense deposit disease, membrano-proliferative glomerulonephritis, type II (proven by immunofluorescence and/or electron microscopy)	13	13	I
Membranous nephropathy	14	14	I
Membrano-proliferative glomerulonephritis, type I (proven by immunofluorescence and/or electron microscopy—not code 84 or 89)	15	15	I
Crescentic (extracapillary) glomerulonephritis (type I, II, III)	16	16	I
Focal segmental glomerulosclerosis with nephrotic syndrome in adults	17	17	I
Glomerulonephritis, examined histologically, not given above	19	19	I
Pyelonephritis—cause not specified	20	20	II
Pyelonephritis associated with neurogenic bladder	21	21	II
Pyelonephritis due to congenital obstructive uropathy with/without vesico-ureteric reflux	22	22	II
Pyelonephritis due to acquired obstructive uropathy	23	23	II
Pyelonephritis due to vesico-ureteric reflux without obstruction	24	24	II
Pyelonephritis due to urolithiasis	25	25	II
Pyelonephritis due to other cause	29	29	II
Interstitial nephritis (not pyelonephritis) due to other cause, or unspecified (not mentioned above)	30	30	VII
Nephropathy (interstitial) due to analgesic drugs	31	31	VII

Table 5 (continued)

PRD	Version 1994	Version 1995	PRD group
Nephropathy (interstitial) due to <i>cis</i> -platinum	32	32	VII
Nephropathy (interstitial) due to cyclosporin A	33	33	VII
Lead-induced nephropathy (interstitial)		34	VII
Drug-induced nephropathy (interstitial), not mentioned above	39	39	VII
Cystic kidney disease—type unspecified	40	40	III
Polycystic kidneys, adult type (dominant)	41	41	III
Polycystic kidneys, infantile (recessive)	42	42	III
Medullary cystic disease, including nephronophthisis	43	43	III
Cystic kidney disease—other specified type	49	49	III
Hereditary/familial nephropathy—type unspecified	50	50	VI
Hereditary nephritis with nerve deafness (Alport syndrome)	51	51	VI
Cystinosis	52	52	VI
Primary oxalosis	53	53	VI
Fabry disease	54	54	VII
Hereditary nephropathy—other specified type	59	59	VI
Renal hypoplasia (congenital)—type unspecified	60	60	IV
Oligomeganephronic hypoplasia	61	61	IV
Congenital renal dysplasia with or without urinary tract malformation	63	63	IV
Syndrome of agenesis of abdominal muscles (Prune-Belly)	66	66	IV
Renal vascular disease—type unspecified	70	70	VII
Renal vascular disease due to malignant hypertension	71	71	VII
Renal vascular disease due to hypertension	72	72	VII
Renal vascular disease due to polyarteritis	73	73	VII
Wegener granulomatosis	74	74	VII
Glomerulonephritis related to liver cirrhosis	76	76	VII
Cryoglobulinemic glomerulonephritis		78	VII
Renal vascular disease—due to other cause (not given above and not code 84–88)	79	79	VII
Diabetes glomerulosclerosis or diabetic nephropathy—type I	80	80	VII
Diabetes glomerulosclerosis or diabetic nephropathy—type II	81	80	VII
Myelomatosis/light chain deposit disease	82	82	VII
Amyloid	83	83	VII
Lupus erythematosus	84	84	VII
Henoch-Schönlein purpura	85	85	VII
Goodpasture syndrome	86	86	VII
Systemic sclerosis (scleroderma)	87	87	VII
Hemolytic uremic syndrome (including Moschcowitz syndrome)	88	88	V
Multi-system disease—other (not mentioned above)	89	89	VII
Tubular necrosis (irreversible) or cortical necrosis (different from 88)	90	90	VII
Tuberculosis	91	91	VII
Gout	92	92	VII
Nephrocalcinosis and hypercalcemic nephropathy	93	93	VII
Balkan nephropathy	94	94	VII
Kidney tumor	95	95	VII
Traumatic or surgical loss of kidney	96	96	VII
Other identified renal disorders	99	99	VII
Chronic renal failure, etiology uncertain	0	0	VIII

Table 6 ERA-EDTA codes for cause of death (COD) in children (ESRF end-stage renal failure, I hyperkalemia, II cardiac arrest, III cardiac, other, IV cerebrovascular accident, V infection, VI malignancy, VII miscellaneous, VIII unknown/unavailable)

COD	Version 1994	Version 1995	COD group
Myocardial ischemia and infarction	11	11	III
Hyperkalemia	12	12	I
Hemorrhagic pericarditis	13	13	VII
Other causes of cardiac failure	14	14	III
Cardiac arrest/sudden death, other cause or unknown	15	15	II
Hypertensive cardiac failure	16	16	III
Hypokalemia	17	17	VII
Fluid overload/pulmonary edema	18	18	III
Pulmonary embolus	21	21	VII
Cerebrovascular accident, other cause or unspecified	22	22	IV
Gastrointestinal hemorrhage	23	23	VII
Hemorrhage from graft site	24	24	VII
Hemorrhage from vascular access or dialysis circuit	25	25	VII
Hemorrhage from ruptured vascular aneurysm (not code 22 or 23)	26	26	VII
Hemorrhage from surgery (not code 23, 24 or 26)	27	27	VII
Other hemorrhage (not codes 23–27)	28	28	VII
Mesenteric infarction	29	29	VII
Pulmonary infection (bacterial-not code 73)	31	31	V
Pulmonary infection (viral)	32	32	V
Pulmonary infection (fungal or protozoal, parasitic)	33	33	V
Infections elsewhere except virus hepatitis	34		V
Septicemia	35	35	V
Tuberculosis (lung)	36	36	V
Tuberculosis (elsewhere)	37	37	V
Generalized viral infection	38	38	V
Peritonitis (all causes except for peritoneal dialysis)	39	39	V
Liver disease due to hepatitis B virus	41	41	VII
Liver disease due to other viral hepatitis	42	42	VII
Liver disease due to drug toxicity	43	43	VII
Cirrhosis—not viral	44	44	VII
Cystic liver disease	45	45	VII
Liver failure—cause unknown	46	46	VII
Patient refused further treatment for ESRF	51	51	VII
Suicide	52	52	VII
ESRF treatment ceased for any other reason	53	53	VII
ESRF treatment withdrawn for medical reasons		54	VII
Uremia caused by graft failure	61		VII
Pancreatitis	62	62	VII
Bone marrow depression	63	63	VII
Cachexia	64	64	VII
Malignant disease, possibly induced by immunosuppressive therapy	66	66	VI
Malignant disease: solid tumors except those of 66	67	67	VI
Malignant disease: lymphoproliferative disorders except those of 66		68	VI
Dementia	69	69	VII
Peritonitis (sclerosing, with peritoneal dialysis)	70	70	V
Perforation of peptic ulcer	71	71	VII
Perforation of colon	72	72	VII
Chronic obstructive airways disease	73	73	VII
Accident related to ESRF treatment (not 25)	81	81	VII
Accident unrelated to ESRF treatment	82	82	VII
Other identified cause of death	99	99	VII
Peritonitis (bacterial, with peritoneal dialysis)		100	V
Peritonitis (fungal, with peritoneal dialysis)		101	V
Peritonitis (due to other cause, with peritoneal dialysis)		102	V
Cause of death uncertain/not determined	0	0	VIII

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