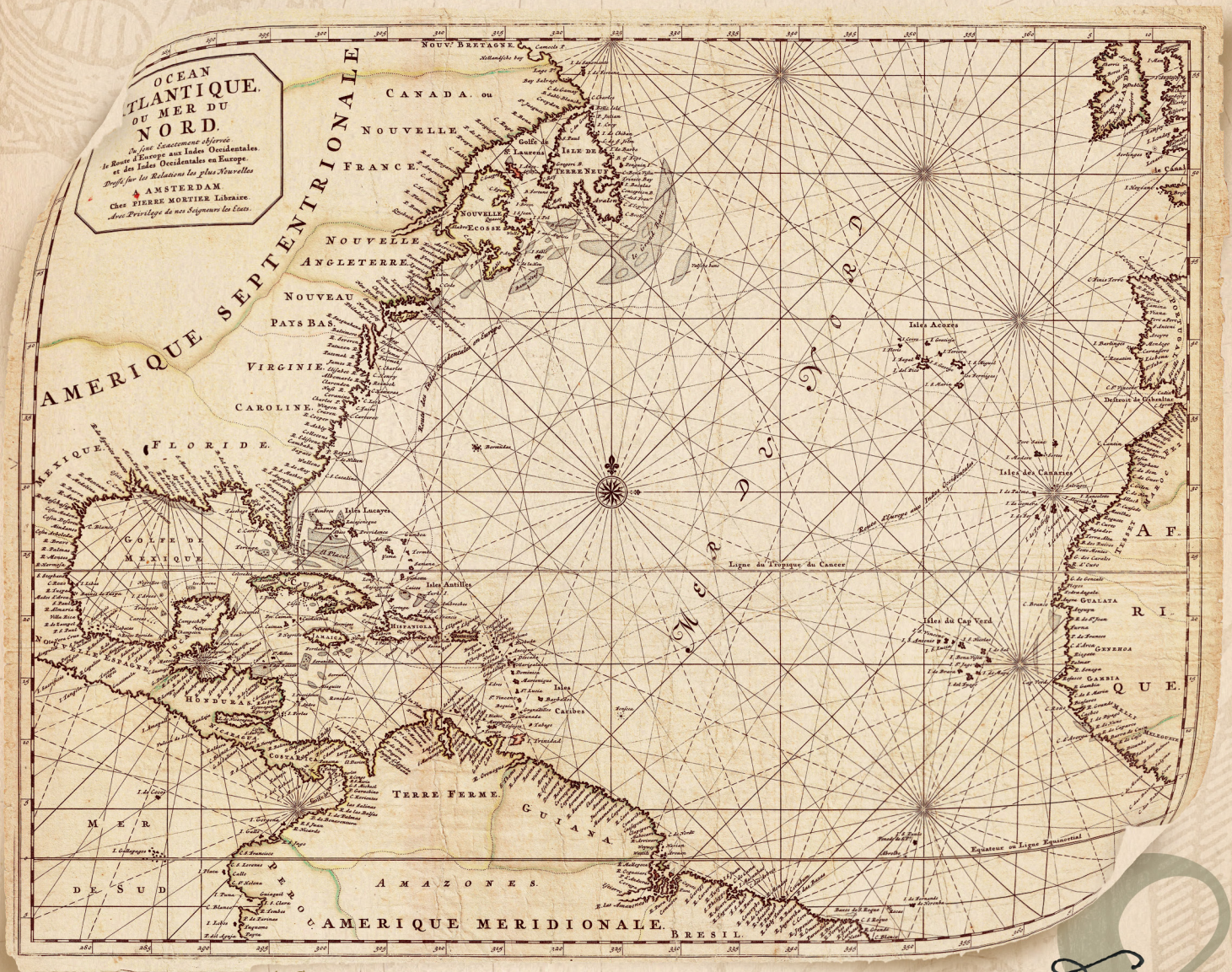


Pierre Mortier, 1693

Pediatric end-stage renal disease

298 ESRD diagnosis in the pediatric population
300 incidence of ESRD; vaccinations
302 hospitalization; mortality
304 hemoglobin; medication use
306 summar

Pediatric end-stage renal disease patients pose unique challenges to parents, providers, and the healthcare system, which must address not only the disease itself, but the many extra-renal manifestations that affect patients' lives and families. On the next spread we detail the causes of kidney failure in children, using data from the Medical Evidence form (2728). The leading causes are cystic/hereditary and congenital disorders, which accounted for 36 percent of pediatric ESRD cases in 2007–2011, while 23 percent were caused by glomerular diseases, and 11 percent by secondary causes of glomerulonephritis, including vasculitis.

Even more striking are the simplest measures of outcomes in the first year of therapy. Thirty-eight percent of pediatric patients receive a transplant in the first year, while 4 percent die; neither rate has altered over the past decade. Considerable progress, however, has been made in the first-year mortality rate among patients with primary glomerular diseases, which has fallen from 2.2 percent in 2002–2006 to 1.5 percent in 2007–2011, and among those with secondary glomerular disease, for whom the rate has fallen from 5.6 to 4.3 percent. Among patients with congenital/hereditary/cystic diseases — the most common diagnoses — first-year mortality has declined from 3.4 to 2.8 percent.

Influenza and pneumococcal pneumonia vaccinations are important preventive measures that can reduce disease burden and rates of hospitalization due to infection. Interestingly, rates of these vaccinations among pediatric patients are half those of their adult counterparts, with only one-third to one-half of patients being vaccinated. There continue to be disparities by modality, with hemodialysis patients more likely to be vaccinated than children on peritoneal dialysis or those with a functioning kidney transplant.

We next examine the considerable degree of morbidity in pediatric patients. Overall, all-cause hospitalization rates for children age 0–9 and 15–19 rose 20 percent between 2001–2005 and 2006–2011. In the hemodialysis population, hospitalization rates increased 10 percent, while those for peritoneal dialysis patients rose nearly 24 percent. In the youngest patients, rates of hospitalization for infection have increased 24 percent overall, and 19 percent in those treated with peritoneal dialysis. Hospitalizations due to pneumonia are most frequent in transplant patients younger than ten, a finding which suggests that low vaccination rates in these patients may be an area to target.

More detailed analyses need to be developed on the specific causes of hospitalization, including congestive heart failure and arrhythmias. These complications are of particular concern in pediatric patients, for whom fluid overload and hypertension are major clinical problems. Also needed are analyses of medication use specific to these areas of morbidity.

Similar analyses of mortality between 2001–2005 and 2006–2011 show a 20 percent increase for patients younger than 10, compared to a decline of

This unlikely story begins on a sea that was a blue dream, as colorful as blue-silk stockings, and beneath a sky as blue as the irises of children's eyes. From the western half of the sky the sun was shying little golden disks at the sea — if you gazed intently enough you could see them skip from wave tip to wave tip until they joined a broad collar of golden coin that was collecting half a mile out and would eventually be a dazzling sunset.

F. Scott Fitzgerald
Flappers and Philosophers

35 percent among those age 10–14. These overall changes, however, are not reflected in rates of cardiovascular mortality, which have risen for all patients younger than 15. The greatest increase, of 17 percent, has occurred among patients treated with peritoneal dialysis; among transplant patients, in contrast, the rate has fallen 46 percent.

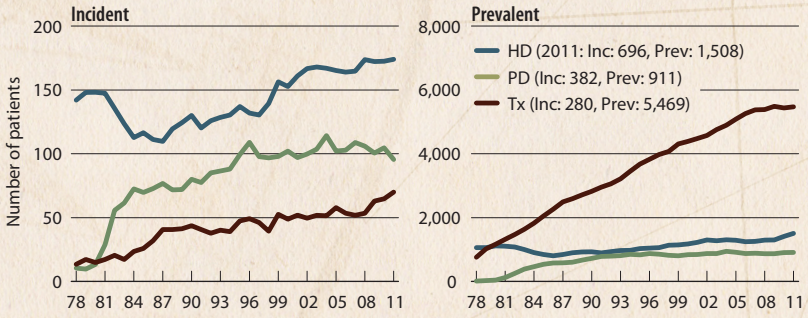
Anemia treatment has changed in ways similar to those seen in the adult population. The mean hemoglobin at initiation among pediatric patients, for example, is 9.9 g/dl, similar to that noted in 2009 and 2010. After a peak of nearly 40 percent in 2006, and a level of 36 percent in 2010, the percentage of patients using an ESA prior to initiation of ESRD therapy has fallen to 33 percent.

Data on the use of prescription drugs among pediatric patients may help identify areas for treatment. With cardiovascular disease and arrhythmias being areas of particular concern, we look at the use of cardiovascular medications in both dialysis and transplant patients. Even with the high degree of left ventricular hypertrophy (LVH), hypertension, and cardiomyopathy reported among pediatric patients, beta blocker therapy is less than half that noted in the adult population and warrents furthur study.

The chapter's last figure illustrates the use of various medications such as ESAs, IV iron, IV vitamin D, cinacalcet, phosphate binders, and growth hormone (somatropin). Use of the latter treatment has been shown to be far less than anticipated based on the poor growth of pediatric ESRD patients, particularly given that the therapy is an effective one. Barriers to treatment may be the patients themselves, their parents, and their doctors, but the fact remains that short stature is a life-long issue for these patients, impacting development and socialization.

Data continue to illustrate the extreme vulnerability of ESRD patients younger than ten. Infection control, uncontrolled hypertension, heart failure, cardiovascular mortality, and sudden death all remain issues of concern. None of these are new challenges, but the community will need to assess them and develop new approaches to improving outcomes in this vulnerable population. • **Figure 8.1;** see page 444 for analytical methods. *Incident & December 31 point prevalent ESRD patients age 0–19; peritoneal dialysis consists of CAPD & CCPD.*

vol 2
8.1 **Incident & prevalent counts for pediatric ESRD patients**



vol 1
8.a **Distribution of reported incident pediatric ESRD patients, by primary diagnosis, 2002–2006 (period A) & 2007–2011 (period B)**

	Total pts		% of inc pts		Median age		% male		White		Black/ African Am		Other race		% tx first year		% dying first year	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
All ESRD (reference)	6,553	6,821	100	100	14	14	56.8	57.0	64.9	68.2	24.7	18.1	10.5	13.8	38.5	38.0	4.1	3.9
Diabetes	65	169	1.0	2.6	16	0	58.5	55.0	56.9	63.9	40.0	29.6	3.1	6.5	7.7	4.1	26.2	17.2
DM w/renal manifestations Type 2	40	132	0.6	2.0	13	0	70.0	52.3	62.5	65.9	32.5	28.0	5.0	6.1	10.0	2.3	35.0	18.9
DM w/renal manifestations Type 1	25	37	0.4	0.6	19	18	40.0	64.9	48.0	56.8	52.0	35.1	0.0	8.1	4.0	10.8	12.0	10.8
Glomerulonephritis (GN)	1,625	1,461	25.6	22.5	16	16	55.1	53.7	59.3	67.2	31.1	24.3	9.5	8.5	34.3	33.7	2.2	1.5
GN (histologically not examined)	316	257	5.0	3.9	17	18	55.7	58.8	60.8	75.9	24.7	17.5	14.6	6.6	27.2	19.5	3.5	1.6
Focal glomer. sclerosis, focal sclerosis GN	857	762	13.5	11.7	15	15	58.5	53.9	52.9	61.9	39.6	30.7	7.6	7.3	35.4	38.7	2.0	1.4
Membranous nephropathy	37	36	0.6	0.6	16	16	40.5	52.8	59.5	41.7	29.7	38.9	10.8	19.4	43.2	33.3	0.0	2.8
Membranopro. GN type 1, diffuse MPGN	76	83	1.2	1.3	15	16	50.0	47.0	82.9	63.9	13.2	18.1	3.9	18.1	42.1	38.6	2.6	1.2
Dense deposit disease, MPGN type 2	31	25	0.5	0.4	13	14	29.0	56.0	90.3	80.0	3.2	4.0	6.5	16.0	35.5	20.0	0.0	4.0
IgA nephropathy, Berger's	126	138	2.0	2.1	17	17	57.1	59.4	68.3	76.1	16.7	13.0	15.1	10.9	41.3	39.9	0.8	0.7
IgM nephropathy	*	15	0.1	0.2	15	17	62.5	66.7	37.5	66.7	37.5	26.7	25.0	6.7	25.0	20.0	0.0	0.0
With lesion of rapidly progressive GN	81	52	1.3	0.8	14	14	40.7	28.8	66.7	82.7	23.5	7.7	9.9	9.6	32.1	19.2	2.5	1.9
Post infectious GN, SBE	11	25	0.2	0.4	14	14	54.5	64.0	72.7	72.0	18.2	24.0	9.1	4.0	36.4	16.0	0.0	4.0
Other proliferative GN	82	68	1.3	1.0	15	16	48.8	41.2	67.1	75.0	26.8	20.6	6.1	4.4	31.7	39.7	2.4	1.5
Secondary GN/vasculitis	710	724	11.2	11.1	16	16	32.1	29.6	54.2	65.3	35.8	26.7	10.0	8.0	15.8	14.9	5.6	4.3
Lupus erythematosus (SLE nephritis)	408	375	6.4	5.8	17	18	24.3	19.2	37.3	48.0	51.0	43.2	11.8	8.8	7.6	6.7	7.1	4.3
Henoch-Schonlein syndrome	22	31	0.3	0.5	15	15	59.1	58.1	90.9	87.1	4.5	6.5	4.5	6.5	50.0	35.5	0.0	3.2
Scleroderma	*	*	0.1	0.1	15	18	40.0	60.0	40.0	100	40.0	0.0	20.0	0.0	0.0	20.0	40.0	20.0
Hemolytic uremic syndrome	124	124	1.9	1.9	6	6	45.2	43.5	76.6	80.6	13.7	12.1	9.7	7.3	27.4	28.2	4.0	5.6
Polyarteritis	*	19	0.2	0.3	15	13	10.0	15.8	80.0	78.9	0.0	5.3	20.0	15.8	10.0	10.5	0.0	0.0
Wegener's granulomatosis	53	57	0.8	0.9	15	15	54.7	43.9	73.6	91.2	20.8	5.3	5.7	3.5	20.8	19.3	3.8	1.8
Nephropathy due to drug abuse	*	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Other vasculitis and its derivatives	52	59	0.8	0.9	15	13	26.9	32.2	71.2	78.0	23.1	15.3	5.8	6.8	26.9	22.0	1.9	5.1
Goodpasture's syndrome	24	36	0.4	0.6	17	16	41.7	33.3	91.7	88.9	8.3	2.8	0.0	8.3	29.2	13.9	4.2	2.8
Secondary GN, other	12	18	0.2	0.3	12	17	33.3	44.4	83.3	88.9	8.3	0.0	8.3	11.1	25.0	27.8	0.0	5.6
Interstitial nephritis/pyelonephritis	432	329	6.8	5.1	14	15	51.9	52.0	80.3	78.4	13.0	7.9	6.7	13.7	48.1	50.8	1.9	5.8
Analgesic abuse	*	*	0.0	0.0	16	17	66.7	66.7	100	33.3	0.0	0.0	0.0	66.7	33.3	33.3	0.0	0.0
Radiation nephritis	*	*	0.0	0.0	16	18	66.7	0.0	100	100	0.0	0.0	0.0	0.0	33.3	0.0	0.0	0.0
Lead nephropathy	*	*	0.0	0.0	19	14	100	100	0.0	100	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nephropathy caused by other agents	41	36	0.6	0.6	14	15	53.7	55.6	82.9	88.9	14.6	2.8	2.4	8.3	53.7	30.6	7.3	22.2
Gouty nephropathy	*	*	0.0	.	0	.	100	.	100	.	0.0	.	0.0	.	0.0	.	100	.
Nephrolithiasis	*	12	0.1	0.2	12	16	42.9	25.0	71.4	66.7	28.6	0.0	0.0	33.3	85.7	66.7	0.0	0.0
Acquired obstructive uropathy	65	40	1.0	0.6	13	15	83.1	72.5	63.1	77.5	24.6	15.0	12.3	7.5	46.2	37.5	0.0	5.0
Chronic pyeloneph., reflux nephropathy	221	164	3.5	2.5	15	15	41.2	47.6	87.3	78.0	5.9	6.1	6.8	15.9	48.9	61.6	0.9	2.4
Chronic interstitial nephritis	79	66	1.2	1.0	14	16	54.4	50.0	75.9	83.3	17.7	9.1	6.3	7.6	49.4	43.9	2.5	4.5
Acute interstitial nephritis	*	*	0.1	0.0	6	15	60.0	100	40.0	0.0	60.0	50.0	0.0	50.0	0.0	50.0	0.0	50.0
Urolithiasis	*	*	0.0	0.0	14	19	50.0	100	100	0.0	0.0	100	0.0	0.0	50.0	0.0	0.0	50.0
Other disorders of calcium metabolism	*	*	0.1	0.0	16	15	25.0	50.0	75.0	50.0	25.0	0.0	0.0	50.0	0.0	50.0	0.0	0.0
Hypertensive/large vessel disease	313	352	4.9	5.4	18	17	56.2	60.5	50.8	59.4	40.3	34.1	8.9	6.5	22.0	16.8	3.2	8.0
Unspecified with renal failure	295	330	4.6	5.1	18	17	56.6	61.2	48.8	57.9	42.0	35.8	9.2	6.4	21.4	15.5	3.1	7.6
Renal artery stenosis	*	11	0.1	0.2	14	14	66.7	45.5	77.8	72.7	22.2	9.1	0.0	18.2	55.6	36.4	0.0	18.2
Renal artery occlusion	*	*	0.1	0.1	0	11	25.0	28.6	87.5	85.7	0.0	14.3	12.5	0.0	0.0	42.9	12.5	0.0
Cholesterol emboli, renal emboli	*	*	0.0	0.1	14	4	100	100	100	100	0.0	0.0	0.0	0.0	100	25.0	0.0	25.0

◆ **Table 8.a;** see page 444 for analytical methods. *Incident ESRD patients age 0–19.*
**Values for cells with ten or fewer patients are suppressed. "." Zero values in this cell.*

Distribution of reported incident pediatric ESRD patients, by primary diagnosis, 2002–2006 (period A) & 2007–2011 (period B)

	Total pts		% of inc pts		Median age		% male		White		Black/ African Am		Other race		% tx first year		% dying first year	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Cystic/heriditary/congenital diseases	2,073	2,326	32.6	35.7	11	10	67.8	67.0	73.8	74.2	17.1	12.6	9.2	13.2	50.0	49.4	3.4	2.8
Polycystic kidneys, adult (dominant)	29	41	0.5	0.6	14	15	44.8	56.1	86.2	68.3	13.8	19.5	0.0	12.2	62.1	46.3	0.0	0.0
Polycystic, infantile (recessive)	135	156	2.1	2.4	9	2	57.0	47.4	75.6	75.0	14.1	12.2	10.4	12.8	54.8	40.4	8.1	10.3
Med. cystic dis., inc. nephronophthisis	101	112	1.6	1.7	12	13	35.6	43.8	84.2	84.8	5.9	1.8	9.9	13.4	64.4	70.5	2.0	0.0
Tuberous sclerosis	*	*	0.1	0.1	17	18	37.5	40.0	50.0	60.0	50.0	40.0	0.0	0.0	25.0	0.0	0.0	0.0
Hereditary nephritis, Alport's syndrome	129	135	2.0	2.1	16	16	86.0	80.7	72.1	63.0	20.9	20.7	7.0	16.3	45.0	51.9	0.0	0.0
Cystinosis	60	58	0.9	0.9	12	13	55.0	51.7	88.3	86.2	8.3	5.2	3.3	8.6	80.0	75.9	0.0	0.0
Primary oxalosis	12	17	0.2	0.3	3	6	58.3	64.7	58.3	88.2	16.7	5.9	25.0	5.9	50.0	64.7	0.0	0.0
Fabry's disease	*	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Congenital nephrotic syndrome	132	135	2.1	2.1	2	3	59.1	60.0	74.2	77.0	15.9	9.6	9.8	13.3	50.0	51.9	8.3	6.7
Drash syndrome, mesangial sclerosis	18	30	0.3	0.5	1	1	61.1	53.3	66.7	83.3	5.6	10.0	27.8	6.7	11.1	40.0	11.1	6.7
Cong. obst. of ureterpelvic junction	55	51	0.9	0.8	9	11	80.0	90.2	61.8	68.6	23.6	19.6	14.5	11.8	47.3	45.1	1.8	2.0
Cong. obst. of uretrovesical junction	17	42	0.3	0.6	11	13	88.2	92.9	76.5	83.3	17.6	7.1	5.9	9.5	47.1	50.0	0.0	0.0
Other congenital obstructive uropathy	494	504	7.8	7.7	10	10	82.6	81.3	68.2	71.8	22.9	14.9	8.9	13.3	48.2	44.8	2.6	2.0
Renal hypoplasia/dysplasia/oligoneph.	704	746	11.1	11.5	10	9	61.4	62.2	74.3	74.0	15.8	12.1	9.9	13.9	47.2	48.5	3.0	2.8
Prune belly syndrome	91	87	1.4	1.3	8	6	97.8	98.9	78.0	71.3	17.6	16.1	4.4	12.6	50.5	55.2	3.3	2.3
Other (cong. malformation syndromes)	88	207	1.4	3.2	15	12	54.5	57.5	81.8	75.8	10.2	10.6	8.0	13.5	53.4	48.3	8.0	1.9
Neoplasms/tumors	139	126	2.2	1.9	13	13	49.6	47.6	68.3	71.4	20.1	14.3	11.5	14.3	33.8	29.4	18.7	17.5
Renal tumor (malignant)	37	35	0.6	0.5	4	5	43.2	34.3	62.2	65.7	27.0	31.4	10.8	2.9	10.8	17.1	24.3	14.3
Urinary tract tumor (malignant)	*	*	0.0	0.0	15	15	100	0.0	0.0	100	100	0.0	0.0	0.0	0.0	100	0.0	0.0
Renal tumor (benign)	*	*	0.0	0.0	1	0	0.0	0.0	100	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100
Urinary tract tumor (benign)	*	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Renal tumor (unspecified)	*	*	0.1	.	17	.	0.0	.	50.0	.	0.0	.	50.0	.	50.0	.	0.0	.
Urinary tract tumor (unspecified)	*	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lymphoma of kidneys	*	*	.	0.0	.	18	.	100	.	100	.	0.0	.	0.0	.	0.0	.	100
Multiple myeloma	*	*	0.0	0.1	0	4	100	75.0	100	75.0	0.0	25.0	0.0	0.0	0.0	0.0	100	50.0
Other immunoproliferative neoplasms (including light chain nephropathy)	*	*	0.0	0.0	11	6	100	0.0	100	0.0	0.0	0.0	0.0	100	0.0	0.0	0.0	0.0
Amyloidosis	*	*	0	0	18	0	66.7	33.3	66.7	66.7	0	0	33.3	33.3	33.3	0	0	33.3
Complications of tx'ed organ, unspec.	*	*	0.1	0.0	17	16	50.0	50.0	75.0	50.0	0.0	50.0	25.0	0.0	50.0	50.0	0.0	0.0
Complications of transplanted kidney	33	*	0.5	0.1	16	17	51.5	80.0	66.7	80.0	21.2	0.0	12.1	20.0	60.6	60.0	0.0	0.0
Complications of transplanted liver	29	*	0.5	0.1	13	15	55.2	33.3	72.4	44.4	20.7	0.0	6.9	55.6	41.4	66.7	24.1	0.0
Complications of transplanted heart	12	27	0.2	0.4	14	15	66.7	44.4	83.3	77.8	8.3	11.1	8.3	11.1	33.3	44.4	25.0	18.5
Complications of transplanted lung	*	*	.	0.0	.	15	.	66.7	.	66.7	.	0.0	.	33.3	.	33.3	.	33.3
Complications of tx'ed bone marrow	*	27	0.1	0.4	16	15	37.5	63.0	75.0	88.9	25.0	7.4	0.0	3.7	12.5	11.1	62.5	11.1
Complications of transplanted pancreas	*	*	0.0	.	11	.	100	.	100	.	0.0	.	0.0	.	0.0	.	0.0	.
Complications of transplanted intestine	*	*	0.0	.	15	.	0.0	.	0.0	.	100	.	0.0	.	0.0	.	0.0	.
Comps of other specified tx'ed organ	*	*	0.0	0.1	14	13	0.0	50.0	50.0	33.3	0.0	0.0	50.0	66.7	50.0	66.7	50.0	33.3
Miscellaneous conditions	404	440	6.4	6.8	14	13	56.4	56.4	63.4	69.3	30.0	17.0	6.7	13.6	34.2	35.0	9.2	7.5
Sickle cell disease/anemia	15	11	0.2	0.2	18	18	73.3	81.8	6.7	9.1	93.3	90.9	0.0	0.0	13.3	9.1	26.7	0.0
Sickle cell trait/other sickle cell	*	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Post partum renal failure	*	12	0.1	0.2	18	18	14.3	0.0	71.4	66.7	28.6	16.7	0.0	16.7	28.6	16.7	0.0	0.0
AIDS nephropathy	53	20	0.8	0.3	15	18	47.2	60.0	9.4	15.0	84.9	85.0	5.7	0.0	0.0	0.0	13.2	25.0
Traumatic or surgical loss of kidney(s)	*	14	0.2	0.2	6	9	70.0	64.3	80.0	71.4	20.0	21.4	0.0	7.1	40.0	42.9	10.0	7.1
Hepatorenal syndrome	*	11	0.0	0.2	14	8	100	36.4	0.0	81.8	100	9.1	0.0	9.1	0.0	18.2	100	36.4
Tubular necrosis (no recovery)	103	160	1.6	2.5	4	11	47.6	60.0	76.7	79.4	16.5	11.3	6.8	9.4	14.6	18.1	11.7	10.6
Other renal disorders	215	212	3.4	3.3	13	12	62.3	55.7	73.5	69.3	18.6	11.3	7.9	19.3	53.5	53.8	5.6	2.8
Etiology uncertain	598	580	9.4	8.9	15	15	56.9	60.0	66.2	73.8	21.2	15.3	12.5	10.9	30.6	32.8	2.8	2.2
Missing	194	314	3.1	4.8	12	13	61.9	62.4	43.3	22.6	9.3	4.5	47.4	72.9	86.1	72.6	4.6	1.6

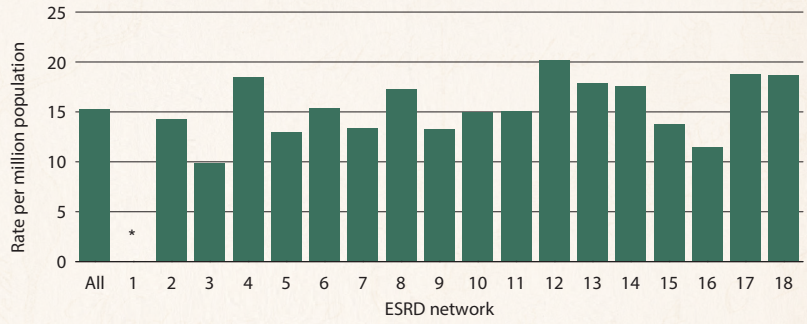
In 2007–2011, the overall incident rate for pediatric patients was 15.2 per million population. The highest rates occured in Network 12, at 20.2 per million, and the lowest in Network 3, at 9.8.

Among patients with a primary diagnosis of glomerulonephritis, the overall incident rate was 3.4 per million population; rates by network ranged from 2.3 in Network 16 to 4.4 in Network 17.

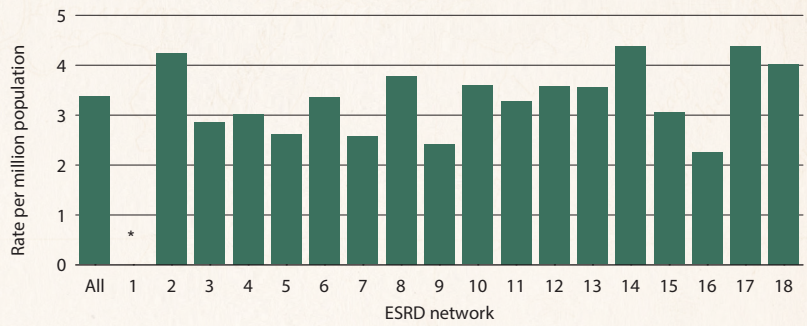
For patients with a primary diagnosis of cystic kidney/hereditary disease, the overall rate was 0.76 per million population; rates ranged from 0.67–0.69 in Networks 5 and 18 to 1.3 in Network 12.

✦ **Figures 8.2–4;** see page 444 for analytical methods. *Incident ESRD patients age 0–19, 2007–2011; Adj: age/gender/race; ref: 2010 ESRD patients. *Primary diagnosis values with ten or fewer patients are suppressed.*

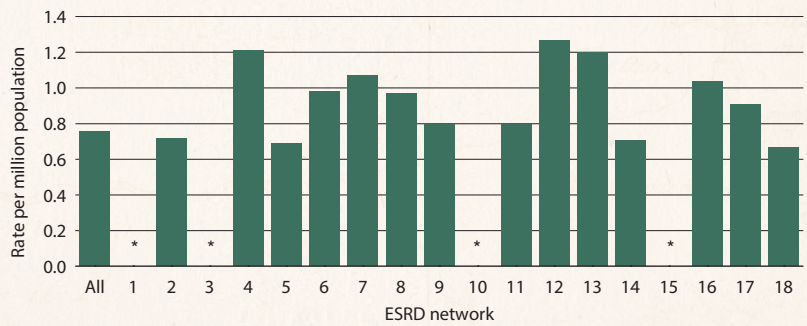
vol 2 **8.2** **Overall incident rates for pediatric ESRD patients, by renal network, 2007–2011**



vol 2 **8.3** **Overall incident rates for pediatric ESRD patients with glomerulonephritis as a primary diagnosis, by renal network, 2007–2011**

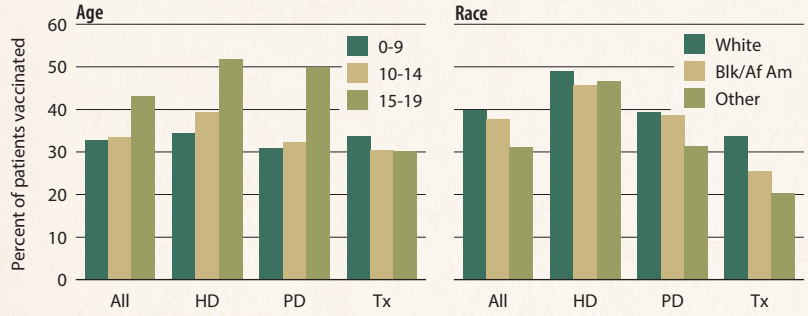


vol 2 **8.4** **Overall incident rates for pediatric ESRD patients with cystic kidney/hereditary disease as a primary diagnosis, by renal network, 2007–2011**



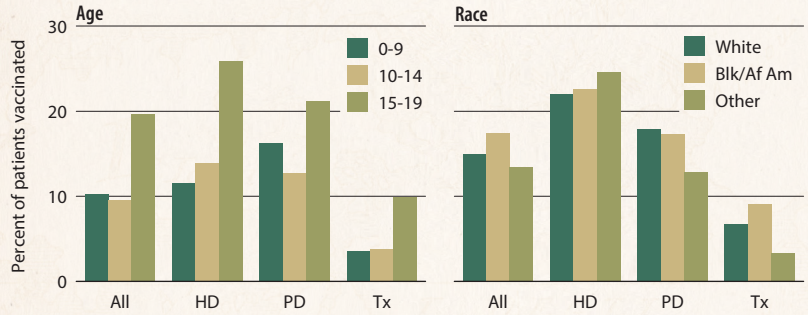
vol 2
8.5

Influenza vaccination rates in pediatric patients, by modality, age, & race, 2008–2011



vol 2
8.6

Pneumococcal vaccination rates in pediatric patients, by modality, age, & race, 2008–2011



Influenza vaccination rates in the pediatric ESRD population have improved, but remain below recommended levels. During 2008–2011, approximately one-third of children age 14 or younger received a vaccination. Rates are highest in those age 15–19, at 43 percent, and vary little by race. In older patients, rates are generally higher in children on hemodialysis compared to those on peritonal dialysis or with a transplant.

In 2008–2011, pneumococcal pneumonia vaccination rates were highest overall in children age 15–19, at 19.6 percent, and were just 10 percent or below in those 14 and younger. When compared to those of white children, rates in blacks/African Americans tend to be higher, at 17.5 versus 14.9 percent, respectively.

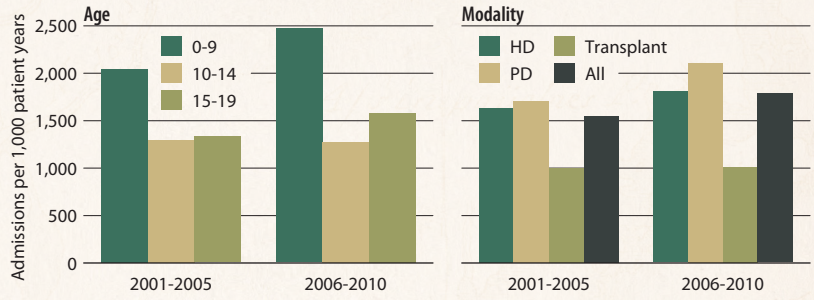
It is important to note that these rates only include Medicare claims, and that all administered vaccinations may not be represented. ✦ **Figures 8.5–6;** see page 444 for analytical methods. *Point prevalent ESRD patients age 0–19 prior to January 1 of the two-year study period & alive through December 31 of the second year, 2008–2009 & 2010–2011.*

Between 2001–2005 and 2006–2010, one-year adjusted all-cause hospitalization rates — with patients followed from day 90 of ESRD — increased 21 and 19 percent, respectively, in patients age 0–9 and 15–19; in patients age 10–14, in contrast, rates fell 1.4 percent. By modality, rates rose 11 percent for hemodialysis patients and 24 percent for those treated with peritoneal dialysis, while increasing just 1.5 percent for patients with a transplant. Overall, the all-cause hospitalization rate in patients followed from day 90 increased 16 percent between the two time periods, reaching 1,789 admissions per 1,000 patient years in the latter period.

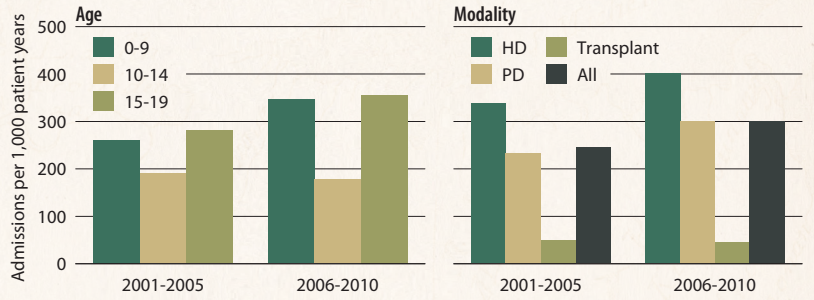
The overall cardiovascular hospitalization rate per 1,000 patient years reached 301 in 2006–2010, 22 percent higher than in 2001–2005. Rates rose 33 and 26 percent, respectively, in children age 0–9 and 15–19, but fell 6.3 percent in those age 10–14. By modality, rates rose 19 and 29 percent in hemodialysis and peritoneal dialysis patients, and fell 8 percent in those with a transplant.

Rates of hospitalization for infection in the pediatric population increased 24 and 12 percent in patients age 0–9 and 15–19 (reaching nearly 890 admissions per 1,000 patient years in the youngest patients), and fell 4.1 percent in those age 10–14. By modality, rates increased 7.2, 19, and 11 percent, respectively, for hemodialysis, peritoneal dialysis, and transplant patients; the overall rate rose 14 percent, to reach 564 admissions per 1,000 patient years in 2006–2010. ✦ **Figures 8.7–9;** see page 444 for analytical methods. *Incident ESRD patients age 0–19, 2001–2010. Adj: gender/race/Hispanic ethnicity/primary diagnosis. Ref: incident ESRD patients age 0–19, 2009–2010. Included patients survived the first 90 days after ESRD initiation & are followed from day 90.*

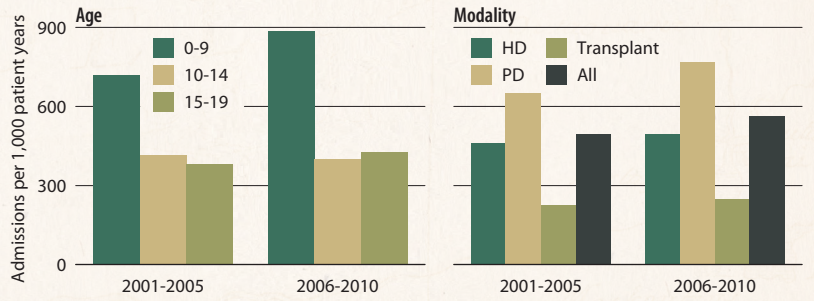
vol 2 **8.7** **One-year adjusted all-cause hospitalization rates in pediatric patients (from day 90), by age & modality**



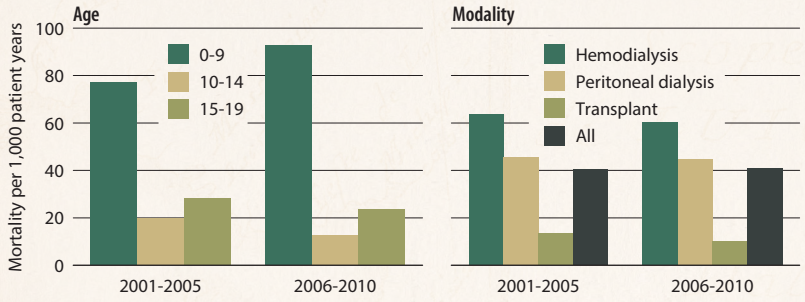
vol 2 **8.8** **One-year adjusted cardiovascular hospitalization rates in pediatric patients (from day 90), by age & modality**



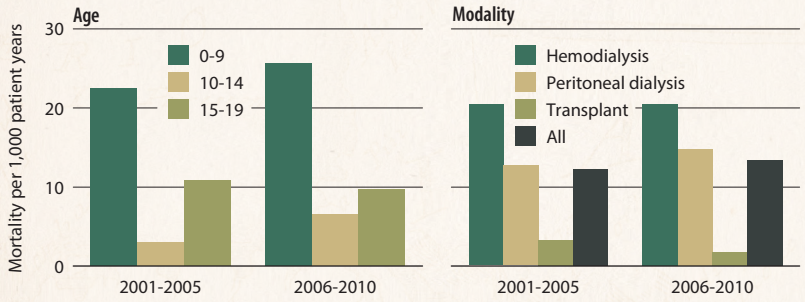
vol 2 **8.9** **One-year adjusted rates of hospitalization for infection in pediatric patients (from day 90), by age & modality**



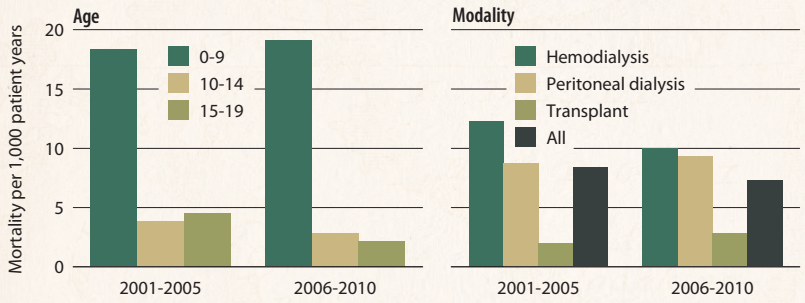
vol 2
8.10 **One-year adjusted all-cause mortality rates in pediatric patients (from day one), by age & modality**



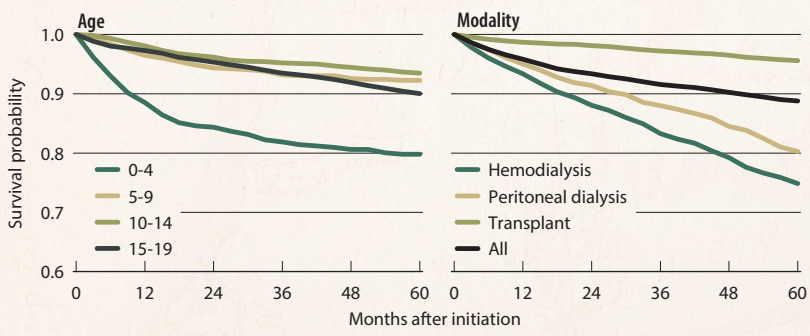
vol 2
8.11 **One-year adjusted cardiovascular mortality rates in pediatric patients (from day one), by age & modality**



vol 2
8.12 **One-year adjusted rates of mortality due to infection in pediatric patients (from day one), by age & modality**



vol 2
8.13 **Adjusted five-year survival in pediatric patients (from day one), by age & modality, 2002–2006**



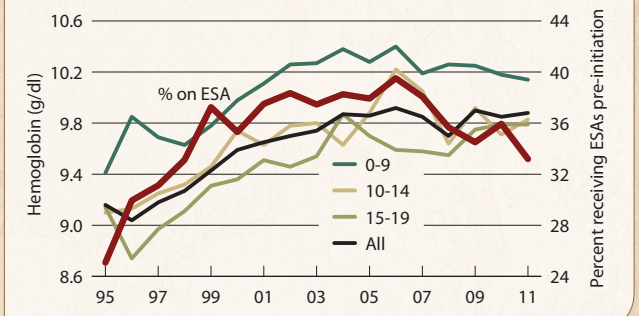
The one-year adjusted all-cause mortality rate in children age 0–9 was 93 per 1,000 patient years in 2006–2010, more than seven times higher than the rate in patients age 10–14, nearly four times higher than for patients age 15–19, and 20.2 percent higher than in 2001–2005. The rate for children on hemodialysis was 60.4, compared to 45 and 10.4, respectively, for those on peritoneal dialysis or with a transplant.

In 2006–2010, the one-year adjusted cardiovascular mortality rate in children age 0–9 was 25.7 per 1,000 patient years, 14.2 percent higher than in 2001–2005 and 3.9 and 2.6 times higher, respectively, than for ages 10–14 and 15–19. Children on hemodialysis had higher cardiovascular mortality than those on peritoneal dialysis, at 20.6 versus 14.9, while children with a transplant had the greatest survival advantage, with a mortality rate of 1.8 per 1,000.

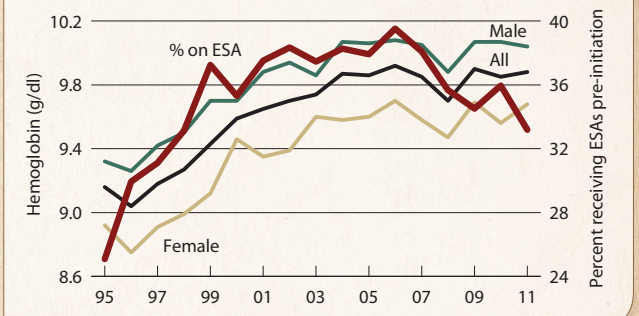
The rate of mortality due to infection was highest in patients age 0–9, at 19.1 per 1,000 patient years in 2006–2011, compared to 2.9 and 2.2, respectively, in children age 10–14 and 15–19. And by modality, rates for children on hemodialysis and peritoneal dialysis were similar, at 10.0 and 9.3 — three times higher, however, than those found in children with a transplant.

For patients beginning ESRD therapy in 2002–2006, the overall probability of surviving five years was 0.89. By age, the five-year survival probability was 0.80 for ages 0–4 and 0.92–0.93 in those age 5–14; in children age 15–19, the survival probability was 0.90. By modality, the highest five-year survival probability occurs in children with a transplant, at 0.96 compared to 0.75 and 0.80, respectively, in those treated with hemodialysis or peritoneal dialysis. ⬩ **Figures 8.10–13;** see page 444 for analytical methods. *Incident dialysis & transplant patients defined at the onset of dialysis or the day of transplant without the 60-day rule; followed to December 31, 2011. Adj: age/gender/race/Hispanic ethnicity/primary diagnosis. Ref: incident ESRD patients age 0–19, 2009–2010.*

vol 2
8.14 **Mean hemoglobin at initiation & pre-initiation ESA treatment in pediatric ESRD patients, by age**



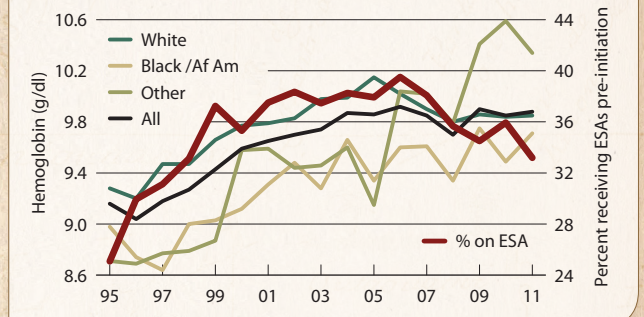
vol 2
8.15 **Mean hemoglobin at initiation & pre-initiation ESA treatment in pediatric ESRD patients, by gender**



After peaking at 40 in 2006, the percentage of pediatric patients receiving ESA therapy prior to initiation fell to 33 in 2011.

The mean hemoglobin at initiation is greatest by age in patients younger than 10, at 10.1 g/dl in 2011 compared to 9.8 among older children, and is consistently higher among males than females, reaching 10.0 compared to 9.7 g/dl in 2011. By race, hemoglobin levels at initiation in 2011 were 9.7 g/dl for black/African American children, 9.9 for whites, and 10.3 for those of other races. ✦ Figures 8.14–16; see page 444 for analytical method. *Incident ESRD patients age 0–19.*

vol 2
8.16 **Mean hemoglobin at initiation & pre-initiation ESA treatment in pediatric ESRD patients, by race**



In 2011, 40 percent of children on dialysis were using ACEI/ARBs compared to 22 percent of those with a transplant. Use of beta blockers, calcium channel blockers, diuretics, alpha agonists, and vasodilaters was at 37, 46, 7.5, 19, and 12 percent, respectively, of dialysis patients, and 29, 58, 15, 14, and 5 percent of children with a transplant. Despite comparable use of cardiovascular drugs, and declining rates of hospitalization in adults, hospitalization rates for children are on the rise (see Figure 8.8), a finding which may suggest inadequate treatment of cardiovascular disease in children. ✦ **Table 8.b;** see page 444 for analytical methods. *Period prevalent ESRD patients with Medicare Part D, 2010–2011.*

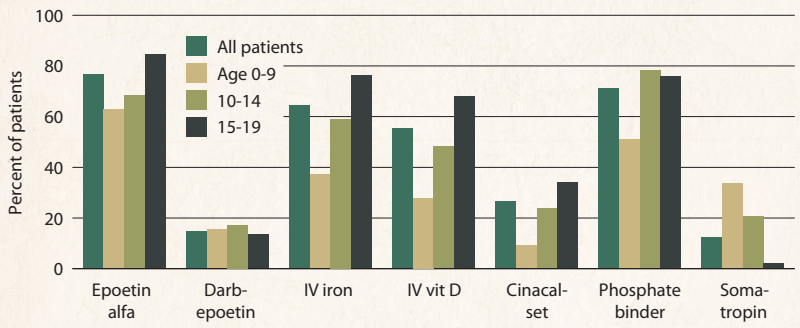
vol 2 **8.b** **Antihypertensive medication use in pediatric patients with ESRD, by age & modality (column %), 2010–2011**

	ACEI/ARB	Beta blocker	Calcium chnel blkr	Diuretics	Alpha-agonist	Vaso-dilator
All patients						
Dialysis	39.8	36.5	46.4	7.5	19.4	12.3
Transplant	21.7	29.0	58.2	15.2	13.5	4.9
Age 0–9						
Dialysis	27.7	23.5	35.8	7.3	9.4	7.1
Transplant	14.7	16.7	53.4	11.9	11.2	3.6
Age 10-14						
Dialysis	42.8	31.9	53.6	6.6	20.0	10.9
Transplant	23.6	26.9	67.7	12.0	15.2	4.8
Age 15–19						
Dialysis	43.6	42.9	48.3	7.8	23.1	14.7
Transplant	24.4	36.0	56.9	18.0	14.1	5.7

vol 2 **8.c** **Average dose per week of injectable medications in pediatric dialysis patients, by age, 2010–2011**

	Epoetin alfa IUs/week	Darbepoetin mcg/week	IV iron mg/week	Pericalcitol IV vit D mcg/week
All patients	13,484	40.9	78.4	16.2
Age 0–9	7,450	23.5	67.1	12.4
10–14	10,184	37.3	67.4	15.7
15–19	15,461	49.2	82.7	16.8

vol 2 **8.17** **Use of injectables & oral medications in pediatric dialysis patients, by age, 2010–2011**



Among pediatric dialysis patients, 77 percent receive epoetin alfa and 15 percent receive darbepoetin. Intravenous iron therapy is provided to 64 percent of children on dialysis and is most common in those age 15–19, at 76 percent. IV vitamin D therapy is used in 55 percent of patients overall.

Cinacalcet, a bone mineral density agent used to treat hyperparathyroidism in dialysis patients, was used in 27 percent of children overall and 34 percent of those age 15–19. It is important to note that the FDA halted all pediatric studies of cinacalcet in February, 2013, following the death of a pediatric patient participating in a cinacalcet trial.

Use of phosphate binders in children on dialysis is common, at 71 percent overall and 51, 78, and 76 percent, respectively, of those age 0–9, 10–14, and 15–19. Recombinant human growth hormone (somatropin) is used in just 12.5 percent of children overall, by one in three patients age 0–9, and one in five of those age 10–14. ✦ **Table 8.c & Figure 8.17;** see page 444 for analytical methods. *Period prevalent ESRD patients with Medicare Part D, 2010–2011. Table 8.c includes Medicare Parts A & B; Figure 8.17 includes Medicare Parts A, B & D.*

pediatric incidence and vaccinations

INFLUENZA VACCINATION RATES IN PEDIATRIC PATIENTS, 2008–2011 (FIGURE 8.5)

	0–9	10–14	15–19	white	black/Af Am	other race
all	33%	33%	43%	40%	38%	31
hemodialysis	34%	39%	52%	49%	46%	47
peritoneal dialysis	31%	32%	50%	39%	39%	31
transplant	34%	30%	30%	34%	26%	20

PNEUMOCOCCAL VACCINATION RATES IN PEDIATRIC PATIENTS, 2008–2011 (FIGURE 8.6)

	0–9%	10–14%	15–19%	white	black/Af Am	other race
all	10.3%	9.5%	19.6%	14.9%	17.5%	13.5%
hemodialysis	11.5%	13.9%	25%	22%	23%	25
peritoneal dialysis	16.3%	12.7%	21%	17.9%	17.3%	12.8
transplant	3.5%	3.7%	9.9%	6.8%	9.1%	3.3

hospitalization

ONE-YEAR ADJUSTED ALL-CAUSE HOSPITALIZATION RATES (FROM DAY 90) IN PEDIATRIC PATIENTS (PER 1,000 PT YEARS; FIGURE 8.7)

	0–9	10–14	15–19	HD	PD	TX	all
2001–2005	2,050	1,295	1,334	1,637	1,708	1,002	1,547
2006–2010	2,472	1,277	1,583	1,809	2,109	1,017	1,789

ONE-YEAR ADJUSTED CARDIOVASCULAR HOSPITALIZATION RATES (FROM DAY 90) IN PEDIATRIC PTS (PER 1,000 PT YEARS; FIGURE 8.8)

	0–9	10–14	15–19	HD	PD	TX	all
2001–2005	261	190	282	338	234	50	246
2006–2010	347	178	356	401	301	46	301

ONE-YEAR ADJUSTED RATES OF HOSPITALIZATION (FROM DAY 90) DUE TO INFECTION IN PEDIATRIC PTS (PER 1,000 PT YEARS; FIGURE 8.9)

	0–9	10–14	15–19	HD	PD	TX	all
2001–2005	717	415	381	460	648	223	496
2006–2010	887	398	425	493	768	247	564

mortality

ONE-YEAR ADJUSTED ALL-CAUSE MORTALITY RATES (FROM DAY 1) IN PEDIATRIC PATIENTS (PER 1,000 PATIENT YEARS; FIGURE 8.10)

	0–9	10–14	15–19	HD	PD	TX	all
2001–2005	77	20	28.2	64	45.8	13.6	41
2006–2010	93	12.9	24	60	45	10.4	41

ONE-YEAR ADJUSTED CARDIOVASCULAR MORTALITY RATES (FROM DAY 1) IN PEDIATRIC PATIENTS (PER 1,000 PT YEARS; FIGURE 8.11)

	0–9	10–14	15–19	HD	PD	TX	all
2001–2005	23	3.0	11.0	21	12.8	3.3	12.3
2006–2010	26	6.6	9.8	21	14.9	1.8	13.4

ONE-YEAR ADJUSTED RATES OF MORTALITY DUE TO INFECTION (FROM DAY 1) IN PEDIATRIC PTS (PER 1,000 PT YEARS; FIGURE 8.12)

	0–9	10–14	15–19	HD	PD	TX	all
2001–2005	18.3	3.8	4.5	12.3	8.7	2.0	8.4
2006–2010	19.1	2.9	2.2	10.0	9.3	2.8	7.3