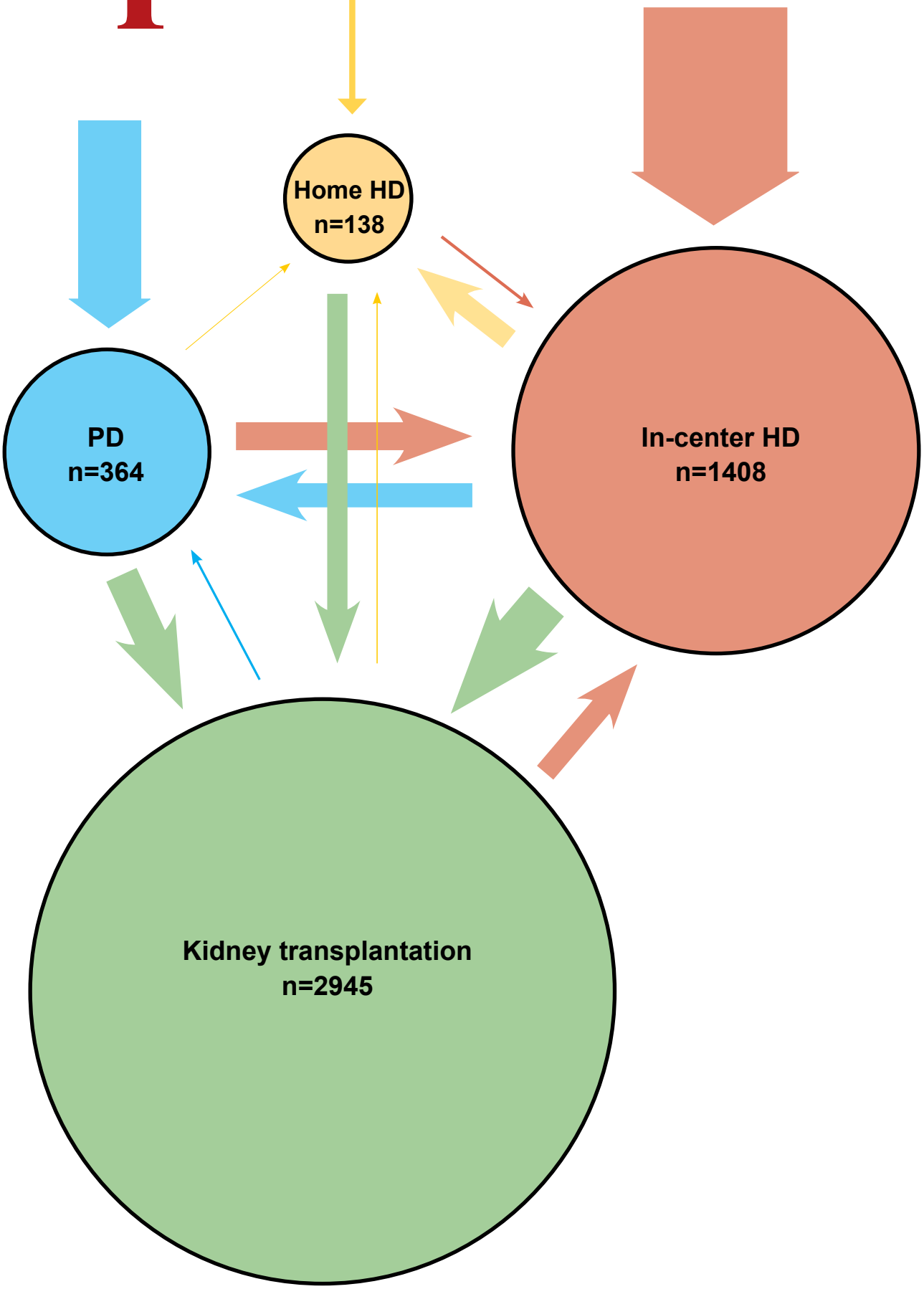
Report 2016

Finnish Registry for Kidney Diseases



Finnish Registry for Kidney Diseases – Report 2016

Content

RRT patients' mortality

Analysis of quality of care

Board of the Finnish Registry for Kidney Diseases

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Is treatment of dialysis and renal transplantation patients in Finland as good as elsewhere? Are treatment criteria similar to those of other countries? Are there differences in treatment quality or outcomes within Finland? How has patients' treatment changed in recent years? Are there areas for improvement? These are some of the questions that the Finnish Registry for Kidney Diseases answers in its annual reports, which have been published since the early 1990s. The report gives yearly updates on incidence and prevalence of renal replacement therapy (RRT, i.e. dialysis and renal transplantation) and mortality of RRT patients. The report also features special analyses that vary from year to year.

Since Report 2012, treatment quality has been analysed regularly, for the fifth time in this report. The expectation is that annually repeated quality analyses, presented openly according to healthcare district, will help to improve the quality of RRT throughout the country. Quality cannot be improved if problems are not identified. The quality analyses have resulted in successful corrective actions in some cases, but the proportion of patients achieving treatment goals has not increased in the entire country.

Identification of deviations in treatment quality is not sufficient. Improving quality requires appropriate methods and knowledge. Here again, the quality analyses can be helpful because they identify healthcare districts with particularly high goal achievement. Finnish nephrologists know each other and regularly come together at meetings. It is easy to ask a colleague for advice. The analyses of treatment quality have not identified districts that are superior (or inferior) regarding all quality measurements. Rather, all healthcare districts have their own areas of strength. We hope that the quality assurance analyses of the Finnish Registry for Kidney Diseases will serve as a basis for fruitful and constructive discussion, where everyone has something to offer.

The Finnish Registry for Kidney Diseases has been funded by the state since the early 1990s, in recent years through the National Institute for Health and Welfare (THL). However, funding has been reduced over the years and in 2016 it was decided that it will be phased out. In 2017, funding had already fallen to half of the previous level. The healthcare districts in Finland saved the registry by paying 10 euros towards each RRT patient in 2017. However, the funding for 2018 was long uncertain. We are now happy to announce that the funding for the next few years has been secured. The Finnish Kidney and Liver Association sent an application for support to the Funding Centre for Social Welfare and Health Organisations (STEA), which will provide the funding for 2018–2020. STEA is an independent authority in connection with the Ministry of Social Affairs and Health, which manages the funding granted for health and well-being from the gaming revenue of Veikkaus Oy.

The Finnish Registry for Kidney Diseases received great support in its struggle for financing. We got important letters of recommendation from the European nephrologists' association ERA-EDTA, the ERA-EDTA Registry, and the Finnish Society of Nephrology. The presidents of the Finnish Society of Nephrology and the Finnish Kidney and Liver Association wrote an important opinion piece in the largest newspaper in Finland and the funding problem was widely noted. Nineteen members of the Parliament of Finland signed a written question to the Speaker of the Parliament about the funding and legal status of our registry and the Minister of Social Services provided a written response. Many nephrologists have also helped by supporting the registry in their healthcare districts. We warmly thank all supporters! We also thank all nephrology units for excellent cooperation!

Patrik Finne
Administrative Director

Anniina Pylsy
Registry Coordinator

Per-Henrik Groop
Chairman of the Board

Summary of Report

Finnish population (pages 8–9)

The Finnish population increased by 4.3% in 2006–2016. The population has grown the most in the healthcare districts of Helsinki-Uusimaa, Åland, Pirkanmaa, and Pohjois-Pohjanmaa. The trend varies throughout the country, and in 11 healthcare districts the population has decreased. In this 10-year period, the Finnish population has aged and the proportion of inhabitants older than 65 years has increased from 16% to 21%.

Incidence of RRT, number of patients entering RRT (pages 10–19)

In 2016, the incidence of RRT was higher than ever before, 102 new RRT patients per million inhabitants, which was 6% larger than in 2015 and 20% larger than in 2014. There is no obvious reason for the increased incidence. Age at start of RRT and distribution of kidney disease diagnoses have remained unchanged. Incidence has increased in all regions. The patients who entered RRT in 2015–2016 did not have a better kidney function than in earlier years, i.e. patients have not entered RRT earlier than before. In an international comparison, the incidence in Finland is still low.

The most frequent kidney disease diagnoses of patients who entered RRT are type 2 diabetes, type 1 diabetes, glomerulonephritis, and polycystic degeneration. Three months after the start of RRT, 33% of patients were on home dialysis (peritoneal dialysis or home hemodialysis), but the proportion varied significantly between healthcare districts. Moreover, 2% had received a kidney transplant at this time point, which is a substantially smaller proportion than in the other Nordic countries (7–17%).

Prevalence of RRT, number of patients at end of year (pages 20–27)

At end of 2016, there were 1910 dialysis patients and 2945 kidney transplantation patients in Finland. The prevalence of RRT was 882 patients per million inhabitants, which is approximately 10% lower than in Sweden, Norway, and Denmark. In healthcare districts, the prevalence of RRT varied between 697 and 1264 patients per million inhabitants. During the past ten years the number of dialysis patients had increased by 24% and the number of kidney transplantation patients by 29%. Of all dialysis patients, 19% were on peritoneal dialysis (PD), and 7% were on home hemodialysis at the end of 2016. The most frequent kidney disease diagnosis of kidney transplantation patients was glomerulonephritis (26% of patients), of hemodialysis patients type 2 diabetes (19%), and of peritoneal dialysis patients type 1 diabetes (22%).

Changes in type of treatment (pages 28–29)

The Report has traditionally presented yearly transitions of patients between the main treatment modalities of PD, hemodialysis, and kidney transplantation. This report includes a new analysis which shows also home dialysis patients' treatment changes. During 2016 home dialysis patients received more frequently a kidney transplant than PD patients or in-center hemodialysis patients. No patient moved directly from PD to home hemodialysis, but a few PD patients were switched first to in-center hemodialysis and then to home hemodialysis.

RRT patients' mortality (page 30)

In 2012–2016, the mortality of RRT patients was 82 deaths per 1000 patient-years. Mortality was slightly higher in the northern and western regions than elsewhere. During the past ten years age- and sex-standardized mortality has decreased in all regions.

Quality of care (pages 32–45)

Since Report 2012, analyses of quality of care have been presented openly according to healthcare district and region. The most central analyses are repeated every year. New in this report are the analyses on dialysis patients' serum concentration of parathyroid hormone (PTH) and hemodialysis patients' urea clearance (weekly standardized Kt/V, StdKt/V). In addition, vascular access of hemodialysis patients is shown by healthcare districts for the first time.

At the end of 2016, 64% of dialysis patients had reached the target PTH concentration of 150–599 ng/l. Since 2009, PTH values higher than 599 ng/l have become more common and values lower than 150 ng/l less common. The proportion of patients reaching the PTH target did not vary by healthcare district, but comparison is hindered by the several different measurement methods in use. The serum phosphorus target (<1.8 mmol/l) was attained by 67%

of dialysis patients, and a significant difference was present between healthcare districts and regions.

Of the in-center hemodialysis patients aged 20–75 years, 83% reached the StdKt/V target of 2.1 or higher. StdKt/V describes how efficiently hemodialysis removes urea. A significant difference existed in achievement of the StdKt/V target between healthcare districts and regions. The vast majority (92%) of hemodialysis patients received sufficient dialysis, as defined by at least 12 hours and 3 times per week.

At the end of 2016, 81% of dialysis patients used erythropoiesis-stimulating agents (ESAs). Of ESA users, 63% reached the hemoglobin target of 100–119 g/l. Of hemodialysis patients, 80% used intravenous iron, and the proportion varied significantly between healthcare districts and regions. Of patients who used intravenous iron, 87% also used ESA.

The recommended type of vascular access for hemodialysis patients is an arteriovenous fistula or graft. Of the patients who entered hemodialysis in 2016, 50% had a fistula or graft, 25% had a temporary central venous catheter, and 25% had a tunneled catheter.

Of kidney transplantation patients, 61% achieved the target for serum LDL cholesterol (<2.6 mmol/l). The proportion of patient achieving the target varied between healthcare districts, but the variation was smaller than in recent years.

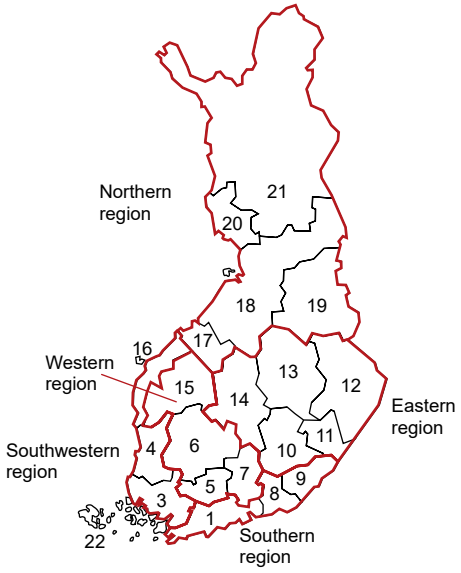
Acknowledgements

The Board of the Finnish Registry for Kidney Diseases participated in the planning of this report and approved the final version. Kaj Metsärinne suggested the new analysis of modality transitions in home dialysis, which is also shown on the cover page. Eero Honkanen provided knowledgeable comments on the StdKt/V analyses. Satu Keronen, Leena Martola, and Eero Honkanen gave valuable advice on the PTH analyses.

Table 1. The Finnish population (as thousands of inhabitants) and its distribution in healthcare districts
Finnish Registry for Kidney Diseases 2006–2016

Healthcare district		Year					Change (%) 2006–2016
		2006	2011	2014	2015	2016	
1	Helsinki–Uusimaa	1463	1545	1599	1616	1634	11.7
3	Varsinais–Suomi	461	470	476	477	479	3.8
4	Satakunta	228	225	224	223	222	–2.8
5	Kanta–Häme	170	175	175	175	174	2.3
6	Pirkanmaa	496	515	524	527	530	6.7
7	Päijät–Häme	211	213	213	212	213	0.9
8	Kymenlaakso	177	175	173	172	171	–3.5
9	Etelä–Karjala	134	133	132	131	131	–2.9
10	Etelä–Savo	109	105	104	103	102	–5.7
11	Itä–Savo	47	45	44	43	43	–9.2
12	Pohjois–Karjala	172	170	169	168	168	–2.4
13	Pohjois–Savo	249	248	248	248	248	–0.7
14	Keski–Suomi	243	249	251	252	253	3.8
15	Etelä–Pohjanmaa	199	199	198	197	197	–1.0
16	Vaasa	162	167	170	170	170	4.7
17	Keski–Pohjanmaa	77	78	78	79	79	1.4
18	Pohjois–Pohjanmaa	384	398	406	407	408	6.3
19	Kainuu	81	78	76	75	75	–7.4
20	Länsi–Pohja	66	65	64	63	63	–5.7
21	Lappi	119	118	118	118	118	–0.8
22	Åland	27	28	29	29	29	8.5
Region	South	1775	1852	1904	1919	1936	9.1
	Southwest	879	892	898	900	900	2.4
	West	1076	1102	1111	1111	1113	3.5
	East	821	818	816	815	813	–0.9
	North	727	738	742	742	742	2.0
Entire country		5277	5401	5472	5487	5503	4.3

Figure 1. Healthcare districts and regions in Finland
Finnish Registry for Kidney Diseases 2016



On 31 December 2016, the population of Finland was 5.503 million (Table 1, Source: Statistics Finland). During the past ten years the population of the country has increased by 4.3%, with the fastest increase occurring in the southern region. The population in the eastern region has decreased. Of the healthcare districts, the population has increased most (more than 5%) in Helsinki-Uusimaa, Åland, Pirkanmaa, and Pohjois-Pohjanmaa. In the healthcare districts of Itä-Savo, Kainuu, Etelä-Savo, and Länsi-Pohja, the population has decreased especially rapidly.

The numbers in Figure 1 refer to the healthcare districts listed in Table 1. In this report, “region” refers to a university hospital region.

Table 2. The Finnish population (as thousands of inhabitants) according to region, age group, and sex
Finnish Registry for Kidney Diseases 2006–2016

Region	2006					2016				
	0–19 y (%)	20–64 y (%)	65–74 y (%)	>75 y (%)	Total	0–19 y (%)	20–64 y (%)	65–74 y (%)	>75 y (%)	Total
South										
Men	209 (24)	552 (64)	61 (7)	37 (4)	859 (100)	214 (23)	583 (62)	94 (10)	54 (6)	945 (100)
Women	202 (22)	564 (62)	76 (8)	74 (8)	916 (100)	205 (21)	583 (59)	112 (11)	91 (9)	991 (100)
Total	411 (23)	1115 (63)	138 (8)	111 (6)	1775 (100)	419 (22)	1166 (60)	206 (11)	145 (7)	1936 (100)
Southwest										
Men	102 (24)	263 (61)	38 (9)	27 (6)	429 (100)	97 (22)	256 (58)	55 (12)	36 (8)	444 (100)
Women	96 (21)	258 (58)	44 (10)	51 (11)	449 (100)	92 (20)	249 (55)	59 (13)	56 (12)	456 (100)
Total	198 (23)	521 (59)	82 (9)	77 (9)	879 (100)	189 (21)	505 (56)	114 (13)	92 (10)	900 (100)
West										
Men	126 (24)	324 (62)	46 (9)	31 (6)	526 (100)	122 (22)	317 (58)	66 (12)	42 (8)	548 (100)
Women	121 (22)	314 (57)	54 (10)	60 (11)	549 (100)	117 (21)	306 (54)	74 (13)	68 (12)	565 (100)
Total	246 (23)	638 (59)	100 (9)	91 (8)	1076 (100)	240 (22)	623 (56)	140 (13)	110 (10)	1113 (100)
East										
Men	94 (23)	248 (61)	38 (9)	25 (6)	405 (100)	85 (21)	233 (58)	52 (13)	33 (8)	403 (100)
Women	90 (22)	235 (57)	44 (10)	47 (11)	416 (100)	81 (20)	222 (54)	54 (13)	53 (13)	410 (100)
Total	184 (22)	483 (59)	81 (10)	72 (9)	821 (100)	166 (20)	455 (56)	106 (13)	86 (11)	813 (100)
North										
Men	96 (26)	220 (60)	30 (8)	19 (5)	365 (100)	92 (25)	213 (57)	42 (11)	27 (7)	373 (100)
Women	91 (25)	204 (56)	34 (9)	33 (9)	363 (100)	87 (24)	199 (54)	43 (12)	40 (11)	369 (100)
Total	187 (26)	424 (58)	64 (9)	52 (7)	727 (100)	179 (24)	411 (55)	84 (11)	67 (9)	742 (100)
Entire country										
Men	626 (24)	1606 (62)	213 (8)	138 (5)	2584 (100)	610 (22)	1601 (59)	308 (11)	192 (7)	2712 (100)
Women	600 (22)	1575 (58)	252 (9)	265 (10)	2693 (100)	583 (21)	1559 (56)	342 (12)	308 (11)	2791 (100)
Total	1227 (23)	3182 (60)	465 (9)	404 (8)	5277 (100)	1193 (22)	3160 (57)	650 (12)	500 (9)	5503 (100)

Table 2 shows the age and sex distribution of the Finnish population at the end of 2006 and 2016. At the end of 2015, 21% of the population was older than 65 years. In 2006, this proportion was 16%. In the southern region, the proportion of inhabitants older than 65 years was the smallest, 18%, whereas in the other regions it was 20–24%. The proportion of inhabitants aged 20–64 years was largest in the southern region, 60%, while it was 55–56% in all other regions. In the northern region, the proportion of inhabitants younger than 20 years was the largest, 24%.

The age of the Finnish population has increased during the past ten years. The proportion of inhabitants older than 75 years has increased from 8% to 9%, and the proportion of 65–74-year-olds from 9% to 12%. The proportion of inhabitants older than 65 years has increased equally in all regions. The proportion of 20–64-year-olds has decreased from 60% to 57%.

Table 3. Number of new RRT patients and incidence of RRT by healthcare district and region
Finnish Registry for Kidney Diseases 2006–2016

Healthcare district		Number of new RRT patients						Incidence of RRT/million inhabitants					
		2006	2011	2014	2015	2016	2012–2016 on average	2006	2011	2014	2015	2016	2012–2016 on average
1	Helsinki-Uusimaa	92	115	123	127	137	127	63	74	77	79	84	79
3	Varsinais-Suomi	47	38	49	46	57	47	102	81	103	96	119	98
4	Satakunta	22	21	20	23	32	23	96	93	89	103	144	103
5	Kanta-Häme	8	29	26	21	22	21	47	165	148	120	127	121
6	Pirkanmaa	60	48	51	51	56	52	121	93	97	97	106	100
7	Päijät-Häme	20	19	23	16	24	18	95	89	108	75	113	85
8	Kymenlaakso	21	8	16	18	13	14	119	46	93	105	76	81
9	Etelä-Karjala	14	14	9	17	21	15	104	106	68	130	161	114
10	Etelä-Savo	10	8	8	16	11	9	92	76	77	155	107	87
11	Itä-Savo	8	5	2	7	4	5	169	111	45	161	93	123
12	Pohjois-Karjala	14	13	11	23	15	15	82	77	65	137	89	88
13	Pohjois-Savo	22	33	22	32	31	29	88	133	89	129	125	117
14	Keski-Suomi	19	21	19	21	27	21	78	84	76	83	107	84
15	Etelä-Pohjanmaa	19	24	19	20	25	19	96	121	96	101	127	98
16	Vaasa	7	16	7	19	18	16	43	96	41	112	106	92
17	Keski-Pohjanmaa	10	5	10	13	8	10	129	64	128	165	102	125
18	Pohjois-Pohjanmaa	30	21	30	24	33	31	78	53	74	59	81	77
19	Kainuu	14	6	8	13	11	10	173	77	105	173	147	129
20	Länsi-Pohja	11	3	8	8	6	6	166	46	126	127	96	98
21	Lappi	9	15	5	7	8	7	76	127	42	59	68	61
22	Åland	1	4		5	2	4	37	141	0	173	68	104
Region	South	127	137	148	162	171	156	72	74	78	84	88	82
	Southwest	77	79	76	93	109	88	88	89	85	103	121	98
	West	107	120	119	108	127	111	99	109	107	97	114	100
	East	73	80	62	99	88	79	89	98	76	121	108	97
	North	74	50	61	65	66	64	102	68	82	88	89	87
Entire country		458	466	466	527	561	499	87	86	85	96	102	91
	Children <15 y	7	6	11	13	3	9	8	7	12	15	3	10

Table 3 shows the number of new RRT (renal replacement therapy, i.e. dialysis and kidney transplantation) patients and the incidence of RRT according to healthcare district and region. In the entire country, the incidence of RRT in 2015 was 102 new RRT patients per million inhabitants, which is larger than ever before. In 2012–2016, the average incidence was highest in the western region and lowest in the southern region. In the healthcare districts, the average incidence in 2012–2016 was lowest in Lapland (61 new RRT patients per million inhabitants) and highest in Kainuu (129 per million inhabitants).

Table 4. Number of new RRT patients by age group in healthcare districts and regions
Finnish Registry for Kidney Diseases 2012–2016

Healthcare district		Average annual number of new RRT patients in 2012–2016 by age group (y)						Incidence*/million inhabitants in 2012–2016 by age group (y)					
		0–19	20–44	45–64	65–74	≥ 75	Total	0–19	20–44	45–64	65–74	≥ 75	Total
1	Helsinki-Uusimaa	3.4	18.2	49.6	30.4	25.4	127	10	32	119	197	249	79
3	Varsinais-Suomi	1.2	6.0	15.6	14.6	9.4	47	12	41	122	261	211	98
4	Satakunta	0.4	2.8	8.6	6.6	4.6	23	9	46	136	225	189	103
5	Kanta-Häme	0.4	2.8	7.0	5.6	5.4	21	10	58	141	263	319	121
6	Pirkanmaa	2.2	7.2	19.8	13.0	10.0	52	19	43	145	222	215	100
7	Päijät-Häme	0.2	2.8	7.0	5.6	2.6	18	5	48	115	197	125	85
8	Kymenlaakso	0.2	2.4	6.6	2.8	2.0	14	6	52	130	120	107	81
9	Etelä-Karjala	0.4	2.2	5.8	4.4	2.2	15	16	61	152	256	149	114
10	Etelä-Savo	0	1.4	3.2	2.6	1.8	9	0	55	102	177	145	87
11	Itä-Savo	0	1.0	1.4	1.8	1.2	5	0	98	103	275	212	123
12	Pohjois-Karjala	0.4	2.4	6.0	3.2	2.8	15	12	52	120	151	160	88
13	Pohjois-Savo	0.4	4.6	12.4	8.8	2.8	29	8	66	173	297	112	117
14	Keski-Suomi	0.8	3.0	8.8	5.2	3.4	21	14	38	133	185	153	84
15	Etelä-Pohjanmaa	0.6	2.2	7.2	5.8	3.6	19	13	41	132	248	174	98
16	Vaasa	0.4	1.2	5.6	4.2	4.2	16	10	23	133	222	255	92
17	Keski-Pohjanmaa	0.6	1.6	2.2	2.0	3.4	10	30	73	109	221	470	125
18	Pohjois-Pohjanmaa	0.6	6.0	10.4	8.4	5.8	31	6	47	102	220	194	77
19	Kainuu	0	1.2	4.6	2.8	1.2	10	0	64	195	284	142	129
20	Länsi-Pohja	0	1.0	2.6	1.8	0.8	6	0	60	139	231	124	97
21	Lappi	0	1.2	2.2	2.2	1.6	7	0	37	61	158	139	61
22	Åland	0	0.4	1.6	1.0	0	3	0	47	197	296	0	104
Region	South	4.0	22.8	62.0	37.6	29.6	156	10	35	122	193	219	82
	Southwest	2.0	10.4	31.4	26.4	18.2	88	10	39	130	245	207	98
	West	3.4	15.0	41.0	30.0	21.6	111	14	45	136	228	206	100
	East	1.6	12.4	31.8	21.6	12.0	79	9	54	137	216	145	97
	North	1.2	11.0	22.0	17.2	12.8	64	7	51	110	218	201	87
Entire country		12.2	71.6	188.2	132.8	94.2	499	10	42	127	217	198	91

*Average annual incidence of RRT in subgroup

Table 4 presents the average annual number of new RRT patients and the incidence of RRT in 2012–2016 according to healthcare district, region, and age group. The incidence was highest among 65–74-year-olds. In the age group of 75 years and older, the incidence was 198 new RRT patients per million age-related inhabitants and varied in healthcare districts in the range of 0–470 and in regions in the range of 145–219.

Table 5. Number of new RRT patients by age group and sex
Finnish Registry for Kidney Diseases 2006–2016

Age group		Number of new RRT patients					Incidence of RRT/million inhabitants				
		2006	2011	2014	2015	2016	2006	2011	2014	2015	2016
0–19 y	Males	2	3	9	10	2	3	5	15	16	3
	Females	7	8	5	8	4	12	13	8	14	7
	Total	9	11	14	18	6	7	9	12	15	5
20–44 y	Males	44	38	42	48	60	51	44	48	55	68
	Females	30	21	24	30	31	36	26	29	36	37
	Total	74	59	66	78	91	44	35	39	46	53
45–64 y	Males	110	119	141	126	130	148	157	191	173	180
	Females	54	62	50	68	72	72	81	67	92	99
	Total	164	181	191	194	202	110	119	129	132	139
65–74 y	Males	81	89	78	113	102	380	355	268	371	331
	Females	38	43	32	40	46	151	151	99	118	135
	Total	119	132	110	153	148	256	246	179	238	228
≥75 y	Males	57	55	54	53	77	412	342	302	291	401
	Females	35	28	31	31	37	132	99	104	104	120
	Total	92	83	85	84	114	228	187	179	175	228
Total	Males	294	304	324	350	371	114	115	120	130	137
	Females	164	162	142	177	190	61	59	51	64	68
	Total	458	466	466	527	561	87	86	85	96	102

Table 5 shows the number of new RRT patients and the incidence of RRT according to age group and sex in 2006–2016. The number of new patients was larger in 2015 and 2016 than in earlier years. Compared with the years 2012–2014, the number of patients had increased in all age groups above 20 years, but the most (39%) in the age group 20–44 years.

In the age group 75 years and older, the incidence in 2016 was larger than in 2011, 2014, or 2015, being similar to that in 2006. The incidence of RRT was twice as high in men as in women.

Figure 2. Standardized incidence of RRT in regions
Finnish Registry for Kidney Diseases 2006–2016

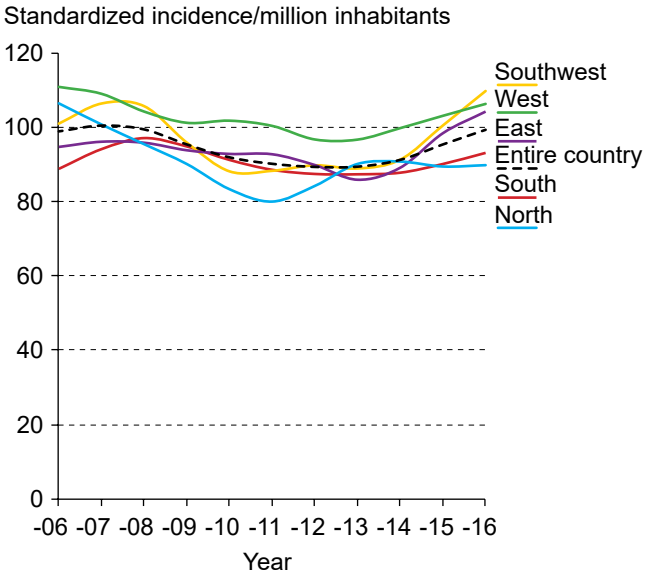


Figure 3. Standardized incidence of RRT in regions
90 days after the start of RRT
Finnish Registry for Kidney Diseases 2006–2016

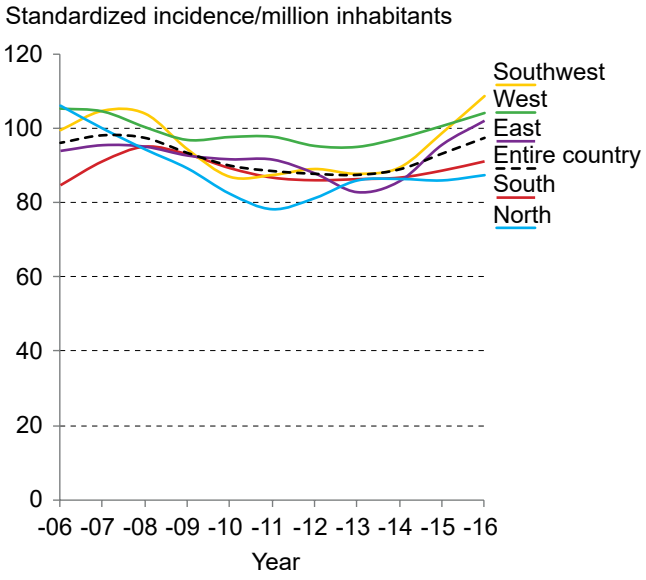
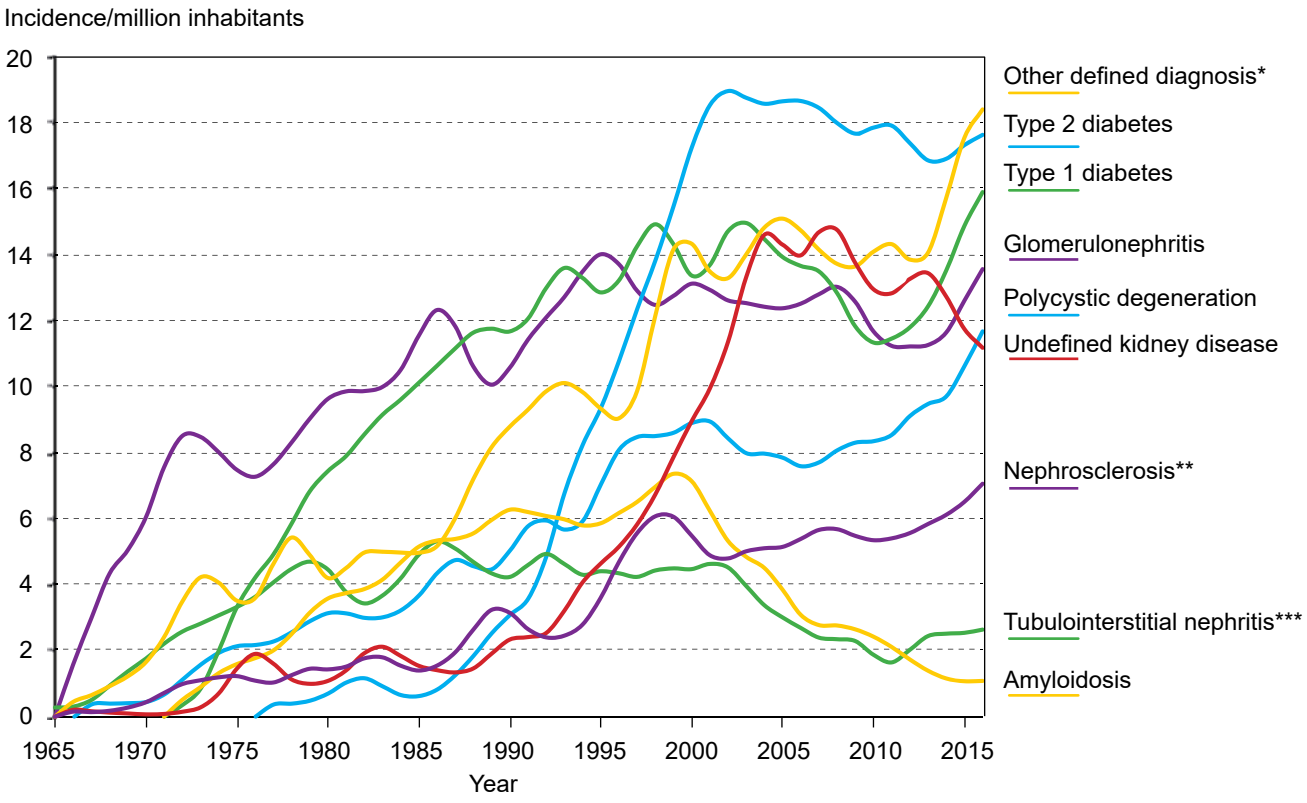


Figure 2 shows the regional incidence of RRT in 2006–2016 as smoothed averages. The incidence rates are age- and sex-standardized using the Finnish general population on 31 December 2016 as the reference population. Population changes in 2006–2016 have been taken into consideration. Standardization removes the effect of age and sex on regional differences in incidence rates. Nationwide, the standardized incidence declined during 2008–2012, but has increased since 2014. Regional differences in standardized incidence are small.

Figure 3 shows the age- and sex-standardized regional incidence of RRT 90 days after the start of RRT. The Finnish Registry for Kidney Diseases does not store data on patients who have regained renal function within 90 days of start of RRT because in that case RRT is not considered chronic. However, the registry does store information on patients who died or moved abroad within 90 days of start of RRT, but these patients were excluded from Figure 3.

Figure 4. Incidence of RRT according to diagnosis
Finnish Registry for Kidney Diseases 1965–2016



*E.g., other systemic diseases, urinary tract obstruction, congenital diseases, and malignancies
**IC-10 codes I12, I13, I70.1, N28.0
***ICD-10 codes N10, N11, and N12

The incidence of RRT according to diagnosis appears as smoothed averages in Figure 4. Until the end of the 1990s, the incidence increased in almost all diagnostic groups, but thereafter the increase stopped. In 2015 and 2016, the incidence was larger than before, and the proportions arising from especially type 1 diabetes, polycystic kidney disease, glomerulonephritis, and other defined kidney disease have increased.

Type 2 diabetes has been the leading cause of end-stage renal disease since 1999. Type 1 diabetes and glomerulonephritis rank as the second most common causes of end-stage renal disease. The number of amyloidosis patients entering RRT has decreased continuously since 2000.

In earlier reports, pyelonephritis was presented as a group of its own and it included also tubulointerstitial nephritis. Now this has been replaced with the group tubulointerstitial nephritis that includes pyelonephritis (ICD-10 codes N11.0 and N11.1), which forms a minor part (4% in 2006–2016) of the tubulointerstitial nephritis group.

The group of other defined diagnoses has grown considerably, being larger than type 2 diabetes in 2016. In 2015 and 2016, altogether 206 new RRT patients had “other defined diagnosis”. The most common diagnoses were urinary tract obstruction (n=27), vasculitis (n=21), congenital malformations (n=19), kidney cancer (n=12), myeloma (n=10), congenital nephrosis of Finnish type (n=8), Goodpasture’s syndrome (n=7), hemolytic-uremic syndrome (n=4), and systemic lupus erythematosus (n=4). Of the 206 patients, 50 had an ICD-10 code of N18.8, which means other defined kidney disease, but does not give further specification. Among these 50 patients, the new ERA-EDTA diagnosis (collected in the Finnish Registry for Kidney Diseases since 2014) specified the diagnosis for 39, whereas for 11 patients the kidney disease remained unknown.

Table 6. Number of RRT patients at 90 days from start of RRT according to type of treatment in healthcare districts and regions
Finnish Registry for Kidney Diseases 2012–2016

Healthcare district		Number of patients (%) at 90 days from start of RRT in 2012–2016						
		Tx	CAPD	APD	Home HD	In-center HD	HDF	Total
1	Helsinki-Uusimaa	13 (2)	53 (9)	78 (13)	56 (9)	395 (65)	13 (2)	608 (100)
3	Varsinais-Suomi	2 (1)	70 (31)	34 (15)	1 (0)	107 (48)	10 (4)	224 (100)
4	Satakunta	0 (0)	30 (27)	8 (7)	1 (1)	69 (63)	2 (2)	110 (100)
5	Kanta-Häme	1 (1)	3 (3)	26 (27)	0 (0)	55 (57)	12 (12)	97 (100)
6	Pirkanmaa	3 (1)	34 (14)	34 (14)	2 (1)	175 (71)	0 (0)	248 (100)
7	Päijät-Häme	0 (0)	18 (20)	8 (9)	2 (2)	60 (67)	1 (1)	89 (100)
8	Kymenlaakso	0 (0)	1 (1)	22 (32)	3 (4)	43 (62)	0 (0)	69 (100)
9	Etelä-Karjala	1 (1)	5 (7)	10 (14)	3 (4)	40 (57)	11 (16)	70 (100)
10	Etelä-Savo	0 (0)	2 (5)	0 (0)	2 (5)	33 (79)	5 (12)	42 (100)
11	Itä-Savo	0 (0)	1 (4)	2 (7)	0 (0)	10 (37)	14 (52)	27 (100)
12	Pohjois-Karjala	0 (0)	9 (13)	13 (19)	2 (3)	38 (56)	6 (9)	68 (100)
13	Pohjois-Savo	1 (1)	5 (4)	32 (23)	23 (16)	77 (55)	3 (2)	141 (100)
14	Keski-Suomi	0 (0)	11 (11)	17 (17)	2 (2)	66 (67)	2 (2)	98 (100)
15	Etelä-Pohjanmaa	0 (0)	19 (21)	9 (10)	0 (0)	45 (49)	19 (21)	92 (100)
16	Vaasa	0 (0)	7 (9)	5 (7)	0 (0)	60 (80)	3 (4)	75 (100)
17	Keski-Pohjanmaa	0 (0)	3 (7)	2 (5)	0 (0)	26 (59)	13 (30)	44 (100)
18	Pohjois-Pohjanmaa	2 (1)	10 (7)	33 (22)	1 (1)	97 (64)	8 (5)	151 (100)
19	Kainuu	1 (2)	12 (27)	9 (20)	1 (2)	21 (47)	1 (2)	45 (100)
20	Länsi-Pohja	0 (0)	4 (14)	5 (17)	1 (3)	4 (14)	15 (52)	29 (100)
21	Lappi	1 (3)	11 (32)	4 (12)	0 (0)	17 (50)	1 (3)	34 (100)
22	Åland	0 (0)	0 (0)	0 (0)	0 (0)	12 (80)	3 (20)	15 (100)
Region	South	14 (2)	59 (8)	110 (15)	62 (8)	478 (64)	24 (3)	747 (100)
	Southwest	2 (0)	107 (25)	47 (11)	2 (0)	248 (58)	18 (4)	424 (100)
	West	4 (1)	74 (14)	77 (15)	4 (1)	335 (64)	32 (6)	526 (100)
	East	1 (0)	28 (7)	64 (17)	29 (8)	224 (60)	30 (8)	376 (100)
	North	4 (1)	40 (13)	53 (17)	3 (1)	165 (54)	38 (13)	303 (100)
Entire country		25 (1)	308 (13)	351 (15)	100 (4)	1450 (61)	142 (6)	2376 (100)

Table 6 presents the number of RRT patients at 90 days from start of RRT in 2012–2016 according to type of treatment in healthcare districts and regions. Of the 2268 patients, only 25 (1.1%) had received a kidney graft (Tx), 28% were on continuous ambulatory or automated peritoneal dialysis (CAPD or APD), 4% were on home hemodialysis (home HD), and 67% were on either in-center hemodialysis (in-center HD) or hemodiafiltration (HDF).

Figure 5. Estimated GFR of new RRT patients older than 20 years
Finnish Registry for Kidney Diseases 2006–2016

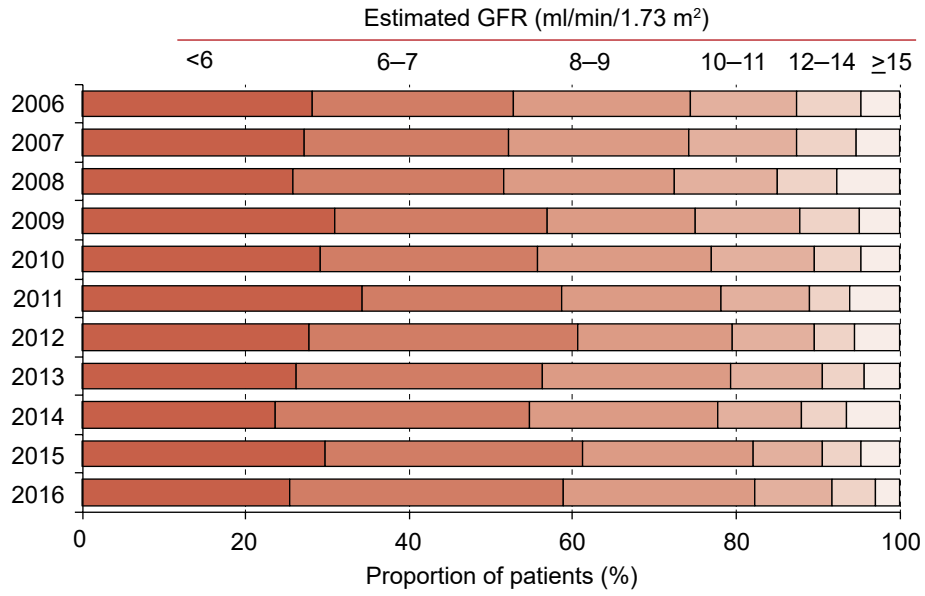


Figure 6. Estimated GFR of new RRT patients older than 20 years in healthcare districts
Finnish Registry for Kidney Diseases 2012–2016

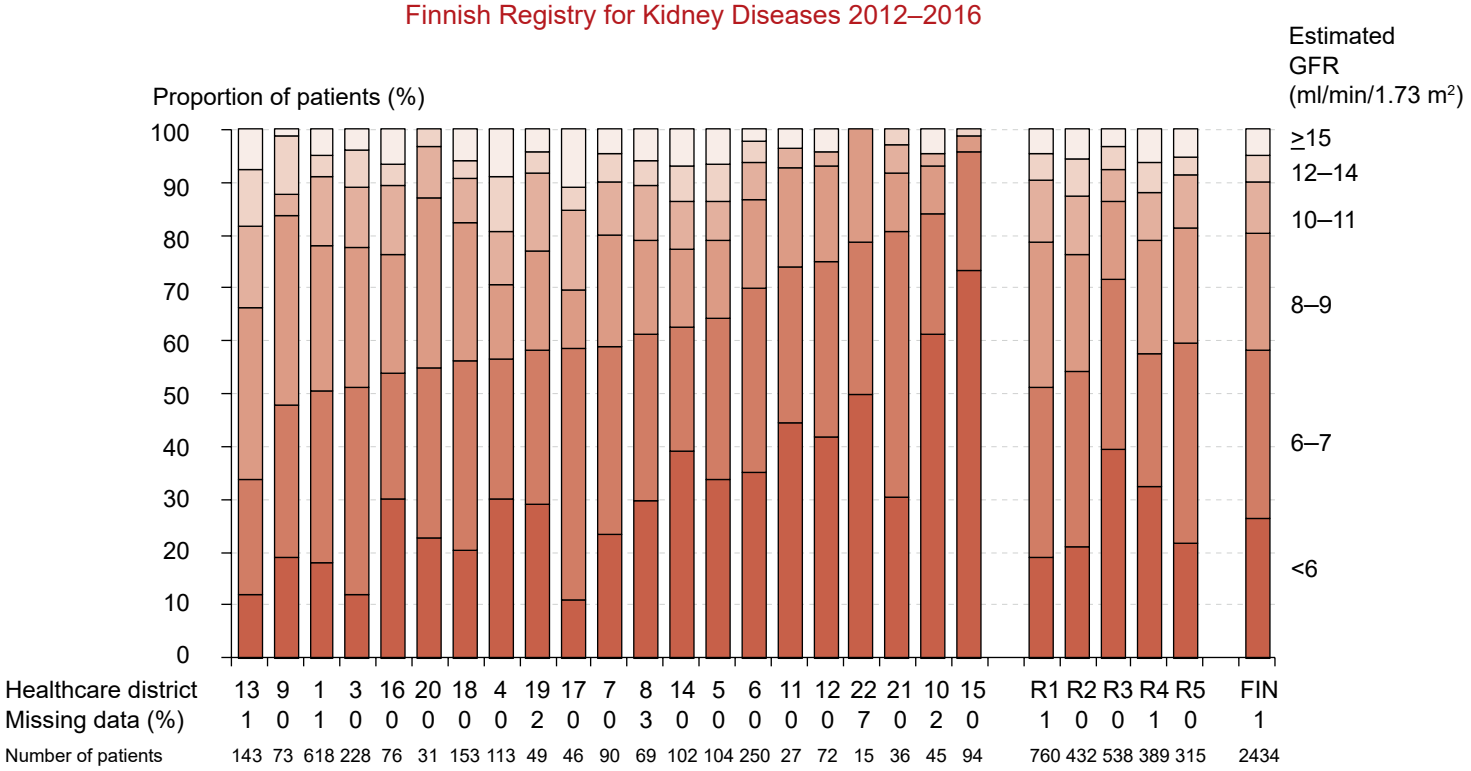
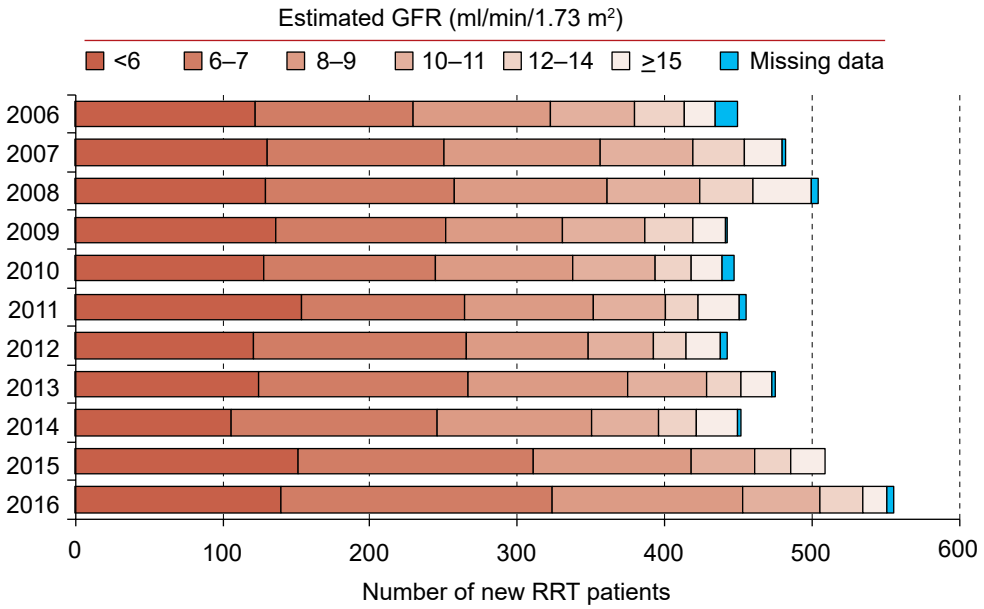


Figure 5 shows the estimated glomerular filtration rate (GFR), calculated with the CKD-EPI formula, of patients who entered RRT in 2006–2016. The estimated GFR is based on serum creatinine concentration measured before first RRT. The decision to start RRT is not based on estimated GFR alone; the patient's symptoms and clinical condition also affect the decision. Research on timing of RRT start has not supported a very early start (at high estimated GFR).

Estimated GFR before start of RRT has somewhat decreased during recent years (p=0.020). In 2006, the median estimated GFR was 7.7 ml/min/1.73 m^2 and in 2016 it was 7.5 ml/min/1.73 m^2.

Figure 6 presents estimated GFR of patients who entered RRT in 2012–2016 in healthcare districts and regions. The healthcare districts are sorted according to proportion of patients with an estimated GFR lower than 8 ml/min/1.73 m^2. This proportion for the entire country was 58%, but varied by healthcare districts in the range of 34–96% (p<0.001) and by region in the range of 51–72% (p<0.001). Age or sex did not correlate significantly with estimated GFR.

Figure 7. Number of new RRT patients older than 20 years according to level of estimated GFR
Finnish Registry for Kidney Diseases 2006–2016



In 2015 and 2016, the number of patients who entered RRT was larger than before. Figure 7 demonstrates that only the number of patients with an estimated GFR lower than 10 ml/min/1.73 m^2 has increased. Thus, the increase in incident number of RRT patients is not due to acceptance of patients to RRT at an earlier stage of renal failure.

Figure 8. Distribution of treatment modalities at 90 days from start of RRT in patients older than 20 years
Finnish Registry for Kidney Diseases 2006–2016

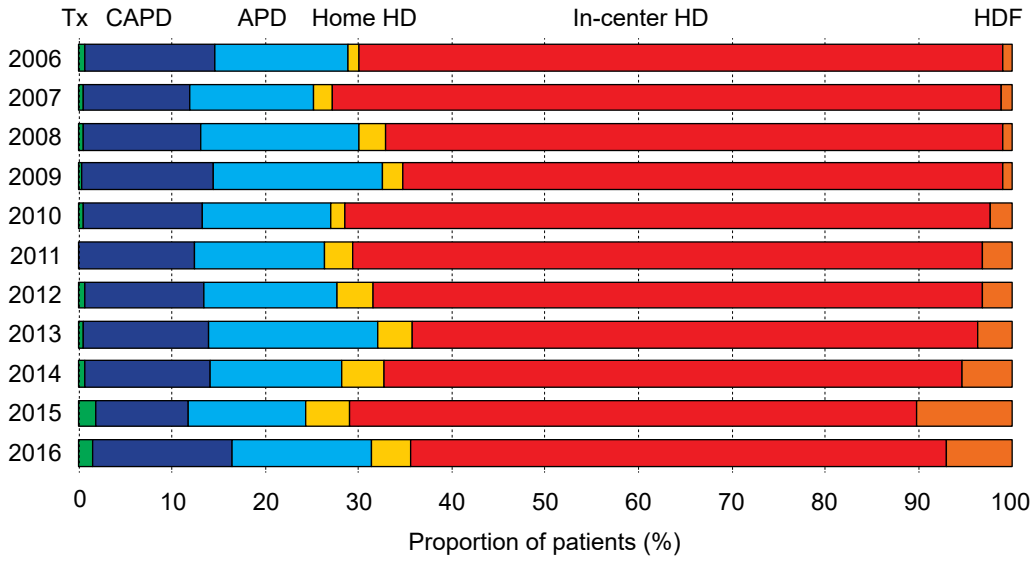


Figure 9. Proportion of home dialysis and kidney transplantation patients of all RRT patients older than 20 years at 90 days from start of RRT
Finnish Registry for Kidney Diseases 2012–2016

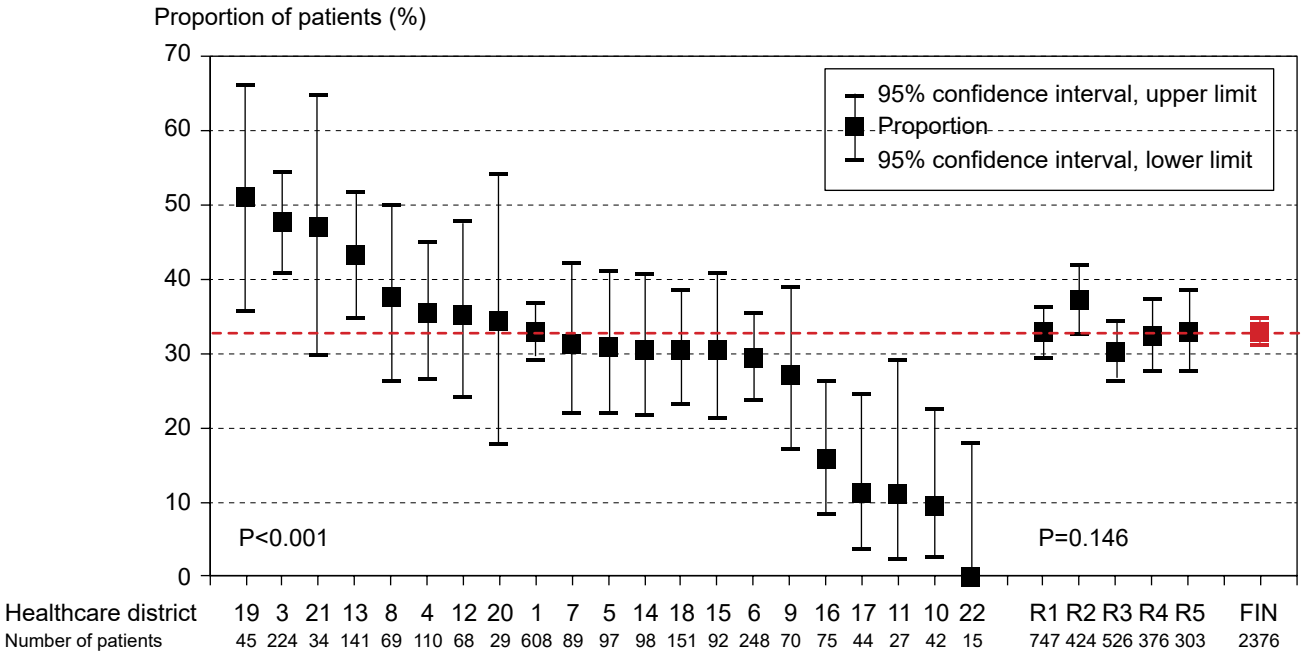


Figure 8 shows the distribution of RRT patients' treatment modalities at 90 days from start of RRT in 2006–2016 (n=5086). The combined proportion of home dialysis and kidney transplantation patients has varied between 27% and 36% in 2006–2016, and it was 36% in 2016. The proportion of kidney transplantation patients was slightly larger in 2015 and 2016 (2%) than earlier. The proportion of patients on continuous (CAPD) or automated peritoneal dialysis (APD) was larger in 2016 (30%) than in 2015. The proportion of patients on home hemodialysis (home HD) has increased during the ten-year period and was 4% in 2016. The proportion of hemodiafiltration (HDF) is small at 90 days from start of RRT.

The combined proportion of home dialysis (CAPD, APD, and home HD) and kidney transplantation at 90 days from start of RRT was 33% in the entire country in 2012–2016 (Figure 9). The proportion varied significantly according to healthcare district (0–51%) but not according to region (30–37%). The P-values shown in the figure were adjusted for age and sex using binary logistic regression.

Figure 10. International comparison of incidence of RRT in 2015
Finnish Registry for Kidney Diseases 2015

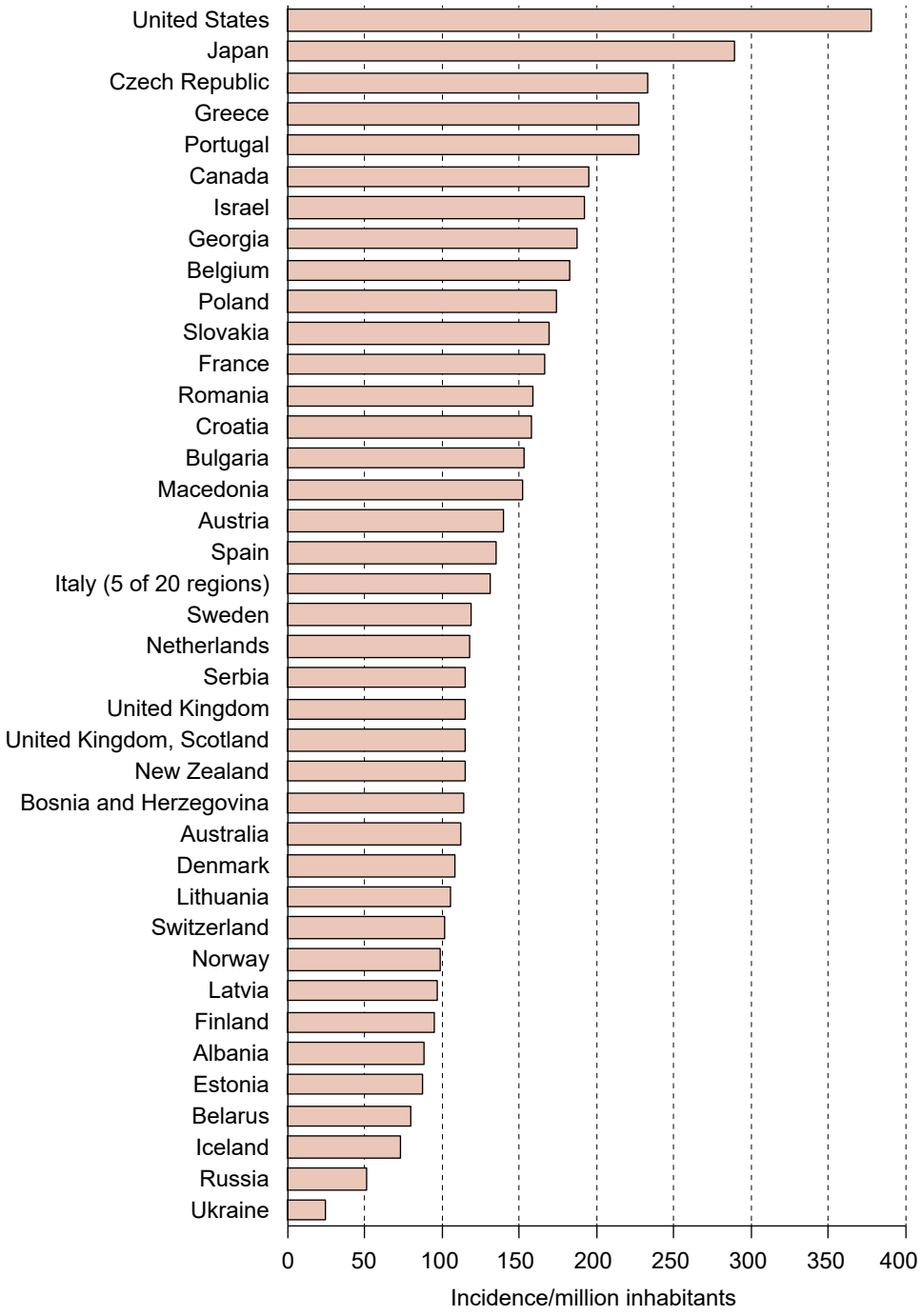


Figure 10 shows the incidence of RRT in 2015 in countries reporting to the ERA-EDTA Registry (Annual Report 2015, http://www.era-edta-reg.org) and in the United States, Canada, Australia, New Zealand, Japan, and Russia (The 2017 USRDS Annual Data Report Atlas, http://www.usrds.org). In 2015, the incidence of RRT in Finland was the second lowest among the Nordic countries. Relative to Finland, the incidence in Norway was 4% higher, in Denmark 14% higher, in Sweden 25% higher, and in Iceland 23% lower.

Table 7. Patients on RRT at end of year according to healthcare district and region
Finnish Registry for Kidney Diseases 2006–2016

Healthcare district		Number of RRT patients					Prevalence of RRT/million inhabitants				
		2006	2011	2014	2015	2016	2006	2011	2014	2015	2016
1	Helsinki-Uusimaa	1016	1169	1272	1302	1335	694	757	795	806	817
3	Varsinais-Suomi	351	402	428	428	441	761	854	899	897	922
4	Satakunta	210	233	213	217	237	921	1034	951	973	1069
5	Kanta-Häme	111	144	161	158	169	653	822	918	904	972
6	Pirkanmaa	376	436	470	475	489	757	847	896	901	923
7	Päijät-Häme	164	176	183	183	194	779	825	859	861	913
8	Kymenlaakso	120	136	135	140	138	678	778	781	815	808
9	Etelä-Karjala	134	152	150	152	165	997	1147	1138	1159	1264
10	Etelä-Savo	75	91	88	101	101	690	863	847	978	986
11	Itä-Savo	43	50	49	51	51	908	1105	1112	1174	1186
12	Pohjois-Karjala	129	138	133	143	148	751	813	787	850	883
13	Pohjois-Savo	216	233	255	263	272	866	939	1027	1060	1098
14	Keski-Suomi	131	165	173	183	196	538	662	689	726	776
15	Etelä-Pohjanmaa	114	133	130	133	138	574	669	656	674	702
16	Vaasa	93	117	133	140	150	572	699	784	823	882
17	Keski-Pohjanmaa	55	59	60	69	71	711	755	765	878	904
18	Pohjois-Pohjanmaa	268	284	309	305	322	697	713	762	749	789
19	Kainuu	73	61	67	70	74	904	782	880	929	989
20	Länsi-Pohja	56	58	58	55	55	845	892	912	872	880
21	Lappi	79	84	79	78	82	666	710	669	662	697
22	Åland	15	27	25	25	27	557	952	865	863	924
Region	South	1270	1457	1557	1594	1638	716	787	818	831	846
	Southwest	669	779	799	810	855	761	874	889	900	950
	West	765	889	944	949	990	711	807	850	854	890
	East	594	677	698	741	768	724	828	855	909	944
	North	531	546	573	577	604	730	740	772	778	814
Entire country		3829	4348	4571	4671	4855	726	805	835	851	882

Table 7 presents the number of RRT patients and the prevalence of RRT on 31 December 2006–2016. In the entire country, the prevalence at the end of 2016 was 882 RRT patients per million inhabitants. On 31 December 2016, the prevalence was the highest in the southwestern and eastern regions and the lowest in the northern region. In the healthcare districts, the prevalence varied between 697 and 1264 patients per million inhabitants.

In the entire country, the prevalence has increased by 22% since 2006 and by 10% since 2011. Since 2011, the prevalence has increased in all regions, the least in the southern region (8%) and the most in the eastern region (14%). In the healthcare districts, the prevalence has increased the most during the past five years in Kainuu and Vaasa (26%). In three healthcare districts (Länsi-Pohja, Lapland, and Åland), the prevalence has decreased.

Table 8. Patients on RRT according to age group and sex
Finnish Registry for Kidney Diseases 2006–2016

Age group		Number of RRT patients					Prevalence of RRT/million inhabitants				
		2006	2011	2014	2015	2016	2006	2011	2014	2015	2016
0–19 y	Males	76	66	70	69	70	121	106	114	113	115
	Females	54	55	50	52	51	90	92	85	89	88
	Total	130	121	120	121	121	106	99	100	101	101
20–44 y	Males	445	425	429	446	466	515	494	493	511	530
	Females	299	254	239	243	260	361	310	289	293	313
	Total	744	679	668	689	726	440	404	394	405	424
45–64 y	Males	1109	1244	1228	1245	1251	1492	1638	1665	1707	1733
	Females	668	725	721	737	755	893	946	969	1002	1037
	Total	1777	1969	1949	1982	2006	1192	1290	1316	1353	1384
65–74 y	Males	421	651	745	796	820	1977	2598	2559	2615	2658
	Females	289	367	414	435	444	1147	1286	1276	1287	1300
	Total	710	1018	1159	1231	1264	1527	1900	1883	1916	1944
≥75 y	Males	281	350	441	427	479	2033	2173	2465	2343	2492
	Females	187	211	234	221	259	704	746	788	741	842
	Total	468	561	675	648	738	1159	1264	1418	1348	1476
Total	Males	2332	2736	2913	2983	3086	903	1031	1082	1104	1138
	Females	1497	1612	1658	1688	1769	556	586	596	606	634
	Total	3829	4348	4571	4671	4855	726	805	835	851	882

Figure 11. Standardized prevalence of RRT in regions
Finnish Registry for Kidney Diseases 2006–2016

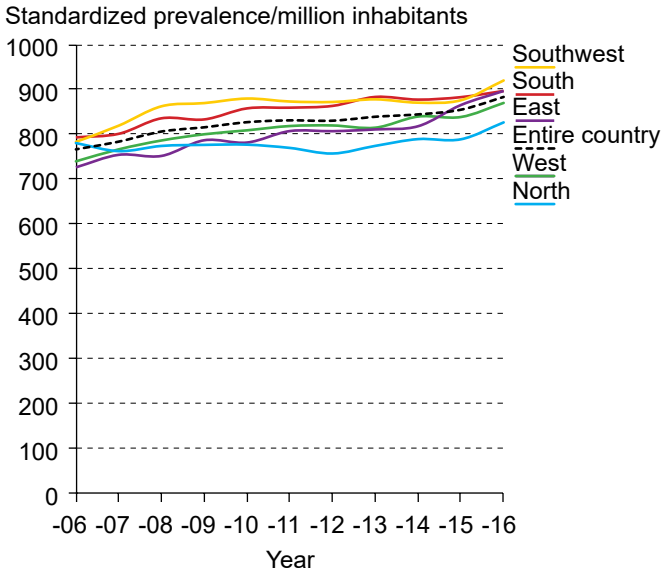
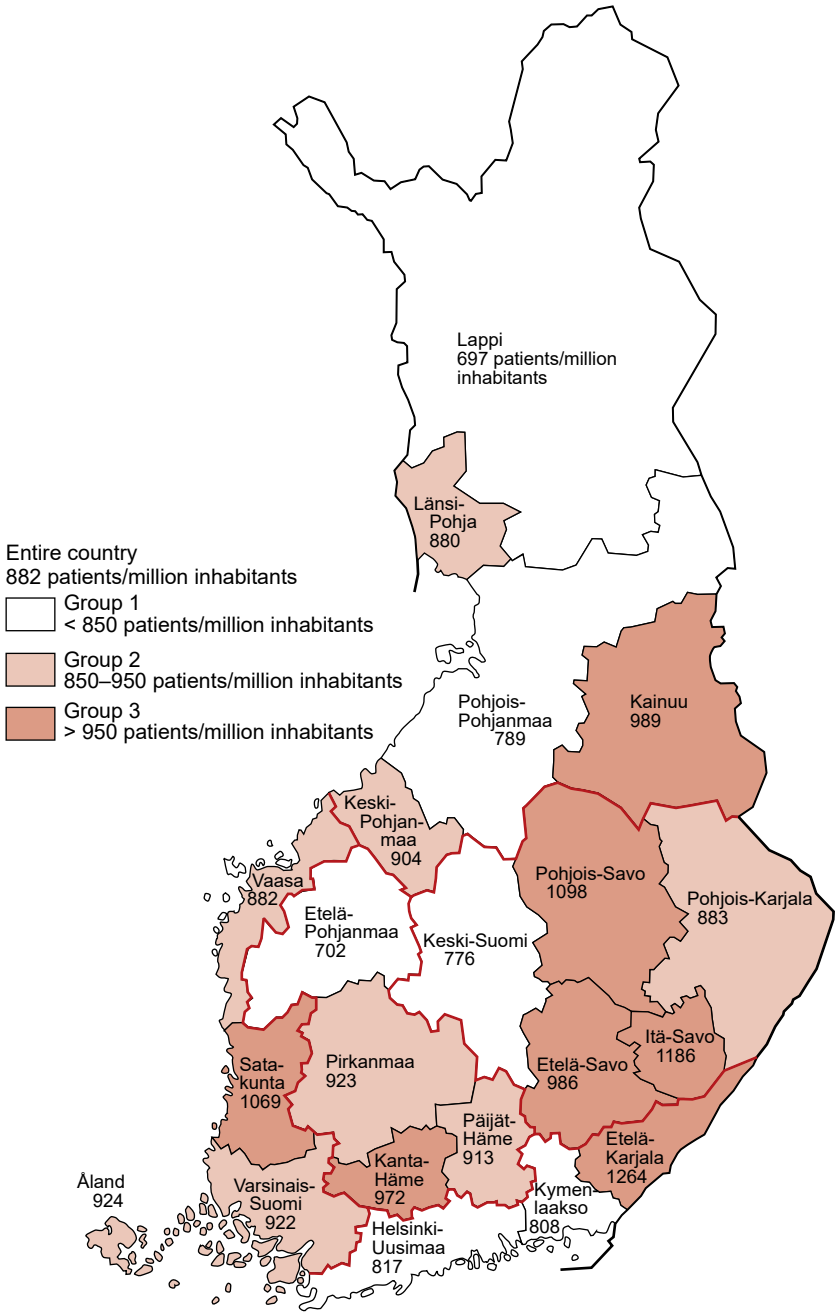


Table 8 shows the number of RRT patients and the prevalence of RRT on 31 December 2006–2016 according to age group and sex. The prevalence of RRT has increased by 22% since 2006. The prevalence has increased by 27% in the age group of 75 years and older, by 27% in 65–74-year-olds, and by 16% in 45–64-year-olds. In the younger age groups, the prevalence of RRT has decreased by 4% during the past ten years. The highest prevalence, observed among men aged 65–74 years at the end of 2016, was 2658 cases per million age-related inhabitants. At the end of 2016, the prevalence was 80% greater among men than among women, and the sex difference was even more pronounced in the oldest age group, in which prevalence was threefold higher in men than in women.

Figure 11 shows the age- and sex-standardized prevalence rates for 2006–2016 using the Finnish general population on 31 December 2016 as the reference population. The standardized prevalence rates have increased slowly in recent years, and the differences between regions are small.

Figure 12. Prevalence of RRT on 31 December 2016
Finnish Registry for Kidney Diseases 2016



The healthcare districts shown on the map are grouped according to the prevalence of RRT at the end of 2016 (Figure 12). The prevalence per million inhabitants was <850 in six districts, 850–950 in eight districts, and >950 in seven districts. The borders of the regions are indicated with thick lines.

Figure 13. Prevalence of RRT at end of year according to type of treatment
Finnish Registry for Kidney Diseases 1965–2016

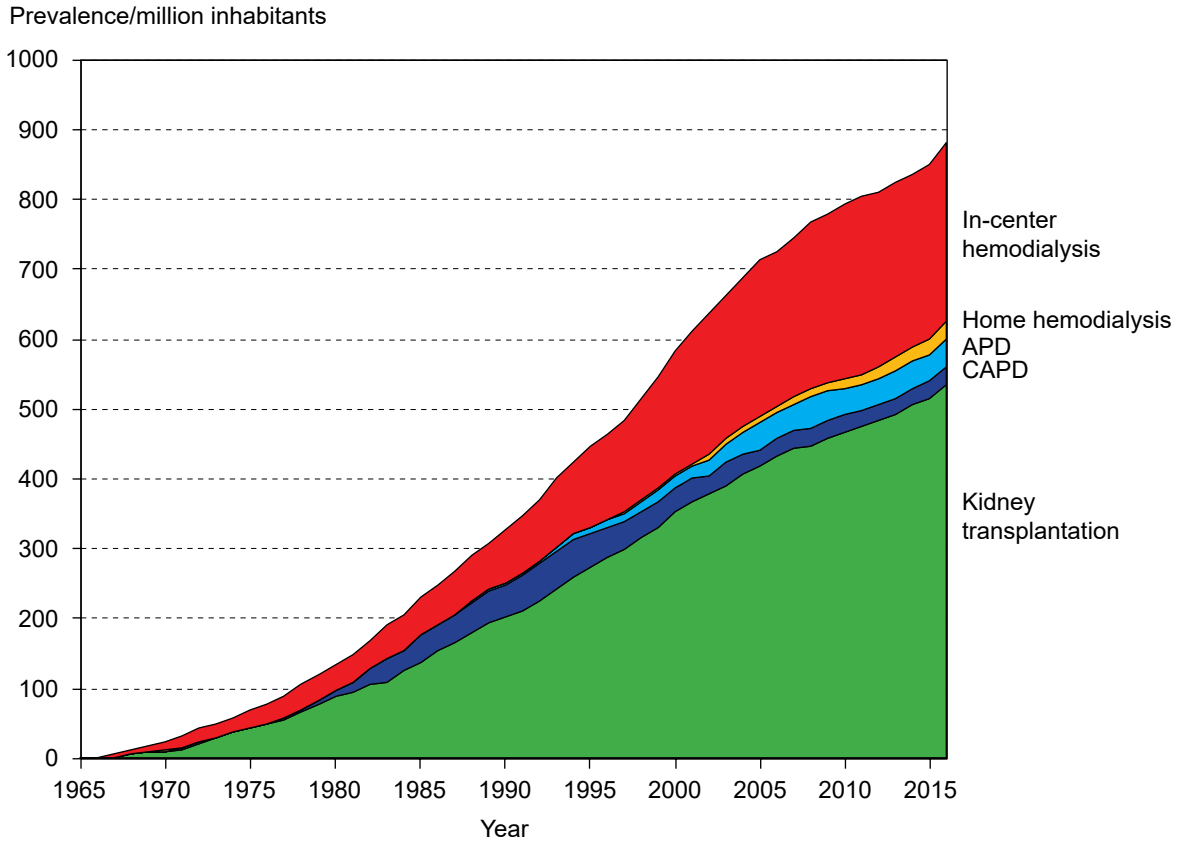


Figure 13 displays the prevalence of RRT according to treatment type. The prevalence of kidney transplantation has shown a continuous increase, 13% during the past five years. The number of in-center hemodialysis patients decreased during 2012–2014, but increased by 2% per year in 2015–2016. The number of patients on peritoneal dialysis has remained virtually unchanged for decades, and since 1990 it has varied in the range of 253–370. The proportion of automated peritoneal dialysis (APD) increased until 2005, while that of continuous ambulatory peritoneal dialysis (CAPD) decreased. Since 2005, the proportion of APD patients of all PD patients has been about 60%. The number of home hemodialysis patients has increased threefold during the past ten years.

Table 9. Prevalence of dialysis and kidney transplantation in healthcare districts and regions
Finnish Registry for Kidney Diseases 2006–2016

Healthcare district		Number of dialysis patients/ million inhabitants					Number of kidney transplantation patients/ million inhabitants				
		2006	2011	2014	2015	2016	2006	2011	2014	2015	2016
1	Helsinki-Uusimaa	251	291	289	301	308	443	466	506	505	509
3	Varsinais-Suomi	306	329	378	377	389	455	525	521	520	533
4	Satakunta	377	364	357	359	424	544	670	594	614	645
5	Kanta-Häme	330	439	416	406	455	324	382	502	498	518
6	Pirkanmaa	308	360	376	362	353	449	488	521	539	570
7	Päijät-Häme	332	342	347	348	358	446	483	512	513	555
8	Kymenlaakso	288	389	416	425	369	390	389	364	390	439
9	Etelä-Karjala	483	551	448	450	521	513	596	691	709	743
10	Etelä-Savo	239	332	289	387	361	451	531	558	591	625
11	Itä-Savo	464	486	409	460	442	443	619	704	713	744
12	Pohjois-Karjala	320	324	302	386	382	431	489	486	463	501
13	Pohjois-Savo	305	395	370	363	351	561	544	656	697	747
14	Keski-Suomi	218	293	263	278	301	321	369	426	449	475
15	Etelä-Pohjanmaa	232	292	318	329	371	342	378	338	345	331
16	Vaasa	228	275	295	311	364	345	424	489	511	517
17	Keski-Pohjanmaa	323	358	306	369	382	388	397	459	509	522
18	Pohjois-Pohjanmaa	315	269	298	280	309	383	444	463	469	480
19	Kainuu	471	269	263	266	294	434	513	617	664	695
20	Länsi-Pohja	392	477	535	460	416	453	415	377	412	464
21	Lappi	194	313	254	221	195	472	397	415	441	501
22	Åland	186	529	242	276	308	371	423	622	587	616
Region	South	272	319	311	322	328	443	468	506	509	519
	Southwest	306	334	353	357	390	455	539	537	544	560
	West	302	357	366	361	373	409	450	483	493	517
	East	283	346	315	350	348	441	482	540	559	596
	North	320	304	309	294	306	410	437	464	484	508
Entire country		292	331	330	336	347	433	474	506	515	535

Table 9 presents the prevalence of dialysis and kidney transplantation per million inhabitants in healthcare districts and regions in 2006–2016. The prevalence of dialysis has increased by 19% and that of kidney transplantation by 23% during the past ten years. During the past five years the prevalence of dialysis has increased by 5%. At the end of 2016, the prevalence of dialysis varied in healthcare districts between 195 and 521 per million inhabitants and that of kidney transplantation between 331 and 747 per million inhabitants. In regions, the prevalence of dialysis varied between 306 and 390 per million inhabitants and that of kidney transplantation between 508 and 596 per million inhabitants.

Table 10. Number of RRT patients at end of year according to type of treatment in healthcare districts and regions
Finnish Registry for Kidney Diseases 2016

Healthcare district		Number of patients on 31 December 2016 (%)						
		CAPD	APD	Home HD	In-center HD	HDF	Tx	Total
1	Helsinki-Uusimaa	35 (3)	56 (4)	72 (5)	252 (19)	88 (7)	832 (62)	1335 (100)
3	Varsinais-Suomi	27 (6)	35 (8)	7 (2)	46 (10)	71 (16)	255 (58)	441 (100)
4	Satakunta	12 (5)	11 (5)	3 (1)	55 (23)	13 (5)	143 (60)	237 (100)
5	Kanta-Häme	4 (2)	14 (8)	1 (1)	29 (17)	31 (18)	90 (53)	169 (100)
6	Pirkanmaa	19 (4)	12 (2)	2 (0)	122 (25)	32 (7)	302 (62)	489 (100)
7	Päijät-Häme	10 (5)	8 (4)	8 (4)	38 (20)	12 (6)	118 (61)	194 (100)
8	Kymenlaakso	0 (0)	12 (9)	7 (5)	36 (26)	8 (6)	75 (54)	138 (100)
9	Etelä-Karjala	2 (1)	5 (3)	5 (3)	10 (6)	46 (28)	97 (59)	165 (100)
10	Etelä-Savo	1 (1)	2 (2)	1 (1)	20 (20)	13 (13)	64 (63)	101 (100)
11	Itä-Savo	0 (0)	1 (2)	0 (0)	0 (0)	18 (35)	32 (63)	51 (100)
12	Pohjois-Karjala	6 (4)	5 (3)	7 (5)	19 (13)	27 (18)	84 (57)	148 (100)
13	Pohjois-Savo	2 (1)	13 (5)	13 (5)	43 (16)	16 (6)	185 (68)	272 (100)
14	Keski-Suomi	5 (3)	7 (4)	3 (2)	38 (19)	23 (12)	120 (61)	196 (100)
15	Etelä-Pohjanmaa	6 (4)	9 (7)	1 (1)	11 (8)	46 (33)	65 (47)	138 (100)
16	Vaasa	3 (2)	2 (1)	5 (3)	27 (18)	25 (17)	88 (59)	150 (100)
17	Keski-Pohjanmaa	0 (0)	1 (1)	0 (0)	9 (13)	20 (28)	41 (58)	71 (100)
18	Pohjois-Pohjanmaa	4 (1)	17 (5)	1 (0)	66 (20)	38 (12)	196 (61)	322 (100)
19	Kainuu	6 (8)	3 (4)	1 (1)	9 (12)	3 (4)	52 (70)	74 (100)
20	Länsi-Pohja	1 (2)	0 (0)	1 (2)	2 (4)	22 (40)	29 (53)	55 (100)
21	Lappi	4 (5)	4 (5)	0 (0)	12 (15)	3 (4)	59 (72)	82 (100)
22	Åland	0 (0)	0 (0)	0 (0)	5 (19)	4 (15)	18 (67)	27 (100)
Region	South	37 (2)	73 (4)	84 (5)	298 (18)	142 (9)	1004 (61)	1638 (100)
	Southwest	42 (5)	48 (6)	15 (2)	133 (16)	113 (13)	504 (59)	855 (100)
	West	39 (4)	43 (4)	12 (1)	200 (20)	121 (12)	575 (58)	990 (100)
	East	14 (2)	28 (4)	24 (3)	120 (16)	97 (13)	485 (63)	768 (100)
	North	15 (2)	25 (4)	3 (0)	98 (16)	86 (14)	377 (62)	604 (100)
Entire country		147 (3)	217 (4)	138 (3)	849 (17)	559 (12)	2945 (61)	4855 (100)

Table 10 presents the number of RRT patients according to type of treatment in healthcare districts and regions at the end of 2016. The proportion of peritoneal dialysis patients was the greatest in the healthcare district of Varsinais-Suomi, where 14% of all RRT patients were receiving either continuous ambulatory peritoneal dialysis (CAPD) or automated peritoneal dialysis (APD). The proportion of patients on home hemodialysis (home HD) was largest, 5%, in the healthcare districts of Helsinki-Uusimaa, Kymenlaakso, Pohjois-Savo, and Pohjois-Karjala. In four healthcare districts, there were no home HD patients.

The proportion of kidney transplantation patients varied between 47% and 72% in the healthcare districts (p=0.010 in age- and gender-adjusted analysis using binary logistic regression). The difference between regions was not significant (p=0.295).

Of all RRT patients, 26% were on home dialysis (CAPD, APD, or home HD) at the end of 2016. The proportion of home dialysis was higher than 35% in two healthcare districts (Kainuu and Varsinais-Suomi) and lower than 15% in five healthcare districts.

Figure 14. International comparison of prevalence of RRT on 31 December 2015
Finnish Registry for Kidney Diseases 2015

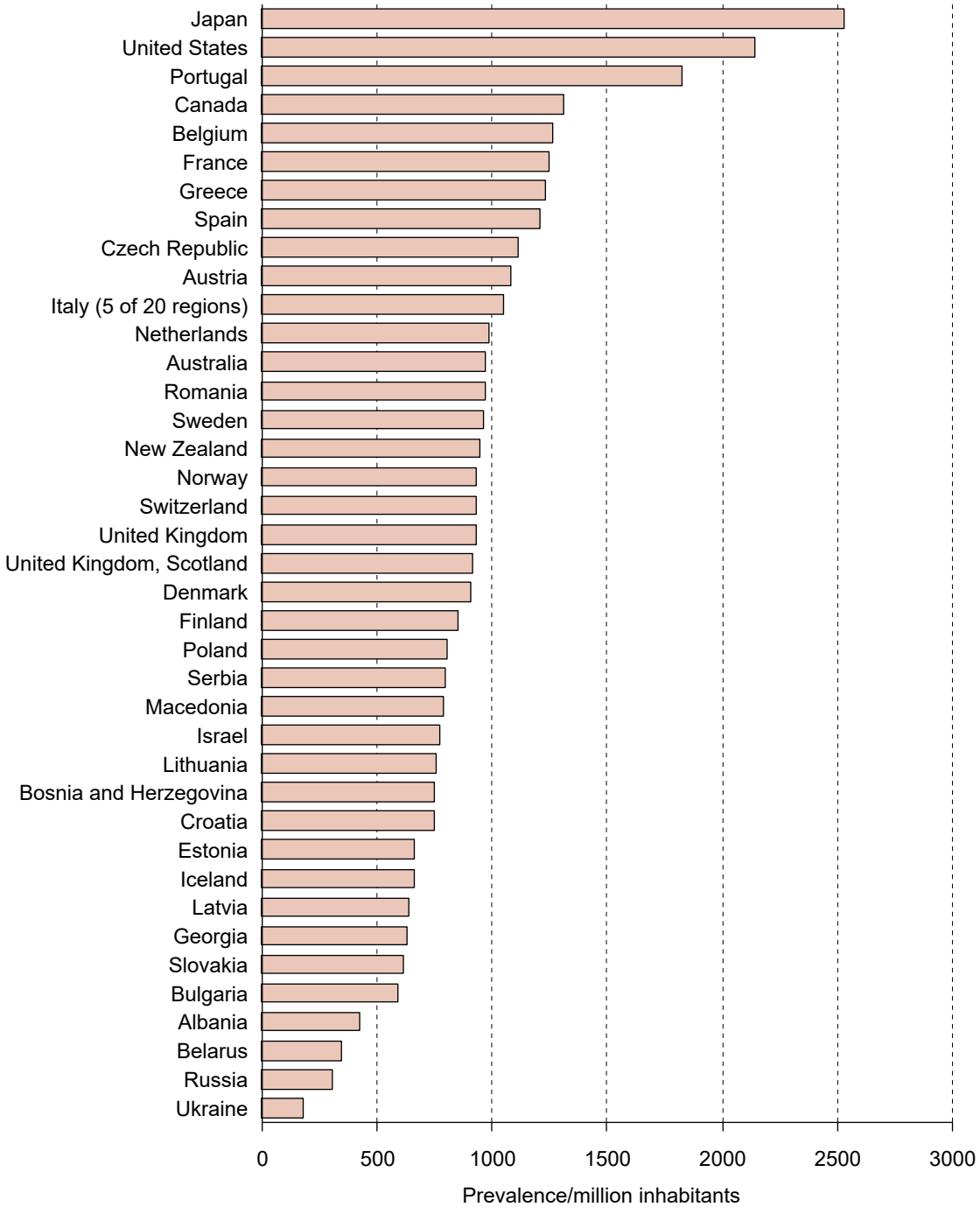


Figure 14 displays the prevalence of RRT on 31 December 2015 in countries reporting to the ERA-EDTA Registry (Annual Report 2014, http://www.era-edta-reg.org) and in the United States, Canada, Australia, New Zealand, Japan, and Russia (The 2017 USRDS Annual Data Report Atlas, http://www.usrds.org). The prevalence rate in Finland was the second lowest of the Nordic countries. Relative to Finland, the prevalence in Denmark was 6% higher, in Norway 9% higher, and in Sweden 13% higher. Figure 10 on page 19 shows the international incidence rates.

Table 11. Number of patient-years of all RRT patients according to diagnosis and type of treatment Finnish Registry for Kidney Diseases 2006–2016

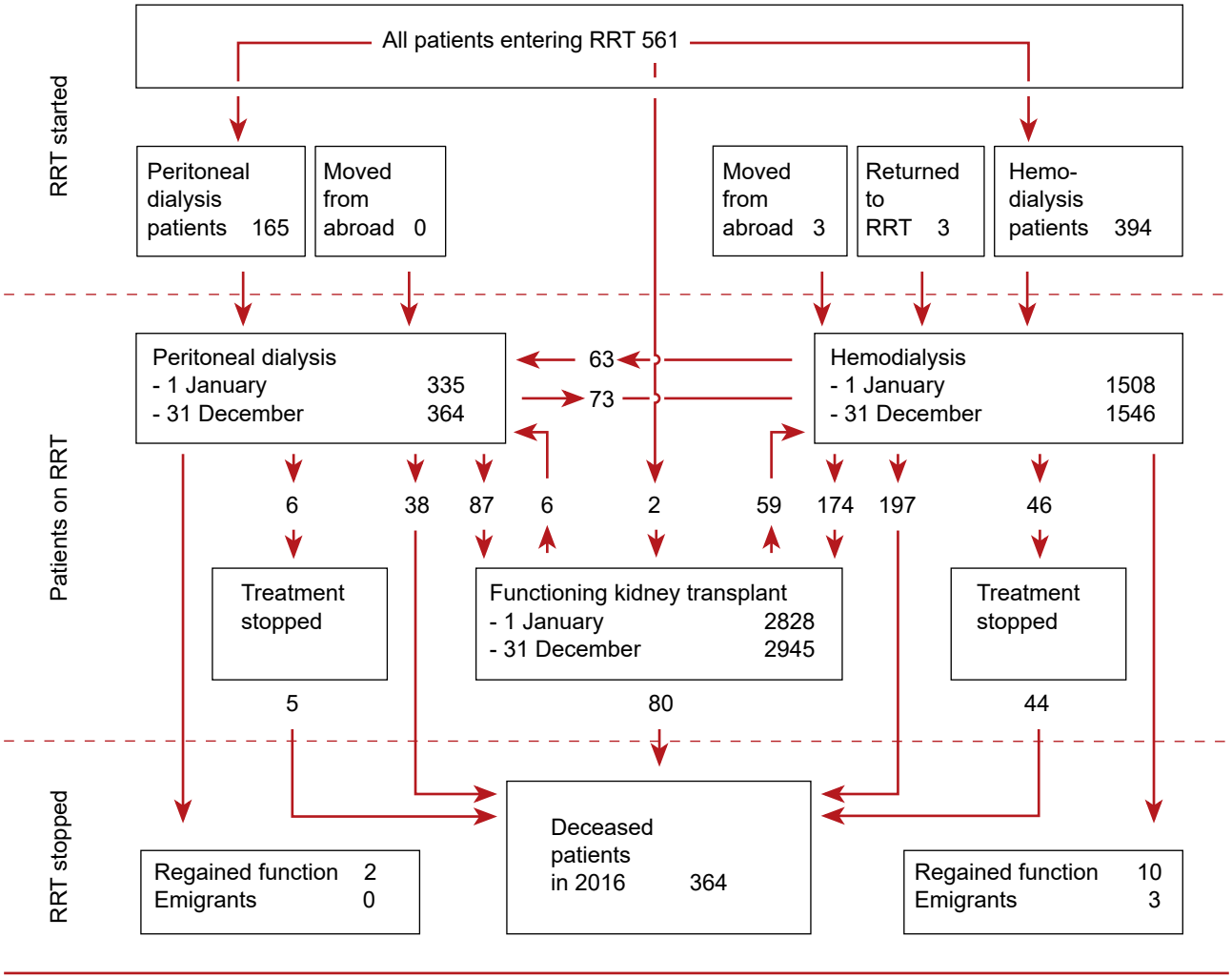
Diagnosis	Number of patient-years in 2006 (%)				Number of patient-years in 2016 (%)			
	Peritoneal dialysis	Hemo-dialysis	Trans-plantation	Total	Peritoneal dialysis	Hemo-dialysis	Trans-plantation	Total
Glomerulonephritis	50 (15.1)	197 (16.3)	622 (27.7)	869 (23.0)	54 (15.1)	232 (15.1)	757 (26.1)	1043 (21.8)
Type 1 diabetes	91 (27.3)	116 (9.6)	437 (19.4)	644 (17.0)	79 (22.0)	193 (12.5)	494 (17.1)	765 (16.0)
Polycystic degeneration	16 (4.9)	112 (9.3)	355 (15.8)	483 (12.8)	34 (9.5)	151 (9.8)	527 (18.2)	712 (14.9)
Undefined kidney disease	33 (9.8)	179 (14.9)	82 (3.7)	295 (7.8)	54 (15.2)	236 (15.4)	168 (5.8)	458 (9.6)
Type 2 diabetes	48 (14.3)	239 (19.8)	53 (2.3)	339 (9.0)	37 (10.4)	298 (19.4)	112 (3.9)	447 (9.3)
Tubulointerstitial nephritis	16 (4.7)	57 (4.7)	202 (9.0)	275 (7.3)	13 (3.6)	49 (3.2)	174 (6.0)	235 (4.9)
Nephrosclerosis	22 (6.7)	66 (5.4)	49 (2.2)	137 (3.6)	28 (7.8)	97 (6.3)	82 (2.8)	207 (4.3)
Other systemic diseases	18 (5.3)	48 (4.0)	74 (3.3)	140 (3.7)	14 (3.9)	66 (4.3)	111 (3.8)	191 (4.0)
Urinary tract obstruction	9 (2.8)	37 (3.1)	86 (3.8)	133 (3.5)	15 (4.3)	47 (3.1)	116 (4.0)	179 (3.7)
Other kidney diseases	5 (1.6)	42 (3.4)	58 (2.6)	104 (2.8)	8 (2.3)	76 (4.9)	79 (2.7)	163 (3.4)
Congenital diseases	3 (1.0)	13 (1.1)	96 (4.3)	112 (3.0)	9 (2.5)	22 (1.4)	120 (4.1)	150 (3.1)
Congenital nephrosis, Finnish type	6 (1.7)	3 (0.3)	57 (2.5)	65 (1.7)	5 (1.3)	5 (0.3)	89 (3.1)	98 (2.1)
Amyloidosis	4 (1.1)	53 (4.4)	40 (1.8)	97 (2.6)	3 (0.9)	22 (1.4)	31 (1.1)	56 (1.2)
Malignancies	4 (1.3)	29 (2.4)	7 (0.3)	40 (1.1)	2 (0.7)	30 (2.0)	11 (0.4)	43 (0.9)
Pyelonephritis	5 (1.4)	10 (0.8)	19 (0.8)	33 (0.9)	1 (0.3)	8 (0.5)	14 (0.5)	23 (0.5)
Metabolic diseases	4 (1.1)	5 (0.4)	10 (0.5)	19 (0.5)	1 (0.2)	5 (0.3)	12 (0.4)	18 (0.4)
Total	333 (100)	1205 (100)	2246 (100)	3784 (100)	358 (100)	1535 (100)	2896 (100)	4789 (100)

Table 11 presents the number of patient-years according to diagnosis of kidney disease and type of treatment in 2006 and 2016. The number of patient-years indicates time spent by patients in RRT during the year. Overall, the number of patient-years has increased by 27% since 2006. The number of patient-years has increased by 27% in hemodialysis, by 7% in peritoneal dialysis, and by 29% in kidney transplantation.

Glomerulonephritis is the most common diagnosis among all RRT patients and among kidney transplantation patients; the proportion of patient-years due to glomerulonephritis was 22% in 2016. Type 1 diabetes is the second most common diagnosis among all RRT patients and the most common diagnosis among peritoneal dialysis patients. The number of patient-years of patients with polycystic degeneration has increased by 47% during the last ten years. Polycystic degeneration is the second most common diagnosis of kidney transplantation patients. Type 2 diabetes is the fourth most common kidney disease diagnosis of all RRT patients and the most common among hemodialysis patients. The proportion of undefined kidney disease has increased during the past decade, reaching 9.6% in 2016.

The definitions of the diagnostic groups presented in Table 11 have been updated in Report 2016. ICD-10 codes N11.8 and N11.9 have been transferred from the group “Pyelonephritis” to the group “Tubulointerstitial nephritis”. For this reason, tubulointerstitial nephritis appears more common and pyelonephritis less common than in earlier reports.

Figure 15. Net changes in type of treatment
Finnish Registry for Kidney Diseases 2016



During 2016 altogether 561 new patients entered RRT (Figure 15), and three patients returned to RRT. In all, 4671 patients were receiving RRT at the beginning of the year. Altogether 365 patients died and dialysis was discontinued for 12 patients because the patient's own kidney function resumed. Of those who died, 80 had a functioning kidney transplant, 38 were receiving peritoneal dialysis, and 198 were on hemodialysis. During 2016 RRT was discontinued for 49 uremic patients. At the end of 2016, the number of peritoneal dialysis patients was 9% smaller, the number of hemodialysis patients 3% larger, and the number of kidney transplantation patients 4% larger than at the beginning of the year.

A total of 262 patients received a kidney transplant. Of these patients, 26 received a combined pancreas and kidney transplantation, two a combined liver and kidney transplantation, and one a combined heart and kidney transplantation (source: Kidney Transplantation Unit, Helsinki University Central Hospital). Twenty-two kidney transplants were received from living donors.

Figure 16. Patient transitions between home dialysis modalities
Finnish Registry for Kidney Diseases 2016

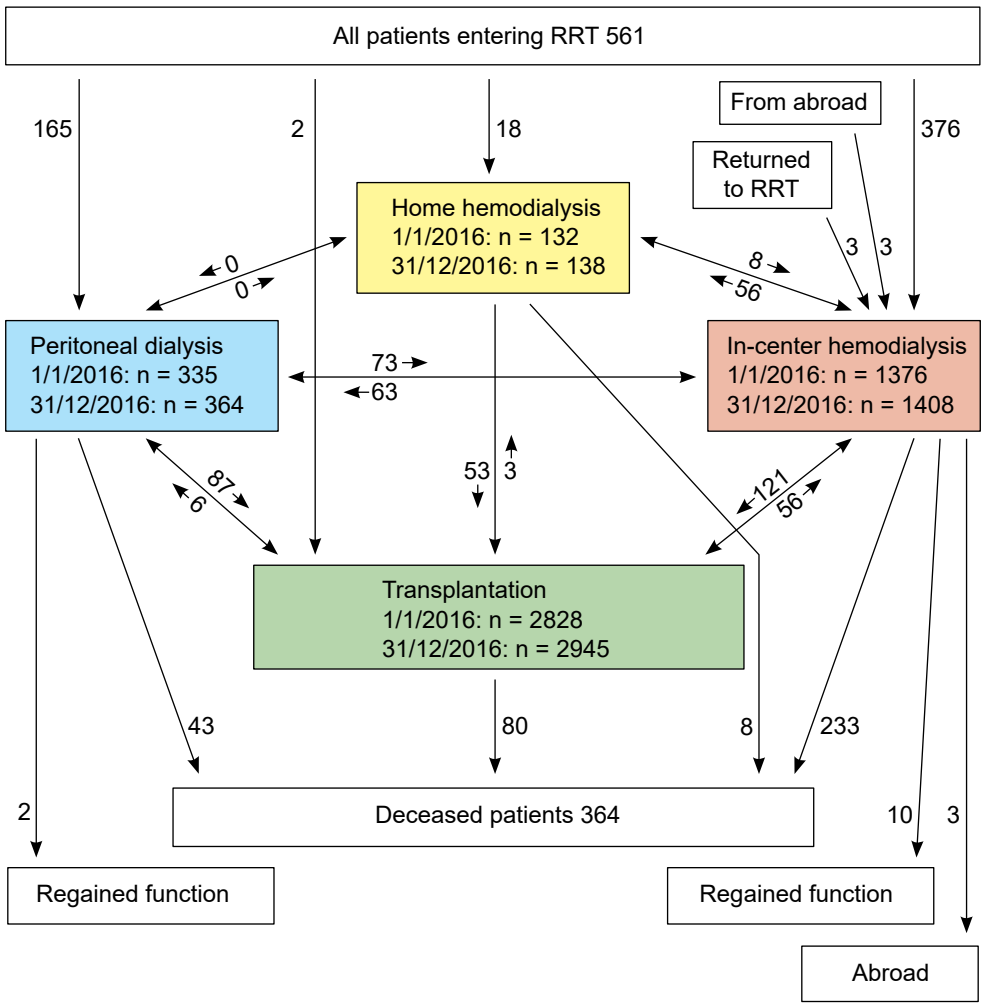


Figure 16 shows which treatment modalities new RRT patients entered during 2016 and how patients moved between the modalities. The presentation is similar to that in Figure 15, but shows separately also the home hemodialysis patients. On the other hand, discontinuation of RRT among uremic patients is not shown. During 2016 no home hemodialysis patients stopped RRT.

Notably, no PD patients moved directly to home hemodialysis in 2016 (one PD patient did so in 2015). However, of the 56 patients who transferred from in-center hemodialysis to home hemodialysis, four had transferred from PD less than 90 days earlier, and nine less than one year earlier. No patients transferred from home hemodialysis to PD, not even via in-center hemodialysis.

Table 12. Mortality of RRT patients by region
Finnish Registry for Kidney Diseases 2006–2016

Region	Deaths/1000 patient-years						Deaths/1000 patient-years[1)]					
	2006	2011	2014	2015	2016	2012–2016	2006	2011	2014	2015	2016	2012–2016
South	72	72	80	77	73	75	68	71	79	76	72	74
Southwest	98	87	101	92	73	87	98	86	99	90	73	86
West	126	110	90	102	84	93	120	105	86	100	81	91
East	108	92	76	74	79	85	105	92	72	73	75	81
North	88	94	76	106	70	92	88	92	73	99	69	87
Entire country	96	88	85	88	76	84	92	87	82	86	74	82

[1)]Patients who died within 90 days of start of RRT excluded

Figure 17. Standardized mortality of RRT patients by region
Finnish Registry for Kidney Diseases 2006–2016

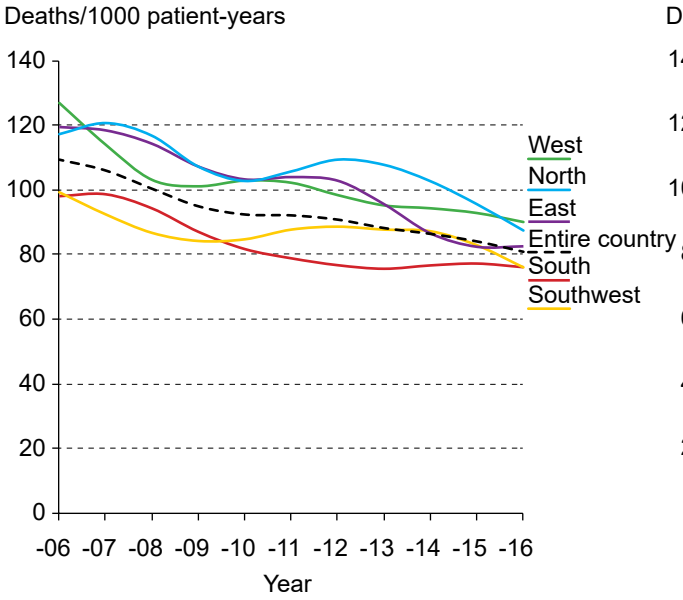


Figure 18. Standardized mortality of RRT patients by region (patients who died within 90 days of start of RRT excluded)
Finnish Registry for Kidney Diseases 2006–2016

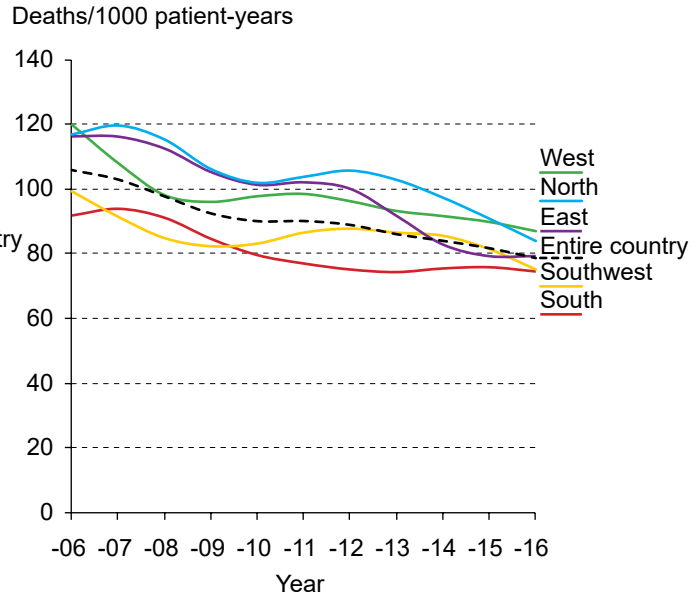


Table 12 shows RRT patients' mortality in 2006–2016 according to region. The mortality of patients who had been on RRT for at least 90 days is presented separately. The average mortality in 2012–2016 was lower in the southern region than elsewhere.

Figures 17 and 18 show regional mortality as smoothed averages. The regional mortality rates for 2006–2016 have been age- and sex-standardized using all patient-years in 2016 as the reference. Changes in age and sex distribution during this ten-year period have been taken into consideration. Patients who died within 90 days of start of RRT were excluded from Figure 18. During the period 2006–2016 the standardized mortality rate has declined in all regions.

Table 13. Number of RRT patients older than 20 years in hospitals
Finnish Registry for Kidney Diseases 2016

Region	Healthcare district	Hospital	No. of RRT patients (≥20 y) on 31/12/2016			
			PD	HD	Tx	Total
South (R1)			108	523	968	1599
	Helsinki-Uusimaa (1)		89	412	809	1310
		Helsinki University Central Hospital	89	295	696	1080
		Nephrology Polyclinic			693	693
		Dialysis unit DHK	89	97		186
		Dialysis unit DOK		75		75
		B. Braun Malmi		59		59
		B. Braun Pitäjänmäki		64		64
		Unit of Transplantation and Liver Surgery			3	3
		Hyvinkää Hospital		38	31	69
		Lohja Hospital		32	34	66
		Länsi-Uusimaa Hospital		21	23	44
		Porvoo Hospital		26	25	51
	Kymenlaakso (8)		12	51	66	129
		Kymenlaakso Central Hospital	12	51	66	129
	Etelä-Karjala (9)		7	60	93	160
		South Karelia Central Hospital	7	41	93	141
		Honkaharju Hospital		19		19
Southwest (R2)			89	259	479	827
	Varsinais-Suomi (3)		60	124	246	430
		Turku University Central Hospital	60	124	246	430
	Satakunta (4)		24	70	139	233
		Satakunta Central Hospital	24	70	139	233
	Vaasa (16)		5	56	76	137
		Vaasa Central Hospital	5	44	75	124
		Pietarsaari Hospital		12	1	13
	Åland (22)			9	18	27
		Åland Central Hospital		9	18	27
West (R3)			79	333	542	954
	Kanta-Häme (5)		18	62	87	167
		Central Hospital of Tavastia	18	62	87	167
	Pirkanmaa (6)		28	154	280	462
		Tampere University Hospital	28	132	279	439
		Valkeakoski Regional Hospital		22	1	23
	Päijät-Häme (7)		18	58	119	195
		Päijänne Tavastia Central Hospital	18	58	119	195
	Etelä-Pohjanmaa (15)		15	59	56	130
		Southern Ostrobothnia Central Hospital	15	59	56	130
East (R4)			43	242	476	761
	Etelä-Savo (10)		3	34	56	93
		Mikkeli Central Hospital	3	34	56	93
	Itä-Savo (11)		1	19	35	55
		Central Hospital of Savonlinna	1	19	35	55
	Pohjois-Karjala (12)		11	52	78	141
		North Karelia Central Hospital	11	52	78	141
	Pohjois-Savo (13)		14	73	183	270
		Kuopio University Hospital	14	46	165	225
		Regional Hospital of Iisalmi		15	11	26
		Regional Hospital of Varkaus		12	7	19
	Keski-Suomi (14)		14	64	124	202
		Central Finland Central Hospital	14	64	124	202
North (R5)			39	187	366	592
	Keski-Pohjanmaa (17)		2	28	43	73
		Central Hospital of Keski-Pohjanmaa	2	28	43	73
	Pohjois-Pohjanmaa (18)		19	106	185	310
		Oulu University Hospital	19	106	185	310
	Kainuu (19)		9	13	53	75
		Kainuu Central Hospital	9	13	53	75
	Länsi-Pohja (20)		1	23	28	52
		Central Hospital of Länsi-Pohja	1	23	28	52
	Lappi (21)		8	17	57	82
		Lapland Central Hospital	8	17	57	82
Entire country			358	1544	2832	4734

At the end of 2016, dialysis and kidney transplantation patients were treated and followed up in 30 hospitals of 21 healthcare districts in five regions (Table 13). In the first part of this report, the healthcare district of the patient is determined according to place of residence. However, in the analysis of treatment quality on pages 32–45, healthcare district of the patient is determined according to treating unit. In the entire country, 98% of patients lived in the same healthcare district in which they were treated.

Figure 19. Hemoglobin distribution of dialysis patients older than 20 years at end of year
Finnish Registry for Kidney Diseases 2006–2016

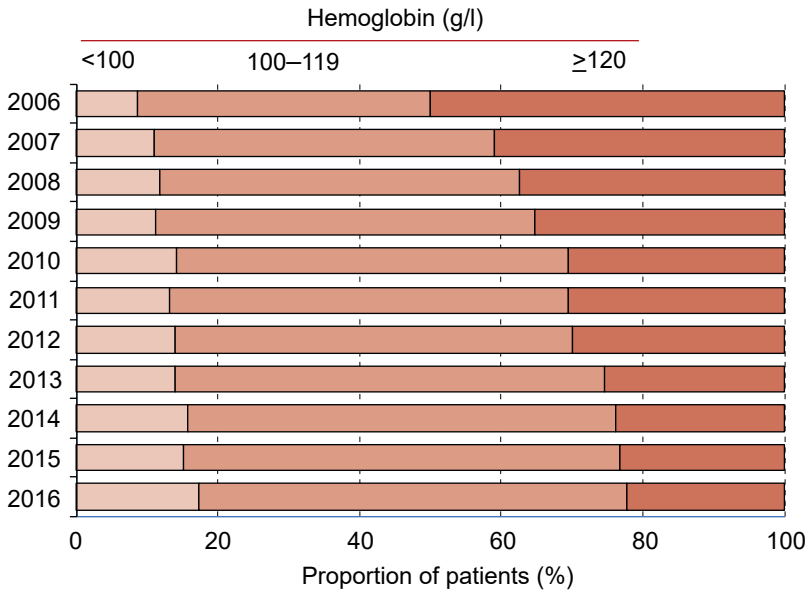
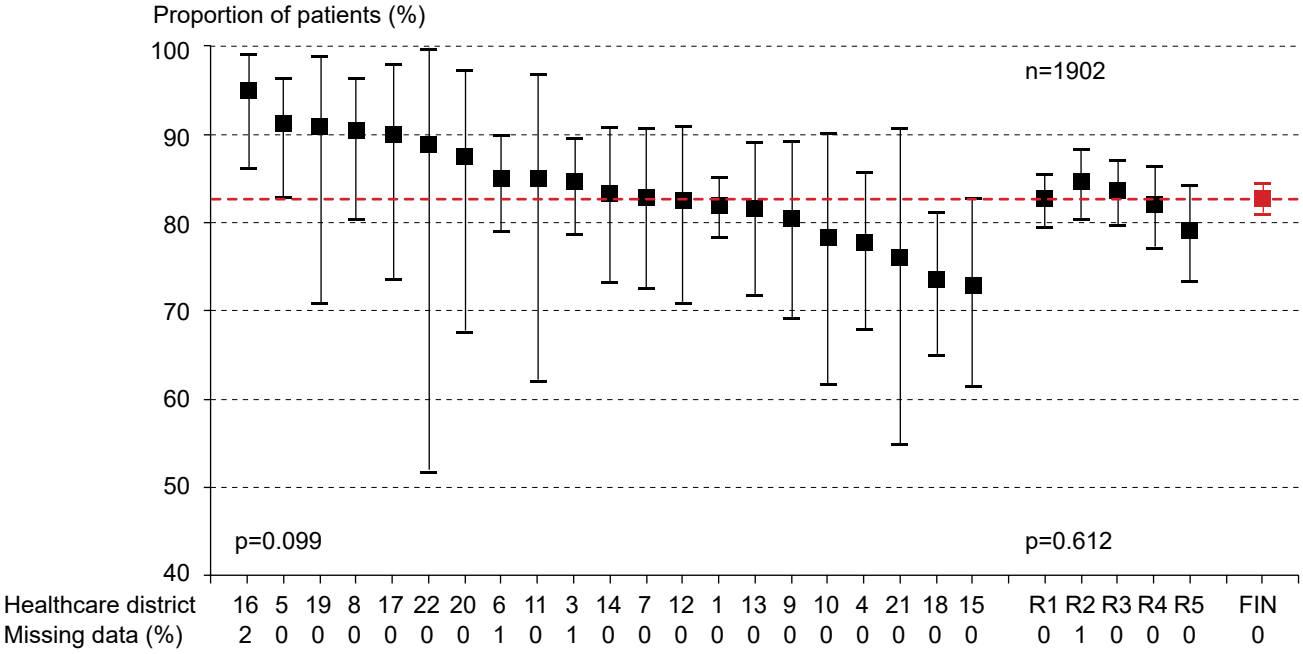


Figure 20. Proportion of dialysis patients older than 20 years with hemoglobin concentration ≥100 g/l in healthcare districts and regions
Finnish Registry for Kidney Diseases 2016



Several guidelines exist regarding the target for blood hemoglobin concentration in dialysis patients: European Best Practice Guidelines (EPBG) and the guidelines of the Kidney Disease Outcome Quality Initiative (KDOQI) and the Kidney Disease Global Outcomes (KDIGO). KDIGO published new guidelines on renal anemia in 2012, according to which erythropoiesis-stimulating agents (ESAs) should be used to keep dialysis patients' hemoglobin in the range of 100–115 g/l.

The renal registries in the UK and Sweden have in their reports used target hemoglobin levels of either 100–120 g/l or ≥100 g/l. For sake of comparison, we have chosen the same cut-offs.

The distribution of dialysis patients' hemoglobin concentration has changed during 2006–2016 (Figure 19). The proportion of patients with a hemoglobin concentration lower than 100 g/l has increased from 9% to 17%, while the proportion of patients with a hemoglobin concentration of 120 g/l or higher has decreased from 50% to 22%. Figures 19 and 20 include all hemodialysis patients, also those who did not use ESAs.

In Figure 20, the hemoglobin target is 100 g/l or higher. At the end of 2016, the proportion of dialysis patients reaching this target was 83%, varying from 73% to 95% in the healthcare districts (p=0.099) and from 79% to 85% in the regions (p=0.612). No significant difference was present in the proportions of men and women with a hemoglobin concentration of 100 g/l or higher.

Figure 21. Proportion of dialysis patients older than 20 years using erythropoiesis-stimulating agents (ESAs) at end of year
Finnish Registry for Kidney Diseases 2013–2016

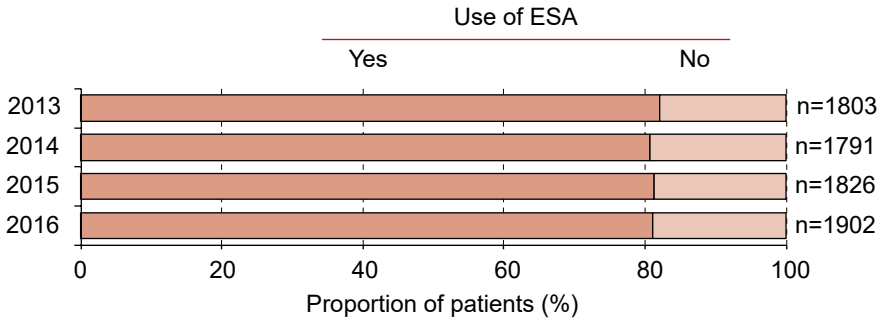
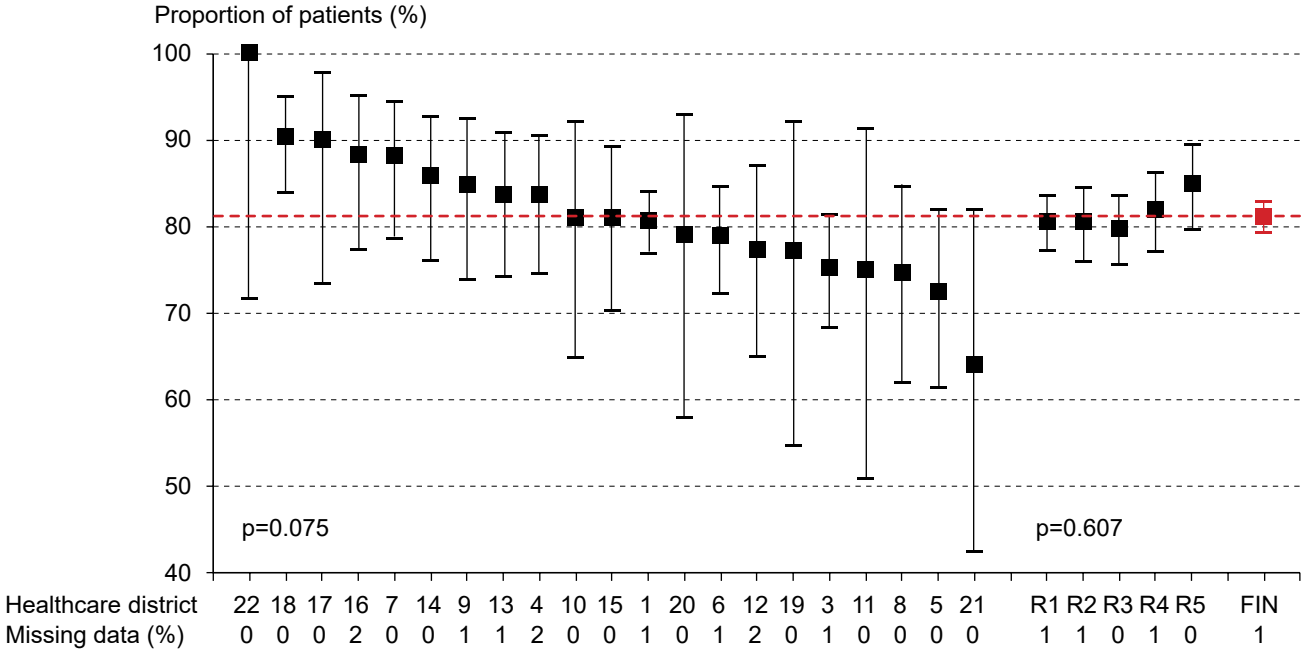


Figure 22. Proportion of dialysis patients older than 20 years using ESAs in healthcare districts
Finnish Registry for Kidney Diseases 2016



The Finnish Registry for Kidney Diseases has since 2013 collected data on RRT patients' use of erythropoiesis-stimulating agents (ESAs) at the end of the year. Among dialysis patients the proportion of ESA users remained unchanged during 2013–2016, at approximately 81–82% (Figure 21).

At the end of 2016, the proportion of ESA-using dialysis patients was 81% in the entire country, varying between 64% and 100% in the healthcare districts (p=0.075) and between 80% and 85% in the regions (p=0.607). Use of ESA was more common among female than male dialysis patients (85% vs. 79%, p=0.002).

Figure 23. Hemoglobin concentration among dialysis patients older than 20 years using ESAs
Finnish Registry for Kidney Diseases 2013–2016

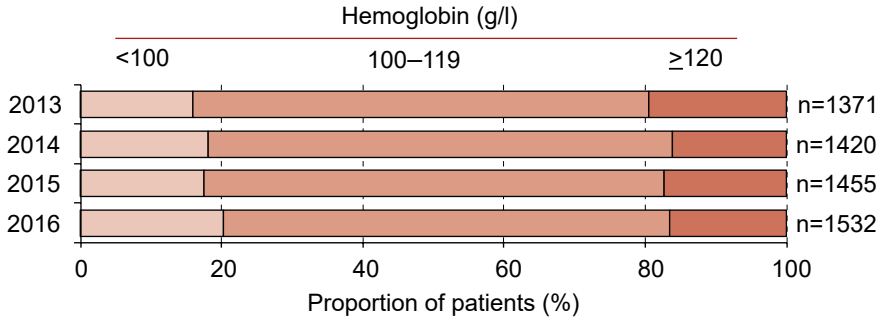


Figure 24. Hemoglobin concentration among dialysis patients older than 20 years who do not use ESAs
Finnish Registry for Kidney Diseases 2013–2016

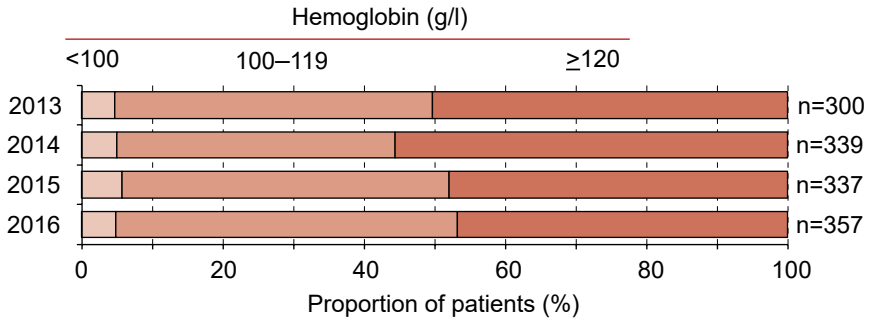


Figure 25. Hemoglobin concentration among dialysis patients older than 20 years using ESAs in healthcare districts
Finnish Registry for Kidney Diseases 2016

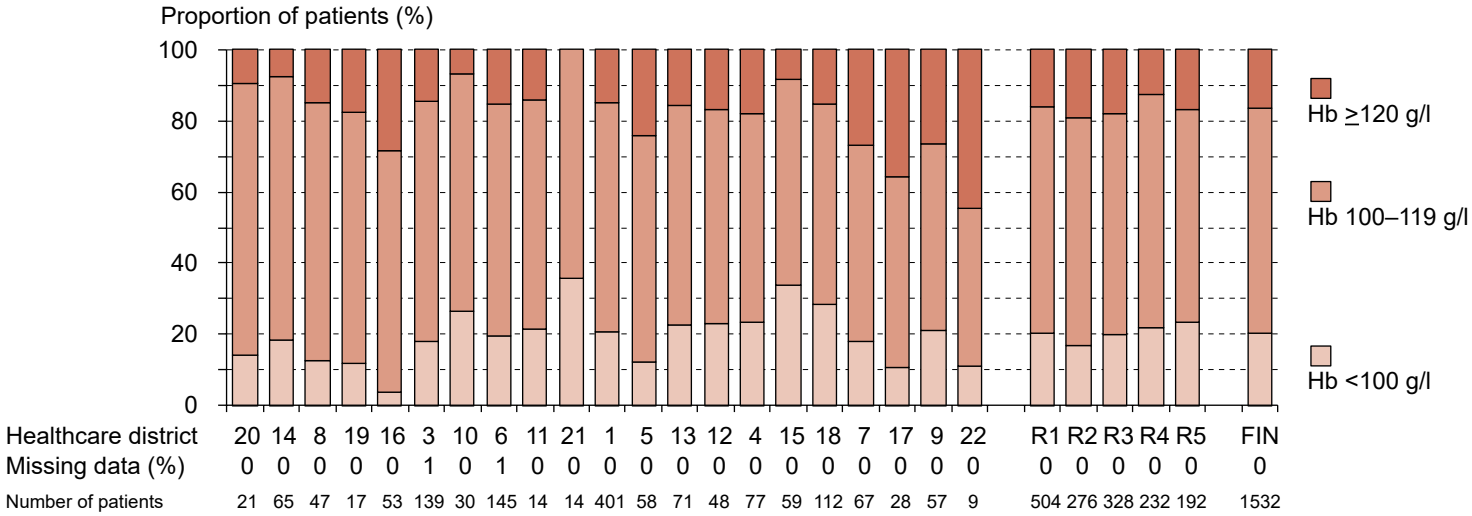


Figure 23 shows the distribution of hemoglobin concentration among ESA-using dialysis patients at the end of the years 2013–2016. The proportion of patients with a hemoglobin concentration lower than 100 g/l was 16% in 2013 and 20% in 2016.

Of dialysis patients who did not use ESA at the end of 2016, hemoglobin concentration was lower than 100 g/l in 5% and higher than 120 g/l in more than half (Figure 24).

Of the ESA-using dialysis patients at the end of 2016, altogether 63 had a hemoglobin concentration in the target range of 100–119 g/l. The proportion of patients reaching this target varied between 44% and 76% in the healthcare districts (p=0.457) and between 60% and 66% in the regions (p=0.713) (Figure 25). Female patients reached the hemoglobin target more frequently than male patients (68 vs. 60%, p=0.002).

Figure 26. Proportion of hemodialysis patients older than 20 years using intravenous iron at end of year
Finnish Registry for Kidney Diseases 2013–2016

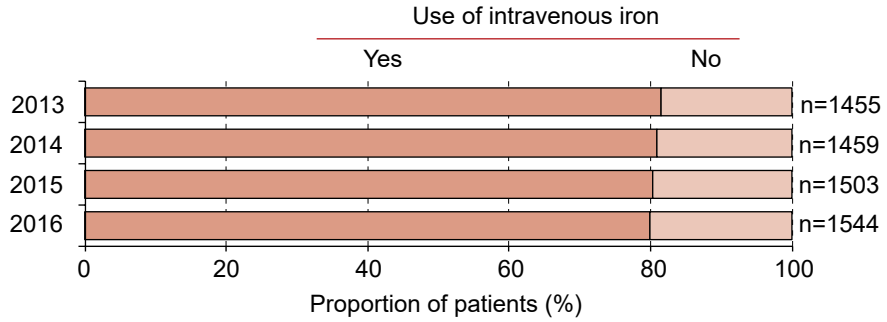
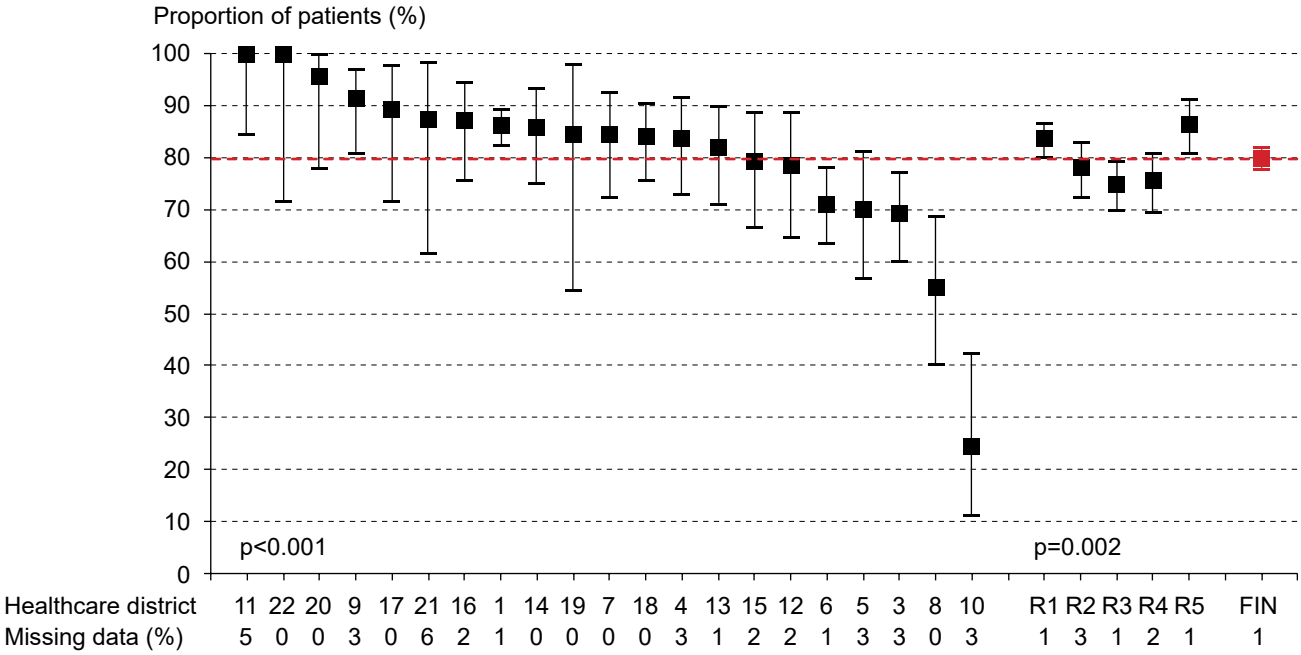


Figure 27. Proportion of hemodialysis patients older than 20 years using intravenous iron in healthcare districts
Finnish Registry for Kidney Diseases 2016



The Finnish Registry for Kidney Diseases has since 2013 collected information on RRT patients' use of intravenous iron at the end of the year. During 2013–2016 the proportion of hemodialysis patients receiving intravenous iron remained unchanged at 80–81% (Figure 26).

Figure 30 shows the proportion of hemodialysis patients receiving intravenous iron at the end of 2016 in healthcare districts and regions. In the entire country, 80% of hemodialysis patients received intravenous iron, with this proportion varying from 24% to 100% in healthcare districts (p<0.001) and from 75% to 87% in regions (p=0.002). Females received intravenous iron more often than males (84% vs. 78%, p=0.007).

Of the hemodialysis patients who received intravenous iron, 87% also used erythropoiesis-stimulating agents (ESAs). Of hemodialysis patients who did not receive intravenous iron, 71% used ESAs. Hemoglobin concentration was 100 g/l or higher among 82% and 120 g/l or higher among 21% of hemodialysis patients.

Of the peritoneal dialysis patients in the entire country, 16% received intravenous iron at the end of 2016.

Figure 28. Distribution of serum phosphorus among dialysis patients older than 20 years at end of year
Finnish Registry for Kidney Diseases 2006–2016

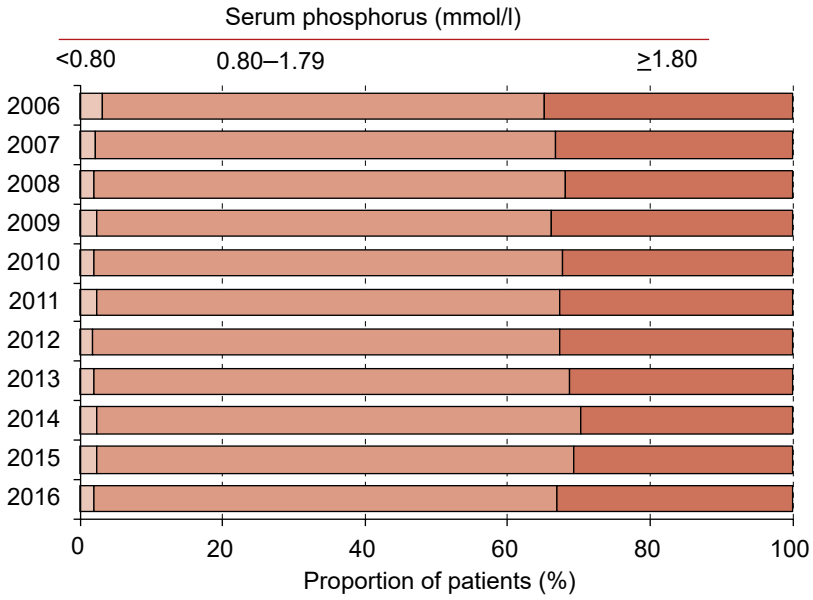
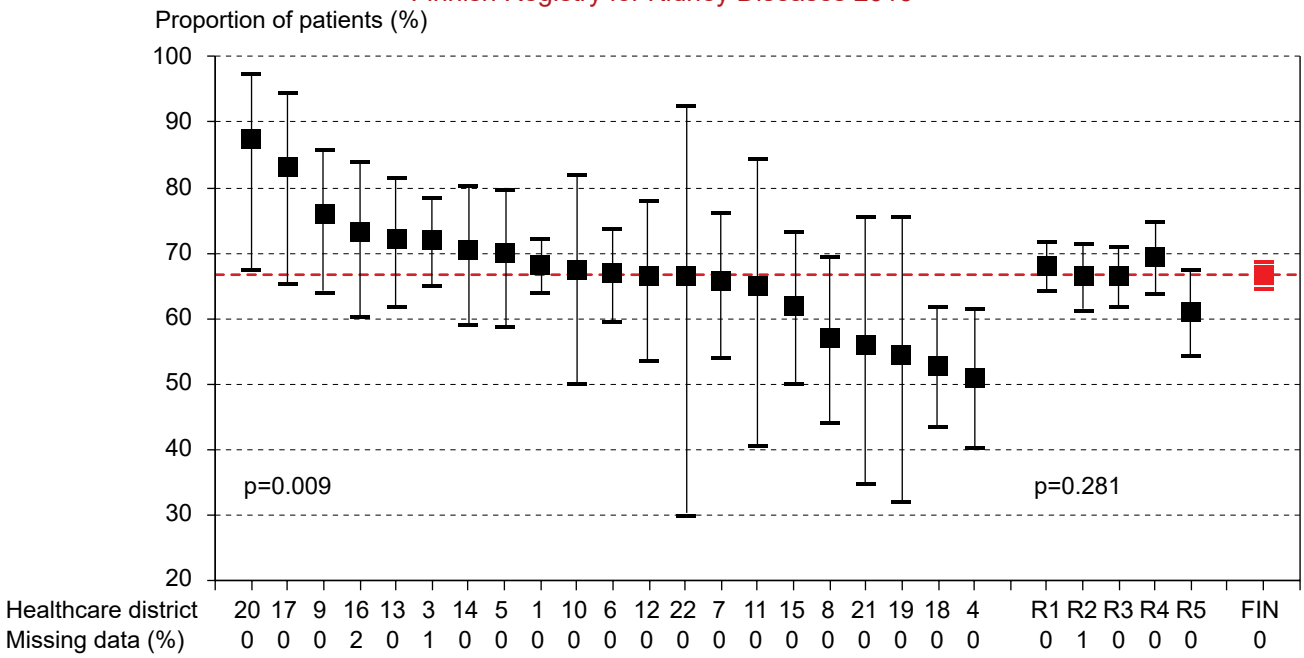


Figure 29. Proportion of dialysis patients older than 20 years with serum phosphorus <1.8 mmol/l in healthcare districts and regions
Finnish Registry for Kidney Diseases 2016



Hyperphosphatemia among patients with kidney disease is associated with vascular calcification and increased mortality. The guideline of the Kidney Disease Global Outcomes (KDIGO) suggests that elevated serum phosphorus of dialysis patients should be lowered towards the normal range with diet, intensified dialysis treatment, and phosphate binders if needed.

At the end of 2016, 67% of hemodialysis and peritoneal dialysis patients had concentrations of serum phosphorus lower than 1.8 mmol/l; this proportion has remained virtually unchanged during the past years (Figure 28). Only 2% of dialysis patients had an excessively low concentration of serum phosphorus (<0.8 mmol/l).

The proportion of patients reaching the treatment target (serum phosphorus <1.8 mmol/l) varied between 51% and 88% in the healthcare districts (p=0.009) and between 61% and 69% in the regions (p=0.281) (Figure 29). No significant difference was present in the proportions of men and women reaching the treatment target.

Figure 30. Distribution of serum parathyroid hormone (PTH) among dialysis patients older than 20 years at end of year
Finnish Registry for Kidney Diseases 2009–2016

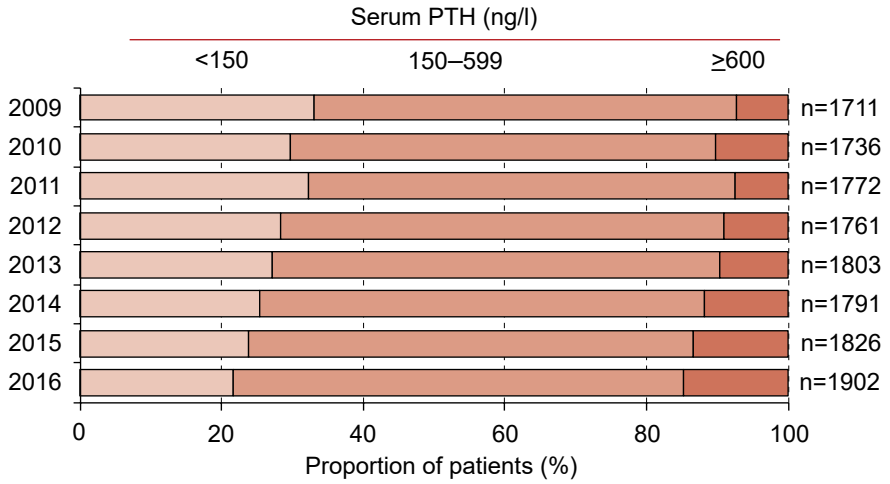
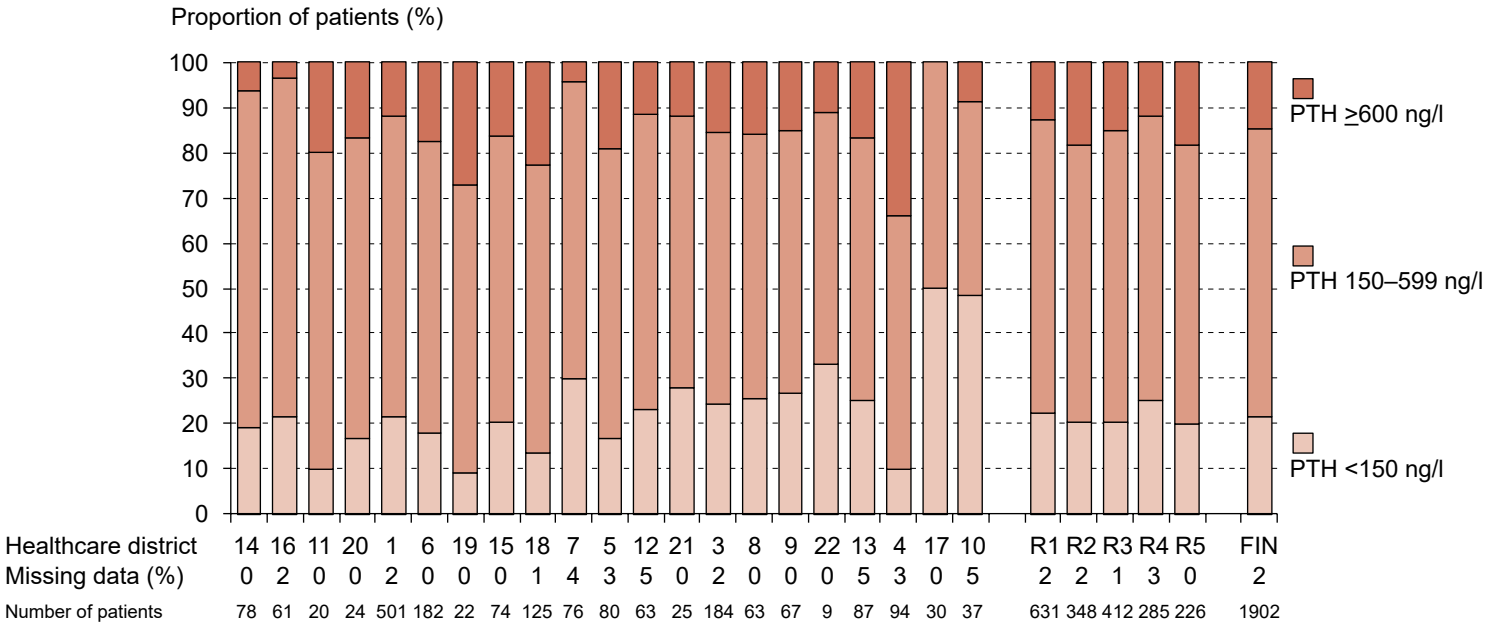


Figure 31. Distribution of serum PTH among dialysis patients older than 20 years in healthcare districts
Finnish Registry for Kidney Diseases 2016



Chronic kidney disease is associated with a disorder known as chronic kidney disease – mineral and bone disorder (CKD-MBD). In CKD-MBD, alterations in serum levels of calcium, phosphorus, vitamin D, and parathyroid hormone (PTH) are observed, and treatment of CKD-MBD focuses on correcting these alterations. The bone abnormalities connected to CKD-MBD are called renal osteodystrophy. CKD-MBD may lead to calcifications in blood vessels and soft tissue and to bone changes. Bone turnover may be high (with serum PTH typically above the target level) or low (with serum PTH usually below the target level) or normal. KDIGO has earlier suggested that dialysis patients' target serum PTH be 2 to 9 times the higher reference limit of healthy persons. However, in the 2017 update of the KDIGO guidelines, exact target levels are not mentioned. Since 2004, the calcimimetic agent cinacalcet has been used to treat secondary hyperparathyroidism, but subtotal parathyroidectomies are still performed as well.

The Finnish Registry for Kidney Diseases has collected data on serum PTH concentrations since 2009. There are several measurement methods of PTH available, hampering comparison of healthcare districts and regions. This report uses the PTH target of 150–599 ng/l.

At the end of 2016, 22% of dialysis patients had a PTH concentration lower than 150 ng/l and 15% had a concentration higher than 599 ng/l. Dialysis patients' level of serum PTH has continuously increased since 2009 (Figure 30). At the end of 2016, 64% of dialysis patients achieved the PTH target of 150–599 ng/l, with the proportion varying from 43% to 74% in healthcare districts (p=0.218) and from 62% to 65% in regions (p=0.803) (Figure 31). No significant difference was present in the proportions of men and women reaching the PTH target.

Figure 32. Vascular access of new hemodialysis patients older than 20 years at end of year
Finnish Registry for Kidney Diseases 2014–2016

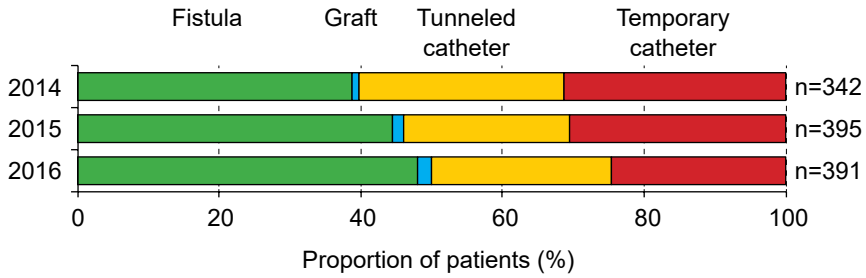
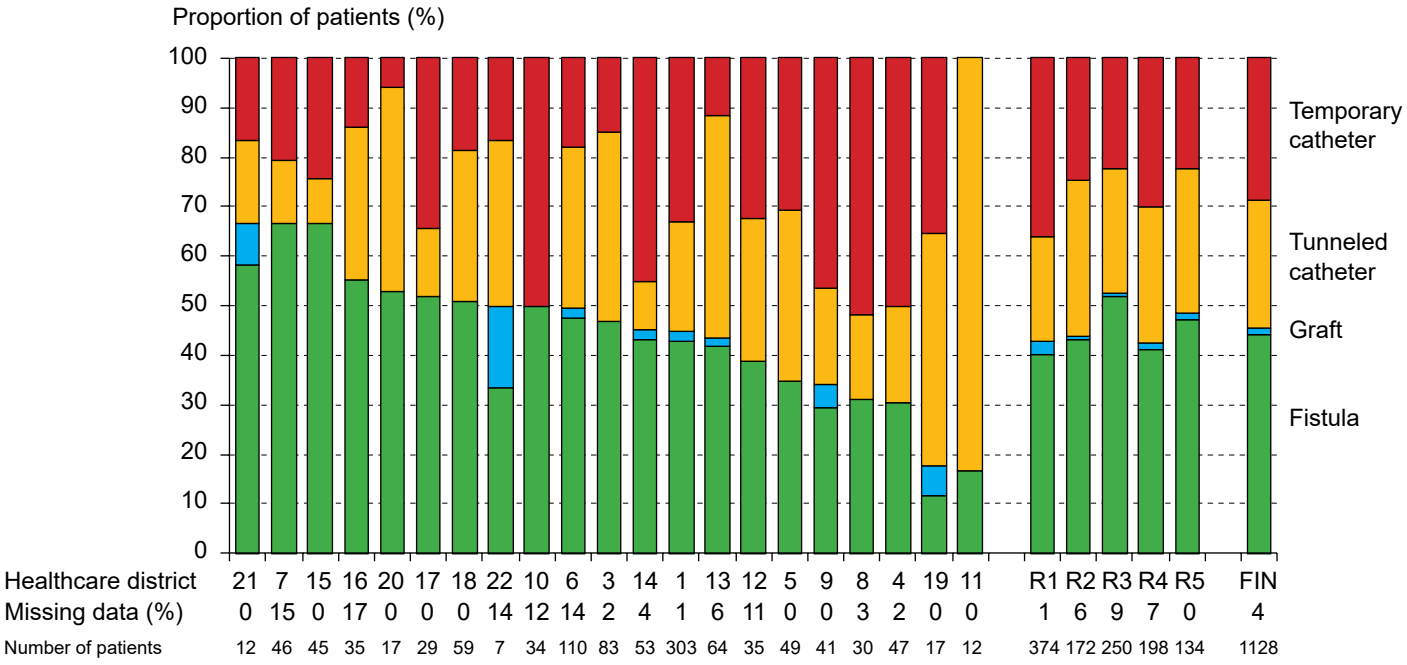


Figure 33. Vascular access of new hemodialysis patients older than 20 years in healthcare districts
Finnish Registry for Kidney Diseases 2014–2016

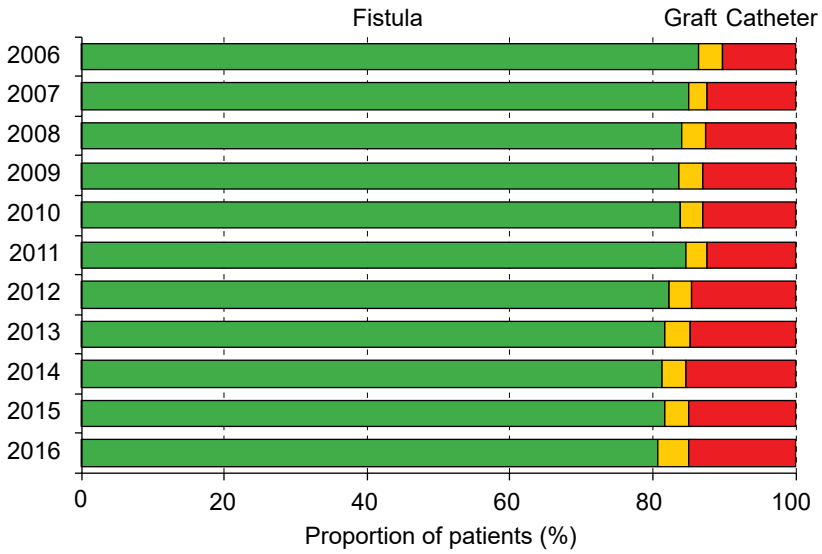


The Finnish Registry for Kidney Diseases has since 2014 collected data on vascular access of patients entering hemodialysis as the first type of RRT. The recommended type of vascular access is an arteriovenous fistula or graft. A tunneled central venous catheter is a better alternative than a temporary (non-cuffed) central venous catheter, which is recommended only when dialysis is started acutely and other types of vascular access are not possible.

In 2016, 50% of patients older than 20 years who entered hemodialysis had an arteriovenous fistula or graft; the proportion had increased since 2014 (Figure 32). In 2016, 25% of new hemodialysis patients started with a temporary catheter.

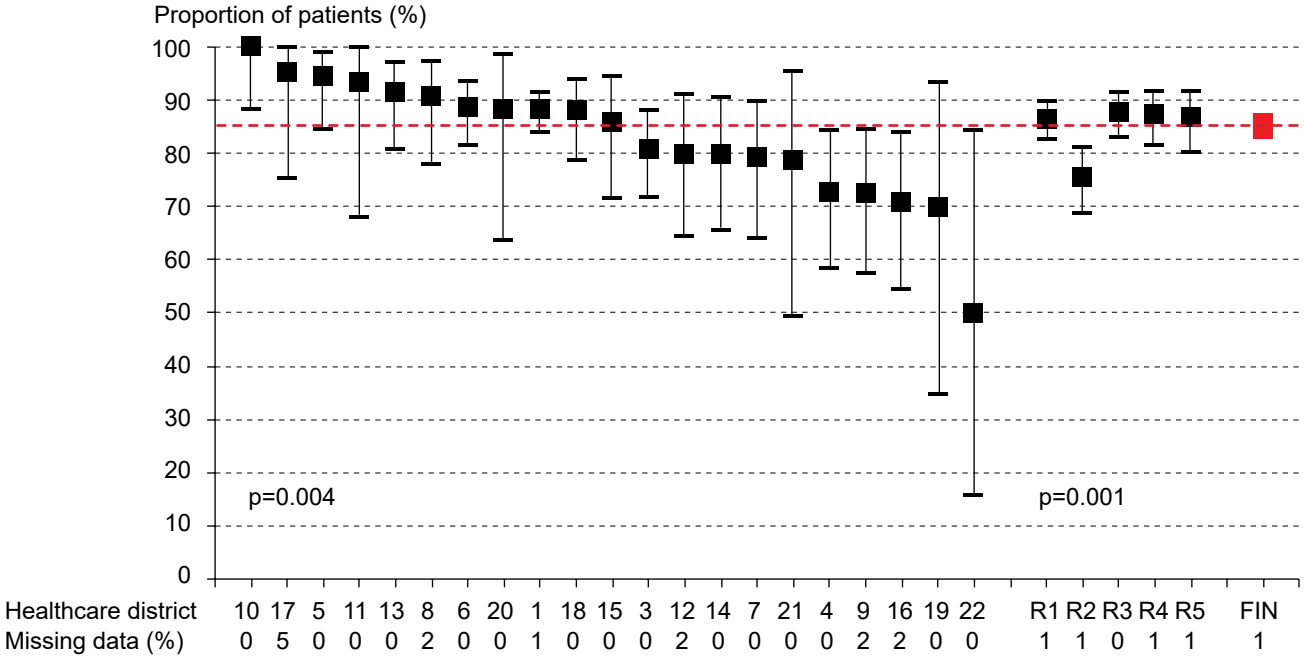
Figure 33 shows the distribution of types of first vascular access among patients who entered hemodialysis in 2014–2016. In the entire country, 46% had a fistula or graft, but the proportion varied between 17% and 67% in healthcare districts (p=0.006) and between 42% and 53% in regions (p=0.118). The proportion of patients with a fistula or graft did not differ between the sexes.

Figure 34. Vascular access of hemodialysis patients older than 20 years at end of year
Finnish Registry for Kidney Diseases 2006–2016



Patients who had been on RRT less than one year were excluded.

Figure 35. Proportion of hemodialysis patients older than 20 years with a fistula or graft in healthcare districts and regions
Finnish Registry for Kidney Diseases 2016

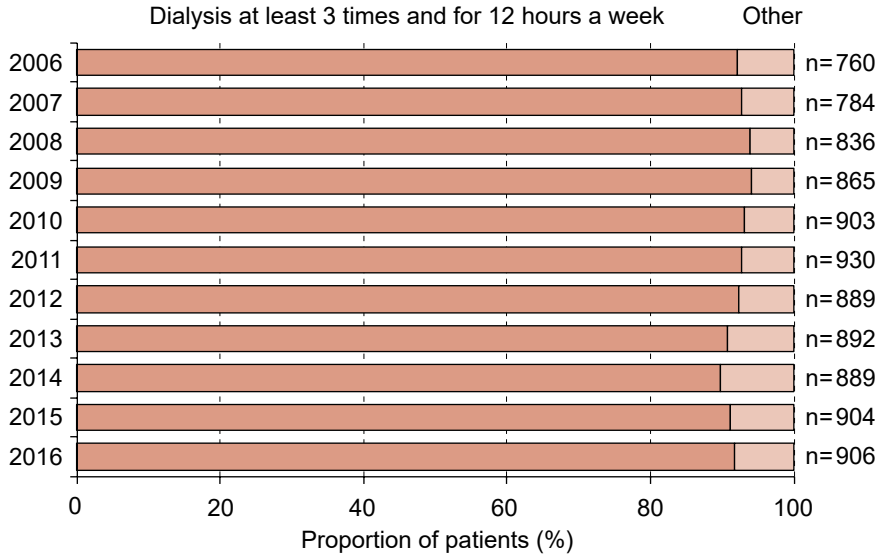


Patients who had been on RRT less than one year were excluded.

Vascular access is one of the most important quality measures of hemodialysis. Use of a central venous catheter is associated with complications, and the goal is that hemodialysis patients have an arteriovenous fistula or graft. Of hemodialysis patients aged 20 years or older who had been on RRT for at least one year, the proportion with a fistula or graft was the largest, 90%, in 2006, after which it has decreased, being 85% since 2012 (Figure 34).

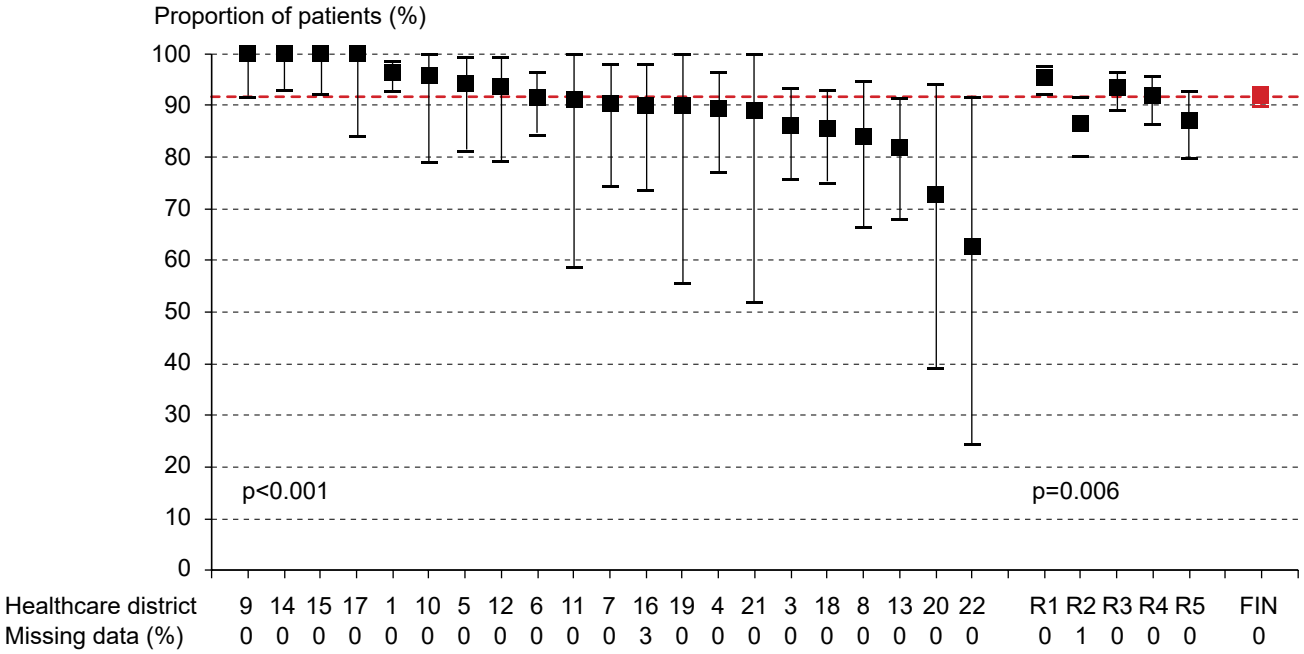
At the end of 2016, the proportion of patients with a fistula or graft varied between 50% and 100% in healthcare districts (p=0.004) and between 75% and 88% in regions (p<0.001) (Figure 35). Female hemodialysis patients less frequently than male patients had a fistula or graft (79% vs. 88%, p<0.001).

Figure 36. Sufficiency of dialysis time among hemodialysis patients aged 20–74 years
Finnish Registry for Kidney Diseases 2006–2016



Patients who had been on RRT less than 91 days and home hemodialysis patients were excluded.

Figure 37. Proportion of hemodialysis patients aged 20–74 years with sufficient dialysis time in healthcare districts and regions
Finnish Registry for Kidney Diseases 2016



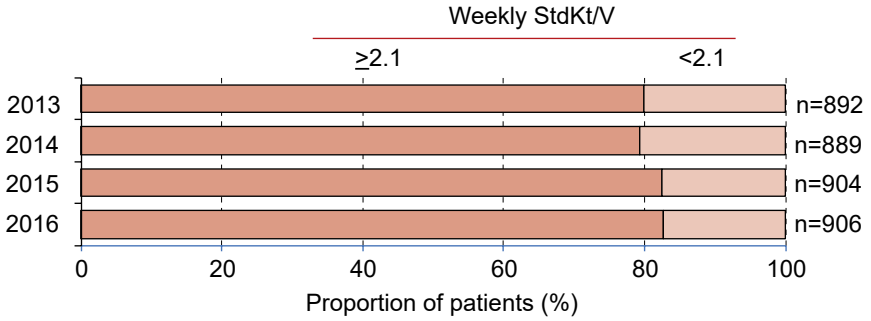
Patients who had been on RRT less than 91 days and home hemodialysis patients were excluded (n=906).

According to the European Best Practice Guidelines (EBPG), hemodialysis should be performed at least three times and for at least 12 hours a week if there is no significant residual kidney function. Based on this definition, 92% of 20–74-year-old in-center hemodialysis patients received sufficient hemodialysis time at the end of 2016 (Figure 36). The proportion has remained virtually unchanged during recent years.

At the end of 2016, the proportion varied between 62% and 100% in healthcare districts (p=0.001) and between 87% and 95% in regions (p=0.006) (Figure 37). At the end of 2016, there was no difference between sexes in sufficient dialysis time.

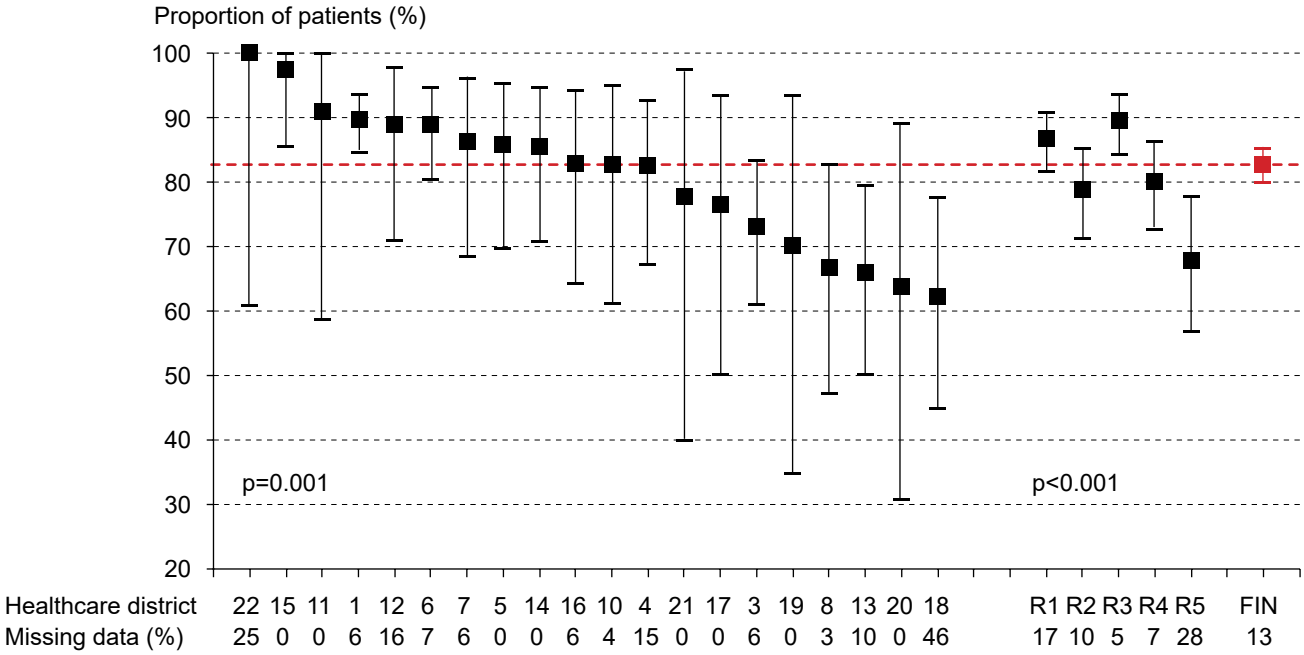
In earlier reports, patients who had been on RRT for less than one year were excluded from the analyses of dialysis time. Now only patients who had been on RRT for less than 91 days were excluded.

Figure 38. Urea removal (weekly StdKt/V) among 20–74-year-old hemodialysis patients at end of year
Finnish Registry for Kidney Diseases 2013–2016



Patients who had been on RRT less than 91 days and home hemodialysis patients were excluded.

Figure 39. Urea removal (weekly StdKt/V) among 20–74-year-old hemodialysis patients in healthcare districts
Finnish Registry for Kidney Diseases 2016



Patients who had been on RRT less than 91 days and home hemodialysis patients were excluded (n=906).

The Finnish Registry for Kidney Diseases has since 2013 collected data on serum urea and patients' weight also after hemodialysis, not only before hemodialysis. Based on this information, it is possible to estimate how efficiently hemodialysis removes urea by calculating weekly standard Kt/V (StdKt/V). This theoretical measure describes how many times the body's urea distribution volume is totally cleared from urea during one week of dialysis. The method of calculating StdKt/V is described on the next page. According to the KDIGO guidelines, StdKt/V should be at least 2.1 volumes and residual renal function should also be considered in the estimate, which is not possible with the data from the Finnish Registry for Kidney Disease. Thus, the StdKt/V estimates presented here describe the urea clearance provided by dialysis or the situation in which there is no residual renal function. The weekly StdKt/V is mostly affected by the amount of urea removal during the dialysis session and the weekly number of dialysis sessions.

At the end of 2016, 83% of 20–74-year-old in-center hemodialysis patients achieved the StdKt/V target, and the proportion of patients attaining the target had not changed significantly since 2013 (Figure 38). The proportion varied from 62% to 100% between healthcare districts (p=0.001) and from 68% to 89% between regions (p<0.001) (Figure 39). Female patients reached the StdKt/V target more often than men (90% vs. 80%, p<0.001).

Of the patients presented in Figure 39, 88% received hemodialysis three times a week, 5% more seldom, and 7% more often. Of those who received hemodialysis three times a week, 86% reached the target for StdKt/V, of those who received hemodialysis more seldom no-one reached the target, and of those who received more frequent hemodialysis everyone reached the target.

Calculation of StdKt/V

Kt/V describes how much urea is removed during a dialysis session, and it has been used more broadly as a measure of dialysis adequacy. Urea is distributed in the body in volume V. K is the urea clearance during dialysis (the unit is volume per time) and t is the duration of the dialysis session. K x t is the theoretical fluid volume that is cleared from urea during the dialysis session. Kt/V thus describes how many times the urea distribution volume is cleared from urea. When hemodialysis is performed three times a week, the recommended Kt/V is 1.3 or higher for each dialysis session. We used the following formula to calculate Kt/V (Daugirdas, 1995):

$$Kt/V = -\ln(R - 0.008 \times t) + (4 - 3.5 \times R) \times 0.55\ UF/V,$$

where ln is the natural logarithm, R is the ratio between postdialytic and the predialytic urea concentration, t is the duration of the dialysis session in hours, UF is the volume of removed fluid in liters (the difference between pre- and postdialytic weight), and V is the distribution volume of urea (for males 0.60 x and for females 0.50 x the postdialytic weight).

After hemodialysis, the urea concentration equilibrates in the entire distribution volume and urea diffuses from tissues to the blood circulation. Because of this, the plasma concentration of urea measured at the end of or very shortly after the dialysis session is lower than the concentration in the whole distribution volume. This is corrected by calculating the equilibrated Kt/V (eKt/V) (Tattersall, 1996):

$$eKt/V = Kt/V \times t/(t + 0.512),$$

where t is the duration of the hemodialysis session in hours. The postdialytic urea rebound is more significant if the dialysis session is short.

Standard Kt/V (StdKt/V) gives a comparable Kt/V estimate regardless of how many times hemodialysis is performed in a week. In addition, StdKt/V enables comparison with the weekly Kt/V estimates of peritoneal dialysis patients. In this report, StdKt/V was calculated using the following formula (Leypoldt, 2004):

$$StdKt/V = \frac{168 \times (1 - e^{-eKt/V})/t}{(1 - e^{-eKt/V})/V + 168/(N \times t) - 1}$$

where e is Euler's number, N is the weekly number of hemodialysis sessions, and t is the duration of one hemodialysis session in hours. This formula does not take residual renal function into account. Some hemodialysis patients do have residual renal function. The Finnish Registry for Kidney Disease has since 2016 collected data on dialysis patients' diuresis, but more exact data on residual renal function are not available. However, if diuresis is less than 500 ml per day, residual renal function is minimal.

According to the KDIGO guidelines, the target for StdKt/V is 2.1 or higher when considering also the residual renal function, which was not done in the analyses on page 41. Of the patients who did not reach the target of StdKt/V in 2016 (Figure 39), 39% did not have significant residual function based on their diuresis being less than 500 ml per day.

References

1. Daugirdas JT. Simplified equation for monitoring Kt/V, PCRn, eKtV, ePCRn. Adv Ren Replace Ther, 1995;11:1574–1581.
2. Tattersall JE, DeTakats D, Chamney P, Greenwood RN, Farrington K. The post-hemodialysis rebound: predicting and quantifying its effect on Kt/V. Kidney Int, 1996;50:2094–2102.
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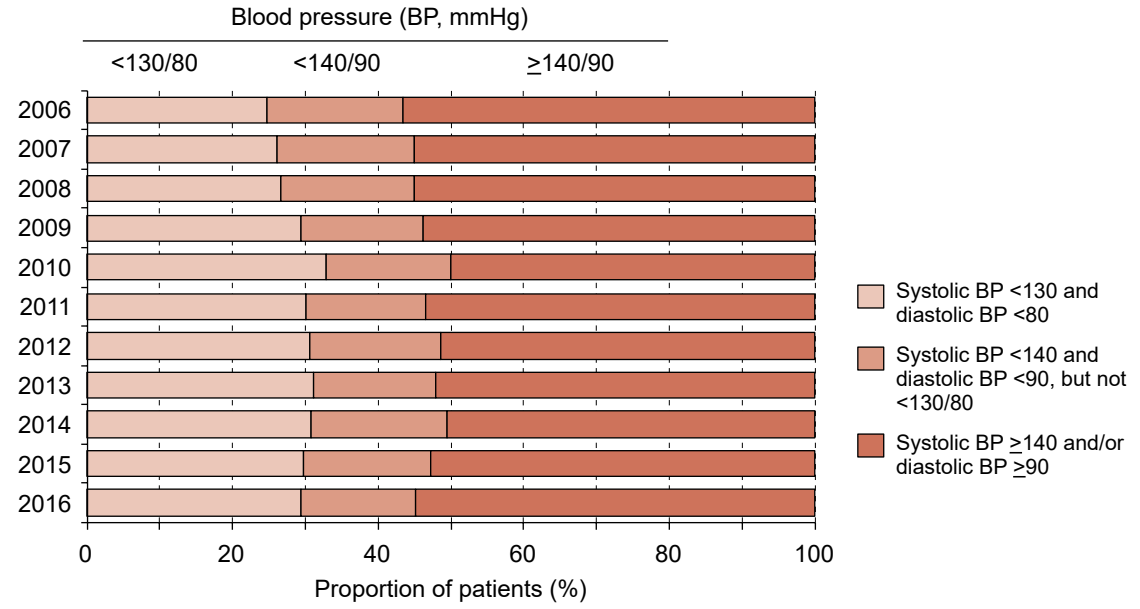
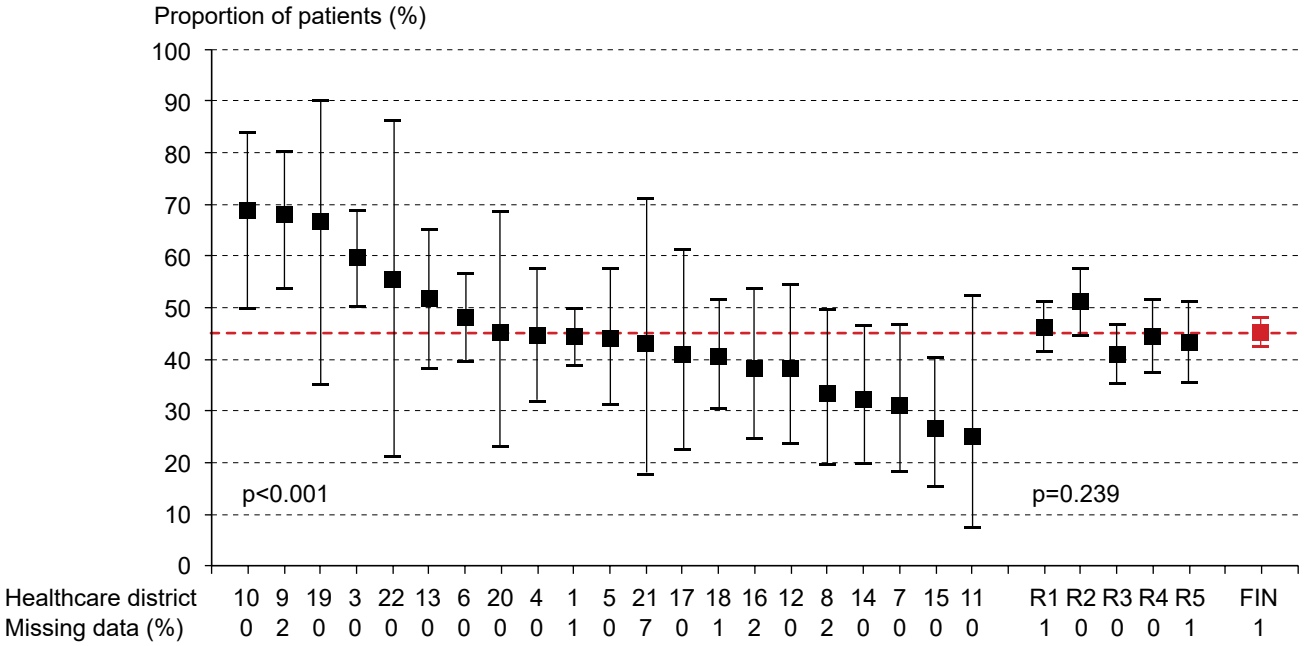
Figure 40. Distribution of predialytic blood pressure among hemodialysis patients older than 20 years
Finnish Registry for Kidney Diseases 2006–2016



Patients who had been on RRT less than 91 days and home hemodialysis patients were excluded.

Figure 41. Proportion of hemodialysis patients older than 20 years with predialytic blood pressure <140/90 mmHg in healthcare districts and regions
Finnish Registry for Kidney Diseases 2016



Patients who had been on RRT less than 91 days and home hemodialysis patients were excluded (n=1361).

According to the guidelines of the Kidney Disease Outcome Quality Initiative (KDOQI), hemodialysis patients' target predialytic blood pressure is under 140/90 mmHg. At the end of 2016, 45% of hemodialysis patients reached this target (Figure 40). The proportion of patients attaining the target varied between 25% and 69% in healthcare districts (p<0.001) and between 41% and 51% in regions (p=0.239) (Figure 41). Female patients achieved the blood pressure target more frequently than males (49% vs. 43%, p=0.032).

Figure 42. Distribution of blood pressure of kidney transplantation patients older than 20 years
Finnish Registry for Kidney Diseases 2006–2016

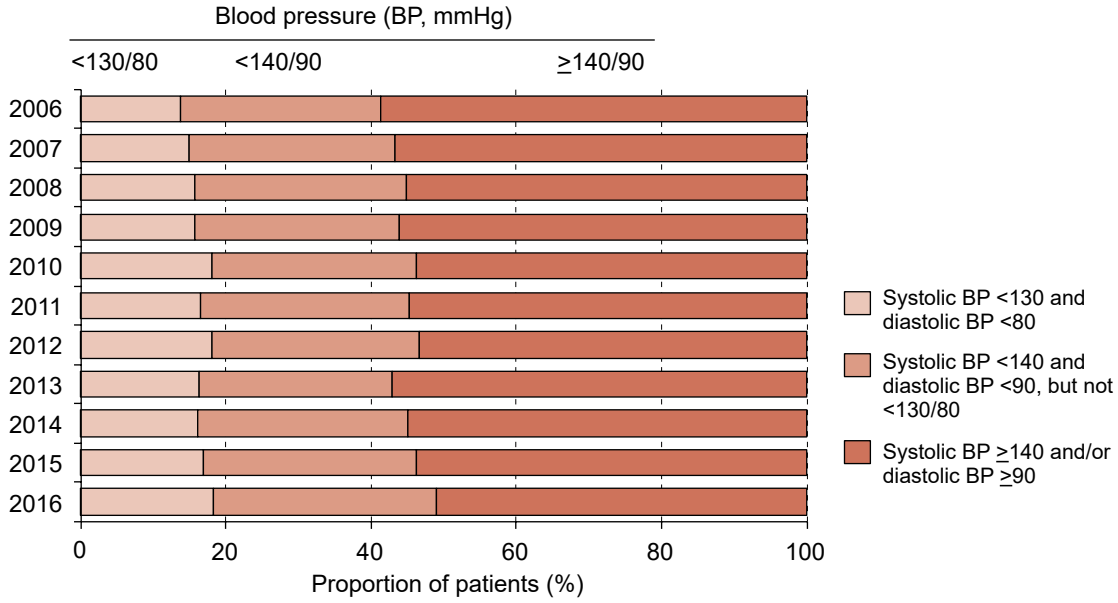
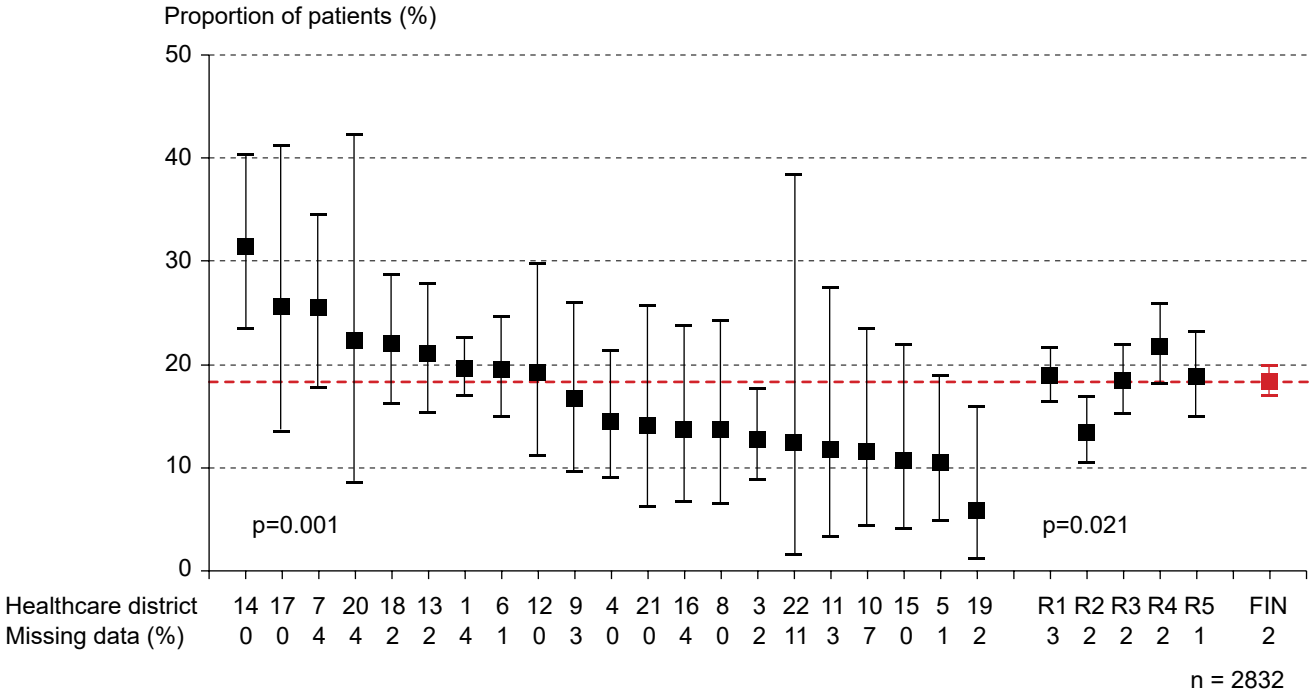


Figure 43. Proportion of kidney transplantation patients older than 20 years with blood pressure <130/80 mmHg in healthcare districts and regions
Finnish Registry for Kidney Diseases 2016



The KDIGO guidelines suggest that the blood pressure target of kidney transplantation patients be lower than 130 mmHg for systolic blood pressure and lower than 80 mmHg for diastolic blood pressure. Figure 42 shows the blood pressure distribution of kidney transplantation patients at the end of the years 2006–2016. The proportion of patients reaching the target (<130/80 mmHg) was 14% in 2006 and 18% in 2016.

At the end of 2016, the proportion of kidney transplantation patients attaining the blood pressure target varied between 6% and 31% in healthcare districts (p=0.001) and between 13% and 23% in regions (p=0.021) (Figure 43). No significant difference was observed between the sexes.

Figure 44. Distribution of serum LDL cholesterol among kidney transplantation patients older than 20 years
Finnish Registry for Kidney Diseases 2006–2016

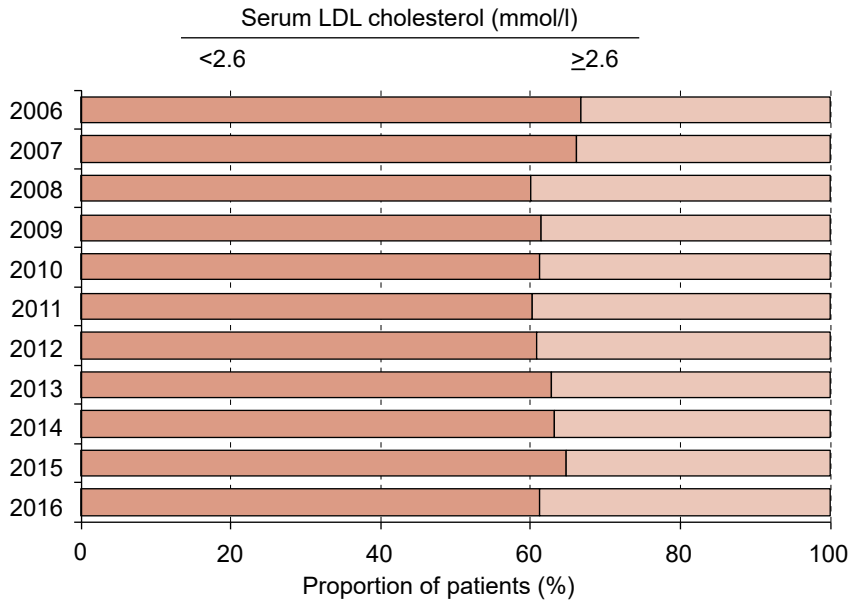
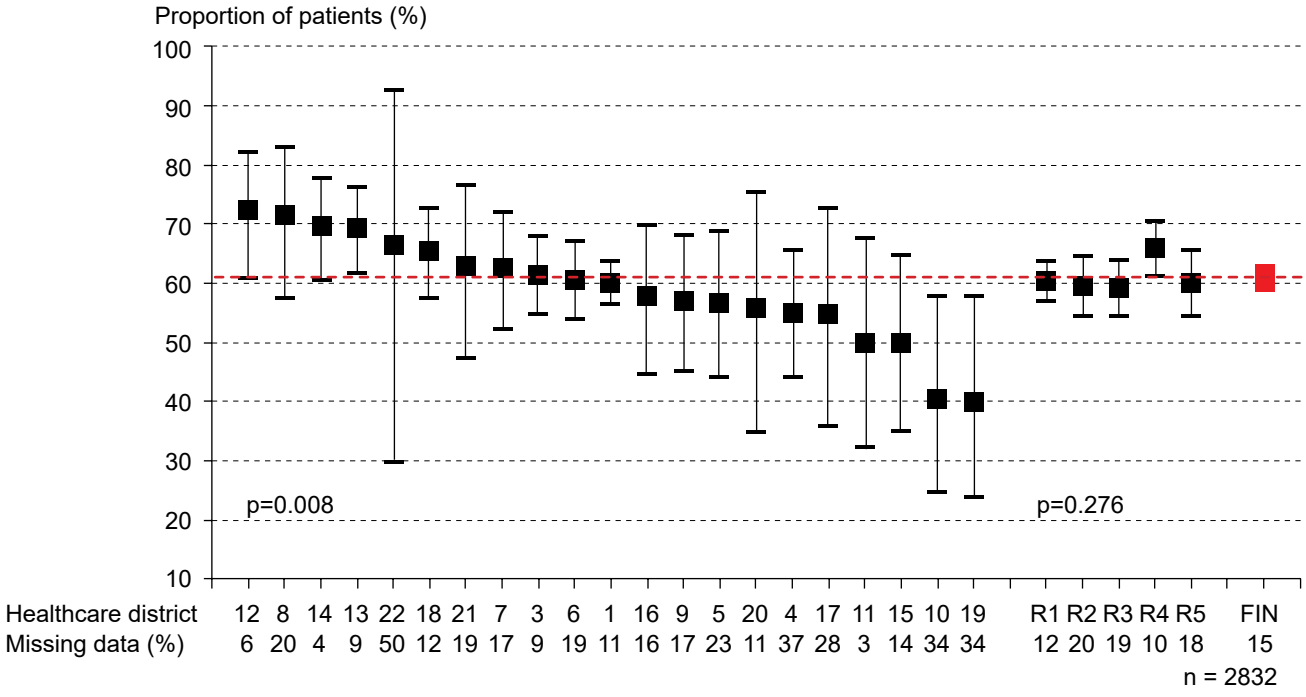


Figure 45. Proportion of kidney transplantation patients older than 20 years with serum LDL cholesterol <2.6 mmol/l in healthcare districts and regions
Finnish Registry for Kidney Diseases 2016



According to the KDIGO and KDOQI guidelines, kidney transplantation patients' concentration of serum low-density lipoprotein (LDL) cholesterol should be less than 2.6 mmol/l. In 2016, 61% of kidney transplantation patients reached this target (Figure 44).

The proportion of kidney transplantation patients reaching the treatment target for LDL cholesterol varied between 40% and 73% in healthcare districts (p=0.008) and between 59% and 66% in regions (p=0.276) (Figure 45). Males reached the target more frequently than females (63% vs. 58%, p=0.008).

The concentration of LDL cholesterol was calculated using the Friedewald formula based on serum concentrations of total cholesterol, high-density lipoprotein (HDL) cholesterol, and triglycerides. Because of restrictions of the Friedewald formula, patients with a triglyceride concentration higher than 4.5 mmol/l were excluded (1% of patients).

Finnish Registry for Kidney Diseases

Report 2016

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