CHAPTER 11

Pediatric Urologic Disorders

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VESICOURETERAL REFLUX

DEFINITION AND DIAGNOSIS

Vesicoureteral reflux (VUR), often referred to simply as reflux, is the retrograde flow of urine from the bladder to the upper urinary tract. Reflux is termed *primary* when it exists as a congenital anomaly that is not associated with any other anatomical or functional abnormality of the urinary tract. *Secondary* VUR is reflux that may be caused by the elevated pressures associated with bladder obstruction. The most common anatomic cause of secondary VUR is posterior urethral valves, which are associated with reflux in approximately 50% of affected boys (1). Common functional causes of secondary VUR may alter bladder dynamics; the ensuing voiding discoordination causes high bladder pressures like those that occur in neurologically normal children with dysfunctional voiding states or the neurogenic bladder seen in children with spina bifida. Analyses for this section are based on the ICD-9 and CPT codes for VUR listed in Table 1.

Reflux severity is usually categorized according to a five-point grading system devised by the International Reflux Study Committee in 1981 (Table 2) to describe VUR by voiding cystourethrography (VCUG). Radionuclide cystography (RNC) does not offer the same level of detail as VCUG, and thus a three-point grading system is employed for VUR described by RNC.

When VUR is suspected, radiographic assessment of the lower urinary tract is warranted. Traditionally, VCUG has been performed as the initial modality to diagnose VUR in infants with prenatally detected hydronephrosis, children under five years of age with a documented urinary tract infection (UTI), and children with a febrile UTI, regardless of age. An RNC is usually employed to follow the progression of VUR once it has been diagnosed and to screen the newborn siblings and offspring of patients with VUR.

Since most cystography is performed to evaluate UTI and 29% to 50% of the children evaluated for UTI have VUR, an alternative strategy has been offered for the evaluation of initial UTI that could reduce the number of children requiring cystography by almost half. This approach is predicated on referring for cystography only those children in whom renal inflammation is identified. It has been shown that an early nuclear renal scan following the first UTI will allow detection of most patients with intermediate-grade VUR and all patients with high-grade VUR (2, 3).

RISK FACTORS

Primary VUR appears to have a multifactorial etiology in addition to an established genetic component. VUR is the most commonly inherited abnormality of the urinary tract. Its incidence in siblings of children with known VUR has been reported to be as high as 45% (4). The incidence is slightly higher among sisters of girls with VUR; however, the association is not strong enough to confirm X-

Table 1. Codes used in the diagnosis and management of pediatric urologic disorders

Vesicoureteral reflux	
Individuals with one or more of the following:	
ICD-9 diagnosis codes	
593.7	Vesicoureteral reflux
593.70	Vesicoureteral reflux, unspecified or without reflux nephropathy
593.71	Vesicoureteral reflux with reflux nephropathy, unilateral
593.72	Vesicoureteral reflux with reflux nephropathy, bilateral
593.73	Other vesicoureteral reflux with reflux nephropathy NOS
CPT procedure codes	
50660[a]	Ureterectomy, total, ectopic ureter, combination abdominal, vaginal and/or perineal approach
50780[a]	Ureteroneocystostomy; anastomosis of single ureter to bladder
50781[a]	Ureteroneocystostomy (pre-1996)
50782	Ureteroneocystostomy; anastomosis of duplicated ureter to bladder
50783	Ureteroneocystostomy; with extensive ureteral tailoring
50785	Ureteroneocystostomy; with vesico-psoas hitch or bladder flap
50947[a]	Laparoscopy, surgical; ureteroneocystostomy with cystoscopy and ureteral stent placement
50948[a]	Laparoscopy, surgical; ureteroneocystostomy without cystoscopy and ureteral stent placement
52327	Cystourethroscopy (including ureteral catheterization); with subureteric injection of implant material
Undescended testes	
Males with one or more of the following:	
ICD-9 diagnosis codes	
752.5	Undescended and retractile testis
752.51	Undescended testis
752.52	Retractile testis
ICD-9 procedure codes	
62.5[b]	Orchiopexy
63.53[b]	Transplantation of spermatic cord
CPT procedure codes	
54550	Exploration for undescended testis (inguinal or scrotal area)
54560	Exploration for undescended testis with abdominal exploration
54640	Orchiopexy, inguinal approach, with or without hernia repair
54650	Orchiopexy, abdominal approach, for intra-abdominal testis (eg, Fowler-Stephens)
54690	Laparoscopy, surgical; orchiectomy
54692	Laparoscopy, surgical; orchiopexy for intra-abdominal testis
54699	Unlisted laparoscopy procedure, testis
Hypospadias	
Males with one or more of the following:	
ICD-9 diagnosis codes	
752.6	Hypospadias and epispadias and other penile anomalies
752.61	Hypospadias
ICD-9 procedure codes	
58.45[c]	Repair of hypospadias and epispadias
CPT procedure codes	
54300	Plastic operation of penis for straightening of chordee (eg, hypospadias), with or without mobilization of urethra
54304	Plastic operation on penis for correction of chordee or for first stage hypospadias repair with or without transplantation of prepuce and/or skin flaps
54308	Urethroplasty for second stage hypospadias repair (including urinary diversion); less than 3 cm
54312	Urethroplasty for second stage hypospadias repair (including urinary diversion); greater than 3 cm
54316	Urethroplasty for second stage hypospadias repair (including urinary diversion) with free skin graft obtained from site other than genitalia
54318	Urethroplasty for third stage hypospadias repair to release penis from scrotum (eg, third stage Cecil repair)

Continued on next page

Table 1 (continued). Codes used in the diagnosis and management of pediatric urologic disorders

54322	One stage distal hypospadias repair (with or without chordee or circumcision); with simple meatal advancement (eg, Magpi, V-flap)
54324	One stage distal hypospadias repair (with or without chordee or circumcision); with urethroplasty by local skin flaps (eg, flip-flap, prepucial flap)
54326	One stage distal hypospadias repair (with or without chordee or circumcision); with urethroplasty by local skin flaps and mobilization of urethra
54328	One stage distal hypospadias repair (with or without chordee or circumcision); with extensive dissection to correct chordee and urethroplasty with local skin flaps, skin graft patch, and/or island flap
54332	One stage proximal penile or penoscrotal hypospadias repair requiring extensive dissection to correct chordee and urethroplasty by use of skin graft tube and/or island flap
54336	One stage perineal hypospadias repair requiring extensive dissection to correct chordee and urethroplasty by use of skin graft tube and/or island flap
54340	Repair of hypospadias complications (ie, fistula, stricture, diverticula); by closure, incision, or excision, simple
54344	Repair of hypospadias complications (ie, fistula, stricture, diverticula); requiring mobilization of skin flaps and urethroplasty with flap or patch graft
54348	Repair of hypospadias complications (ie, fistula, stricture, diverticula); requiring extensive dissection and urethroplasty with, flap, patch or tubed graft (includes urinary diversion)
54352	Repair of hypospadias cripple requiring extensive dissection and excision of previously constructed structures including re-release of chordee and reconstruction of urethra and penis by use of local skin as grafts and island flaps and skin brought in as flaps or grafts
54360	Plastic operation on penis to correct angulation
	Ureterocele
	Individuals with one or more of the following:
	ICD-9 diagnosis codes
593.89	Other specified disorders of kidney and ureter
753.23	Congenital ureterocele
	CPT procedure codes
50660	Ureterectomy, total, ectopic ureter, combination abdominal, vaginal and/or perineal approach
51535	Cystotomy for excision, incision, or repair of ureterocele
52300	Cystourethroscopy; with resection or fulguration of orthotopic ureterocele(s), unilateral or bilateral
52301	Cystourethroscopy; with resection or fulguration of ectopic ureterocele(s), unilateral or bilateral
	Posterior urethral valves
	Males with one or more of the following:
	ICD-9 diagnosis codes
753.6	Congential atresia and stenosis of urethra and bladder neck
	CPT procedure codes
52340	Cystourethroscopy with incision, fulguration, or resection of congenital posterior urethral valves, or congenital obstructive hypertrophic mucosal folds
52400	Cystourethroscopy with incision, fulguration, or resection of congenital posterior urethral valves, or congenital obstructive hypertrophic mucosal folds (2003 and later)

[a]Include only if patient under 30 years old.

[b]Must occur with diagnosis of 550.XX or 752.XX.

[c]Include only if under 18 years old.

Table 2. Grades of vesicoureteral reflux

Grade	Description
I	Into the nondilated ureter
II	Into the pelvis and calyces without dilatation
III	Mild to moderate dilatation of the ureter, renal, pelvis, and calyces with minimal blunting of the fornices
IV	Moderate ureteral tortuosity and dilatation of the pelvis and calyces
V	Gross dilatation of the ureter, pelvis, and calyces; loss of papillary impressions; and ureteral tortuosity

SOURCE: Reprinted from Walsh: Campbell's Urology, 8th ed., Saunders, Copyright 2002.

linked inheritance (5). There is a high parent-to-child transmission of VUR that further supports autosomal dominant transmission (5).

TREATMENT

Treatment for VUR has been predicated on the concept that the condition usually resolves spontaneously, although various factors modify the rate of resolution, including the initial grade, age at presentation, and the presence of abnormal toileting habits or bladder obstruction. In 1997, the American Urological Association Pediatric Vesicoureteral Reflux Guidelines Panel published resolution rates based on grade, age, and whether VUR is present in one ureter or both (Figures 1a and 1b). A favorable resolution rate can be predicted for children who are younger at presentation, have lower-grade VUR (grade III or less), and have unilateral VUR. Most VUR resolves within four years, but some cases resolve after five or more years of follow-up, even in the absence of interval improvement (6).

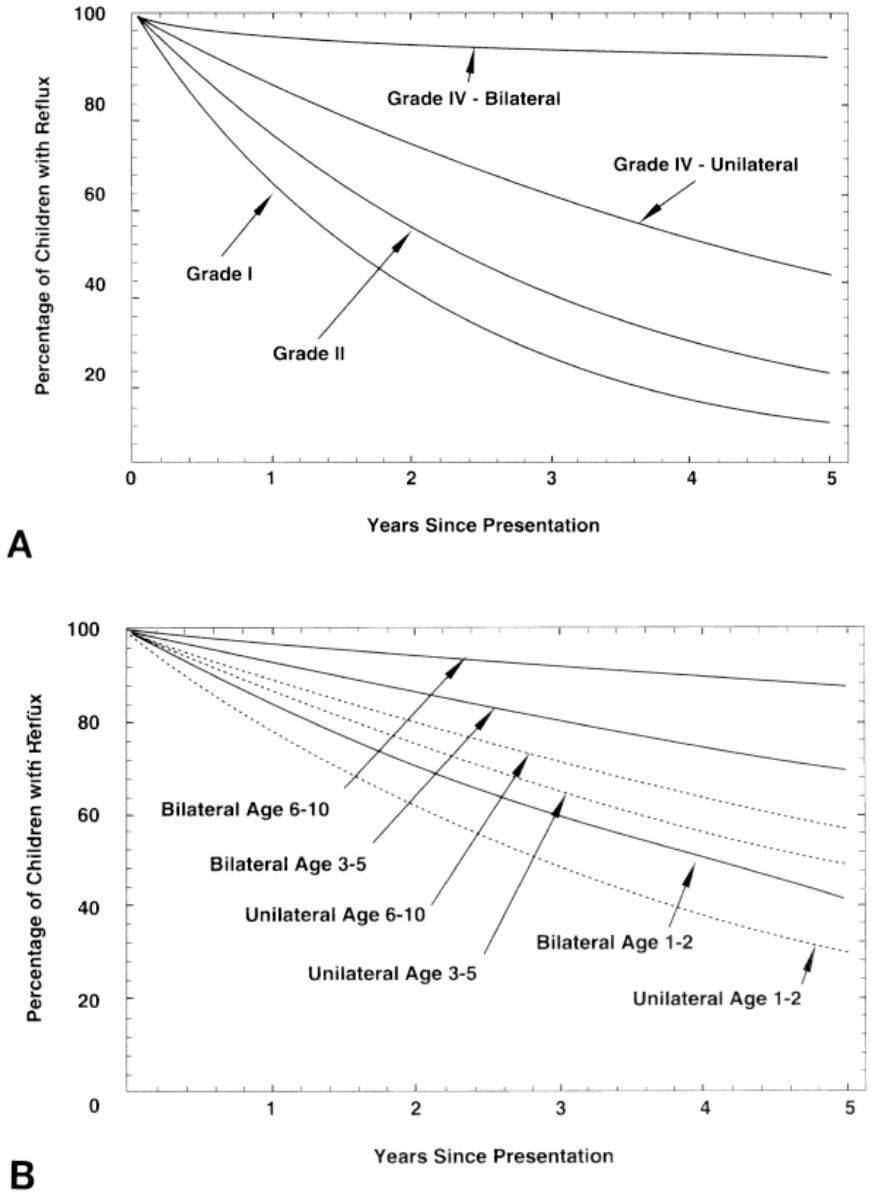
Given the natural history of VUR, initial management in the majority of cases relies on prevention of UTI, the etiology of acquired renal scars in VUR, by the daily administration of low doses of antibiotic. Extended prophylactic antibiotic therapy is generally well-tolerated in children and rarely needs to be discontinued. Breakthrough UTIs occasionally warrant surgical correction of VUR.

Differences of opinion exist regarding the indications for surgical correction of VUR, particularly since the advent of minimally invasive options. Classical indications include grade V reflux that has not resolved after a year of surveillance and acute pyelonephritis with fever and a positive urine culture. Some clinicians contend that VUR should be corrected if there is evidence of renal inflammation on renal scan. Open surgical correction of uncomplicated VUR requires general anesthesia, an abdominal incision, and a one- to three-day hospitalization. Endoscopic treatment of VUR, while also performed under general anesthesia, is an incisionless outpatient procedure in which a dextranomer/hyaluronic acid paste (Deflux™) is injected cystoscopically under the ureteral opening. The success rate for a single open-surgery procedure typically exceeds 95%. The aggregate success rate for one or more endoscopic treatments is 85% but varies by grade and upper tract abnormalities (7)

PREVALENCE AND INCIDENCE

The overall incidence of reflux in all children is estimated at approximately 10%; however, many children with VUR of low severity remain asymptomatic. Sargent performed the most comprehensive review of the prevalence of VUR in children undergoing cystography for various suspected urological indications (Table 3) (6). The data from this review demonstrate that prevalence is largely determined by the mode of presentation and whether there are any coexisting anatomical abnormalities of the urinary tract (8). Sargent found that the prevalence of VUR in children without a history of a UTI was 17.2%; others have found that up to 70% of infants who present with UTIs have VUR (8–12). The advent of high-resolution prenatal ultrasound has facilitated the identification of VUR in fetuses with hydronephrosis, where the prevalence is 37% (13).

A preponderance of the patients with VUR is male when evaluation is performed in infancy in response to prenatal hydronephrosis; in contrast, females predominate when VUR is diagnosed in the evaluation of UTIs later in development (14). Affected infant boys also often arrive with more severe degrees



Figures 1a and 1b. Persistence of vesicoureteral reflux, grades I, II, and IV (panel A) and III (panel B) 1 to 5 years after presentation.

SOURCE: Reprinted from Walsh: Campbell's Urology, 8th ed., Saunders, Copyright 2002.

Table 3. Prevalence of vesicoureteral reflux in children, by clinical indication for cystogram

Indication for cystogram	Prevalence of VUR (95% CI)	Subjects[a]	Prevalence compared with all UTI (P-value)
Normal children	9.0% (6.0–12.0)	31/344	< 0.001
All urinary tract infections	31.1% (29.8–32.4)	1,527/4914	…
Clinical pyelonephritis	31.5% (29.8–32.4)	114/362	…
Symptomatic/febrile UTI	29.0% (25.3–32.6)	170/587	…
Non-specified UTI	31.1% (29.9–32.8)	1,243/,3965	…
UTI < 1 year	31.0% (26.6–35.4)	133/429	…
UTI < 5 years	31.6% (28.9–34.3)	371/1,174	…
UTI > 5 years	30.3% (26.5–34.2)	165/544	…
Male UTI	30.0% (26.2–33.8)	166/553	…
Female UTI	33.1% (30.9–35.3)	600/1,813	…
Asymptomatic bacteriuria	29.8% (25.3–34.4)	114/382	…
All family screening	33.5% (31.3–35.6)	601/1,796	NS
Sibling with VUR	33.4% (31.1–35.7)	547/1,637	NS
Anorectal malformation	30.6% (24.4–36.7)	66/216	NS
Cloaca	60.0% (48.6–73.4)	39/65	< 0.001
Posterior urethral valve	59.6% (53.1–66.1)	130/218	< 0.001
Hypospadias	9.4% (7.9–11.0)	128/1356	< 0.001
Undescended testis	3.3% (1.6–5.0)	14/426	< 0.001
Renal anomaly	23.7% (21.3–26.9)	215/909	< 0.001
UPJO	16.1% (12.6–19.6)	69/428	< 0.001
Multicystic dysplastic	23.3% (17.5–29.1)	48/206	< 0.001
Solitary kidney	40.7% (27.6–55.0)	22/54	NS
Ectopic kidney	14.6% (7.8–24.2)	12/82	< 0.001
Duplex kidney	46.0% (37.8–54.3)	64/139	< 0.001
All prenatal hydronephrosis	20.5% (18.6–22.4)	349/1,702	< 0.001
Prenatal hydronephrosis, persistent postnatal	25.1% (21.7–28.5)	158/630	< 0.001
Prenatal hydronephrosis, normal postnatal	23.8% (14.0–36.2)	15/63	NS
Neonatal hydronephrosis on screening	18.3% (12.4–24.2)	30/164	< 0.001
Neurogenic bladder (MMC etc.)	33.3% (28.9–37.7)	146/438	NS
Voiding dysfunction	12.4% (10.6–14.2)	157/1,268	< 0.001
"Normal kidneys"	17.2% (14.4–20.1)	115/668	< 0.001
Contralateral to prenatal hydronephrosis	24.7% (15.3–36.1)	18/73	NS
Contralateral to neonatal hydronephrosis	11.8% (6.0–17.6)	14/119	< 0.001
Contralateral to UPJO	11.3% (6.4–16.1)	18/160	< 0.001
Contralateral to MCDK	19.6% (15.0–24.1)	57/291	< 0.001
Contralateral to agenesis	32.0% (15.0–53.5)	8/25	NS
Meatal stenosis	14.3% (1.8–42.8)	2/14	NS
Other organ anomalies	25.7% (12.5–43.3)	9/35	NS
Miscellaneous	54.8% (36.0–72.7)	17/31	< 0.001

…data not available.

UTI, urinary tract infection; VUR, vesicoureteral reflux; UPJO, Ureteropelvic junction obstruction; MCDK, multicystic dysplastic kidney; MMC, myelomeningocele.

[a]Subjects: number of children with vesicoureteral reflux/number of children undergoing cystogram.

Source: Reprinted from Pediatric Radiology, 30, Sargent MA, What is the normal prevalence of vesicoureteral reflux?, 587–593 Copyright 2000, with permission from Springer Science and Business Media.

Table 4. Incidence of vesicoureteral reflux severity in females, by race and age

Race and Age (yr)	Count	Incidence (95% CI)
Grades 1–2		
Black		
< 2	40	0.91 (0.82–0.99)
2–6	28	0.82 (0.70–0.95)
White		
< 2	797	0.73 (0.70–0.75)
2-6	908	0.76 (0.74–0.79)
Grade 3		
Black		
< 2	4	0.09 (0.01–0.18)
2–6	6	0.18 (0.05–0.30)
White		
< 2	239	0.22 (0.19–0.24)
2–6	247	0.21 (0.18–0.23)
Grades 4–5		
Black		
< 2	0	0
2–6	0	0
White		
< 2	58	0.05 (0.04–0.07)
2–6	38	0.03 (0.02–0.04)

Source: Reprinted from Journal of Urology, 170, Chand DH, Rhoades T, Poe SA, Kraus S, and Strife CF, Incidence and severity of vesicoureteral reflux in children related to age, gender, race and diagnosis, 1,548–1,550 Copyright 2003, with permission from American Urological Association.

of VUR, especially if diagnosed in infancy or during the postnatal workup of antenatal hydronephrosis (15). Although 85% of VUR diagnosed in older children occurs in girls, boys who present with UTIs have a higher likelihood of having the anomaly (16). Since circumcision status influences the predisposition to infection (17), this same propensity toward UTI affects the detection of VUR as well. In the International Reflux Study in Children, 10% of the VUR patients from the United States were boys, compared with 24% of those from Europe. Notably, circumcision had been performed in 62% of the American boys, but in only 5% of the European boys ($p < 0.001$) (18).

The prevalence of VUR in African American children with UTI is less than that in Caucasian children up to age ten (Table 4) (19, 20). However, once reflux is discovered, its grade and chance of spontaneous resolution are similar for female children of both races (21). Reflux is a concern because of its association with renal scarring. The associated sequelae of renal scarring include high blood pressure and renal insufficiency, the severity of both being related to the proportion of kidney tissue that is scarred. Once the association was established in the 1970s, VUR was identified as the underlying cause in up to 50% of children with high blood pressure and was reported to be present in up to 40% of children in renal failure clinics (22–25). A more contemporary series has estimated that only 6% of children with high blood pressure and renal insufficiency have VUR as the underlying cause. It is unclear whether improved recognition of VUR as a cause of renal scarring and improved treatment algorithms has influenced this rate, or whether the apparent decrease in scarring reflects changes in disease coding (26).

TRENDS IN HEALTHCARE RESOURCE UTILIZATION

Inpatient Care

Data from the Healthcare Cost and Utilization Project (HCUP) reveal that for children under 18 years of age, the annual rate of inpatient hospitalizations for VUR increased slightly between 1994 and 2000, from 6.4 per 100,000 children to 7.0 per 100,000 children (Table 5), although this trend did not reach statistical significance. This increasing trend was noted in both girls and boys, with the ratio of girls to boys remaining relatively constant at 3:1. The ratio of Caucasian to Hispanic children hospitalized for VUR has also remained constant at 3:2. Data from the HCUP Kids' Inpatient Database (KID) (1997 and 2000) provide insight into the inpatient visits for each age group (< 3 years, 3 to 10 years, and 11 to 17 years) (Table 6). KID is based on a sample of pediatric discharges from US community hospitals. Because it samples only pediatric discharges, KID allows a more in-depth analysis of pediatric resource utilization than is available in the all-ages HCUP dataset. KID for 2000 includes 2,784 hospitals from 27 States. KID for 1997 includes 2,521 hospitals from 22 States. These data confirm the general trend toward more inpatient visits across all age groups, although the trend does not reach statistical significance. Regionally, the rates have been relatively constant.

Table 5. Inpatient hospital stays for vesicoureteral reflux listed as primary diagnosis, count, rate[a] (95% CI), age-adjusted rate[b]

	1994			1996			1998			2000		
	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate
Total[c]	4,913	1.9 (1.5–2.4)	1.9	5,105	1.9 (1.4–2.4)	1.9	6,469	2.4 (1.3–3.6)	2.4	5,675	2.1 (1.5–2.7)	2.1
Age												
< 18	4,328	6.4 (4.8–7.8)		4,442	6.2 (4.5–8.0)		5,907	8.2 (4.2–12)		5,047	7.0 (4.9–9.1)	
18–24	173	0.7 (0.5–0.9)		155	0.6 (0.4–0.8)		165	0.7 (0.4–0.9)		203	0.8 (0.5–1.0)	
25–34	153	0.4 (0.2–0.5)		167	0.4 (0.2–0.6)		*	*		186	0.5 (0.3–0.7)	
35–54	*	*		193	0.3 (0.2–0.4)		*	*		*	*	
55+	*	*		*	*		*	*		*	*	
Gender												
Male	1,335	1.1 (0.8–1.4)	1.0	1,163	0.9 (0.7–1.1)	0.9	1,574	1.2 (0.6–1.8)	1.2	1,454	1.1 (0.8–1.4)	1.0
Female	3,578	2.8 (2.1–3.4)	2.9	3,942	2.9 (2.1–3.7)	3.0	4,895	3.6 (1.8–5.3)	3.7	4,222	3.0 (2.1–3.9)	3.2
Race/ethnicity												
White	3,279	1.8 (1.3–2.2)	1.9	2,892	1.5 (1.1–1.9)	1.7	4,075	2.1 (0.9–3.4)	2.4	3,488	1.8 (1.2–2.4)	2.0
Hispanic	402	*	1.2	483	*	1.3	574	*	1.5	520	1.6 (0.8–2.4)	1.3
Region												
Midwest	1,369	2.3 (1.5–3.0)	2.2	1,319	2.1 (1.2–3.1)	2.1	1,037	1.7 (1.1–2.2)	1.6	1,375	2.2 (1.3–3.0)	2.1
Northeast	1,070	2.1 (1.1–3.1)	2.2	988	1.9 (0.8–3.0)	2.0	2,426	*	*	877	1.7 (0.9–2.5)	1.8
South	1,751	2.0 (1.1–3.0)	2.1	2,068	2.2 (1.1–3.4)	2.3	2,316	2.5 (1.1–3.8)	2.5	1,584	1.6 (0.8–2.6)	1.7
West	722	1.3 (0.8–1.8)	1.2	730	1.2 (0.8–1.7)	1.2	691	1.2 (0.6–1.7)	1.1	1,839	*	2.8
MSA												
Rural	236	0.4 (0.2–0.6)	0.4	300	0.5 (0.3–0.7)	0.5	227	0.4 (0.2–0.5)	0.4	184	0.3 (0.2–0.4)	0.3
Urban	4,676	2.5 (1.9–3.1)	2.5	4,798	2.4 (1.7–3.0)	2.4	6,233	3.0 (1.5–4.5)	3.0	5,491	2.6 (1.8–3.4)	2.6

*Figure does not meet standard for reliability or precision.

MSA, metropolitan statistical area.

[a]Rate per 100,000 is based on 1994, 1996, 1998, 2000 population estimates from Current Population Survey (CPS), CPS Utilities, Unicon Research Corporation, for relevant demographic categories of US civilian non-institutionalized population.

[b]Age-adjusted to the US Census-derived age distribution of the year under analysis.

[c]Persons of other races, missing or unavailable race and ethnicity, and missing MSA are included in the totals.

NOTE: Counts may not sum to totals due to rounding.

SOURCE: Healthcare Cost and Utilization Project Nationwide Inpatient Sample, 1994, 1996, 1998, 2000.

Table 6. Inpatient hospital stays for vesicoureteral reflux listed as primary diagnosis in 2000, count, rate[a] (95% CI), percent of all hospitalizations

	1997			2000		
	Count	Rate	Percent of all hospitalizations	Count	Rate	Percent of all hospitalizations
Total[b]	6,290	8.8 (7.4–10)	0.10%	7,210	10 (8.3–12)	0.11%
Age						
0–2	2,029	17 (13–21)	0.04%	2,236	19 (15–23)	0.05%
3–10	3,698	11 (9.8–13)	0.56%	4,250	13 (11–15)	0.75%
11–17	564	2.1 (1.7–2.4)	0.06%	723	2.6 (2.0–3.1)	0.08%
Race/ethnicity						
White	…	...	…	4,678	10 (8.2–12)	0.16%
Black	…	...	…	132	1.2 (0.8–1.6)	0.02%
Hispanic	…	...	…	811	6.9 (4.7–9.2)	0.08%
Gender						
Male	1,747	4.8 (3.8–5.7)	0.05%	1,815	4.9 (4.0–5.8)	0.06%
Female	4,544	13 (11–15)	0.14%	5,395	15 (13–18)	0.17%
Region						
Midwest	1,065	6.3 (4.2–8.4)	0.07%	1,117	6.4 (3.9–9.0)	0.08%
Northeast	1,691	13 (6.0–20)	0.14%	1,694	13 (5.7–20)	0.14%
South	1,790	7.3 (4.6–10)	0.08%	2,511	10 (7.2–13)	0.11%
West	1,744	10 (7.4–13)	0.12%	1,888	11 (7.5–14)	0.13%
MSA						
Rural	189	1.2 (0.7–1.6)	0.02%	182	1.2 (0.6–1.8)	0.02%
Urban	6,101	11 (9.2–13)	0.11%	6,996	12 (10–14)	0.13%

…data not available.

MSA, metropolitan statistical area.

[a]Rate per 100,000 is based on 2000 population estimates from Current Population Survey (CPS), CPS Utilities, Unicon Research Corporation, for relevant demographic categories of US civilian noninstitutional population under age 18.

[b]Persons of other races, missing race and ethnicity, and missing MSA are included in the totals.

NOTE: Counts may not sum to totals due to rounding.

SOURCE: Healthcare Cost and Utilization Project Kids' Inpatient Database, 2000.

Table 7. Physician office visits for vesicoureteral reflux, 1992–2000 (merged), count, rate[a] (95% CI), annualized rate[b], age-adjusted rate[c]

	1992–2000			
	Count	5-Year Rate	Annualized Rate	5-Year Age-Adjusted Rate
Primary diagnosis	418,954	160 (73–247)	32	159
Any diagnosis	700,489	268 (139–396)	54	266

[a]Rate per 100,000 is based on 1992, 1994, 1996, 1998, 2000 population estimates from Current Population Survey (CPS), CPS Utilities, Unicon Research Corporation, for relevant demographic categories of US civilian non-institutionalized population.

[b]Average annualized rate per year.

[c]Age-adjusted to the US Census-derived age distribution of the midpoint of years.

SOURCE: National Ambulatory Medical Care Survey, 1992, 1994, 1996, 1998, 2000.

Table 8. Visits for vesicoureteral reflux listed as primary diagnosis among children having commercial health insurance, count, rate[a]

	1994		1996		1998		2000		2002	
	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate
Physician Office										
Total	123	12	239	15	536	22	655	24	617	26
Age										
0–2	33	*	83	143	182	207	232	243	228	305
3–10	59	41	119	58	268	88	333	103	321	124
11–17	11	*	13	*	53	20	48	16	32	13
Gender										
Male	29	*	65	8.3	122	10	150	11	145	12
Female	94	17	174	22	414	34	505	37	472	41
Region										
Midwest	95	15	147	17	250	21	287	21	287	23
Northeast	6	*	16	*	56	28	46	28	22	*
Southeast	9	*	60	14	207	22	300	28	294	32
West	13	*	16	*	23	*	22	*	14	*
Emergency Room										
Total	0	*	1	*	2	*	0	*	0	*
Age										
0–2	0	*	0	*	1	*	0	*	0	*
3–10	0	*	0	*	0	*	0	*	0	*
11–17	0	*	0	*	0	*	0	*	0	*
Gender										
Male	0	*	1	*	0	*	0	*	0	*
Female	0	*	0	*	2	*	0	*	0	*
Region										
Midwest	0	*	0	*	1	*	0	*	0	*
Northeast	0	*	0	*	1	*	0	*	0	*
Southeast	0	*	0	*	0	*	0	*	0	*
West	0	*	1	*	0	*	0	*	0	*
Inpatient										
Total	32	3.0	66	4.2	74	3.0	100	3.7	66	2.8
Age										
0–2	7	*	14	*	12	*	21	*	16	*
3–10	17	*	35	17	48	16	66	20	42	16
11–17	3	*	5	*	9	*	8	*	4	*
Gender										
Male	4	*	12	*	11	*	20	*	17	*
Female	28	*	54	6.8	63	5.2	80	5.9	49	4.2
Region										
Midwest	21	*	39	4.4	33	2.8	52	3.8	35	2.8
Northeast	4	*	4	*	10	*	7	*	4	*
Southeast	1	*	19	*	28	*	36	3.3	23	*
West	6	*	4	*	3	*	5	*	4	*

Continued on next page

Table 8 (continued). Visits for vesicoureteral reflux listed as primary diagnosis among children having commercial health insurance, count, rate[a]

	1994		1996		1998		2000		2002	
	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate
	Hospital Outpatient									
Total	15	*	28	*	52	2.1	36	1.3	49	2.1
Age										
0–2	4	*	8	*	16	*	12	*	18	*
3–10	9	*	16	*	28	*	16	*	26	*
11–17	2	*	2	*	5	*	5	*	1	*
Gender										
Male	2	*	9	*	9	*	9	*	13	*
Female	13	*	19	*	43	3.5	27	*	36	3.1
Region										
Midwest	14	*	25	*	47	3.9	26	*	27	*
Northeast	0	0	0	0	2	*	2	*	1	*
Southeast	0	0	2	*	2	*	8	*	21	*
West	1	*	1	*	1	*	0	0	0	0
	Ambulatory Surgery									
Total	14	*	22	*	82	3.4	117	4.3	113	4.8
Age										
0–2	1	*	2	*	17	*	36	38	33	44
3–10	9	*	14	*	42	14	56	17	68	26
11–17	1	*	0	*	11	*	7	*	7	*
Gender										
Male	4	*	3	*	21	*	28	*	21	*
Female	10	*	19	*	61	5.0	89	6.5	92	7.9
Region										
Midwest	9	*	17	*	32	2.7	46	3.4	36	2.9
Northeast	0	*	1	*	23	*	28	*	5	*
Southeast	5	*	3	*	21	*	42	3.9	57	6.2
West	0	*	1	*	6	*	1	*	15	*

*Figure does not meet standard for reliability or precision.

[a]Rate per 100,000 based on member months of enrollment in calendar years for males in the same demographic stratum.

SOURCE: Center for Health Care Policy and Evaluation, 1994, 1996, 1998, 2000, 2002.

Table 9. Visits for vesicoureteral reflux listed as primary diagnosis among children having Medicaid health insurance, count, rate[a]

	1994		1996		1998		2000		2002	
	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate
Physician Office	7	*	39	43	59	103	58	85	32	60
Age										
0–2	4	*	20	*	28	*	30	306	10	*
3–10	3	*	17	*	26	*	27	*	19	*
11–17	0	*	1	*	5	*	1	*	2	*
Gender										
Female	5	*	20	*	29	*	38	92	25	*
Male	2	*	19	*	30	136	20	*	7	*
Region										
Midwest	6	*	10	*	2	*	1	*	0	*
Northeast	0	*	27	*	39	110	36	88	28	*
Southeast	0	*	0	0	0	*	0	*	0	*
West	1	*	2	*	18	*	21	*	4	*
Emergency Room	0	*	0	*	0	*	2	*	0	*
Inpatient	4	*	6	*	4	*	9	*	5	*
Hospital Outpatient	0	0	2	*	2	*	1	*	18	*
Ambulatory Surgery	1	*	3	*	16	*	28	*	18	*

*Figure does not meet standard for reliability or precision.

[a]Rate per 100,000 based on member months of enrollment in calendar years for males in the same demographic stratum.

SOURCE: Center for Health Care Policy and Evaluation, 1994, 1996, 1998, 2000, 2002.

Outpatient Care

Physician Office Visits

Data from the National Ambulatory Medical Care Survey (NAMCS) indicate that during five years sampled between 1992 and 2000, 418,954 office visits (32 per 100,000 in each year) were associated with VUR as the primary diagnosis (Table 7). Tables 8 and 9 and Figures 2 and 3 present data from the Center for Healthcare Policy and Evaluation (CHCPE) on visits by children insured commercially or through Medicaid for whom VUR was listed as the primary diagnosis. The rates of visits to physicians' offices doubled during the 1990s for both commercially insured children (12 per 100,000 in 1994, 26 per 100,000 in 2002) and children covered by Medicaid (43 per 100,000 in 1996, 60 per 100,000 in 2002) (Tables 8 and 9). During this period, visit rates for children with Medicaid were higher than for those with commercial insurance. This difference is probably not explained by a greater severity of VUR among Medicaid participants. Rather, socioeconomic factors may have influenced compliance with treatment, leading to more frequent office visits for the management of complications of VUR. Among commercially insured children, the ratio of outpatient visits by girls to visits by boys was constant at 3:1 (Figure 4). This trend could not be analyzed for children with Medicaid, because Medicaid data did not meet the criteria for reliability or precision. Regional data on commercially insured children showed relatively constant rates during the years that could be evaluated (Figure 2).

Ambulatory Surgery

CHCPE data on ambulatory surgery visits by children with VUR as the primary diagnosis demonstrate a trend toward increasing outpatient surgical procedures. Overall, the rate of ambulatory surgery visits by commercially insured children rose from 3.4 per 100,000 in 1998 to 4.8 per 100,000 in 2002 (Table 8). Similar estimates are not available for children covered by Medicaid (Table 9). The increase in ambulatory surgery for VUR may represent more patients opting for Deflux™ implantation in lieu of open surgical correction and/or more repeat Deflux™ procedures. Data from the National Survey

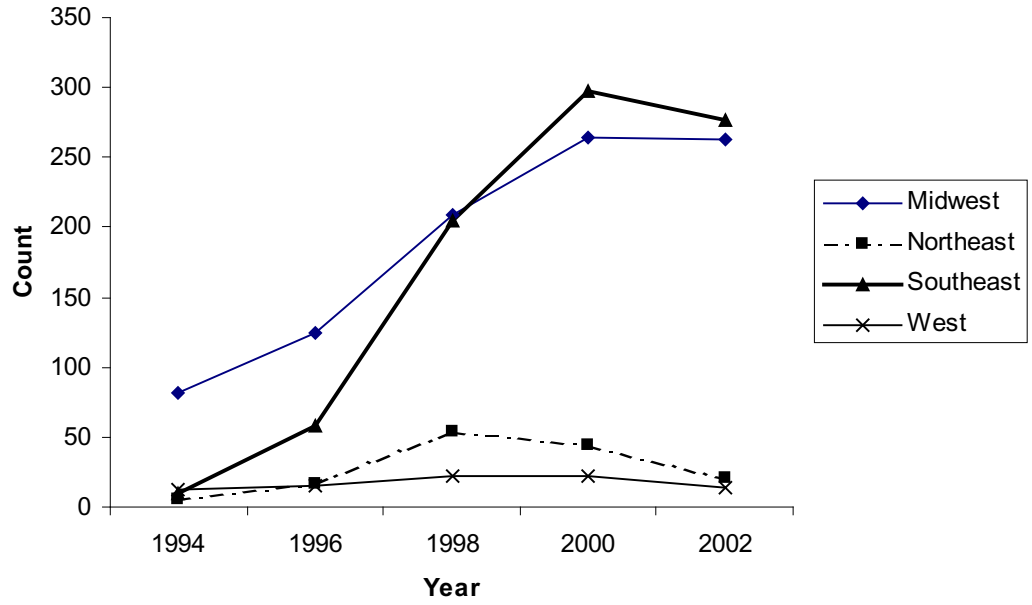


Figure 2. Physician office visits for children with vesicoureteral reflux having commercial health insurance, by region.

SOURCE: Center for Health Care Policy and Evaluation, 1994, 1996, 1998, 2000, 2002.

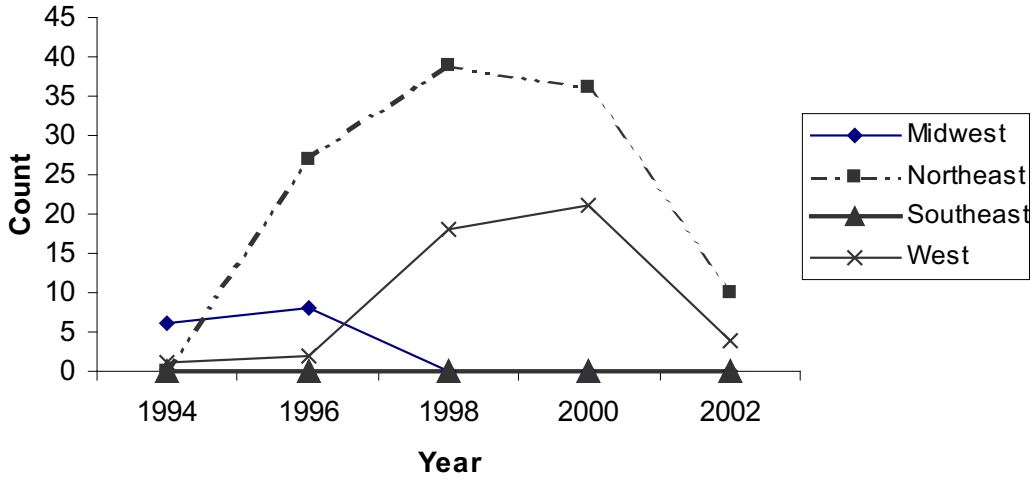


Figure 3. Physician office visits for children with vesicoureteral reflux having Medicaid health insurance, by region.

SOURCE: Center for Health Care Policy and Evaluation, 1994, 1996, 1998, 2000, 2002.

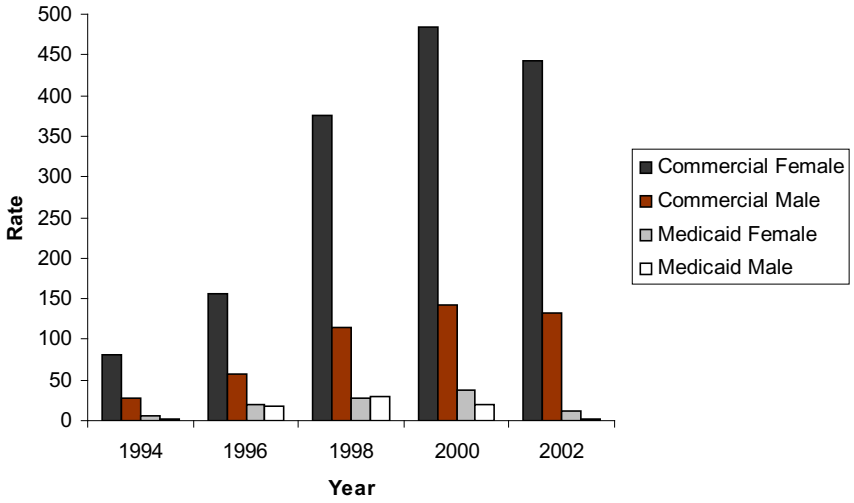


Figure 4. Physician outpatient visits for children with vesicoureteral reflux having commercial or Medicaid health insurance, by gender.

SOURCE: Center for Health Care Policy and Evaluation, 1994, 1996, 1998, 2000, 2002.

of Ambulatory Surgery in 1994, 1995, and 1996, reflect an annualized rate of implantation of 0.6 per 100,000 children (Table 10). Approximately two-thirds of these cases were associated with procedure codes for cystoscopy, most of which predated the FDA approval of Deflux™. Few diagnostic cystoscopies are performed on children with VUR, but the authors' anecdotal review of current utilization suggests increased use of therapeutic cystoscopic procedures.

Emergency Room Care

Emergency room utilization by children with a primary diagnosis of VUR is rare, reflecting the trend toward delivery of care in physicians' offices, ambulatory surgery centers, and inpatient hospitals.

ECONOMIC IMPACT

The economic burden of VUR was estimated by combining data from several sources. The National Association of Children's Hospitals and Related Institutions (NACHRI) provided data on the mean cost of treating a child with a primary diagnosis of VUR in 1999–2003, and the HCUP Kids' Inpatient Database provided information on the number of pediatric inpatient hospitalizations for VUR in 1997 and 2000 (Table 11). The average cost per hospitalization derived from NACHRI was applied to case counts reported in KID to calculate annual national estimates for inpatient pediatric VUR expenditures by sex, age, and region. NACHRI data represent practices at specific children hospitals and thus may differ from practices at community hospitals.

In 2000, total expenditures for inpatient pediatric VUR amounted to $47 million, an increase of over $10 million since 1997 (Table 11). Expenditures increased between 1997 and 2000 for all ages and regions and for both sexes. The increase between 1997 and 2000 was particularly large in the South, where expenditures grew by 56%. Inpatient pediatric VUR costs were greatest among three- to ten-year-olds, primarily because of the large number of cases in this group. Inpatient cases of VUR were most costly among 11- to 17-year-olds, totaling $7,699 in 2000. The cost of an inpatient VUR case was slightly higher for males than for females, but there were almost three times as many female cases, leading to higher overall costs for female patients. High spending in the South was the result of a moderate cost per case but a high number of cases, while expenditures in the Northeast reflected a high cost per case and only a moderate number of

Table 10. Ambulatory surgery visits for vesicoureteral reflux listed as primary diagnosis, 1994–1996 (merged), count, rate[a] (95% CI), annualized rate[b], rate per 100,000 visit[c] (95% CI)

	1994–1996			
	Count	3-Year Rate	Annualized Rate	3-YearRate per 100,000 visits
Total	4,928	1.9 (1.1–2.7)	0.6	100,000 (57,082–142,918)
with associated cystoscopy (ICD-9 57.32)	3,387	1.3 (0.6–2.0)	0.4	66,730 (33,868–103,592)

[a]Rate per 100,000 is based on 1994–1996 population estimates from Current Population Survey (CPS), CPS Utilities, Unicon Research Corporation, for relevant demographic categories of US civilian non-institutionalized population.

[b]Average annualized rate per year.

[c]Rate per 100,000 is based on estimated number of visits for vesicoureteral reflux in NSAS 1994–1996.

SOURCE: National Survey of Ambulatory Surgery, 1994, 1995, 1996.

cases. Costs were low in the Midwest because of the relatively small number of cases there.

The economic impact of inpatient treatment of pediatric VUR is considerable (Tables 11 and 12). If other service types, such as pharmaceuticals and outpatient and ambulatory services, were taken into account, the observed impact of this condition would certainly be greater. Importantly, the costs of prophylactic medical therapy and emerging therapies such as Deflux™ are not accounted for in this estimate. Furthermore, indirect economic costs such as work loss to parents of pediatric VUR cases were not taken into account, causing an even greater underestimation of the true costs associated with the condition.

RECOMMENDATIONS

- The paucity of data on Medicaid-insured children with VUR should stimulate further research into identifying potential inequities in care of children with VUR who are of lower socioeconomic status.
- Studies should be performed on cost-effective strategies for evaluation of children of various ages who present with UTI.
- Future studies should include cost analysis of various treatment strategies as an outcome, in addition to therapy-related success and complication rates.

Table 11. Cost per child admitted with vesicoureteral reflux[a] listed as primary diagnosis, total number of cases, estimated total costs

	1997			2000		
	Cost per Child	Number of Cases	Estimated Total Cost	Cost per Child	Number of Cases	Estimated Total Cost
Total	$5,892	6,291	$37,061,475	$6,551	7,210	$47,230,671
Age						
0–2	$6,008	2,029	$12,188,151	$6,680	2,236	$14,937,974
3–10	$5,700	3,698	$21,081,036	$6,338	4,250	$26,938,748
11–17	$6,925	564	$3,902,218	$7,699	723	$5,568,983
Gender						
Female	$5,617	4,544	$25,523,411	$6,246	5,395	$33,694,918
Male	$6,726	1,747	$11,749,518	$7,479	1,815	$13,574,641
Region						
Midwest	$6,046	1,065	$6,438,820	$6,722	1,117	$7,510,553
Northeast	$7,607	1,691	$12,864,860	$8,458	1,694	$14,324,996
South	$5,451	1,790	$9,757,451	$6,060	2,511	$15,218,755
West	$5,141	1,744	$8,965,905	$5,716	1,888	$10,790,123

[a]Using ICD-9 codes 593.70 (vesicoureteral reflux, unspecified or without reflux nephropathy), 593.71 (vesicoureteral reflux with reflux nephropathy unilateral), 593.72 (vesicoureteral reflux with reflux nephropathy bilateral), and 593.73 (other vesicoureteral reflux with reflux nephropathy NOS).

SOURCE: Healthcare Cost and Utilization Project Kids' Inpatient Database, 2000 and National Association of Children's Hospitals and Related Institutions, 1999–2003.

Table 12. Trends in mean inpatient length of stay (LOS) and cost per child (in $) admitted with vesicoureteral reflux[a], 1999–2003

	Count	Percent	LOS	Mean Cost
Primary diagnosis				
Total	14,629		2.7	$6,852
Age				
0–2	4,424	30%	2.9	$6,987
3–10	9,058	62%	2.6	$6,629
11–17	1,090	7%	3.1	$8,053
18+	57	0%	3.3	$8,768
Race/ethnicity				
White	10,744	73%	2.6	$6,792
Black	313	2%	3.5	$8,395
Asian	161	1%	2.9	$7,682
Hispanic	1,338	9%	3.0	$6,741
N. American Native	28	0%	2.8	$6,968
Missing	797	5%	2.6	$6,567
Other	1,248	9%	2.7	$7,170
Gender*				
Female	11,012	75%	2.6	$6,533
Male	3,616	25%	3.1	$7,823
Region				
Midwest	4,403	30%	2.7	$7,031
Northeast	2,132	15%	3.3	$8,847
South	5,628	38%	2.6	$6,339
West	2,466	17%	2.4	$5,979
Any diagnosis				
Total	28,777		5.5	$12,230
Age				
0–2	13,931	48%	7.7	$16,476
3–10	12,641	44%	3.2	$7,654
11–17	2,061	7%	4.7	$11,579
18+	144	1%	5.0	$12,479
Race/ethnicity				
White	19,664	68%	5.1	$11,541
Black	1,411	5%	9.0	$17,896
Asian	389	1%	6.2	$13,021
Hispanic	3,610	13%	5.9	$12,263
N. American Native	69	0%	10.6	$22,731
Missing	1,406	5%	5.7	$12,208
Other	2,228	8%	6.1	$14,213
Gender*				
Female	19,075	66%	4.6	$10,139
Male	9,700	34%	7.3	$16,341
Region				
Midwest	9,062	31%	5.6	$12,534
Northeast	3,285	11%	4.8	$11,717
South	11,757	41%	5.7	$12,113
West	4,673	16%	5.3	$12,293

*Three cases, (1 primary, 2 any) not coded for gender.

[a]Using ICD-9 codes 593.70 (vesicoureteral reflux, unspecified or without reflux nephropathy), 593.71 (vesicoureteral reflux with reflux nephropathy unilateral), 593.72 (vesicoureteral reflux with reflux nephropathy bilateral), and 593.73 (other vesicoureteral reflux with reflux nephropathy NOS).

SOURCE: National Association of Children's Hospitals and Related Institutions, 1999–2003.

UNDESCENDED TESTIS

INTRODUCTION

Cryptorchidism is derived from two Greek words: *kryptos*, meaning hidden, and *orchis*, meaning testis. Any testis that is not within the scrotum is referred to as cryptorchid, even if it is palpable within the inguinal canal. A cryptorchid testis is also commonly referred to as an *undescended testis* (UDT). The ectopic, absent, and ascending testis are all part of a spectrum representing maldescent of the testis into the normal scrotal position. Analyses for this section are based on the ICD-9 and CPT codes for undescended testes listed in Table 1.

DEFINITION AND DIAGNOSIS

There is no uniform or standard classification of cryptorchidism. In broad terms, the undescended testis can be thought of as either congenital or acquired. The congenitally undescended testis is usually diagnosed at an earlier age and is often located proximal to the external inguinal ring, in association with an open processus vaginalis and epididymal deformities.

The congenital undescended testis can be further classified as palpable or impalpable. The palpable testis is typically either intracanicular (palpable between the internal and the external inguinal rings) or extracanicular (palpable beyond the external inguinal ring). An impalpable testis may be intra-abdominal, absent, or atrophic. A so-called vanishing testis refers to the condition of no identifiable testicular tissue but the intraoperative finding of blind-ending testicular vessels and vas deferens.

The acquired undescended testis refers to testicular ascent wherein a previously-scrotal testis ascends to an extrascrotal position during normal growth and development. The acquired undescended testis usually presents later in childhood and is often identified distal to the external ring and associated with a small hernia sac.

The diagnosis of cryptorchidism is established by physical examination that determines whether the testis is palpable or impalpable. No imaging is necessary for the palpable undescended testis. Some have advocated using ultrasonography or magnetic resonance imaging (MRI) to locate an impalpable testis. MRI is considered the single best imaging method and has an accuracy of 94% in locating UDT (27). However, diagnostic laparoscopy is the most reliable and accurate means for evaluating patients with impalpable testes.

Table 13. Prevalence of cryptorchidism, by birth weight

Weight	%
≤ 2000 gm	7.7%
2000–2499 gm	2.5%
≥ 2500 gm	1.4%

SOURCE: Adapted from Journal of Urology, 170, Barthold JS, Gonzalez R, The epidemiology of congenital cryptorchidism, testicular ascent and orchiopexy, 2,396–2,401, Copyright 2003, with permission from American Urological Association.

RISK FACTORS

Gestational age, closely associated with birth weight, has been strongly associated with the likelihood of identifying cryptorchidism (Table 13 and Figure 5) (28). Race does not appear to be a factor, although there does appear to be a genetic component to UDT. Approximately 14% of boys with UDT have some family history in which other males are affected (29). Male siblings of boys with UDT have a 7% to 10% chance of cryptorchidism (30).

TREATMENT

The standard therapy for cryptorchidism is surgical orchiopexy to move the testis into the scrotum. The recommended age for this surgery is at one year, but this has changed dramatically over the years (28).

Hormonal therapy, though not FDA-approved, has also been used, but this approach is based on evidence from a few trials with small sample sizes and risks of bias (31). Medical therapies include exogenous hCG-intramuscular and exogenous gonadotropin releasing hormone (GnRH) or intranasal luteinizing hormone-releasing hormone (LHRH). The mechanism of action is to increase serum testosterone by stimulation of the hypothalamic-pituitary-gonadal axis.

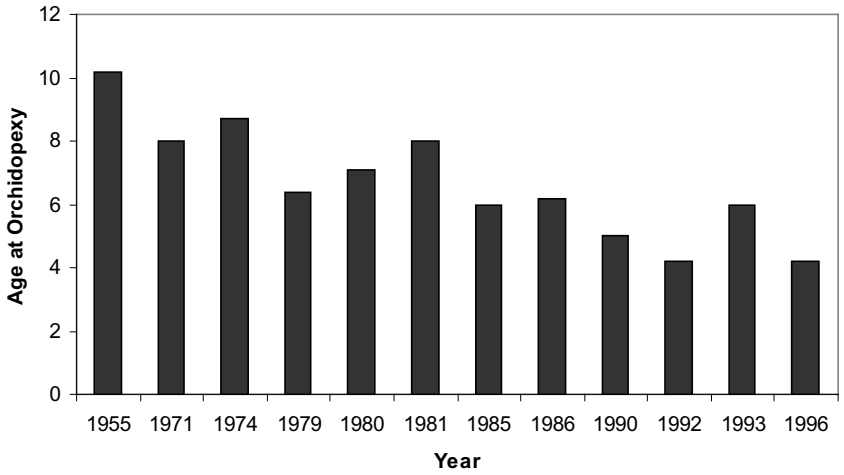


Figure 5. Mean or median age at orchiopexy in selected large cryptorchidism series.

SOURCE: Adapted from Journal of Urology, 170, Barthold JS, Gonzalez R, The epidemiology of congenital cryptorchidism, testicular ascent and orchiopexy, 2,396–2,401, Copyright 2003, with permission from American Urological Association.

PREVALENCE AND INCIDENCE

Cryptorchidism affects 3% of full-term male newborns. It is the most common genital anomaly identified at birth in males, and it has not increased in the past few decades. Between 70% and 77% of undescended testes will descend spontaneously by three months of age. By one year of age, the incidence of cryptorchidism declines to about 1% and remains constant. Recent data indicate that spontaneous descent beyond six months of age is rare (32).

Table 14. Physician office visits for undescended testes listed as primary diagnosis, 1992–2000 (merged), count, rate[a] (95% CI), annualized rate[b], age-adjusted rate[c]

	1992–2000			
	Count	5-Year Rate	Annualized Rate	5-Year Age-Adjusted Rate
Total[c]	611,647	480 (288–671)	96	476
Age				
< 18	534,144	1,492 (838–2,146)	298	
18+	*	*	*	
Race/ethnicity				
White	*	*	*	*
Other	*	*	*	*
MSA				
MSA	583,235	599 (351–847)	120	589
Non-MSA	*	*	*	*

*Figure does not meet standard for reliability or precision.

MSA, metropolitan statistical area.

[a]Rate per 100,000 is based on 1992, 1994, 1996, 1998, 2000 population estimates from Current Population Survey (CPS), CPS Utilities, Unicon Research Corporation, for relevant demographic categories of US male civilian non-institutionalized population.

[b]Age-adjusted to the US Census-derived age distribution of the midpoint of years.

[c]Persons of missing or unavailable race and ethnicity, and missing MSA are included in the total.

NOTE: Counts may not sum to total due to rounding.

SOURCE: National Ambulatory Medical Care Survey, 1992, 1994, 1996, 1998, 2000.

TRENDS IN HEALTHCARE RESOURCE UTILIZATION

According to NAMCS data, between 1992 and 2000, there were 611,647 physician office visits (96 per 100,000 in each year) for UDT listed as the primary diagnosis (Table 14). The overwhelming majority of the patients were under 18 years of age.

Data from the National Survey of Ambulatory Surgery indicate an annualized rate of 18 cases per 100,000 in 1994–1996 (Table 15); the rate remained relatively constant during these three years. Although orchiopexy rates are highest in children 0–2 years old, as recommended, a substantial minority of these procedures were done in children 3–10 years old. Geographic variation was noted, with higher ambulatory surgery rates in the Northeast and Midwest than in the South and West.

ECONOMIC IMPACT

The consequences of cryptorchidism include neoplasia and infertility. There is a 15- to 40-fold increased risk for testicular malignancy (usually seminoma) among men with a history of cryptorchidism. From 3% to 10% of testicular tumors arise from UDT. The incidence of germ cell tumor in men with formerly cryptorchid is one in 2,550, whereas in the general population it is one in 100,000.

Infertility is also a possible consequence of cryptorchidism, because spermatogenesis is impaired at core body temperature, which is four to five degrees warmer than the temperature in the scrotum. Early surgical relocation of the testis into the scrotum is sometimes undertaken to reduce the risk of infertility.

NACHRI and KID data on cryptorchidism are too sparse to provide insights into its downstream economic costs.

CONCLUSIONS

Cryptorchidism affects 3% of full-term male infants. However 50% to 77% of the undescended testes will spontaneously descend, leaving an incidence of 1% at six months of age. Those that do not descend require surgical intervention. Virtually all orchiopexies are outpatient surgical procedures with high success rates. Long-term consequences include increased risk of neoplasia and infertility.

RECOMMENDATIONS

Longitudinal studies are needed to determine whether earlier intervention, such as orchiopexy, reduces the risk of infertility or alters that of neoplasia and to quantify the economic burden associated with these conditions.

Table 15. Ambulatory surgery visits for undescended testes listed as primary diagnosis, 1994–1996 (merged and by year), count, rate[a] (95% CI), annualized rate[b], age-adjusted rate[c]

	1994–1996				1994			1995			1996		
	Count	3-Year Rate	Annualized Rate	3-Year Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate
Total	69,731	55 (47–63)	18	55	24,247	20 (15–25)	20	18,781	15 (11–18)	15	26,703	21 (16–26)	21
Age													
0–2	25,907	422 (329–515)	141		8,622	141 (89–192)		8,581	139 (78–201)		8,704	142 (96–189)	
3–10	31,853	196 (153–239)	65		11,842	74 (45–104)		6,668	41 (28–54)		13,343	81 (53–109)	
11–17	5,782	43 (26–60)	14		*	*		*	*		*	*	
18+	*	*	*		*	*		*	*		*	*	
Region													
Northeast	17,172	69 (46–92)	23	72	7,325	*	31	4,500	*	19	5,347	22 (13–30)	22
Midwest	17,806	60 (44–76)	20	59	5,910	20 (10–30)	20	5,899	20 (10–29)	20	5,997	20 (12–28)	20
South	21,593	50 (37–62)	17	49	5,974	14 (9.4–20)	15	4,656	11 (6.9–14)	11	10,963	25 (14–35)	25
West	13,160	46 (31–61)	15	45	5,038	18 (8.6–28)	17	3,726	13 (5.5–21)	12	4,396	15 (6.7–24)	15

*Figure does not meet standard for reliability or precision.

[a]Rate per 100,000 is based on 1994, 1995, 1996 population estimates from Current Population Survey (CPS), CPS Utilities, Unicon Research Corporation, for relevant demographic categories of US male civilian non-institutionalized population.

[b]Average annualized rate per year.

[c]Grouped years age-adjusted to the US Census-derived age distribution of the midpoint of years. Individual years age-adjusted to the US Census-derived age distribution of the year under analysis.

NOTE: Counts may not sum to totals due to rounding.

SOURCE: National Survey of Ambulatory Surgery, 1994, 1995, 1996.

HYPOSPADIAS

DEFINITION AND DIAGNOSIS

Hypospadias is an abnormally located opening of the urethral meatus anywhere along the ventral aspect of the penis from the glans to the perineum (Figure 6). It may be associated with an abnormal distribution of foreskin and an abnormal ventral curvature of the penis (chordee). Distal defects (glanular, coronal, and subcoronal) constitute 50% to 75% of hypospadias. In the majority of cases, diagnosis is easily made on visual inspection; however, in milder forms, the abnormal opening may be missed. Various classification systems have been created to describe the severity of hypospadias. Moreover, in many of the datasets analyzed for this compendium, children are subdivided into infants (less than 3 years of age), older children (3 to 10 years of age), and adolescents (11 to 17 years of age). Analyses for this chapter are based on the ICD-9 and CPT codes defining hypospadias and hypospadias-related procedures listed in Table 1.

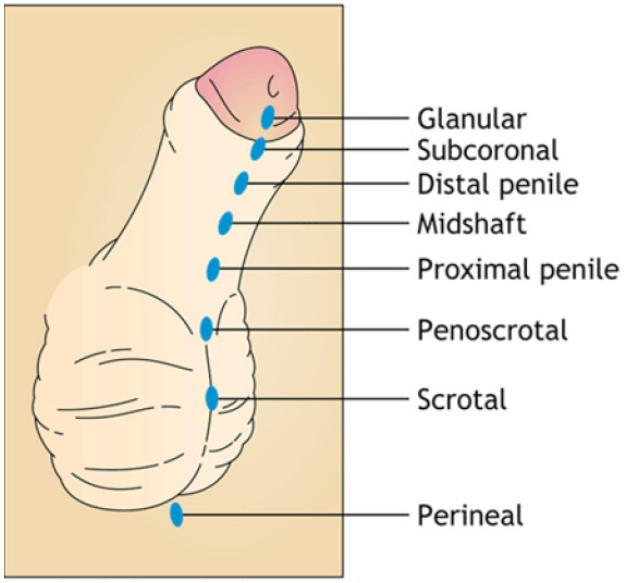


Figure 6. Types of hypospadias.

SOURCE: Reprinted from Walsh: Campbell's Urology, 8th ed., Saunders, Copyright 2002.

RISK FACTORS

Hypospadias is thought to result from incomplete closure of the tissue on the undersurface of the penis that embryologically is destined to become the urethra (33). An inherent endocrine, enzymatic, or tissue defect, environmental endocrine disruptors, and developmental arrest have all been implicated as causes of hypospadias. Inherent defects include impaired testosterone biosynthesis (34), 5-alpha-reductase type 2 gene mutations (35), and androgen receptor mutations (36).

Other risk factors for hypospadias include advanced maternal age (36); paternal risk factors, such as a history of undescended testes and varicoceles (37); prematurity (37, 38); low birth weight (38); and monozygotic-twin gestation (33).

Racial/ethnic risk factors have been proposed to explain an increased incidence of hypospadias in Caucasians. For example, maternal serum testosterone values during early pregnancy have been shown to be 48% greater in African American women than in Caucasian women (39). Additional support for ethnic differences in androgenic exposure during early gestation comes from similar analysis of serum testosterone levels in Hispanic women, whose infants have an incidence of hypospadias between that of Caucasians and that of African Americans.

TREATMENT

At least 200 surgical procedures have been used to correct hypospadias of varying severity. However, the universal concerns of hypospadias repair have always included correction of penile curvature, placement of the urethral opening at the tip of the penis, creation of a cosmetically pleasing glans penis, and complete coverage of the surgical repair with local skin. For hypospadias of low to moderate complexity, correction can be performed at the age of six months in a single outpatient procedure under general anesthesia, with excellent results. More-severe cases may require a two-stage repair at six and twelve months of age. After urethral reconstruction, the infant is discharged with a temporary urinary catheter and may be prescribed oral antibiotics and anticholinergics. Follow-up care is provided in the office setting, where the dressing and urinary catheter are removed. Complications, such

Table 16. Incidence of hypospadias, by race/ethnicity

Race/ethnicity	Male Live Births	Hypospadias	Incidence
White	68,444	520	0.8%
Black	18,984	120	0.6%
Asian	1,761	9	0.5%
N. American Native	175	1	0.6%
Unknown	9,846	59	0.6%
Total	99,210	709	0.7%

SOURCE: Reprinted from Urology, 57, Gallentine ML, Morey AF, and Thompson, IM, Hypospadias: A contemporary epidemiologic assessment, 788–790, Copyright 2001, with permission from Elsevier.

as bleeding, narrowing of the urethra (i.e., meatal stenosis, stricture), formation of urethrocutaneous fistula, infection, and urethral diverticula, may occur but generally do not require emergent reoperation.

PREVALENCE AND INCIDENCE

The classically reported incidence of hypospadias is 0.3% (40), but recent evidence suggests that worldwide incidence is increasing and may have risen to 0.8% (36) of Caucasian newborn males and 0.4% (41–44) of non-Caucasians. These reports are principally from industrialized Western countries, so environmental toxins may play an etiologic role (41, 43–49). Paulozzi, Erickson, and Jackson reported data from two surveillance systems in the United States that demonstrated a near doubling of the rate of hypospadias between 1968 and 1993, with an overall annual rate of increase of 1.4% (41). Analyzed by race, the overall rate of increase was 2.9% per year among Caucasians and 5.7% per year among non-Caucasians (41). Additionally, the rate of severe hypospadias increased three to fivefold (41). Gallantine, Morey, and Thompson reported a contemporary incidence of hypospadias of 0.7% among 99,210 live male births (Table 16) (50). Although no statistically significant racial difference in the incidence of hypospadias was noted, there was a trend toward a greater incidence in Caucasians (50). The authors surmised that the incidence of hypospadias was too low to detect racial group differences. Taken together, these findings strongly indicate an increasing incidence of hypospadias in the United States affecting all racial groups, although non-Caucasians have experienced both greater incidence and greater severity. More-recent data indicate that the rate of increase may be leveling off (51).

TRENDS IN HEALTHCARE RESOURCE UTILIZATION

Inpatient Care

According to HCUP data, annual inpatient hospitalizations for hypospadias decreased by 75% between 1994 and 2000, from 2,669 (2.2 per 100,000 children) to 849 (0.6 per 100,000 children) (Table 17). This declining trend was noted across all racial/ethnic groups from which data were collected. Age-adjusted rates of inpatient hospitalization did not meet the standard for reliability for African Americans and Hispanics, which limited the analysis of utilization trends in recent years for these two groups.

Additional data from the HCUP Kids' Inpatient Database in 1997 and 2000 demonstrate that the majority of inpatient hospitalizations for hypospadias occur in children under three years of age (Table 18). In fact, inpatient hospitalizations were ten times more likely to occur in these children than in those aged three to ten years. This is consistent with the common surgical practice of performing correction in younger children, ideally within the first year of life. Despite the trend toward referring infants less than one year of age for hypospadias repair, some of the children hospitalized for hypospadias in 1997 were as old as 17. Many of the admissions of older children may have been to treat complications of earlier hypospadias repairs or may have been late referrals of children who should have undergone correction earlier. The proportion of visits for children hospitalized in 2000 for hypospadias repair who were older than three rose to 28% (391 of 1,385), which may reflect an overall trend toward performing more infant hypospadias procedures as outpatient surgery. Interestingly, there was a small trend towards an increase in the rate of inpatient stays for hypospadias repair in children aged

Table 17. Inpatient hospital stays for hypospadias listed as primary diagnosis, count, rate[a] (95% CI), age-adjusted rate[b]

	1994				1996				1998				2000			
	Count	Rate		Age-Adjusted Rate	Count	Rate		Age-Adjusted Rate	Count	Rate		Age-Adjusted Rate	Count	Rate		Age-Adjusted Rate
Total[c]	2,669	2.2	(1.4–3.0)	2.2	1,955	1.5	(0.8–2.2)	1.5	1,600	1.2	(0.6–1.9)	1.2	849	0.6	(0.4–0.9)	0.6
Age																
< 18	2,558	7.3	(4.6–10)		1,846	5.1	(2.7–7.4)		1,472	4.0	(1.8–6.2)		686	1.8	(1.0–2.7)	
18+	*	*			*	*			129	*			*	*		
Race/ethnicity																
White	1,402	1.5	(0.8–2.3)	1.7	1,064	1.1	(0.5–1.8)	1.3	821	*		1.0	371	0.4	(0.2–0.5)	0.4
Black	424	2.9	(1.6–4.1)	2.2	308	2.0	(0.8–3.2)	1.5	197	*		1.0	*	*		*
Hispanic	231	1.8	(0.8–2.7)	1.4	245	*		1.4	*	*		*	*	*		*
Region																
Midwest	516	1.8	(0.8–2.7)	1.7	164	*		*	*	*		*	*	*		*
Northeast	684	*		*	667	*		*	913	*		*	177	*		*
South	958	*		*	711	*		*	207	0.4	(0.2–0.7)	0.5	187	*		*
West	511	*		*	413	*		*	324	*		*	367	*		*
MSA																
Rural	*	*		*	*	*		*	*	*		*	*	*		*
Urban	2,602	2.8	1.8–3.9)	2.8	1,898	1.9	(1.0–2.8)	1.9	1,572	1.6	(0.7–2.4)	1.6	817	0.8	(0.4–1.1)	0.8

*Figure does not meet standard for reliability or precision.

MSA, metropolitan statistical area.

[a]Rate per 100,000 is based on 1994, 1996, 1998, 2000 population estimates from Current Population Survey (CPS), CPS Utilities, Unicon Research Corporation, for relevant demographic categories of US adult male civilian non-institutionalized population.

[b]Age-adjusted to the US Census-derived age distribution of the year under analysis.

[c]Persons of other races, missing or unavailable race and ethnicity, and missing MSA are included in the totals.

NOTE: Counts may not sum to totals due to rounding.

SOURCE: Healthcare Cost and Utilization Project Nationwide Inpatient Sample, 1994, 1996, 1998, 2000.

Table 18. Inpatient hospital stays for hypospadias listed as primary diagnosis in 1997 and 2000, count, rate[a] (95% CI), age-adjusted rate[b], percent of all hospitalizations

	1997				2000			
	Count	Rate	Age-Adjusted Rate	Percent of all hospitalizations	Count	Rate		Percent of all hospitalizations
Total[c]	1,889	5.2 (3.6–6.7)	5.1	0.06%	1,385	3.7	(2.5–5.0)	0.04%
Age								
0–2	1,421	24 (16–31)		0.06%	993	17	(11–22)	0.04%
3–10	385	2.3 (1.6–3.1)		0.10%	277	1.6	(0.9–2.4)	0.09%
11–17	82	0.6 (0.3–0.9)		0.02%	114	0.8	(0.4–1.1)	0.03%
Race/ethnicity								
White	954	4.0 (2.7–5.4)	4.1	0.07%	643	2.8	(1.8–3.7)	0.04%
Black	169	3.0 (1.5–4.5)	3.1	0.04%	132	2.3	(1.4–3.3)	0.03%
Hispanic	274	*	4.2	0.07%	200	*		0.04%
Region								
Midwest	149	1.7 (0.9–2.6)	1.6	0.02%	140	*		0.02%
Northeast	706	10 (5.6–15)	11.0	0.11%	463	7.0	(3.5–10)	0.08%
South	388	*	3.1	0.03%	282	2.2	(1.0–3.5)	0.02%
West	646	*	7.2	0.08%	499	*		0.06%
MSA								
Rural	44	*	*	0.01%	25	*		0.01%
Urban	1,845	6.6 (4.6–8.5)	6.3	0.07%	1,357	4.7	(3.1–6.2)	0.05%

*Figure does not meet standard for reliability or precision.

MSA, metropolitan statistical area.

[a]Rate per 100,000 is based on 1997 population estimates from Current Population Survey (CPS), CPS Utilities, Unicon Research Corporation, for relevant demographic categories of US male civilian noninstitutional population under age 18.

[b]Age-adjusted to the US Census-derived age distribution of the year under analysis.

[c]Persons of other races, missing race and ethnicity, and missing MSA are included in the totals.

NOTE: Counts may not sum to totals due to rounding.

SOURCE: Healthcare Cost and Utilization Project Kids' Inpatient Database, 1997 and 2000.

11 to 17, from 0.6 per 100,000 in 1997 to 0.8 per 100,000 in 2000, which although not statististically significant raises the question of whether more complications are being managed in older children.

Data on inpatient hospital stays for children insured commercially or through Medicaid were insufficient to generate reliable estimates of utilization by insurer type.

Outpatient Care

Tables 19 and 20 present CHCPE data regarding outpatient care of children with commercial and Medicaid insurance, respectively.

Physician Office Visits

In both commercially- and Medicaid-insured boys, the most common site of care was physicians' offices (Tables 19 and 20). The rate of physician office visits for hypospadias by commercially insured boys under three years of age increased, from 429 per 100,000 in 1994 to 655 per 100,000 in 2002. Data from Medicaid for 1994 and 2002 were less reliable; however, they suggest stable utilization of physician office visits at 161 per 100,000 throughout the mid to late 1990s, decreasing to 118 per 100,000 in subsequent years.

Ambulatory Surgery

Since hypospadias is a disease that must be treated surgically in most cases, it is not surprising that almost as many visits occurred in ambulatory surgery centers as in the office setting. Data from commercially-insured boys under three years of age revealed a 1.5-fold overall increase in the rate of hypospadias surgery, from 321 per 100,000 in 1994 to 468 per 100,000 in 2002, reflecting the known increase in hypospadias incidence in the United States during the late 1990s (Tables 19 and 20). Similar estimates could not be obtained for Medicaid-insured boys. Data from

Table 19. Visits for hypospadias listed as primary diagnosis among children having commercial health insurance, count, rate[a]

	1994		1996		1998		2000		2002	
	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate
Physician Office	124	24	215	27	329	27	387	28	335	28
Age										
0–2	88	429	143	483	224	497	280	583	252	655
3–10	19	*	43	41	70	45	73	44	57	43
11–17	7	*	14	*	13	*	13	*	15	*
Region										
Midwest	84	27	123	28	147	25	168	25	173	27
Northeast	11	*	17	*	41	41	20	*	11	*
Southeast	14	*	56	26	112	24	173	32	141	31
West	15	*	19	*	29	*	26	*	10	*
Emergency Room	0	*	1	*	1	*	4	*	1	*
Inpatient	3	*	6	*	2	*	7	*	6	*
Hospital Outpatient	1	*	15	*	19	*	18	*	21	*
Ambulatory Surgery	86	17	127	16	187	15	262	19	256	22
Age										
< 3	66	321	82	277	134	297	189	387	180	468
3–10	10	*	33	31	36	23	48	29	50	38
11–17	4	*	5	*	8	*	11	*	12	*
Region										
Midwest	55	18	71	16	89	15	126	19	123	19
Northeast	14	*	13	*	18	*	11	*	9	*
Southeast	9	*	28	*	63	13	106	19	112	24
West	8	*	15	*	17	*	19	*	12	*

*Figure does not meet standard for reliability or precision.

[a]Rate per 100,000 based on member months of enrollment in calendar years for males in the same demographic stratum.

SOURCE: Center for Health Care Policy and Evaluation, 1994, 1996, 1998, 2000, 2002.

Table 20. Visits for hypospadias listed as primary diagnosis among children having Medicaid health insurance, count, rate[a]

	1994		1996		1998		2000		2002	
	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate
Physician Office	19	*	52	161	36	163	32	118	21	*
Age										
0–2	15	*	37	537	29	*	21	*	15	*
3–10	4	*	12	*	5	*	10	*	4	*
11–17	0	*	3	*	2	*	1	*	2	*
Region										
Midwest	18	*	18	*	0	*	0	*	0	*
Northeast	0	*	21	*	19	*	16	*	14	*
Southeast	0	*	0	*	0	*	0	*	0	*
West	1	*	13	*	17	*	16	*	7	*
Emergency Room	0	*	0	*	0	*	0	*	1	*
Inpatient	1	*	1	*	1	*	0	*	0	*
Hospital Outpatient	0	0	0	0	0	0	0	0	6	*
Ambulatory Surgery	10	*	27	*	21	*	21	*	18	*

*Figure does not meet standard for reliability or precision.

[a]Rate per 100,000 based on member months of enrollment in calendar years for males in the same demographic stratum.

SOURCE: Center for Health Care Policy and Evaluation, 1994, 1996, 1998, 2000, 2002.

Table 21. Ambulatory surgery visits for hypospadias listed as any diagnosis, 1994–1996 (merged and by year), count, rate[a] (95% CI), annualized rate[b], age-adjusted rate[c]

	1994–1996		
	Count	3- Year Rate	Annualized Rate
Total	39,631	31 (25–38)	10
Age			
0–2	26,381	430 (333–527)	143
3–10	7,296	45 (22–68)	15
11–17	*	*	*
18+	*	*	*
Region			
Midwest	13,480	45 (28–62)	15
Northeast	9,706	39 (19–59)	13
South	8,345	19 (13–25)	6.3
West	8,100	28 (16–40)	9.3

	1994				1995				1996			
	Count	Rate		Age-Adjusted Rate	Count	Rate		Age-Adjusted Rate	Count	Rate		Age-Adjusted Rate
Total	16,171	13	(8.2–18)	13	10,465	8.2	(5.0–11)	8.2	12,995	10	(7.2–13)	10
Age												
0–2	9,032	147	(84–211)		7,700	125	(75–176)		9,649	158	(104–211)	
3–10	*	*			*	*			*	*		
11–17	*	*			*	*			*	*		
18+	*	*			*	*			*	*		
Region												
Midwest	*	*			*	*			*	*		
Northeast	*	*			*	*			*	*		
South	*	*			*	*			*	*		
West	*	*			*	*			*	*		

*Figure does not meet standard for reliability or precision.

[a]Rate per 100,000 is based on 1994, 1995, 1996 population estimates from Current Population Survey (CPS), CPS Utilities, Unicon Research Corporation, for relevant demographic categories of US male civilian non-institutionalized population.

[b]Average annualized rate per year.

[c]Grouped years age-adjusted to the US Census-derived age distribution of the midpoint of years. Individual years age-adjusted to the US Census-derived age distribution of the year under analysis.

NOTE: Counts may not sum to totals due to rounding.

SOURCE: National Survey of Ambulatory Surgery, 1994, 1995, 1996.

Table 22. Hospital outpatient visits for hypospadias listed as any diagnosis, 1994–2000 (merged), count, rate[a] (95% CI), annualized rate[b], age-adjusted rate[c]

	1994–2000			
	Count	4- Year Rate	Annualized Rate	4-Year Age-Adjusted Rate
Total	69,457	54 (30–77)	14	54

MSA, metropolitan statistical area.

[a]Rate per 100,000 is based on 1994, 1996, 1998, 2000 population estimates from Current Population Survey (CPS), CPS Utilities, Unicon Research Corporation, for relevant demographic categories of US male civilian non-institutionalized population.

[b]Average annualized rate per year.

[c]Age-adjusted to the US Census-derived age distribution of the midpoint of years.

SOURCE: National Hospital Ambulatory Medical Care Survey, 1994, 1996, 1998, 2000.

the National Survey of Ambulatory Surgery showed that during 1994, 1995, and 1996, more than 39,000 visits to ambulatory surgery centers were associated with hypospadias repair, 67% in infants and the remainder in children from three to ten years of age (Table 21). Age-adjusted rates of visits were highest in the Northeast and Midwest—on average, 1.5 to 2.2 times the rates on the West and South, respectively.

Hospital Outpatient Visits

Data from the National Hospital Ambulatory Medical Care Survey indicate an average annualized rate of hospital outpatient visits for hypospadias of 14 per 100,000 children (Table 22). CHCPE data on visits by children insured commercially or through Medicaid for whom hypospadias was listed as a primary diagnosis were inconclusive, since the majority of hypospadias is evaluated on a non-emergent basis (Tables 19 and 20).

Table 23. Mean inpatient cost per child[a] admitted with hypospadias listed as primary diagnosis, 1999–2001 (95% CI)

	Count	Mean Cost	
Total	765	$5,389	(5,170–5,609)
Age			
0–2	551	$5,194	(4,925–5,463)
3–10	154	$5,858	(5,414–6,303)
11–17	47	$5,716	(5,136–6,296)
18–29	13	$6,914	(4,546–9,282)
Race/ethnicity			
White	453	$5,366	(5,090–5,642)
Black	83	$5,802	(4,925–6,679)
Asian	25	$4,871	(3,889–5,852)
Hispanic	92	$5,416	(4,822-6,011)
Missing	31	$6,420	(5,425–7,415)
Other	81	$4,832	(4,138–5,526)
N. American Native	0		
Region			
Midwest	126	$5,330	(4,802–5,858)
Northeast	155	$5,834	(5,309–6,360)
South	233	$5,582	(5,168–5,996)
West	251	$4,966	(4,610–5,321)

[a]Calculated using adjusted ratio of costs to charges, including variable and fixed cost among participating children's hospitals.

SOURCE: National Association of Children's Hospitals and Related Institutions, 1999–2001.

ECONOMIC IMPACT

The average cost per hospitalization for hypospadias exceeded $5,389, with costs per case being higher in children three years of age and older, although there were more cases for children under three years of age (Table 23). The cost per case of hypospadias was higher in the Northeast and the South than in other regions. A total of 1,385 cases of hypospadias were observed in 2000 in the HCUP Kids' Inpatient Database data (Table 18), incurring an estimated $8 million in national inpatient expenditures.

RECOMMENDATIONS

The management of patients with hypospadias is primarily surgical, with most pediatric urologists employing a limited number of surgical techniques. Surgical outcomes and the cost of hypospadias management are likely to be only nominally improved by cost-reduction strategies. Significant effort should be placed on identification of environmental risk factors, since prevention of hypospadias by mitigating exposure to endocrine disruptors is the best approach to reducing medical care expenditures for hypospadias treatment in the United States.

URETEROCELE

DEFINITION AND DIAGNOSIS

Ureteroceles are cyst-like dilatations of the terminal ureter. Several classification systems have been used in an effort to reflect the position of the ureterocele and the ureteric opening, the presence of obstruction and renal parenchymal abnormalities, and distortion of the bladder outlet. Each of these features poses management dilemmas and may affect renal function and urinary continence. In routine clinical practice, ureteroceles are described as *intravesical* (within the bladder) or *extravesical* (outside the bladder), with additional comment made as to the presence or absence of obstruction to urine flow. Ureteroceles may be associated with a kidney that is drained by either one ureter (*single system*) or two ureters (*duplex system*). When ureteroceles are associated with duplex systems, they always emanate from the ureter that drains the upper portion (*pole*) of the kidney. The ureter from the lower pole of the affected kidney may be normal or associated with vesicoureteral reflux.

The advent of routine prenatal screening ultrasonography has facilitated the detection of many causes of upper urinary tract dilatation (*hydronephrosis*). Ureteroceles are among the most prevalent diagnoses associated with this condition. The postnatal evaluation includes confirmatory renal and bladder ultrasonography, contrast VCUG, and at times, nuclear renal scintigraphy. Each component of the evaluation paradigm affords the clinician key information with which to direct therapy. While prenatal screening ultrasonography may suggest the presence of a ureterocele by demonstrating a duplication abnormality with isolated hydronephrosis, postnatal ultrasonography is indicated to confirm the anatomical abnormality and to provide a baseline assessment from which to monitor the natural history of the disease and the outcome of any intervention. VCUG is performed to determine whether vesicoureteral reflux is associated with the ureter draining the lower pole of a duplicated collecting system. Finally, renal scintigraphy provides useful information for surgical decision making regarding the renal function.

Postnatal diagnosis is made in the context of UTI, which stimulates evaluation of the infant or child for an underlying urinary tract abnormality, or in the context of bladder outlet obstruction. Analyses in this section are based ICD-9 and CPT codes defining ureteroceles and related procedures listed in Table 1.

RISK FACTORS

Various theories have been proposed to account for ureterocele formation, although the exact etiology remains unclear. These theories include failure of the normal dissolution of a membrane covering the ureteric opening (52), abnormal development of the smooth muscle layer of the terminal ureter (53–55), and abnormal widening of the terminal portion of the ureter during bladder development (56). No genetic or environmental risk factors for ureteroceles have been identified.

TREATMENT

The treatment of ureteroceles is predicated on preservation of renal function. The evaluation paradigm should provide information on whether the ureterocele is associated with a single or double system, the presence of associated vesicoureteral reflux, the presence of renal obstruction, and the degree of renal dysfunction, if any. The management of ureteroceles has become somewhat controversial. An extensive discussion of the indications for various surgical approaches can be found in a general pediatric urology text (57). Non-obstructing, simple ureteroceles in adults may be managed expectantly. Endoscopic and open surgical approaches are available for the management of ureteroceles. Endoscopic puncture of the ureterocele is generally considered a temporizing measure to relieve obstruction, thus preventing loss of renal function. Endoscopic puncture may be the definitive procedure if obstruction is relieved and if any associated vesocioureteral reflux resolves. Open surgical approaches include relief of obstruction by "bypassing" the upper pole collecting system to that of the lower pole, removal of poorly functioning upper-pole segments, and reconstruction at the level of the bladder to remove the ureterocele and treat the vesicoureteral reflux.

Table 24. Inpatient hospital stays for ureterocele listed as primary diagnosis, count, rate[a] (95% CI), age-adjusted rate[b]

	1994			1996			1998			2000		
	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate
Total[c]	2,786	1.1 (1.0–1.2)	1.1	2,848	1.1 (1.0–1.2)	1.1	3,018	1.1 (1.0–1.2)	1.1	2,818	1.0 (0.9–1.2)	1.0
Age												
< 18	257	0.4 (0.2–0.5)		376	0.5 (0.4–0.7)		525	0.7 (0.5–0.9)		494	0.7 (0.4–1.0)	
18–24	*	*		167	0.7 (0.4–0.9)		*	*		169	0.6 (0.4–0.9)	
25–34	320	0.8 (0.6–1.0)		350	0.9 (0.7–1.1)		359	0.9 (0.7–1.2)		224	0.6 (0.4–0.8)	
35–44	504	1.2 (1.0–1.5)		467	1.1 (0.8–1.3)		437	1.0 (0.8–1.2)		373	0.8 (0.6–1.0)	
45–54	413	1.4 (1.0–1.8)		377	1.2 (0.9–1.5)		376	1.1 (0.8–1.4)		424	1.2 (0.9–1.4)	
55–64	316	1.6 (1.1–2.0)		330	1.6 (1.2–2.0)		322	1.4 (1.0–1.9)		290	1.2 (0.9–1.6)	
65–74	475	2.7 (2.1–3.3)		386	2.1 (1.6–2.6)		426	2.4 (1.8–3.0)		398	2.2 (1.8–2.7)	
75+	354	2.8 (2.1–3.6)		393	2.9 (2.2–3.7)		416	2.3 (2.2–3.6)		448	3.0 (2.3–3.7)	
Race/ethnicity												
White	1,692	0.9 (0.8–1.0)	0.9	1,738	0.9 (0.8–1.0)	0.9	1,657	0.9 (0.8–1.0)	0.8	1,578	0.8 (0.7–0.9)	0.8
Black	279	0.9 (0.6–1.1)	1.0	238	0.7 (0.5–0.9)	0.8	256	0.8 (0.6–1.0)	0.8	220	0.6 (0.4–0.9)	0.8
Hispanic	204	0.8 (0.5–1.1)	1.1	252	0.9 (0.6–1.1)	1.2	219	0.7 (0.5–0.9)	1.1	248	0.8 (0.5–1.0)	0.9
Gender												
Male	1,423	1.2 (1.0–1.3)	1.2	1,359	1.1 (0.9–1.2)	1.1	1,546	1.2 (1.0–1.4)	1.2	1,308	1.0 (0.8–1.1)	1.0
Female	1,363	1.0 (0.9–1.2)	1.0	1,489	1.1 (0.9–1.3)	1.1	1,473	1.1 (0.9–1.2)	1.0	1,510	1.1 (0.9–1.2)	1.1
Region												
Midwest	638	1.1 (0.8–1.3)	1.1	714	1.2 (0.9–1.4)	1.2	773	1.2 (1.0–1.5)	1.2	598	0.9 (0.8–1.1)	1.0
Northeast	610	1.2 (0.9–1.5)	1.1	637	1.2 (0.9–1.5)	1.2	596	1.2 (0.8–1.5)	1.1	516	1.0 (0.8–1.2)	1.0
South	1,129	1.3 (1.1–1.6)	1.3	1,066	1.2 (1.0–1.3)	1.2	1,169	1.2 (1.0–1.4)	1.2	1,095	1.1 (1.0–1.3)	1.1
West	409	0.7 (0.5–0.9)	0.8	430	0.7 (0.5–1.0)	0.8	480	0.8 (0.6–1.0)	0.8	610	1.0 (0.7–1.3)	1.0
MSA												
Rural	540	0.8 (0.6–1.1)	0.8	439	0.7 (0.6–0.9)	0.7	571	1.0 (0.7–1.2)	0.9	451	0.8 (0.6–0.9)	0.7
Urban	2,230	1.2 (1.0–1.3)	1.2	2,402	1.2 (1.0–1.3)	1.2	2,434	1.2 (1.0–1.3)	1.2	2,367	1.1 (1.0–1.2)	1.1

*Figure does not meet standard for reliability or precision.

MSA, metropolitan statistical area.

[a]Rate per 100,000 is based on 1994, 1996, 1998, 2000 population estimates from Current Population Survey (CPS), CPS Utilities, Unicon Research Corporation, for relevant demographic categories of US civilian non-institutionalized population.

[b]Age-adjusted to the US Census-derived age distribution of the year under analysis.

[c]Persons of other races, missing or unavailable race and ethnicity, and missing MSA are included in the totals.

NOTE: Counts may not sum to totals due to rounding.

SOURCE: Healthcare Cost and Utilization Project Nationwide Inpatient Sample, 1994, 1996, 1998, 2000.

Table 25. Trends in mean inpatient length of stay (LOS) in days and cost per child admitted with ureterocele[a], listed as primary diagnosis, 1999–2003

	Count	Percent	LOS	Mean Cost
Total	473		3.3	$7,669
Age				
0–2	433	92%	3.3	$7,576
3–10	37	8%	3.5	$8,716
11–17	3	1%	4.3	$8,219
Race/ethnicity				
White	301	64%	3.4	$7,928
Black	25	5%	3.1	$7,465
Asian	6	1%	2.4	$5,891
Hispanic	66	14%	3.4	$7,075
Missing	23	5%	3.3	$7,799
Other	52	11%	2.8	$7,171
Gender				
Female	336	71%	3.3	$7,593
Male	137	29%	3.2	$7,858
Region				
Midwest	115	24%	3.2	$7,812
Northeast	75	16%	3.6	$8,834
South	176	37%	3.4	$7,630
West	107	23%	2.9	$6,765

[a]ICD-9 code 753.23 (congenital ureterocele).
SOURCE: National Association of Children's Hospitals and Related Institutions, 1999–2003.

PREVALENCE AND INCIDENCE

The incidence of ureteroceles may be as high as one in 500. Ureteroceles occur more commonly in girls than in boys by a 4:1 ratio. Ureteroceles occur in association with duplication of the ureters in 80% of cases, with the ureter to the upper pole of the kidney being affected. In 20% of cases, the ureterocele is associated with a single ureter. Bilateral involvement occurs in 15% of cases. Ureteroceles are associated with duplex systems in 95% of cases in girls, while in boys, only 44% of cases involve duplex systems. Ureteroceles occur almost exclusively in Caucasians.

TRENDS IN HEALTHCARE RESOURCE UTILIZATION

Inpatient Care

According to HCUP data, inpatient hospitalization for ureteroceles remained relatively stable between 1994 and 2000, averaging approximately 2,818 cases annually (1.0 to 1.1 per 100,000 children) (Table 24). The rate of inpatient hospitalization was similar for males and females (1.0 to 1.1 per 100,000 children) and varied little between 1994 and 2000. Of the inpatient admissions, 77% were Caucasians. However, there were no significant differences in the rate of hospitalization among racial/ethnic groups, suggesting that although ureteroceles do occur more commonly in Caucasians, the natural history is independent of race. Averaging across the years studied in Table 24, inpatient admissions for ureteroceles were highest in the South (1,115 cases annually), intermediate in the Northeast and Midwest (590 and 681 cases annually, respectively), and lowest in the West (482 cases annually). The age-adjusted rates differed little among the regions or during the years of study.

In the NACHRI data from 1999 to 2001, 92% of admissions were children under three years of age, and 8% were three- to ten-year-olds. The average length of inpatient stay for ureteroceles was independent of age, 3.3 days, which is consistent with uncomplicated postoperative recovery following open surgery for upper or lower urinary tract reconstruction. The average length of stay was not statistically different when stratified by gender, race/ethnicity, or region (Tables 25 and 26).

Table 26. Inpatient hospital stays for ureterocele listed as primary diagnosis in 1997 and 2000, count, rate[a] (95% CI), age-adjusted rate[b], percent of all hospitalizations

	1997				2000		
	Count	Rate	Age-Adjusted Rate	Percent of all hospitalizations	Count	Rate	Percent of all hospitalizations
Total[c]	608	0.8 (0.7–1.0)	0.8	0.01%	604	0.8 (0.7–1.0)	0.01%
Age							
0–2	321	2.7 (2.1–3.4)		0.01%	350	3.0 (2.2–3.7)	0.01%
3–10	173	0.5 (0.4–0.7)		0.03%	157	0.5 (0.4–0.6)	0.03%
11–17	114	0.4 (0.2–0.6)		0.01%	96	0.3 (0.2–0.5)	0.01%
Race/ethnicity							
White	*	*		…	359	0.8 (0.6–1.0)	0.01%
Black	*	*		…	36	*	0%
Hispanic	*	*		…	78	0.7 (0.4–0.9)	0.01%
Gender							
Male	255	0.7 (0.5–0.9)	0.7	0.01%	285	0.8 (0.6–0.9)	0.01%
Female	353	1.0 (0.8–1.2)	1.0	0.01%	319	0.9 (0.7–1.1)	0.01%
Region							
Midwest	136	0.8 (0.4–1.2)	0.8	0.01%	132	1.0 (0.5–1.5)	0.01%
Northeast	144	1.1 (0.6–1.6)	1.2	0.01%	99	*	0.01%
South	189	0.8 (0.5–1.1)	0.8	0.01%	227	0.9 (0.7–1.2)	0.01%
West	139	0.8 (0.6–1.1)	0.8	0.01%	146	0.8 (0.5–1.2)	0.01%
MSA							
Rural	23	*	*	0%	15	*	0%
Urban	586	1.1 (0.9–1.3)	1.0	0.01%	589	1.0 (0.8–1.2)	0.01%

*Figure does not meet standard for reliability or precision.

MSA, metropolitan statistical area.

[a]Rate per 100,000 is based on 1997 population estimates from Current Population Survey (CPS), CPS Utilities, Unicon Research Rate Corporation, for relevant demographic categories of US civilian noninstitutional population under age 18.

[b]Age-adjusted to 2000 US Census.

[c]Persons of other races and missing race and ethnicity are included in the totals.

NOTE: Counts may not sum to totals due to rounding. Race/ethnicity breakdown not included because of large percent of missing values in 1997.

SOURCE: Healthcare Cost and Utilization Project Kids' Inpatient Database, 1997 and 2000.

Outpatient Care

No reliable data could be obtained on outpatient visits or ambulatory surgery for treatment of ureteroceles.

ECONOMIC IMPACT

NACHRI and HCUP KID include limited data on ureteroceles, and thus could not be used to discern reliable cost trends.

The available data indicate that the mean cost per ureterocele case was nearly $8,000; little variation was observed across age, region, or sex (Table 25). For the 604 cases of ureteroceles in 2000 in the HCUP Kids' Inpatient Database (Table 26), national inpatient expenditures amounted to an estimated $4 million.

RECOMMENDATIONS

The paucity of data on ambulatory treatment of children with ureteroceles should be remedied by more comprehensive data collection and reporting.

POSTERIOR URETHRAL VALVES

INTRODUCTION

Normal fetal bladder development requires a repetitive processes of filling and emptying. In the presence of bladder outlet obstruction, such as posterior urethral valves (PUV), this process is altered. The bladder must work harder to empty, leading to detrusor (bladder muscle) hypertrophy. Increased muscle leads to decreased compliance and higher storage pressures, which ultimately may be transmitted to the ureter and renal parenchyma. In some patients, this can eventually lead to renal insufficiency or renal failure. Fortunately, the incidence of PUV is low, and the condition is most often detected shortly after birth. Early diagnosis has been made possible by the use of routine prenatal ultrasonography. Early diagnosis, ablation of PUV, and close follow-up has maximized the long-term outcome of these patients. Analyses for this condition are based on the ICD-9 and CPT codes defining PUV listed in Table 1.

DEFINITION AND DIAGNOSIS

PUV are persistent embryonic membranes located in the posterior urethra at the level of the verumontanum, causing bladder outlet obstruction during voiding. There are several different types and appearances of PUV, but their diagnosis, treatment, and management are identical. The most widely accepted and used classification comes from Hugh Hamptom Young's original description of the condition (58). The prenatal diagnosis may be suggested by oligohydramnios, hydronephrosis, hydroureteronephrosis, thickened bladder, incomplete emptying of the neonatal bladder, or dilated posterior urethra. The diagnosis is confirmed in the postnatal period by VCUG, which may show a thickened bladder wall, bladder trabeculations, bladder diverticulae, dilated and/or elongated posterior urethra, normal-caliber anterior urethra, vesicoureteral reflux, and reflux of contrast into the prostate, utricle, or ejaculatory ducts. Some or all of these findings may be present. Postnatal renal and bladder ultrasound may be used to assess renal characteristics, such as the presence of hydronephrosis or abnormal renal echogenicity (associated with medical renal disease from ongoing obstruction).

RISK FACTORS

Posterior urethral valves are a congenital condition, the etiology of which has remained elusive. No known risk factors are associated with the development of PUV.

TREATMENT

Relief of PUV requires a surgical procedure. However, initial treatment may include urethral catheterization with a small feeding tube while the newborn is stabilized and any electrolyte imbalances are corrected. Prophylactic antibiotics are used to prevent UTI. The diagnosis is confirmed with a VCUG. Once the infant is stable, operative endoscopic ablation of the PUV may be safely and reliably performed. A post-procedure VCUG ensures complete valve ablation and relief of obstruction. Urodynamic testing is helpful in assessing the degree of bladder dysfunction and may help guide the use of anticholinergic medication to reduce high bladder pressures or uninhibited bladder contractions. Vesicostomy is sometimes performed if renal dysfunction persists. Periodic renal and bladder ultrasounds are necessary to assess renal echogenicity, hydroureteronephrosis, and bladder wall thickness. The presence of the corticomedullary junction can be determined by ultrasound to predict good renal function (59). Consultation with a pediatric nephrologist facilitates medical management and optimizes preservation of renal function. Patients with progressive hydronephrosis, rising serum creatinine and blood pressure, or noncompliant bladder may ultimately need bladder augmentation to increase storage capacity and lower pressure. Even when bladder augmentation has achieved those objectives, progressive renal insufficiency and failure may necessitate renal transplantation.

PREVALENCE AND INCIDENCE

Lary and Paulozzi, from the Centers for Disease Control and Prevention (CDC), studied the Metropolitan Atlanta Congenital Disease Program (MACDP) database to determine the full extent of birth

Table 27. Inpatient hospital stays for posterior urethral valves listed as primary diagnosis in 1997 and 2000, count, rate[a] (95% CI), age-adjusted rate[b], percent of all hospitalizations

	1997					2000				
	Count	Rate		Age-Adjusted Rate	Percent of all hospitalizations	Count	Rate		Percent of all hospitalizations	
Total[c]	336	0.6	(0.4–0.8)	0.9	0.01%	225	0.6	(0.4–0.8)	0.01%	
Age										
0–2	235	2.8	(2.1–3.6)		0.01%	167	2.8	(2.1–3.6)	0.01%	
3–10	74	*			0.02%	46	*		0.01%	
11–17	27	*			0.01%	11	*		0%	
Race/ethnicity										
White	*	*			*	85	0.4	(0.2–0.5)	0.01%	
Black	*	*			*	53	*		0.01%	
Hispanic	*	*			*	27	*		0.01%	
Region										
Midwest	56	*		*	0.01%	20	*		0.01%	
Northeast	75	*		1.2	0.01%	49	*		0.01%	
South	136	0.8	(0.5–1.2)	1.1	0.01%	107	0.8	(0.5–1.2)	0.01%	
West	69	*		0.8	0.01%	49	*		0.01%	
MSA										
Rural	336	0.7	(0.6–0.9)	1.2	0.01%	4	*		0%	
Urban		*				215	0.7	(0.6–0.9)	0.01%	

*Figure does not meet standard for reliability or precision.

MSA, metropolitan statistical area.

[a]Rate per 100,000 is based on 1997 population estimates from Current Population Survey (CPS), CPS Utilities, Unicon Research Corporation, for relevant demographic categories of US male civilian noninstitutional population under age 18.

[b]Age-adjusted to the US Census-derived age distribution of the year under analysis.

[c]Persons of other races, missing race and ethnicity, and missing MSA are included in the totals.

NOTE: Counts may not sum to totals due to rounding. Race/ethnicity breakdown not included because of large percent of missing values in 1997.

SOURCE: Healthcare Cost and Utilization Project Kids' Inpatient Database,1997 and 2000.

defects in the population. The MACDP is the oldest continuously operating birth-defects surveillance program in the country. These authors determined the incidence rate of posterior urethral valves to be 2.24 per 10,000 births (60). Casale estimated incidence of posterior urethral valves to be one in 8,000 to 25,000 live male births (61). Atwall suggested a frequency of one in 5,000 to 8,000 live births (62).

At a rate of 2.24 per 10,000 births, 451 male babies will be born with posterior urethral valves in the United States each year.

TRENDS IN HEALTHCARE RESOURCE UTILIZATION

Inpatient Care

PUV was the primary diagnosis in 0.6 cases per 100,000 children in 2000 (Table 27). The vast majority of inpatient hospitalization was for children under three years of age.

Additional HCUP data from 1994 thru 2000 demonstrated a slightly higher incidence, 0.9 cases per 100,000. There were significant racial differences, possibly reflecting differences in prenatal care: Caucasians had an inpatient hospitalization rate of 0.5 per 100,000, while African Americans had a rate of 2.1 per 100,000. There was no difference in occurrence across geographic regions. Nearly all cases occurred in urban centers (Table 28).

Outpatient Care

Insufficient data were available regarding ambulatory surgery visits, hospital outpatient visits, or physicians' office visits by children with PUV to generate reliable estimates of utilization. The national databases surveyed provided no data that would

Table 28. Inpatient hospital stays for posterior urethral valves listed as primary diagnosis, 1994–2000 (merged and by year), count, rate[a] (95% CI), annualized rate[b], age-adjusted rate[c]

	1994–2000				
	Count	4-Year Rate		Annualized Rate	4-Year Age-Adjusted Rate
Total[d]	1,173	0.9	0.9 (0.7–1.2)	0.23	0.9
Age					
< 18	1,083	3.0	3.0 (2.2–3.8)	0.75	
18+	*	*	*	*	
Race/ethnicity					
White	499	0.5	0.5 (0.4–0.7)	0.13	0.6
Black	328	2.1	2.1 (1.2–3.1)	0.53	1.7
Region					
Northeast	293	1.2	1.2 (0.6–1.8)	0.3	1.2
Midwest	252	0.8	0.8 (0.4–1.3)	0.2	0.8
South	519	1.2	1.2 (0.6–1.7)	0.3	1.2
West	*	*	*	*	*
MSA					
Rural	*	*	*	*	*
Urban	1,152	1.2	1.2 (0.8–1.5)	0.3	1.2
	1-Year Rate				
1994	340	0.3	0.3 (0.2–0.4)		
1996	320	0.2	0.2 (0.1–0.4)		
1998	366	0.3	0.3 (0.1–0.4)		
2000	148	0.1	0.1 (0–0.2)		

*Figure does not meet standard for reliability or precision.

MSA, metropolitan statistical area.

[a]Rate per 100,000 is based on 1994, 1996, 1998, 2000 population estimates from Current Population Survey (CPS), CPS Utilities, Unicon Research Corporation, for relevant demographic categories of US male civilian non-institutionalized population.

[b]Average annualized rate per year.

[c]Grouped years age-adjusted to the US Census-derived age distribution of the midpoint of years. Individual age-adjusted to the US Census-derived age distribution of the year under analysis.

[d]Persons of other races, missing or unavailable race and ethnicity, and missing MSA are included in the total.

NOTE: Counts may not sum to total due to rounding.

SOURCE: Healthcare Cost and Utilization Project Nationwide Inpatient Sample, 1994, 1996, 1998, 2000.

enable meaningful conclusions regarding emergency room care for patients with PUV.

ECONOMIC IMPACT

Data on costs per case and on the number of cases occurring each year were too sparse to permit cost estimates to be made. However, the economic impact in absolute dollars is probably smaller than that of more prevalent medical conditions. Nevertheless, because severe PUV can lead to renal insufficiency and renal failure, potentially requiring dialysis or renal transplantation, this condition may have a significant economic impact.

CONCLUSIONS

Posterior urethral valves, a potentially devastating condition, have a low incidence. While treatment of the valve is straightforward, the long-term clinical sequellae are often severe. The degree of bladder dysfunction and renal impairment varies, depending primarily on the severity of obstruction but also on the timing of surgical intervention and long-term medical management. Some patients may ultimately require bladder augmentation because of high bladder storage pressure and small-capacity, noncompliant bladders. Additionally, some patients may require renal transplantation because of progressive renal failure. Most patients will require neither; however, long-term follow-up is essential. Fortunately, PUV is most often detected shortly after birth. Early diagnosis has been made possible with the advent of routine prenatal ultrasonography; and early diagnosis, ablation of PUV, and close follow-up have maximized the long-term prognosis of these patients.

RECOMMENDATIONS

There are approximately 265 independent children's hospitals in the United States, which presumably care for the majority of PUV patients. More active participation and more vigilant data collection would enable more meaningful analysis of the impact of PUV on the US healthcare system. Delayed, long-term costs of PUV sequellae should also be studied.

OVERALL BURDEN OF PEDIATRIC UROLOGIC DISORDERS

Despite limitations of the available data, direct costs related to pediatric urologic hospitalizations appear to be substantial and would be even higher if all service types were accounted for. Further exploration of indirect costs (e.g., parental loss of work time) related to these conditions is warranted and would likely demonstrate that pediatric urologic conditions have an even greater economic burden than that observed in this analysis.

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