8

Havasu Falls, Grand Canyon National Park, Arizona

PEDIATRIC ESRD

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 account for 32 percent of pediatric ESRD cases, while 26 percent are 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 patients receive a transplant in the first year, while 4 percent die; neither of these rates has altered over the past decade. Considerable progress, however, has been made in the first-year mortality rate among patients with primary glomerular diseases, falling from 2.1 to 1.1 percent. But both the transplant and mortality rates among patients with congenital/hereditary/cystic diseases — the most common diagnoses — remain unchanged.

In this chapter we highlight the considerable degree of morbidity in pediatric patients, manifested not only in overall hospitalization rates, but in rates of repeated hospitalizations. Almost 35 percent of children with ESRD are rehospitalized within 30 days of discharge. As with the adult population (discussed in Chapter Three), this rate has not changed in a decade. Rates of hospitalization related to infection are highest in the youngest patients and in those on peritoneal dialysis, while hospitalizations due to bacteremia/sepsis are most frequent in the youngest patients on hemodialysis — an area of major concern. Hospitalizations due to pneumonia are greatest in transplant patients younger than ten, a finding which suggests that the low rates of pneumonia vaccinations may be an area to target.

Next we compare rates over time, allowing us to focus providers' attention on areas which may need to be prioritized for greater prevention efforts. Between the periods of 2000–2004 and 2005–2010, overall hospitalization rates rose 29 percent for children younger than ten, and 17 percent for those age 15–19; hospitalizations in the hemodialysis and peritoneal dialysis populations rose 18–19 percent. Hospitalizations for cardiovascular causes rose 38 percent in the youngest children, and 47 percent in the oldest. Cardiovascular hospitalizations have increased the most in patients on hemodialysis and in those with a transplant, rising 49 and 56 percent, respectively, compared to 10 percent among those treated with peritoneal dialysis. And rates of hospitalization due to infection have increased 32 percent among patients younger than 10.

In similar analyses of mortality, adjusted rates show small increases in mortality in those younger than ten and those age 15–19, in contrast to a 31 percent decline among those age 10–14. These overall changes, however, are not reflected in rates of cardiovascular mortality, which have increased across all age groups in the hemodialysis population, and risen 17 percent for those on peritoneal dialysis; the rate among transplant patients, in contrast, has fallen 24 percent. More detailed analyses need to be developed on the specific causes of hospitalization, including congestive heart failure and arrhythmias. These complications are of

A child's world is fresh and new and beautiful, full of wonder and excitement. It is our misfortune that for most of us that clear-eyed vision, that true instinct for what is beautiful and awe-inspiring, is dimmed and even lost before we reach adulthood. If I had influence with the good fairy who is supposed to preside over the christening of all children I should ask that her gift to each child in the world be a sense of wonder so indestructible that it would last throughout life, as an unfailing antidote against the boredom and disenchantments of later years, the sterile preoccupation with things that are artificial, the alienation from the sources of our strength.

RACHEL CARSON,
The Sense of Wonder

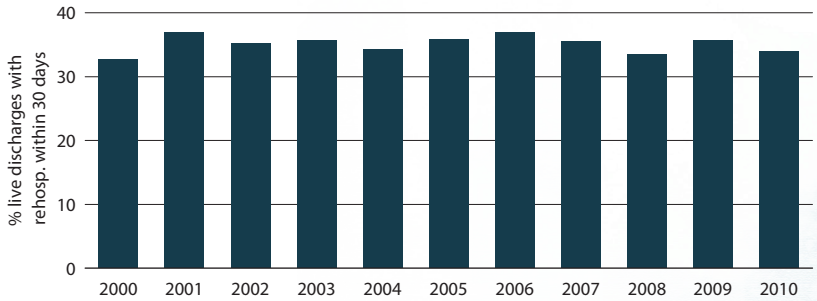
particular concern in pediatric patients, in whom fluid overload and hypertension are major clinical problems. Also needed are analyses of medication use specific to these areas of morbidity.

Influenza and pneumococcal pneumonia can, of course, lead to increased hospitalization rates and higher risks of mortality. Rates of vaccination against these diseases have improved in the pediatric population, but still remain far below recommended levels, at less than half the rates seen in the adult population. There also continue to be disparities in vaccination rates by modality, with hemodialysis patients more likely to be vaccinated than children on peritoneal dialysis. This year we present new data on the various types of pneumococcal pneumonia vaccines.

Data on trends in incidence and prevalence are presented later in this year's chapter, as we wanted to ensure that data on hospitalization were given high priority by providers, policy makers, and regulators. There are a few trends that merit particular attention. Rates of incidence due to cystic/hereditary/congenital diseases, for instance, appear to be increasing. This trend, which may be related to earlier diagnosis and better treatment (allowing children to survive to ESRD), needs to be investigated, but the small numbers pose many challenges. There also appears to be a real decline in ESRD due to glomerular disease, a trend noted in adults as well. The high use of kidney protective medications needs to be assessed to provide insight into this area. And the decrease in incidence among black/African American patients is parallel to a rise in rates among patients of other races, suggesting that reclassification may have occurred.

Overall, the most striking findings related to pediatric ESRD patients continue to center on the extreme vulnerability of patients younger than ten. Issues of infection control, which could lower the rate of complications, need to be addressed. This year we also show that cardiovascular mortality has increased, and should be addressed as well. In past ADRs we have noted issues of uncontrolled hypertension and heart failure, and of sudden death, which 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 442 for analytical methods. *ESRD patients age 0–19. Adj: gender/race/primary diagnosis; ref: discharges in 2005.*

vol 2
8.1 **Adjusted all-cause rehospitalization rates in pediatric patients 30 days after live hospital discharge**



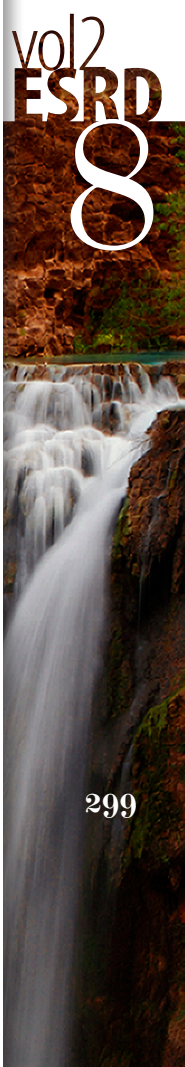
vol 2
8.a Distribution of reported incident ESRD pediatric patients, by primary diagnosis, 2001–2005 (period A) & 2006–2010 (period B)

	Total pts		% of inc pts		Median age		% male		White		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)	6,505	6,711	100	100	14	14	56.8	57.5	64.7	67.4	24.9	19.2	10.4	13.4	38.2	38.2	4.1	4.0
Diabetes	59	133	0.9	2.1	16	2	52.5	59.4	57.6	66.9	39.0	26.3	3.4	6.8	11.9	4.5	25.4	17.3
DM w/renal manifestations Type 2	36	97	0.6	1.5	13	0	58.3	59.8	61.1	69.1	33.3	23.7	5.6	7.2	13.9	3.1	33.3	20.6
DM w/renal manifestations Type 1	23	36	0.4	0.6	18	18	43.5	58.3	52.2	61.1	47.8	33.3	0.0	5.6	8.7	8.3	13.0	8.3
Glomerulonephritis (GN)	1,640	1,501	26.1	23.2	16	16	55.7	53.4	58.8	64.5	31.3	27.0	9.9	8.5	33.2	34.0	2.1	1.1
GN (histologically not examined)	335	268	5.3	4.2	17	18	57.0	58.6	59.1	72.4	24.5	20.5	16.4	7.1	26.6	20.1	3.3	1.1
Focal glomer. sclerosis, focal sclerosis GN	839	790	13.3	12.2	15	15	58.2	53.7	52.1	58.5	40.9	34.2	7.0	7.3	33.4	39.7	1.9	1.3
Membranous nephropathy	36	37	0.6	0.6	16	17	41.7	45.9	52.8	56.8	30.6	29.7	16.7	13.5	44.4	29.7	0.0	0.0
Membranopro. GN type 1, diffuse MPGN	90	78	1.4	1.2	16	16	54.4	44.9	81.1	64.1	14.4	17.9	4.4	17.9	36.7	43.6	3.3	0.0
Dense deposit disease, MPGN type 2	33	27	0.5	0.4	13	14	27.3	51.9	90.9	88.9	3.0	0.0	6.1	11.1	30.3	25.9	0.0	3.7
IgA nephropathy, Berger's	124	135	2.0	2.1	17	18	60.5	59.3	71.0	71.9	12.9	15.6	16.1	12.6	45.2	34.1	0.8	0.0
IgM nephropathy	*	17	0.1	0.3	16	16	71.4	70.6	28.6	64.7	42.9	29.4	28.6	5.9	28.6	23.5	0.0	0.0
With lesion of rapidly progressive GN	89	50	1.4	0.8	14	13	38.2	36.0	66.3	72.0	25.8	14.0	7.9	14.0	33.7	16.0	3.4	2.0
Post infectious GN, SBE	14	22	0.2	0.3	15	14	71.4	63.6	64.3	63.6	28.6	31.8	7.1	4.5	35.7	13.6	0.0	0.0
Other proliferative GN	73	77	1.2	1.2	15	15	50.7	39.0	67.1	76.6	24.7	19.5	8.2	3.9	31.5	37.7	1.4	2.6
Secondary GN/vasculitis	706	732	11.2	11.3	16	16	31.0	32.1	53.7	64.8	36.0	27.0	10.3	8.2	17.3	14.8	5.5	4.5
Lupus erythematosus (SLE nephritis)	400	379	6.4	5.9	17	17	21.8	21.6	35.5	48.0	52.3	42.5	12.3	9.5	9.8	6.1	6.8	5.8
Henoch-Schonlein syndrome	29	30	0.5	0.5	13	17	55.2	53.3	79.3	90.0	10.3	6.7	10.3	3.3	41.4	33.3	0.0	3.3
Scleroderma	*	*	0.1	0.1	17	17	50.0	40.0	66.7	100	16.7	0.0	16.7	0.0	16.7	20.0	50.0	0.0
Hemolytic uremic syndrome	123	133	2.0	2.1	6	6	43.9	48.9	76.4	81.2	13.8	12.0	9.8	6.8	31.7	24.8	4.1	5.3
Polyarteritis	*	16	0.1	0.2	14	13	22.2	12.5	100	62.5	0.0	6.3	0.0	31.3	11.1	6.3	0.0	0.0
Wegener's granulomatosis	54	53	0.9	0.8	15	15	53.7	47.2	74.1	90.6	20.4	7.5	5.6	1.9	18.5	20.8	3.7	0.0
Nephropathy due to drug abuse	*	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Other vasculitis and its derivatives	47	64	0.7	1.0	12	15	23.4	37.5	72.3	71.9	21.3	20.3	6.4	7.8	25.5	25.0	2.1	1.6
Goodpasture's syndrome	26	34	0.4	0.5	17	17	46.2	29.4	92.3	91.2	7.7	2.9	0.0	5.9	19.2	23.5	3.8	2.9
Secondary GN, other	12	18	0.2	0.3	11	17	41.7	50.0	75.0	94.4	8.3	0.0	16.7	5.6	25.0	27.8	0.0	5.6
Interstitial nephritis/pyelonephritis	452	335	7.2	5.2	14	15	51.5	51.3	80.5	78.2	13.3	7.5	6.2	14.3	46.5	52.8	1.8	5.7
Analgesic abuse	*	*	0.0	0.0	16	17	66.7	50.0	100	0.0	0.0	0.0	0.0	100	33.3	0.0	0.0	0.0
Radiation nephritis	*	*	0.0	0.0	18	11	50.0	50.0	100	100	0.0	0.0	0.0	0.0	50.0	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	35	0.7	0.5	13	15	56.1	54.3	82.9	85.7	17.1	2.9	0.0	11.4	46.3	40.0	9.8	22.9
Gouty nephropathy	*	*	.	0.0	.	0	.	100	.	100	.	0.0	.	0.0	.	0.0	.	100
Nephrolithiasis	*	13	0.1	0.2	12	16	55.6	30.8	77.8	69.2	22.2	0.0	0.0	30.8	77.8	69.2	0.0	0.0
Acquired obstructive uropathy	72	38	1.1	0.6	13	15	81.9	76.3	68.1	73.7	23.6	13.2	8.3	13.2	48.6	44.7	1.4	5.3
Chronic pyeloneph., reflux nephropathy	238	169	3.8	2.6	14	15	40.3	46.2	84.9	79.9	8.4	3.6	6.7	16.6	44.1	61.5	1.3	1.8
Chronic interstitial nephritis	75	68	1.2	1.1	14	15	53.3	51.5	78.7	80.9	13.3	14.7	8.0	4.4	54.7	45.6	0.0	5.9
Acute interstitial nephritis	*	*	0.1	0.0	6	11	80.0	66.7	60.0	0.0	40.0	66.7	0.0	33.3	0.0	33.3	0.0	33.3
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	0.0
Other disorders of calcium metabolism	*	*	0.1	0.0	17	11	25.0	0.0	75.0	50.0	25.0	0.0	0.0	50.0	0.0	50.0	0.0	0.0
Hypertensive/large vessel disease	309	326	4.9	5.0	17	17	56.0	61.3	48.2	58.3	40.8	34.4	11.0	7.4	22.0	18.4	5.5	6.4
Unspecified with renal failure	289	310	4.6	4.8	18	17	56.4	61.0	46.0	57.4	42.6	35.5	11.4	7.1	21.1	17.1	5.2	6.8
Renal artery stenosis	*	*	0.1	0.1	14	14	66.7	62.5	77.8	62.5	22.2	12.5	0.0	25.0	55.6	50.0	0.0	0.0
Renal artery occlusion	*	*	0.1	0.1	0	11	33.3	60.0	88.9	80.0	0.0	20.0	11.1	0.0	11.1	40.0	22.2	0.0
Cholesterol emboli, renal emboli	*	*	0.0	0.0	16	7	50.0	100	50.0	100	50.0	0.0	0.0	0.0	50.0	33.3	0.0	0.0

vol 2
8.a Distribution of reported incident ESRD pediatric patients, by primary diagnosis, 2001–2005 (period A) & 2006–2010 (period B)

	Total pts		% of inc pts		Median age		% male		White		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	2,018	2,260	32.1	35.0	10	10	68.0	67.5	73.6	73.9	17.1	13.5	9.3	12.6	49.5	49.2	3.1	3.2
Polycystic kidneys, adult (dominant)	32	37	0.5	0.6	14	15	56.3	51.4	84.4	70.3	12.5	18.9	3.1	10.8	65.6	48.6	0.0	0.0
Polycystic, infantile (recessive)	128	146	2.0	2.3	9	3	57.8	48.6	71.9	77.4	13.3	13.7	14.8	8.9	57.0	42.5	4.7	13.7
Med. cystic dis., inc. nephronophthisis	104	109	1.7	1.7	13	12	39.4	41.3	82.7	86.2	5.8	1.8	11.5	11.9	65.4	71.6	1.9	0.0
Tuberous sclerosis	*	*	0.1	0.1	17	18	50.0	33.3	75.0	50.0	25.0	50.0	0.0	0.0	50.0	0.0	0.0	0.0
Hereditary nephritis, Alport's syndrome	127	139	2.0	2.2	16	16	83.5	83.5	71.7	64.0	20.5	20.9	7.9	15.1	40.9	52.5	0.8	0.0
Cystinosis	62	57	1.0	0.9	12	13	56.5	50.9	87.1	87.7	8.1	3.5	4.8	8.8	79.0	73.7	0.0	0.0
Primary oxalosis	*	18	0.2	0.3	6	4	70.0	55.6	60.0	77.8	10.0	11.1	30.0	11.1	60.0	61.1	0.0	0.0
Fabry's disease	*	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Congenital nephrotic syndrome	135	125	2.1	1.9	2	2	61.5	60.0	71.9	74.4	14.8	12.8	13.3	12.8	45.9	54.4	8.1	6.4
Drash syndrome, mesangial sclerosis	12	29	0.2	0.4	2	1	66.7	51.7	58.3	86.2	8.3	10.3	33.3	3.4	8.3	37.9	16.7	6.9
Cong. obst. of ureterpelvic junction	47	53	0.7	0.8	9	13	80.9	88.7	61.7	67.9	25.5	18.9	12.8	13.2	44.7	45.3	2.1	1.9
Cong. obst. of uretrovesical junction	11	45	0.2	0.7	15	11	90.9	88.9	72.7	77.8	18.2	8.9	9.1	13.3	63.6	46.7	0.0	0.0
Other congenital obstructive uropathy	497	484	7.9	7.5	10	10	81.9	82.9	69.2	71.5	23.1	15.5	7.6	13.0	47.9	43.6	2.8	1.9
Renal hypoplasia/dysplasia/oligoneph.	700	744	11.1	11.5	10	10	60.1	63.6	74.7	72.7	16.0	13.7	9.3	13.6	46.0	48.1	3.0	3.2
Prune belly syndrome	90	85	1.4	1.3	7	7	98.9	97.6	77.8	70.6	20.0	14.1	2.2	15.3	53.3	51.8	2.2	3.5
Other (cong. malformation syndromes)	55	183	0.9	2.8	15	13	56.4	54.6	81.8	79.8	9.1	9.3	9.1	10.9	47.3	49.7	5.5	3.3
Neoplasms/tumors	128	132	2.0	2.0	13	14	50.8	49.2	70.3	69.7	20.3	13.6	9.4	16.7	32.0	32.6	18.8	20.5
Renal tumor (malignant)	41	29	0.7	0.4	5	5	46.3	48.3	61.0	65.5	24.4	31.0	14.6	3.4	12.2	17.2	24.4	20.7
Urinary tract tumor (malignant)	*	*	0.0	.	15	.	100	.	0.0	.	100	.	0.0	.	0.0	.	0.0	.
Renal tumor (benign)	*	*	.	0.0	.	1	.	0.0	.	100	.	0.0	.	0.0	.	0.0	.	50.0
Urinary tract tumor (benign)	*	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Renal tumor (unspecified)	*	*	0.0	0.0	8	18	0.0	0.0	100	0.0	0.0	0.0	0.0	100	0.0	100	0.0	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	0	100	60.0	100	80.0	0.0	20.0	0.0	0.0	0.0	0.0	100	40.0
Other immunoproliferative neoplasms (including light chain nephropathy)	*	*	.	0.0	.	9	.	50.0	.	50.0	.	0.0	.	50.0	.	0.0	.	0.0
Amyloidosis	*	*	0.0	0.0	12	10	33.3	33.3	66.7	66.7	0.0	0.0	33.3	33.3	33.3	0.0	33.3	33.3
Complications of tx'ed organ, unspec.	*	*	0.1	0.0	17	16	40.0	50.0	80.0	50.0	0.0	50.0	20.0	0.0	40.0	50.0	20.0	0.0
Complications of transplanted kidney	36	*	0.6	0.1	16	17	55.6	71.4	75.0	71.4	16.7	14.3	8.3	14.3	61.1	85.7	0.0	0.0
Complications of transplanted liver	27	15	0.4	0.2	13	15	51.9	46.7	74.1	53.3	22.2	6.7	3.7	40.0	33.3	60.0	29.6	0.0
Complications of transplanted heart	*	28	0.1	0.4	14	15	66.7	50.0	83.3	75.0	16.7	10.7	0.0	14.3	33.3	42.9	16.7	21.4
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	*	25	0.0	0.4	12	15	50.0	48.0	50.0	92.0	50.0	8.0	0.0	0.0	0.0	8.0	50.0	24.0
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	12	14	0.0	42.9	100	28.6	0.0	0.0	0.0	71.4	0.0	71.4	100	28.6
Miscellaneous conditions	423	408	6.7	6.3	13	13	58.2	57.6	63.8	66.7	28.8	19.9	7.3	13.5	34.5	34.6	8.7	8.3
Sickle cell disease/anemia	19	11	0.3	0.2	18	18	78.9	81.8	10.5	9.1	89.5	90.9	0.0	0.0	15.8	18.2	21.1	0.0
Sickle cell trait/other sickle cell	*	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Post partum renal failure	*	13	0.1	0.2	18	18	0.0	7.7	60.0	76.9	40.0	15.4	0.0	7.7	20.0	23.1	0.0	0.0
AIDS nephropathy	49	27	0.8	0.4	15	18	49.0	55.6	10.2	11.1	83.7	88.9	6.1	0.0	0.0	0.0	14.3	18.5
Traumatic or surgical loss of kidney(s)	14	14	0.2	0.2	6	9	78.6	50.0	78.6	78.6	14.3	7.1	7.1	14.3	42.9	50.0	7.1	7.1
Hepatorenal syndrome	*	*	0.0	0.1	13	4	33.3	16.7	33.3	100	66.7	0.0	0.0	0.0	66.7	0.0	66.7	66.7
Tubular necrosis (no recovery)	111	145	1.8	2.2	2	10	51.4	61.4	76.6	78.6	16.2	11.7	7.2	9.7	15.3	17.9	11.7	9.7
Other renal disorders	222	192	3.5	3.0	13	13	62.2	58.9	73.4	66.1	18.0	14.1	8.6	19.8	52.7	53.6	4.5	5.2
Etiology uncertain	552	629	8.8	9.7	15	15	55.4	61.0	64.1	72.7	23.2	16.2	12.7	11.1	29.0	33.4	2.9	2.5
Missing	218	255	3.5	3.9	12	13	64.2	62.7	55.0	18.8	10.1	3.5	34.9	77.6	85.8	76.1	5.0	2.0

» **Table 8.a;** see page 442 for analytical methods. *Incident ESRD patients age 0–19. *Values for cells with ten or fewer patients are suppressed. "." Zero values in this cell.*



For pediatric hemodialysis and peritoneal dialysis (PD) patients prevalent in 2007–2010, unadjusted rates of hospitalization for infection are highest in those age 0–4, at 1,130 per 1,000 patient years; in all age groups the lowest rates occur in pediatric patients with a transplant. By race, overall rates are highest in blacks/African Americans and lowest in whites, at 560 and 429, respectively.

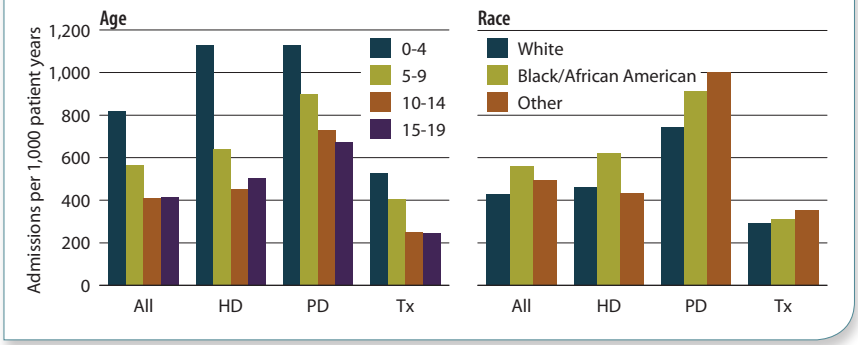
Hemodialysis patients age 0–9 have higher rates of admission for infection due to an internal device then do PD patients, and infection is more common in younger patients. For blacks/African Americans on dialysis, admission rates due to infection from an internal device are higher compared to whites, at 272 and 234, respectively.

Rates of hospitalization for bacteria/septicemia are highest in hemodialysis patients. By race, they tend to be higher in blacks/African Americans compared to whites or patients of other races.

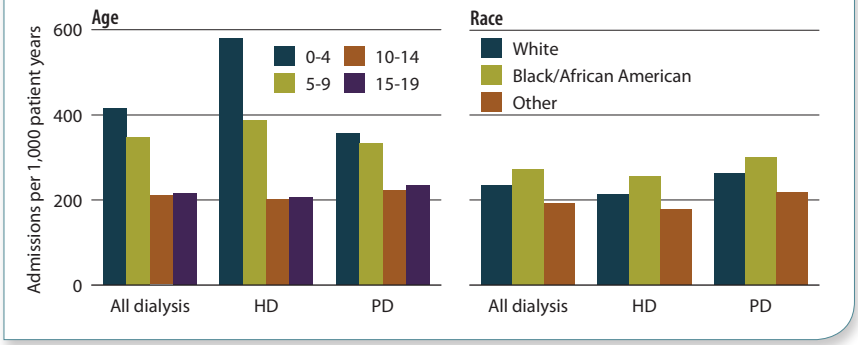
Rates of admission for respiratory infection (including pneumonia) overall are highest in patients age 0–4, at 161, and in patients of race other than white or black/African American, at 124.

The rate of vascular access infections in children on hemodialysis is higher in those using a catheter compared to those using an AV fistula or graph, at 1.7 vs. 14.6 percent. » **Figures 8.2–6;** see page 442 for analytical methods. *Period prevalent ESRD (8.2, 8.4–5) & dialysis (8.3) patients, & point prevalent hemodialysis patients (8.6), age 0–19; rates for 8.2–5 are unadjusted. In Figure 8.3,"infection due to internal device" includes those related to a vascular access device or peritoneal dialysis catheter.*

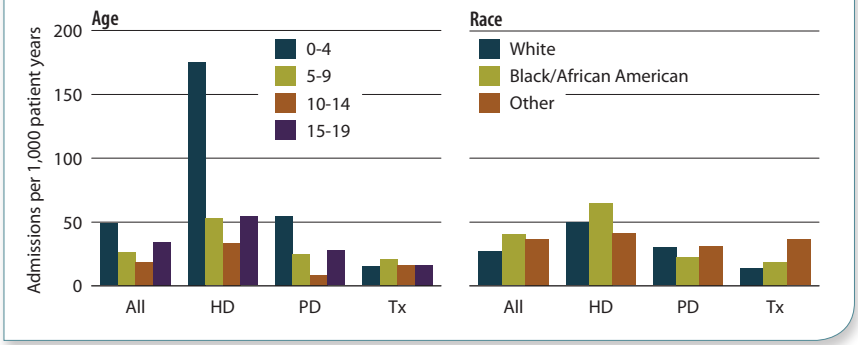
vol 2 **8.2** **Unadjusted rates of hospitalization for any infection in pediatric patients, by modality, age, & race, 2007–2010**



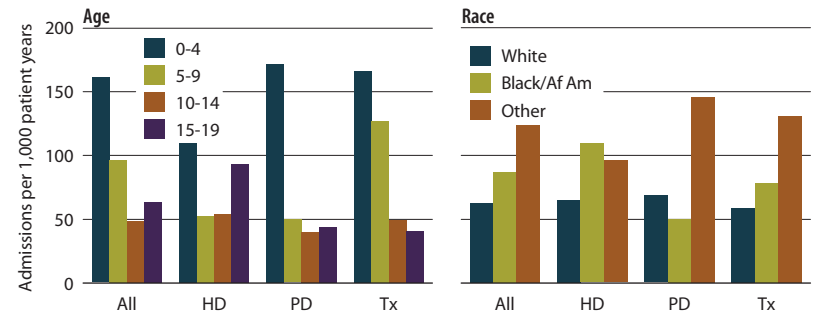
vol 2 **8.3** **Unadjusted rates of hospitalization for infection due to internal device in pediatric patients, by modality, age, & race, 2007–2010**



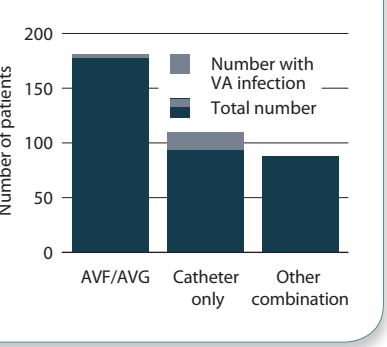
vol 2 **8.4** **Unadjusted rates of hospitalization for bacteremia/septicemia in pediatric patients, by modality, age, & race, 2007–2010**



vol 2 **8.5** **Unadjusted rates of hospitalization for respiratory infection (including pneumonia) in pediatric patients, by modality, age, & race, 2007–2010**

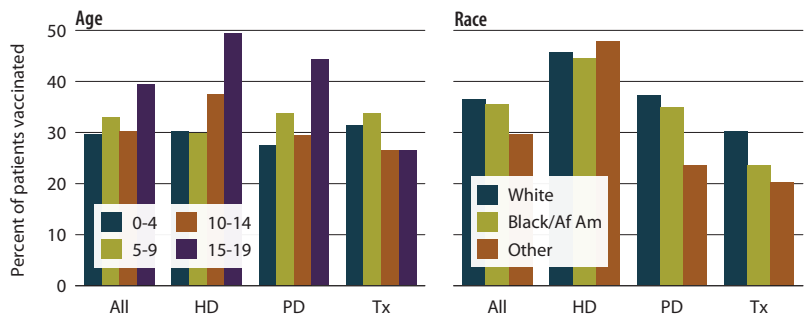


vol 2 **8.6** **Infections in pediatric patients by vascular access use, July–December, 2010**



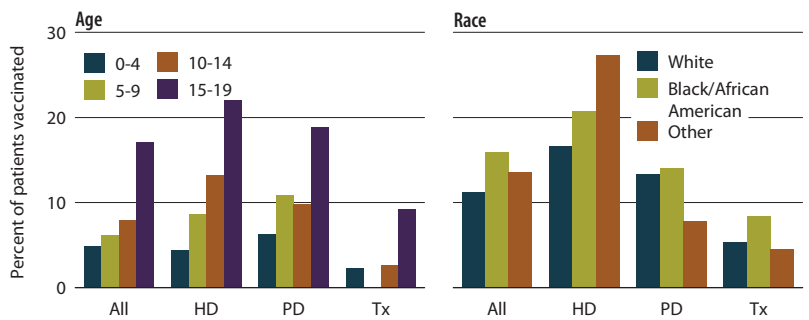
vol 2
8.7

Influenza vaccination rates in pediatric patients, by modality, age, & race, 2007–2010



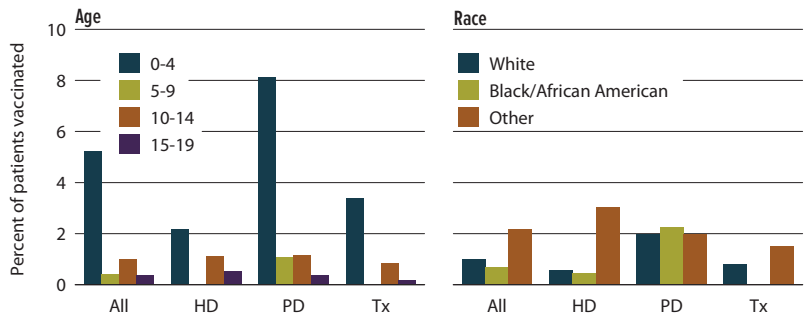
vol 2
8.8

Pneumovax vaccination rates in pediatric patients, by modality, age, & race, 2007–2010



vol 2
8.9

Prevnar vaccination rates in pediatric patients, by modality, age, & race, 2007–2010



Rates of vaccination against influenza in the pediatric ESRD population have improved, but remain below recommended levels. In 2007–2010, approximately one-third of children age 14 or younger received a vaccination. Rates are highest in those age 15–19, at nearly 40 percent, and vary little by race. In older patients, rates are generally higher in those on hemodialysis compared to those on peritonal dialysis or with a transplant.

In 2007–2010, pneumovax vaccination rates were highest overall in children age 15–19, at 17 percent, and were just 8 percent or below in those 14 and younger. When compared to white children, rates in blacks/African Americans tend to be higher, at 11.2 versus 15.9 percent, respectively.

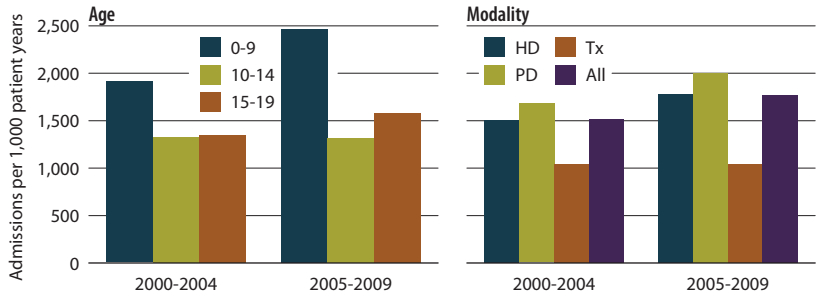
The use of Prevnar is most common in children age 0–4 who are on peritoneal dialysis. Use varies little by race, at 1.0 and 0.7 percent, respectively, in whites and blacks/African Americans. » **Figures 8.7–9;** see page 442 for analytical methods. *Point prevalent ESRD patients age 0–19 prior to January 1 of the two-year study period & alive through December 31 of the second year, 2007–2008 & 2009–2010.*

Between 2000–2004 and 2005–2009, one-year adjusted all-cause hospitalization rates per 1,000 patient years increased 29 and 17 percent, respectively, in patients age 0–9 and 15–19; in patients age 10–14, in contrast, rates fell one percent. By modality, rates rose 18–19 percent for dialysis patients and remained stable in those with a transplant; overall, all-cause hospitalization rates increased 16 percent between the two time periods.

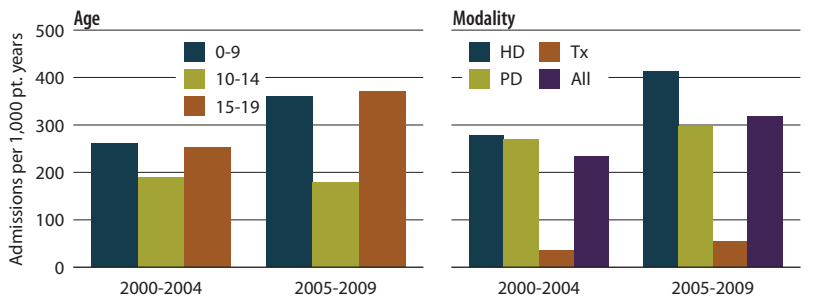
Cardiovascular hospitalization rates increased 38 and 47 percent, respectively, in children age 0–9 and 15–19, but fell 6 percent in those age 10–14. Rates rose 49 and 56 percent in hemodialysis and transplant patients, but just 10 percent in patients on peritoneal dialysis. Overall, rates increased 36 percent between the two periods.

Rates of hospitalization for infection increased 32 and 9 percent in patients age 0–9 and 15–19, and fell 9 percent in those age 10–14. By modality, rates increased 12, 8, and 15 percent, respectively, for hemodialysis, peritoneal dialysis, and transplant patients; the overall rate rose 12 percent. » **Figures 8.10–12;** see page 442 for analytical methods. *Incident ESRD patients age 0–19, 2000–2009. Adjusted for gender, race, & primary diagnosis. Ref: incident ESRD patients age 0–19, 2004–2005. Included patients survived the first 90 days after ESRD initiation & are followed from day 90.*

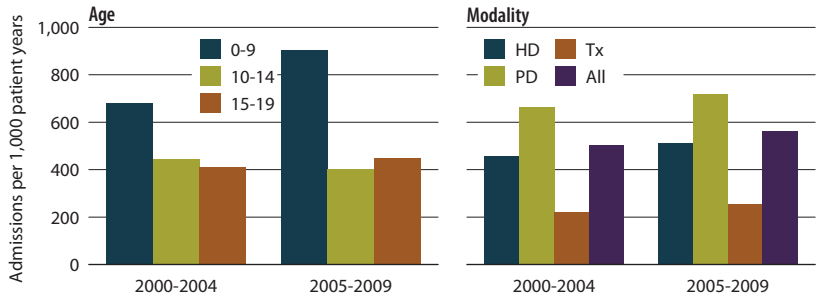
vol 2 **8.10** **One-year adjusted all-cause hospitalization rates in pediatric patients (from day 90), by age & modality**



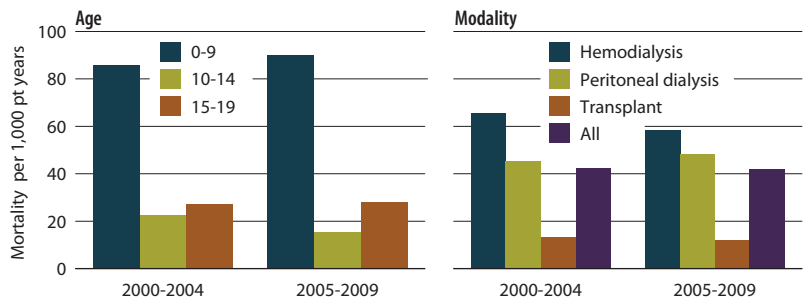
vol 2 **8.11** **One-year adjusted cardiovascular hospitalization rates in pediatric patients (from day 90), by age & modality**



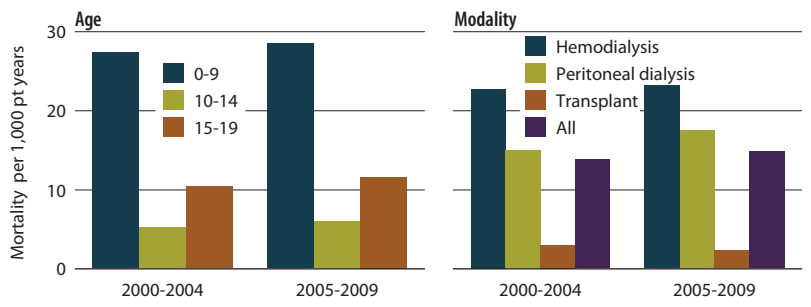
vol 2 **8.12** **One-year adjusted rates of hospitalization for infection in pediatric patients (from day 90), by age & modality**



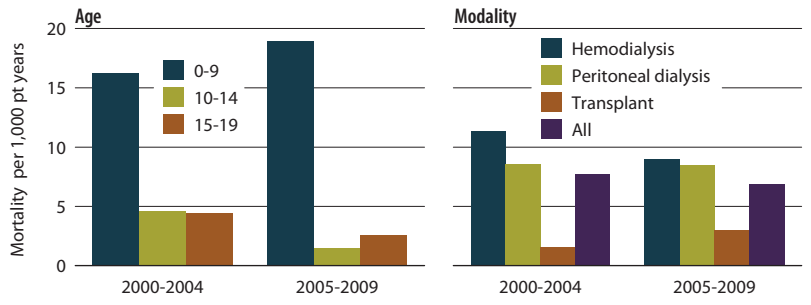
vol 2
8.13 One-year adjusted all-cause mortality rates in pediatric patients (from day one), by age & modality



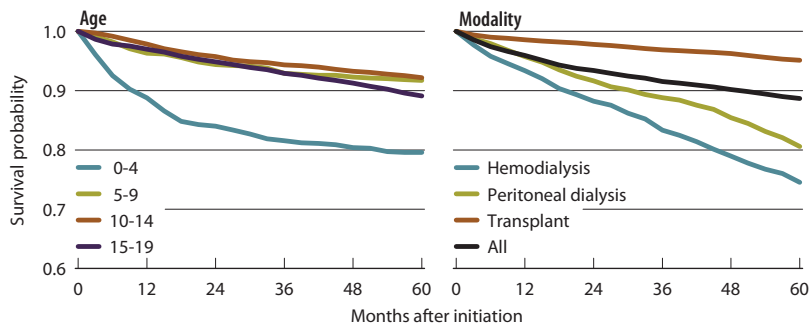
vol 2
8.14 One-year adjusted cardiovascular mortality rates in pediatric patients (from day one), by age & modality



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



vol 2
8.16 Adjusted five-year survival in pediatric patients (from day one), by age & modality, 2001–2005

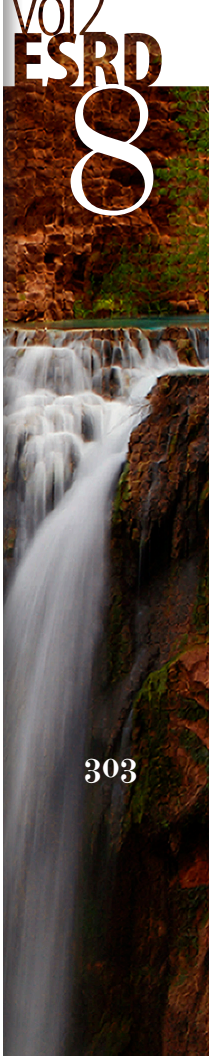


The one-year adjusted all-cause mortality rate in children age 0–9 was 89.8 per 1,000 patient years in 2005–2009, nearly six times higher than the rate in patients age 10–14, and slightly more than three times higher than for patients age 15–19. The rate for children on hemodialysis was 58.2, compared to 48.0 and 11.9, respectively, for those on peritoneal dialysis or with a transplant.

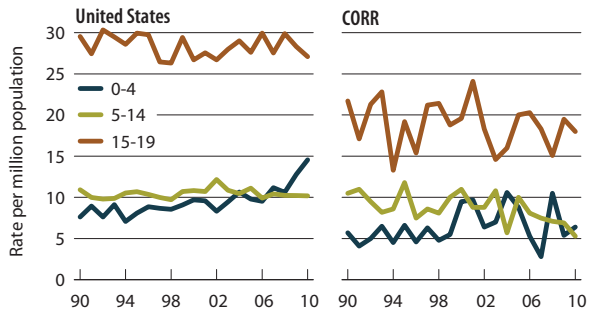
In 2005–2009, the one-year adjusted cardiovascular mortality rate in children age 0–9 was 28.5 per 1,000 patient years, 4.8 and 2.5 times higher, respectively, than for ages 10–14 and 15–19. Children on hemodialysis have higher cardiovascular mortality than those on peritoneal dialysis, at 23.2 versus 17.5, while children with a transplant have the greatest survival advantage, with a mortality rate of 2.3.

The rate of mortality due to infection is highest in patients age 0–9, at 18.9 per 1,000 patient years in 2005–2009, compared to 1.4 and 2.5, respectively, in children age 10–14 and 15–19. And by modality, rates for children on hemodialysis and peritoneal dialysis are similar, at 9.0 and 8.4 — three times higher than those found in children with a transplant.

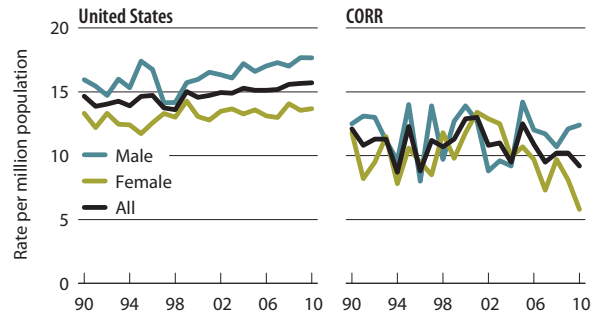
For patients beginning ESRD therapy in 2001–2005, the overall probability of surviving five years was 0.89. By age, the five-year survival probability ranged from 0.80 for ages 0–4 to 0.92 in those age 5–14; in children age 15–19, the survival probability was 0.89. By modality, the highest five-year survial probability occurs in children with a transplant, at 0.95 compared to 0.75 and 0.81, respectively, in those treated with hemodialysis or peritoneal dialysis. » **Figures 8.13–16;** see page 443 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, 2010. Adjusted for age, gender, race, Hispanic ethnicity, & primary diagnosis. Ref: incident ESRD patients age 0–19, 2004–2005.*



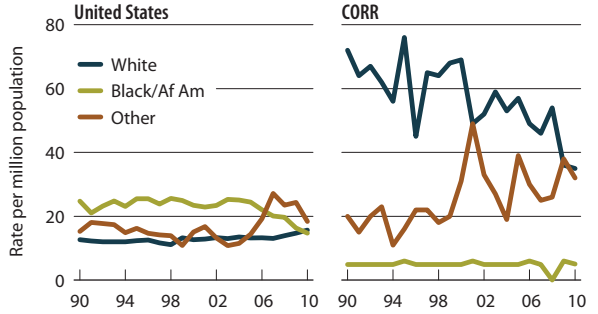
vol 2 8.17 **Incident rates of pediatric ESRD in the United States & Canada, by age**



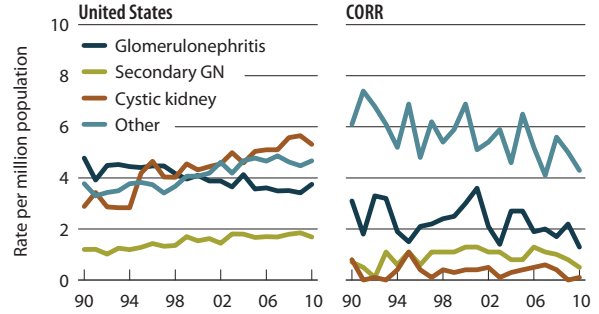
vol 2 8.18 **Incident rates of pediatric ESRD in the United States & Canada, by gender**



vol 2 8.19 **Incident rates of pediatric ESRD in the United States & Canada, by race**



vol 2 8.20 **Incident rates of pediatric ESRD in the United States & Canada, by primary diagnosis**



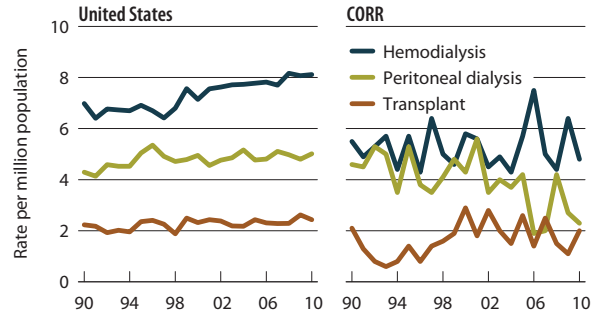
Here we present data graciously sent by CORR, the Canadian Organ Replacement Register. Together with U.S. data, these data provide a perspective on pediatric ESRD in North America, and allow comparisons of incidence, prevalence, patient characteristics, and modalities of therapy. The USRDS sincerely thanks the Canadian registry and providers for their efforts.

In 2010, the incident rate of ESRD per million population was 16.0 for U.S. children compared to 9.2 for children in Canada. In both countries the rate is higher for adolescents age 15–19 compared to younger children; in the U.S., however, the rate for adolescents is 51 percent greater than for their Canadian counterparts, at 27 per million population.

By race, incident rates for whites are 35 and 16, respectively in Canada and the U.S., and 32 and 18 in children of other races. The extremely low rate of 5 per million among black children in Canada, compared to 15 per million in black/African American children in the U.S., likely reflects differences in ethnic group composition between the two countries.

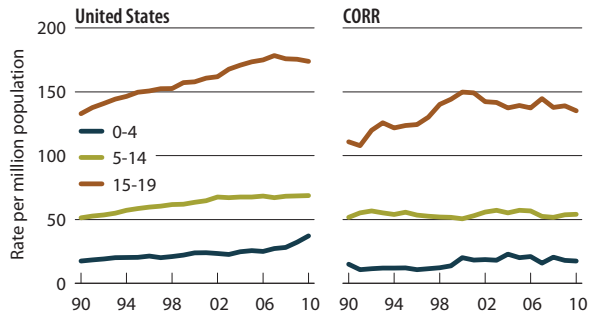
In the U.S., cystic kidney disease is the most common cause of ESRD in children, with a rate that has increased to 5.3 per million population; in Canada, in contrast, the rate is only 0.1, the lowest rate by primary diagnosis.

vol 2 8.21 **Incident rates of pediatric ESRD in the United States & Canada, by modality**

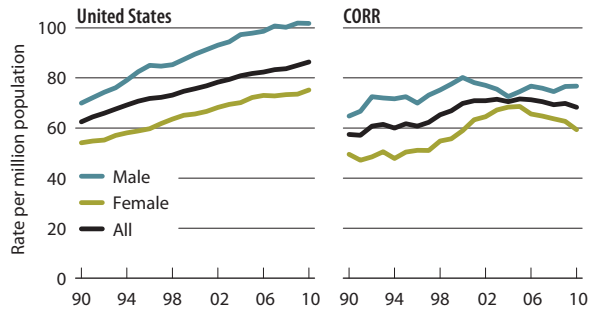


By modality, hemodialysis is the most common therapy for pediatric patients in both countries, with an incident rate of 8.0 per million population in the U.S. and 4.8 in Canada. Use of peritoneal dialysis among incident pediatric patients in Canada has been declining over the past decade. » **Figures 8.17–21;** see page 443 for analytical methods. *Incident ESRD patients age 0–19; unadjusted.*

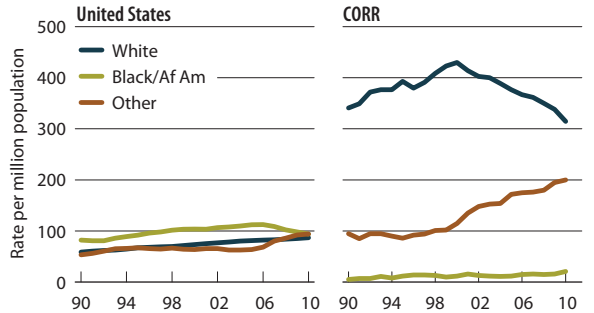
vol 2 **8.22** **Prevalent rates of pediatric ESRD in the United States & Canada, by age**



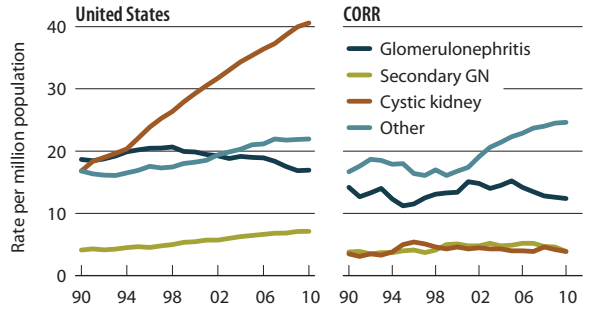
vol 2 **8.23** **Prevalent rates of pediatric ESRD in the United States & Canada, by gender**



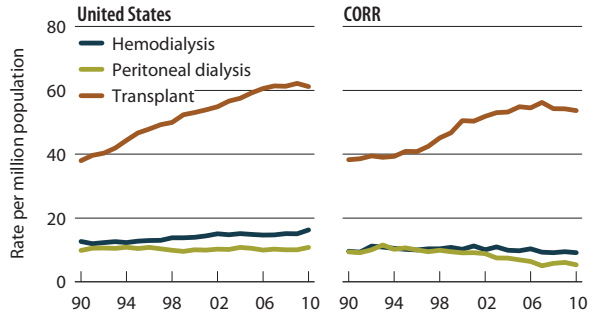
vol 2 **8.24** **Prevalent rates of pediatric ESRD in the United States & Canada, by race**



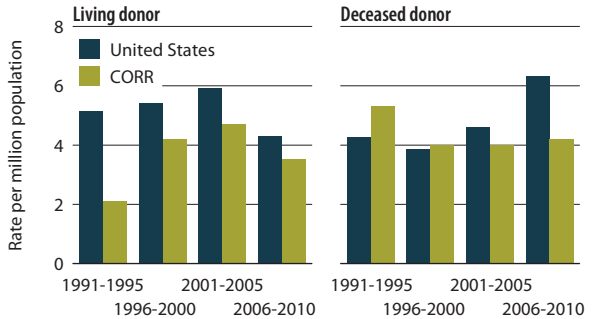
vol 2 **8.25** **Prevalent rates of pediatric ESRD in the United States & Canada, by primary diagnosis**



vol 2 **8.26** **Prevalent rates of pediatric ESRD in the United State & Canada, by modality**



vol 2 **8.27** **Pediatric first transplant rates in the United States & Canada, by donor type**



The prevalent rate of ESRD per million population in 2010 reached 86.0 for U.S. children and 68.3 for children in Canada. As seen with incident rates, rates of prevalent ESRD are highest in children age 15–19 and in males compared to females. The rate is four times higher in white children in Canada than in their U.S. counterparts, while the rate of ESRD due to cystic kidney disease is ten times greater in the U.S. Rates of ESRD due to glomerulonephritis and secondary glomerulonephritis are higher in the U.S. as well, at 16.9 versus 12.4 and 7.1 versus 3.9 per million population.

Kidney transplantation is the most common mode of therapy for both U.S. and Canadian children with ESRD. Living donor transplant rates for U.S. children in 2006–2010 were 4.3 per million population, compared to 3.5 in Canadian children; rates of deceased donor transplants were 6.3 and 4.2 per million, respectively. » **Figures 8.22–27;** see page 443 for analytical methods. *December 31 point prevalent patients age 0–19, unadjusted. First transplant rates in Figure 8.27 include cases in which a kidney was simultaneously transplanted in combination with another organ.*

Because data have been unavailable, use of prescription medications in children with ESRD has received little attention. As of 2006, however, medication use can now be assessed in children covered by Medicare based on their Part D prescription drug use.

Reported comorbidity and complications in children include persistent hypertension, left ventricular hypetrophy (LVH), and heart failure with cardiomyopathy, and are far too common. The use of cardio-protective medications, however, appears to be similar to that of the adult population.

In 2010, 40 percent of children were using ACEI/ARBs compared to 45 percent of adults; 35 percent of children on dialysis used beta blockers, compared to 52–56 percent of their adult counterparts (see Table 4.c in Chapter Four). Despite comparable use of cardiovascular drugs, and declining rates of hospitalization in adults, hospitalization rates for children are on the rise (Figure 8.11), findings which may suggest inadequate treatment of CVD in children. » **Table 8.b;** see page 443 for analytical methods. *Period prevalent ESRD patients with Medicare Part D, 2009–2010.*

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

	ACEI/ARB	Beta blocker	Calcium chnel blkr	Diuretics	Alpha-agonist	Vaso-dilator
All patients						
Dialysis	39.9	35.0	45.8	45.8	45.8	13.0
Transplant	23.2	30.2	60.8	60.8	60.8	4.5
Age <6						
Dialysis	26.5	21.1	35.2	35.2	35.2	7.4
Transplant	12.1	11.7	55.7	55.7	55.7	2.2
Age 6-14						
Dialysis	41.1	29.0	48.8	48.8	48.8	9.6
Transplant	24.4	25.2	64.5	64.5	64.5	6.4
Age >14						
Dialysis	42.4	39.6	47.2	47.2	47.2	15.2
Transplant	25.5	37.1	60.5	60.5	60.5	4.2

Children appear to receive less intranvenous anemia treatment than adults, with more than 85 percent of adult patients receiving IV iron, compared to 61 percent of children. Vitamin D therapy appears to be a combination of IV vitamin D analogs and oral therapy, and may reflect the fact that peritoneal dialysis patients receive oral medications and those on hemodialysis receive them by IV.

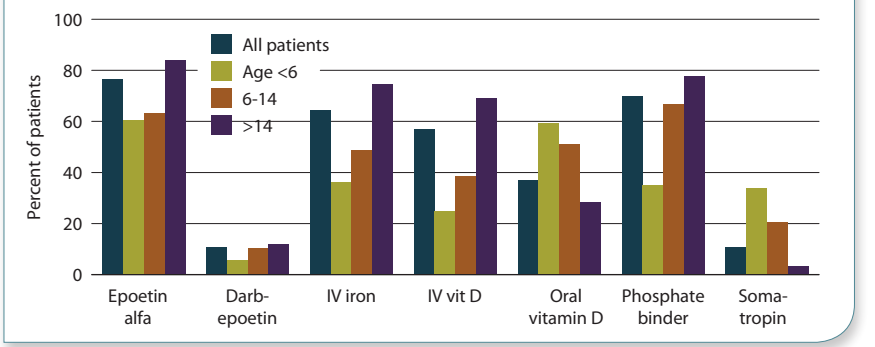
Growth hormone therapy, an area reported previously by the USRDS and others, is used in less than 30 percent of children under age 6, and by only one in five of those age 6–14.

These rates stand out sharply in light of the very high prevalence of short stature and poor growth in children with kidney disease, as shown in the USRDS 2009 Annual Data Report (Volume Two, Figure 8.1). » **Table 8.c & Figure 8.28;** see page 443 for analytical methods. *Period prevalent ESRD patients with Medicare Part D, 2009–2010. IV vitamin D dose in paricalcitol-equivalent units.*

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

	Epoetin alfa IUs/week	Darbepoetin mcg/week	IV iron mg/week	Pericalcitol IV vit D mcg/week
All patients	14,615	44.4	82.2	16.0
Age <6	7,115	34.2	66.1	10.7
6–14	9,025	36.2	64.2	12.5
>14	16,472	48.3	86.2	16.7

vol 2 **8.28** **Use of injectables & oral medications in pediatric dialysis patients, by age**



vol 2 8.d **Top 25 drugs used in pediatric ESRD patients, sorted by total days supply, 2009–2010**

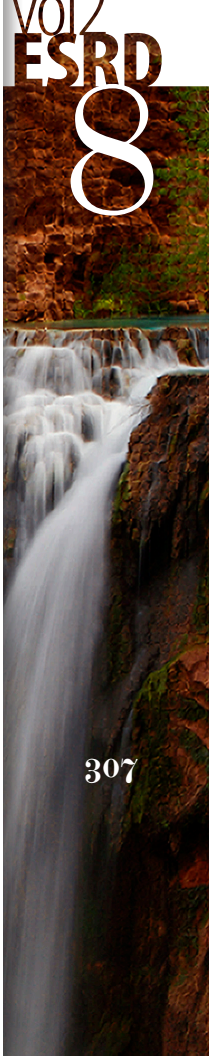
Dialysis Generic name	Total days supply	Transplant Generic name	Total days supply
Sevelamer	121,409	Sulfamethoxazole-Trimethoprim	201,368
Amlodipine	96,633	Amlodipine	177,744
Calcitriol	77,784	Prednisone or Prednisolone	168,680
Cinacalcet	64,755	Valganciclovir	127,089
Calcium acetate	62,678	Omeprazole	66,711
Clonidine	61,667	Ranitidine	52,745
Lisinopril	55,928	Tacrolimus	46,794
Nifedipine	39,063	Famotidine	43,731
Enalapril	35,938	Atenolol	38,993
Labetalol	32,710	Clonidine	36,913
Metoprolol	32,571	Labetalol	36,299
Somatropin	29,418	Lisinopril	35,639
Omeprazole	29,194	Nystatin	35,560
Carvedilol	25,898	Nifedipine	34,021
Minoxidil	20,827	Lansoprazole	32,106
Benzocaine	20,378	Calcitriol	32,023
Levetiracetam	20,337	Enalapril	31,971
Prednisone	20,145	Mycophenolate	31,618
Lansoprazole	19,538	Furosemide	26,174
Ranitidine	18,904	Esomeprazole	23,725
Atenolol	17,242	Nitrofurantoin	22,730
Levothyroxine	16,976	Metoprolol	18,659
Sulfamethoxazole-Trimethoprim	16,431	Oxybutynin	17,702
Paricalcitol	14,346	Levothyroxine	17,402
Metoclopramide	14,058	Metoclopramide	16,270

vol 2 8.e **Top 25 drugs used in pediatric ESRD patients, sorted by percentage of patients with at least one fill, 2009–2010**

Dialysis Generic name	Percent	Transplant Generic name	Percent
Sevelamer (carbonate or hydrochloride)	47.9	Sulfamethoxazole-Trimethoprim	72.5
Amlodipine	33.2	Valganciclovir	59.7
Calcitriol	31.1	Prednisone or Prednisolone	54.7
Calcium acetate	27.7	Amlodipine	50.5
Cinacalcet	24.6	Amoxicillin	33.9
Amoxicillin	24.3	Nystatin	32.6
Hydrocodone-Acetaminophen	23.0	Omeprazole	21.1
Lisinopril	20.1	Ranitidine	20.1
Clonidine	19.9	Ciprofloxacin	18.8
Azithromycin	16.8	Hydrocodone-Acetaminophen	18.6
Cephalexin	15.8	Azithromycin	17.0
Mupirocin	15.2	Amoxicillin-Potassium clavulanate	16.8
Nifedipine	13.6	Cephalexin	15.7
Prednisone or Prednisolone	13.2	Famotidine	15.7
Enalapril	13.2	Furosemide	15.5
Sulfamethoxazole-Trimethoprim	12.6	Clonidine	14.8
Omeprazole	12.3	Tacrolimus	13.7
Ciprofloxacin	12.2	Nifedipine	13.5
Polyethylene glycol 3350	12.1	Calcitriol	13.3
Benzocaine-Benzethonium	11.8	Lansoprazole	13.1
Sodium polystyrene sulfonate	11.6	Cefdinir	12.9
Metoprolol	11.4	Labetalol	12.6
Labetalol	11.3	Oseltamivir	12.3
Somatropin	10.7	Lisinopril	12.2
Oxycodone-Acetaminophen	10.6	Acetaminophen-Codeine	12.0

Sevelamer (carbonate or hydrochloride), a drug to treat high phosphorus levels, was used by 47.9 percent of pediatric dialysis patients who had at least one prescription fill in 2009–2010; amlodipine, calcitriol, calcium acetate and cinacalcet were used by 33.2, 31.1, 27.7, and 24.6 of patients, respectively.

In children with a transplant, sulfamethoxazole-trimethoprim, an antibacterial, is used in nearly three of four patients, while more than 50 percent of patients had at least one fill of valganciclovir, or prednisone or prednisolone. Amlodipine, and amoxicillin round out the top five medications used by pediatric transplant recipients. » **Tables 8.d–e;** see page 443 for analytical methods. *Period prevalent ESRD patients with Medicare Part D, 2009–2010. For Table 8.d, each prescription drug is disbursed with sufficient quantity to administer for a set number of days, so long as instructions are followed (i.e., so long as adherence is perfect). Total days supplied equals the cumulative number of days supplied through all fills of a particular medication in a population.*



INFECTIONS

unadjusted rates of hospitalization for any infection, 2007–2010 (per 1,000 patient years; Figure 8.2)

age 0–4	» all · 818	» hemodialysis · 1,130	» peritoneal dialysis · 1,130	» transplant · 526
age 5–9	· 565	· 643	· 897	· 405
age 10–14	· 410	· 453	· 729	· 252
age 15–19	· 416	· 504	· 674	· 244
whites	· 429	· 463	· 744	· 291
blacks/African Amercans	· 560	· 622	· 913	· 310

VACCINATIONS

influenza vaccination rates, 2007–2010 (percent; Figure 8.7)

age 0–4	» all · 29.8	» hemodialysis · 30.3	» peritoneal dialysis · 27.6	» transplant · 31.3
age 5–9	· 33.0	· 29.9	· 33.9	· 33.8
age 10–14	· 30.3	· 37.5	· 29.5	· 26.5
age 15–19	· 39.5	· 49.5	· 44.3	· 26.6
whites	· 36.6	· 45.8	· 37.2	· 30.2
black/African Americans	· 35.5	· 44.6	· 35.0	· 23.5

HOSPITALIZATION AND MORTALITY

one-year adjusted all-cause hospitalization rates in pediatric patients (per 1,000 patient years; Figure 8.10)

2000–2004 » overall · 1,519 » age 0–9 · 1,915 » age 10–14 · 1,329 » age 15–19 · 1,347
» hemodialysis · 1,511 » peritoneal dialysis · 1,683 » transplant · 1,043

2005–2009 » overall · 1,768 » age 0–9 · 2,469 » age 10–14 · 1,316 » age 15–19 · 1,580
» hemodialysis · 1,781 » peritoneal dialysis · 2,000 » transplant · 1,041

one-year adjusted cardiovascular hospitalization rates in pediatric patients (per 1,000 patient years; Figure 8.11)

2000–2004 » overall · 235 » age 0–9 · 261 » age 10–14 · 191 » age 15–19 · 253
» hemodialysis · 278 » peritoneal dialysis · 270 » transplant · 36

2005–2009 » overall · 319 » age 0–9 · 360 » age 10–14 · 180 » age 15–19 · 371
» hemodialysis · 413 » peritoneal dialysis · 297 » transplant · 56

adjusted five-year survival probabilities, 2001–2005 (from day one; Figure 8.16)

» overall · 0.89
» age 0–4 · 0.80 » age 5–9 · 0.92 » age 10–14 · 0.92 » age 15–19 · 0.89
» hemodialysis · 0.75 » peritoneal dialysis · 0.81 » transplant · 0.95

PEDIATRIC ESRD IN THE UNITED STATES AND CANADA

prevalent rates per million population (Figures 8.17–21)

overall » U.S. · 86.0 » Canada · 68.3

age » U.S. » 0–4 · 37 » 5–14 · 69 » 15–19 · 174
» Canada » 0–4 · 17.5 » 5–14 · 54.0 » 15–19 · 135.1

race » U.S. » white · 16 » black/African American · 15 » other · 18
» Canada » white · 35 » black · 5 » other · 32

primary diagnosis » U.S. » GN · 3.8 » secondary GN · 1.7 » cystic kidney · 5.3
» Canada » GN · 1.3 » secondary GN · 0.5 » cystic kidney · 0.1