

UROLOGIC DISEASES IN NORTH AMERICA PROJECT: TRENDS IN RESOURCE UTILIZATION FOR URINARY TRACT INFECTIONS IN CHILDREN

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ABSTRACT

Purpose: We evaluated the health utilization and economic burden on society of urinary tract infections (UTIs) in children using a variety of public and commercial health care databases.

Materials and Methods: Numerous available databases were evaluated for health care utilization, including inpatient hospitalization, and outpatient physician and emergency department visits, by children with a coded diagnosis of urinary tract infection. Utilization was analyzed by age, gender, race, insurance type and geographic location, and trends were assessed during the last decade.

Results: UTIs resulted in more than 1.1 million physician visits annually, accounting for 0.7% of doctor visits and occurring in 2.4% to 2.8% of children. Overall, inpatient hospitalization decreased slightly, although pyelonephritis still accounted for more than 13,000 admissions. Infants were more likely to receive inpatient care for UTIs than children or adolescents, although hospital costs were higher in adolescents. Inpatient hospital costs are estimated to be greater than 180 million dollars per year.

Conclusions: Pediatric UTIs constitute a significant health burden on society. Available data do not allow a full accounting of costs due to a lack of information regarding outpatient expenses, as well as the cost of ancillary evaluation and treatment. However, the magnitude of the burden suggests the importance of further research and data collection of health care utilization in the pediatric population.

KEY WORDS: urinary tract infections, pediatrics, pyelonephritis, cystitis, utilization review

Urinary tract infections (UTIs) occur commonly during childhood, affecting an estimated 2.6% to 3.4% of children every year. Throughout childhood the risk of UTI is 2% for boys and 8% for girls.¹ Yet little is known of the societal burden of pediatric UTIs in human and financial terms. As part of the larger Urologic Diseases in America project, available health utilization databases were analyzed to assess the current public burden as well as the trends in utilization and cost during the last decade.

MATERIALS AND METHODS

The analytical methods used to generate these results have been described previously.^{2,3} In this study children are defined as persons younger than 18 years. Where possible they are further subdivided into infants (younger than 3 years), older children (3 to 10 years) and adolescents (11 to 17 years). Most of the datasets analyzed for this series do not distinguish the site of the UTI, with the notable exception of data from the Healthcare Cost and Utilization Project (HCUP) and MarketScan (Thomson Medstat, Ann Arbor, Michigan), in which pyelonephritis is distinguished from UTIs at other sites. The method by which the site of UTI is determined in these datasets is based on diagnostic coding, and likely varies across the population.

RESULTS

Health care utilization. Trends in Inpatient Care: Data from HCUP reveal that annual inpatient hospitalizations for UTI decreased slightly between 1994 and 2000, from 41,204

(60/100,000 children) to 36,568 (51/100,000, table 1). This declining trend was noted in both genders but was inconsistent across racial/ethnic groups and geographic regions. In 2000 hospitalization rates for UTI in infants (174/100,000) were substantially higher than those for older children (29/100,000) or adolescents (24/100,000). Girls were about 2.5 times more likely than boys to be hospitalized for UTI. Although not age adjusted, the data from HCUP suggest that Hispanics were at much greater risk for UTI related hospitalization than other racial/ethnic groups, and that blacks were at greater risk than whites.

HCUP data also indicate that between 1994 and 2000 annual inpatient hospitalizations associated with pyelonephritis as a primary diagnosis remained stable at about 13,000 per year (18 to 20/100,000, table 2). Despite recent support for outpatient treatment of pediatric pyelonephritis, these data indicate no downward trend in hospitalization rates for this condition.⁴ From 1996 onward the hospitalization rate was at least 2.5 times higher for infants than it was for older children or adolescents. The female-to-male ratio was at least 5:1 for each year analyzed. Racial/ethnic stratification suggested that black children had a trend toward somewhat lower hospitalization rates for pyelonephritis, and rates for Asian children were even lower. While the gender differences are consistent with clinical experience, the reasons for the racial/ethnic differences are not apparent. Hospitalization rates did not appear to vary by geographic region, but urban teaching hospitals had higher rates than did rural hospitals.

Age differences were most prominent among patients requiring hospitalization. The rate of inpatient hospital stays was 6.4 times higher among commercially insured infants

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TABLE 1. Inpatient hospital stays by children with urinary tract infection listed as primary diagnosis

	1994		1996		1998		2000	
	No. Stays	Rate	No. Stays	Rate	No. Stays	Rate	No. Stays	Rate
Totals*†	41,204	60 (54–67)	40,378	57 (51–63)	39,822	56 (50–61)	36,568	51 (46–55)
Age (yrs):								
0–2	21,128	177 (150–203)	22,797	191 (163–219)	22,591	194 (166–222)	20,372	174 (153–195)
3–10	11,629	38 (34–41)	10,185	32 (28–35)	9,987	31 (27–34)	9,323	29 (26–31)
11–17	8,447	33 (30–36)	7,396	27 (25–30)	7,245	26 (24–28)	6,874	24 (23–26)
Gender:								
Male	12,516	36 (30–42)	12,341	34 (28–40)	11,317	31 (26–36)	10,258	28 (24–31)
Female	28,678	86 (79–94)	28,037	81 (73–89)	28,501	81 (75–88)	26,306	75 (68–81)
Race/ethnicity:								
White	18,579	41 (38–44)	17,276	38 (34–41)	16,339	36 (33–39)	14,504	32 (28–35)
Black	5,954	55 (48–62)	5,601	50 (43–57)	4,373	39 (33–46)	3,364	30 (25–36)
Asian/Pacific Islander	549	28 (20–37)	411	14 (8–20)	900	29 (20–39)	851	28 (19–38)
Hispanic	6,872	74 (50–97)	8,452	82 (56–107)	7,159	66 (45–86)	8,032	69 (58–80)
Geographic region:								
Midwest	8,394	51 (45–56)	7,393	44 (37–51)	7,443	44 (39–48)	7,666	44 (37–51)
Northeast	7,553	59 (49–68)	7,600	58 (48–67)	8,231	64 (51–76)	6,044	46 (39–54)
South	17,204	75 (61–90)	16,756	69 (57–80)	16,453	66 (55–77)	15,036	61 (52–71)
West	8,053	50 (38–63)	8,630	52 (34–69)	7,695	45 (35–56)	7,822	45 (37–53)
Metropolitan statistical area:								
Rural	7,946	46 (41–52)	7,738	48 (42–53)	6,780	41 (38–45)	6,938	44 (40–48)
Urban	33,114	65 (57–73)	32,595	59 (51–67)	32,794	59 (53–66)	29,594	52 (47–58)
Hospital type:								
Rural	7,946	12 (10–13)	7,738	11 (10–12)	6,780	9 (9–10)	6,938	10 (9–10)
Urban nonteaching	16,230	24 (21–27)	16,764	24 (20–27)	10,929	15 (13–17)	11,435	16 (14–18)
Urban teaching	16,885	25 (20–30)	15,831	22 (17–27)	21,865	31 (26–35)	18,159	25 (21–29)

Rate (95% CI) per 100,000 based on 1994, 1996, 1998 and 2000 population estimates from Current Population Survey, Current Population Survey Utilities, Unicon Research Corp., for relevant demographic categories of United States civilian noninstitutionalized population younger than 18 years.

Data from Healthcare Cost and Utilization Project Nationwide Inpatient Sample, 1994, 1996, 1998 and 2000.

* Persons of missing gender, other races, missing or unavailable race and ethnicity, missing metropolitan statistical area and missing hospital type are included in totals.

† Numbers may not sum to totals due to rounding.

TABLE 2. Inpatient hospital stays by children with pyelonephritis listed as primary diagnosis

	1994		1996		1998		2000	
	No. Stays	Rate	No. Stays	Rate	No. Stays	Rate	No. Stays	Rate
Totals*†	13,334	20 (18–21)	13,536	19 (17–21)	13,226	18 (17–20)	12,926	18 (16–20)
Age (yrs):								
0–2	3,372	28 (23–33)	4,537	38 (31–45)	4,206	36 (29–43)	4,466	38 (32–45)
3–10	5,268	17 (15–19)	4,818	15 (13–17)	4,728	15 (12–17)	4,450	14 (12–15)
11–17	4,695	18 (17–20)	4,181	15 (14–17)	4,292	16 (14–17)	4,010	14 (13–16)
Gender:								
Male	2,229	6.4 (5.3–7.4)	2,200	6.0 (4.7–7.4)	2,024	5.5 (4.5–6.6)	2,206	6.0 (4.9–7.0)
Female	11,099	33 (30–36)	11,336	33 (30–36)	11,201	32 (29–35)	10,720	30 (27–33)
Race/ethnicity:								
White	7,150	16 (14–17)	6,869	15 (13–16)	6,647	14 (13–16)	5,934	13 (11–15)
Black	1,398	13 (11–15)	1,297	12 (10–14)	928	8.3 (6.5–10.1)	940	8.4 (6.2–10.6)
Asian/Pacific Islander	178	9.2 (5.2–13)	‡	‡	185	6.0 (3.2–8.8)	171	5.7 (3.2–8.2)
Hispanic	1,390	15 (12–18)	2,170	21 (15–27)	1,443	13 (9–17)	1,942	17 (13–20)
Geographic region:								
Midwest	3,032	18 (16–21)	3,036	18 (15–21)	3,066	18 (15–21)	3,263	19 (15–22)
Northeast	2,422	19 (14–23)	2,476	19 (15–22)	2,227	17 (14–20)	1,881	14 (12–17)
South	5,019	22 (19–25)	4,630	19 (16–22)	4,860	20 (17–23)	4,701	19 (15–23)
West	2,861	18 (14–21)	3,394	20 (14–27)	3,073	18 (13–23)	3,080	18 (14–22)
Metropolitan statistical area:								
Rural	3,314	19 (16–22)	2,903	18 (16–20)	3,104	19 (17–21)	2,846	18 (16–21)
Urban	9,964	20 (17–22)	10,589	19 (17–22)	10,025	18 (16–20)	10,067	18 (16–20)
Hospital type:								
Rural	3,314	4.9 (4.1–5.6)	2,903	4.1 (3.6–4.6)	3,104	4.3 (3.8–4.9)	2,846	3.9 (3.4–4.5)
Urban nonteaching	5,450	8.0 (7.1–8.8)	5,552	7.8 (6.8–8.8)	3,933	5.5 (4.8–6.2)	4,169	5.8 (5.0–6.6)
Urban teaching	4,514	6.6 (5.3–8.0)	5,037	7.1 (5.5–8.6)	6,092	8.5 (6.8–10.2)	5,898	8.2 (6.6–9.7)

Rate (95% CI) per 100,000 based on 1994, 1996, 1998 and 2000 population estimates from Current Population Survey, Current Population Survey Utilities, Unicon Research Corp., for relevant demographic categories of United States civilian noninstitutionalized population younger than 18 years.

Data from Healthcare Cost and Utilization Project Nationwide Inpatient Sample, 1994, 1996, 1998 and 2000.

* Persons of other races, missing or unavailable race and ethnicity, missing metropolitan statistical area and missing hospital type are included in totals.

† Numbers may not sum to totals due to rounding.

‡ No. and rate do not meet standard for reliability or precision.

than the rate among older children, and 11 times higher than the rate among adolescents (table 3).

Trends in Outpatient Care: Tables 3 and 4 contain data from the Center for Health Care Policy and Evaluation on visits by children insured commercially or through Medicaid for whom UTI was listed as the primary diagnosis. In both

groups the most common site of care for UTI was physicians offices. Overall rates of visits to physicians offices remained stable throughout the 1990s at approximately 2,400/100,000 (2.4%) for children with commercial insurance (table 3) and 2,800/100,000 (2.8%) for children with Medicaid (table 4). Among other settings—all much less commonly used than

TABLE 3. Visits for urinary tract infections listed as primary diagnosis among children with commercial health insurance

	1994		1996		1998		2000	
	No. Visits	Rate	No. Visits	Rate	No. Visits	Rate	No. Visits	Rate
Totals	7,600	2,395	10,801	3,382	16,206	2,425	17,101	2,374
Age (yrs):	<i>Physician office visits</i>							
Less than 3	1,234	3,033	1,802	3,078	3,001	3,383	3,033	3,181
3-10	4,105	2,816	5,923	2,841	9,059	2,950	9,338	2,864
11-17	2,261	1,727	3,076	1,651	4,146	1,522	4,730	1,582
Gender:	<i>Emergency room visits</i>							
Male	1,474	906	2,057	887	2,988	872	3,087	835
Female	6,126	3,961	8,744	3,950	13,218	4,059	14,014	3,997
Totals	431	136	575	127	958	143	1,079	150
Age (yrs):	<i>Inpatient visits</i>							
Less than 3	81	199	97	166	197	222	183	192
3-10	185	127	271	130	422	137	459	141
11-17	165	126	207	111	339	124	437	146
Gender:	<i>Inpatient visits</i>							
Male	85	52	132	57	176	51	218	59
Female	346	224	443	200	782	240	861	246
Totals	147	46	206	45	370	55	367	51
Age (yrs):	<i>Inpatient visits</i>							
Less than 3	68	167	104	178	178	201	202	212
3-10	54	37	67	32	115	37	108	33
11-17	25	*	35	19	77	28	57	19
Gender:	<i>Inpatient visits</i>							
Male	32	20	41	18	56	16	88	24
Female	115	74	165	75	314	96	279	80

Visits less than 30 should be interpreted with caution.
 Rate per 100,000 based on member months of enrollment in calendar year for children in same demographic stratum.
 Data from Center for Health Care Policy and Evaluation, 1994, 1996, 1998 and 2000.
 * Rate does not meet standard for reliability or precision.

TABLE 4. Visits for urinary tract infections listed as primary diagnosis among children with Medicaid

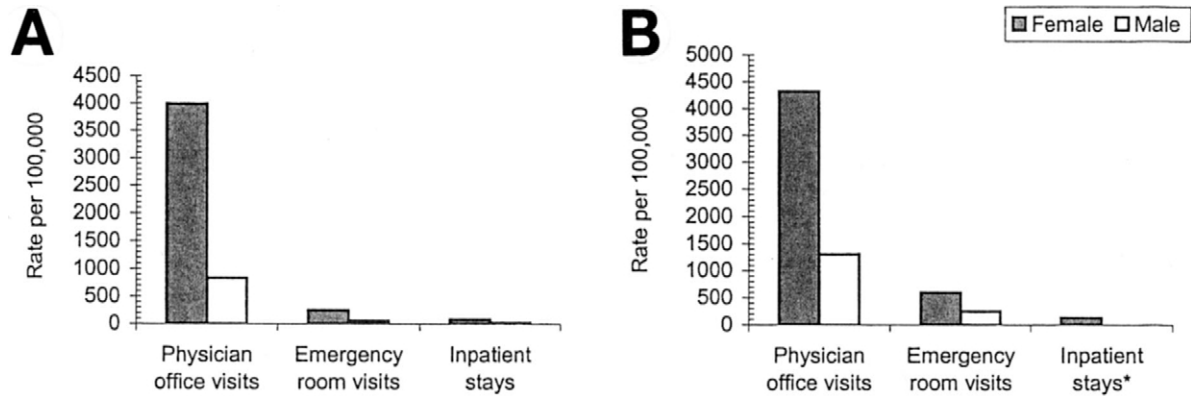
	1994		1996		1998		2000	
	No. Visits	Rate	No. Visits	Rate	No. Visits	Rate	No. Visits	Rate
Totals	910	2,842	1,428	2,420	1,096	2,893	1,309	2,806
Age (yrs):	<i>Physician office visits</i>							
Less than 3	193	2,427	350	2,569	312	3,551	335	3,232
3-10	554	3,035	838	2,576	572	2,955	733	3,147
11-17	163	2,804	240	1,868	212	2,177	241	1,855
Gender:	<i>Emergency room visits</i>							
Male	214	1,334	337	1,140	271	1,424	305	1,304
Female	696	4,355	1,091	3,704	825	4,378	1,004	4,318
Totals	193	603	303	514	155	409	197	422
Age (yrs):	<i>Inpatient stays</i>							
Less than 3	52	654	93	683	56	637	80	772
3-10	95	520	125	384	65	336	75	322
11-17	46	791	85	662	34	349	42	323
Gender:	<i>Inpatient stays</i>							
Male	40	249	68	230	33	173	59	252
Female	153	957	235	798	122	647	138	594
Totals	36	112	59	100	43	114	44	94
Age (yrs):	<i>Inpatient stays</i>							
Less than 3	22	*	39	286	31	353	32	309
3-10	12	*	16	*	11	*	7	*
11-17	2	*	4	*	1	*	5	*
Gender:	<i>Inpatient stays</i>							
Male	10	*	17	*	14	*	14	*
Female	26	*	42	143	29	*	30	129

Rate per 100,000 based on member months of enrollment in calendar year for children in same demographic stratum.
 Visits less than 30 should be interpreted with caution.
 Data from Center for Health Care Policy and Evaluation, 1994, 1996, 1998 and 2000.
 * Rate does not meet standard for reliability or precision.

physicians offices—emergency room (ER) visits were 3 times more common than inpatient hospitalizations. Of all encounters for which UTI was listed as the primary diagnosis the rates of ER visits were substantially higher for those insured by Medicaid than the rates for those insured commercially. Hospital outpatient clinics and ambulatory surgical centers contributed minimally, especially in the Medicaid population

(data not shown). Children with Medicaid visited physicians offices, ERs and ambulatory surgery centers more often than did children with commercial insurance.

As expected, girls had much higher visit rates than boys (tables 3 and 4, and figure). The female-to-male ratio for physicians office visits by commercially insured children increased from 4.4:1 in 1994 to 4.8:1 in 2000 but it remained



Urinary tract infections listed as primary diagnosis among children with commercial health insurance (A) and Medicaid (B) by visit setting and gender. Asterisk indicates rate for males was too low to produce reliable national estimate. Data from Center for Health Care Policy and Evaluation, 2000.

TABLE 5. National physician office visits by children with urinary tract infections

Diagnosis	Primary Diagnosis	Any
5-Yr total (95% CI) 7,171,390 (5,995,021–8,347,759)	5,556,971 (4,502,468–6,611,474)	
Total No. visits by pts younger than age 18 yrs 809,286,031	809,286,031	
% Visits 0.7		0.9
5-Yr rate (95% CI) (8,575–11,941)	7,949 (6,440–9,457)	10,258

Rate per 100,000 based on sum of weighted counts in 1992, 1994, 1996, 1998 and 2000 over mean estimated base population across 5 years. Population estimates from Current Population Survey, Current Population Survey Utilities, Unicon Research Corp., for relevant demographic categories of United States civilian noninstitutionalized population younger than 18 years. Data from National Ambulatory Medical Care Survey, 1992, 1994, 1996, 1998 and 2000.

TABLE 6. National hospital outpatient visits by children with urinary tract infections

Any Diagnosis	Primary Diagnosis
4-Yr total (95% CI) 527,424 (430,174–624,674)	374,907 (298,369–451,445)
Total No. visits by pts younger than age 18 yrs 72,578,652	72,578,652
% Visits 0.7	0.5
4-Yr rate (95% CI) 744 (607–882)	529 (421–637)

Rate per 100,000 based on sum of weighted counts in 1994, 1996, 1998 and 2000 over mean estimated base population across 4 years. Population estimates from Current Population Survey, Current Population Survey Utilities, Unicon Research Corp., for relevant demographic categories of United States civilian noninstitutionalized population younger than 18 years. Data from National Hospital Ambulatory Medical Care Survey, 1994, 1996, 1998 and 2000.

stable at about 3.3:1 for children insured through Medicaid during the same time period. In the office setting adolescents had lower visit rates than did either infants or older children, regardless of insurance status.

Data from the National Ambulatory Medical Care Survey showed that during 1992, 1994, 1996, 1998 and 2000 there were more than 1.1 million annual physician office visits (1,590/100,000 in each year) associated with UTI as the primary diagnosis and 1.4 million annual physician office visits (2,051/100,000 in each year) associated with UTI as any listed diagnosis. As a primary diagnosis UTI accounted for 0.7% of all physician office visits by children during those years (table 5).

Data from the National Hospital Ambulatory Medical Care Survey demonstrated that during 1994, 1996, 1998 and 2000 approximately 94,000 annual hospital outpatient visits (132/100,000 in each year) were associated with UTI as a primary

TABLE 7. Inpatient cost in dollars per child hospitalized with urinary tract infection listed as primary diagnosis, 1999–2001

	No. Hospitalizations	Mean Cost
Totals*	16,024	4,501 (4,324–4,678)
Age (yrs):		
0–2	10,383	4,069 (3,963–4,175)
3–10	3,774	4,554 (4,177–4,930)
11–17	1,867	6,796 (5,630–7,963)
Race/ethnicity:		
White	7,807	4,500 (4,263–4,737)
Black	2,862	4,730 (4,158–5,302)
Asian	300	4,569 (3,966–5,172)
Hispanic	3,050	4,778 (4,364–5,192)
American Indian	39	8,851 (475–17,227)
Gender:		
Male	6,092	5,165 (4,776–5,554)
Female	9,932	4,094 (3,938–4,249)
Geographic region:		
Midwest	4,635	3,948 (3,812–4,084)
Northeast	850	5,518 (4,794–6,241)
South	7,900	4,864 (4,535–5,194)
West	2,363	4,531 (4,259–4,804)

Mean cost (95% CI) calculated using adjusted ratio of costs to charges, including variable and fixed cost among participating children's hospitals.

Data from National Association of Children's Hospitals and Related Institutions, 1999–2001.

* Children of other races and missing race/ethnicity or region are included in totals.

diagnosis, representing 0.5% of all hospital outpatient visits by children (table 6).

Economic burden. Direct Cost: According to data from the National Association of Children's Hospitals and Related Institutions, the mean cost per child hospitalized for a UTI from 1999 to 2001 was \$4,501 (table 7). The cost was higher among adolescents (\$6,796) than among infants (\$4,069) or older children (\$4,554). Costs were higher for boys (\$5,165) than for girls (\$4,094). Costs were highest in the Northeast (\$5,518) and lowest in the Midwest (\$3,948). No racial/ethnic

TABLE 8. *Inpatient cost in dollars per child hospitalized with urinary tract infection listed as primary diagnosis*

	1999		2000		2001	
	No. Hospitalizations	Mean Cost	No. Hospitalizations	Mean Cost	No. Hospitalizations	Mean Cost
Totals*	5,039	3,869 (3,706–4,033)	5,551	4,444 (4,182–4,706)	5,434	5,145 (4,726–5,564)
Age (yrs):						
0–2	3,248	3,702 (3,498–3,906)	3,617	3,954 (3,827–4,081)	3,518	4,526 (4,315–4,738)
3–10	1,223	3,611 (3,417–3,805)	1,287	5,357 (4,314–6,399)	1,264	4,648 (4,331–4,964)
11–17	568	5,381 (4,630–6,132)	647	5,365 (4,867–5,863)	652	9,450 (6,216–12,684)
Race/ethnicity:						
White	2,525	3,951 (3,769–4,132)	2,600	4,286 (4,058–4,513)	2,682	5,226 (4,595–5,857)
Black	867	4,227 (3,511–4,943)	1,011	4,386 (3,968–4,804)	984	5,526 (4,047–7,005)
Asian	87	4,041 (3,256–4,827)	100	4,571 (3,416–5,727)	113	4,973 (3,881–6,066)
Hispanic	749	3,562 (3,376–3,748)	1,087	5,327 (4,236–6,418)	1,214	5,036 (4,704–5,369)
American Indian	5	2,737 (705–4,768)	17	15,163 (0–35,084)	17	4,337 (2,879–5,795)
Gender:						
Male	1,877	4,327 (3,946–4,709)	2,114	4,697 (4,427–4,966)	2,101	6,384 (5,346–7,423)
Female	3,162	3,598 (3,468–3,727)	3,437	4,288 (3,898–4,678)	3,333	4,364 (4,171–4,557)
Geographic region:						
Midwest	1,505	3,481 (3,277–3,686)	1,596	3,934 (3,762–4,106)	1,534	4,420 (4,111–4,730)
Northeast	180	4,929 (4,062–5,796)	325	5,034 (3,922–6,145)	345	6,281 (4,907–7,655)
South	2,399	4,261 (3,973–4,549)	2,744	4,799 (4,328–5,270)	2,757	5,454 (4,673–6,235)
West	800	3,937 (3,593–4,281)	765	4,684 (4,050–5,319)	798	4,981 (4,579–5,382)

Mean cost (95% CI) calculated using adjusted ratio of costs to charges, including variable and fixed cost among participating childrens hospitals.

Data from National Association of Children’s Hospitals and Related Institutions, 1999–2001.

* Children of other races and missing race/ethnicity or region are included in totals.

differences in costs were apparent. Inpatient costs per hospitalization increased from \$3,869 in 1999 to \$4,444 in 2000 and \$5,145 in 2001, although the increase was not caused by significant changes in any particular gender, geographic or racial/ethnic group (table 8).

Despite shorter length of stay for all groups analyzed between 1999 and 2001 (table 9), nominal costs increased in all regions of the country in children hospitalized for UTI. Although hospitalized less often than girls, boys had higher inpatient costs, undoubtedly related to their longer hospital stays, a finding noted in data from the National Association of Children’s Hospitals and Related Institutions (table 9) and HCUP (table 10). Stays were longer in urban teaching hospitals, a finding likely related to differences in case mix between teaching and nonteaching facilities. The general trend toward shorter length of stay for UTI may reflect changing practice patterns in the treatment of uncomplicated UTI, with a greater reliance on outpatient oral antibiotics to complete the therapeutic course initiated in the hospital.

Nonetheless, the data suggest that inpatient costs have increased despite efforts to reduce them through shorter hospital stays. Caution should be used in interpreting this trend, because these costs are not adjusted for inflation. Given an average of 40,000 hospitalizations per year for UTIs and an average cost of \$4,500 per inpatient episode, a rough estimate of the annual economic burden for inpatient treatment of UTI would be 180 million dollars.

DISCUSSION

Pediatric UTIs are a significant source of health care utilization and expenditure. Yet little is known about the overall burden of illness to society. These data suggest that UTIs are a frequent cause for seeking medical care, occurring in 2.4% to 2.8% of children annually and accounting for more than 1 million office visits or 0.7% of all physician visits by children annually. Inpatient hospital costs, while only the tip of the iceberg, are estimated to be greater than 180 million dollars

TABLE 9. *Trends in mean inpatient length of stay for children hospitalized with urinary tract infection listed as primary diagnosis*

	1999		2000		2001	
	No. Hospitalizations	Length of Stay (days, 95% CI)	No. Hospitalizations	Length of Stay (days, 95% CI)	No. Hospitalizations	Length of Stay (days, 95% CI)
Totals	5,039	3.7 (3.6–3.8)	5,551	3.6 (3.5–3.8)	5,434	3.6 (3.6–3.7)
Age (yrs):						
0–2	3,248	3.8 (3.6–4.0)	3,617	3.5 (3.4–3.6)	3,518	3.7 (3.6–3.8)
3–10	1,223	3.4 (3.2–3.5)	1,287	3.8 (3.3–4.3)	1,264	3.3 (3.1–3.4)
11–17	568	3.9 (3.5–4.2)	647	3.8 (3.5–4.1)	652	4.3 (3.8–4.7)
Race/ethnicity:						
White	2,525	3.4 (3.3–3.5)	2,600	3.3 (3.2–3.4)	2,682	3.5 (3.3–3.6)
Black	867	4.2 (3.5–5.0)	1,011	3.8 (3.3–4.4)	984	3.7 (3.5–4.0)
Asian	87	3.3 (2.8–3.8)	100	3.4 (2.8–4.1)	113	3.7 (3.1–4.4)
Hispanic	749	3.7 (3.5–3.8)	1,087	4.0 (3.8–4.3)	1,214	4.0 (3.8–4.2)
American Indian	5	2.2 (0.8–3.6)	17	6.2 (2.9–9.4)	17	3.5 (2.4–5.5)
Other	325	3.9 (3.4–4.3)	345	3.4 (3.1–3.7)	242	3.4 (3.0–3.7)
Missing	481	4.3 (4.0–4.6)	391	3.9 (3.5–4.3)	182	3.3 (3.0–3.6)
Gender:						
Male	1,877	4.2 (3.8–4.5)	2,114	3.9 (3.8–4.1)	2,101	4.1 (3.9–4.3)
Female	3,162	3.4 (3.3–3.5)	3,437	3.4 (3.2–3.6)	3,333	3.3 (3.2–3.4)
Geographic region:						
Midwest	1,505	3.2 (3.1–3.4)	1,596	3.1 (3.0–3.2)	1,534	3.2 (3.1–3.4)
Northeast	180	3.8 (3.2–4.4)	325	3.4 (3.1–3.8)	345	3.4 (3.0–3.7)
South	2,399	4.1 (3.8–4.4)	2,744	3.9 (3.7–4.2)	2,757	3.9 (3.8–4.1)
West	800	3.2 (3.0–3.4)	765	3.5 (3.2–3.8)	798	3.5 (3.3–3.7)
Missing	155	4.2 (3.6–4.8)	120	5.1 (4.3–5.9)	0	

Data from National Association of Children’s Hospitals and Related Institutions, 1999–2001.

TABLE 10. National trends in mean length of stay for children hospitalized with urinary tract infection listed as primary diagnosis

	Length of Stay (days)			
	1994	1996	1998	2000
Mean	4.2	3.6	3.4	3.1
Age (yrs):				
0-2	4.7	3.9	3.6	3.4
3-10	3.7	3.2	3.1	2.8
11-17	3.5	3.0	3.1	2.7
Gender:				
Male	4.9	4.2	4.0	3.7
Female	3.8	3.3	3.1	2.9
Race/ethnicity:				
White	3.7	3.3	3.1	2.9
Black	5.1	4.2	4.0	3.6
Asian/Pacific Islander	4.8	4.1	3.6	4.2
Hispanic	4.4	4.2	4.2	3.6
Other	6.8	4.4	3.3	3.6
Geographic region:				
Midwest	3.5	3.2	2.9	2.8
Northeast	5.0	4.0	3.5	3.6
South	4.2	3.7	3.5	3.2
West	3.8	3.5	3.6	3.0
Metropolitan statistical area:				
Rural	3.5	3.0	2.8	2.6
Urban	4.3	3.7	3.5	3.2
Hospital type:				
Rural	3.5	3.0	2.8	2.6
Urban nonteaching	3.7	3.4	3.1	3.1
Urban teaching	4.9	4.1	3.7	3.4

Data from Healthcare Cost and Utilization Project Nationwide Inpatient Sample, 1994, 1996, 1998 and 2000.

per year. Despite efforts to promote outpatient treatment of pyelonephritis, inpatient admissions have remained stable and inpatients costs have steadily increased despite shorter hospital stays. Infants are significantly more likely to receive inpatient care than older children. This finding may reflect that UTIs in young children are more likely to be complicated by comorbidities such as newly diagnosed anatomical abnormalities as well as the more aggressive treatment recommendations for the young, including parenteral antibiotics.

The data also reveal that emergency room utilization is higher in the Medicaid population than in those commercially insured, although it decreased during the study period. That children with Medicaid visited emergency rooms for UTI related care 2.8 times more frequently than did those with commercial insurance (422/100,000 vs 150/100,000) is consistent with well-known patterns of care in socioeconomically disadvantaged populations. The slight decrease in the use of ERs by those insured through Medicaid from 1994 to 2000 may reflect improved access to primary care physicians or increasing dissatisfaction with the availability of ER care.

The datasets analyzed for this study afford limited ability to assess the complete economic burden of pediatric UTI, as they are limited to the immediate costs of treatment of the acute infection. UTI is frequently a manifestation of a larger underlying condition. Hence, much of the economic burden of diagnosing and treating the related conditions is not included here. Costs are not included for followup imaging, long-term antibiotics or treatment of anatomical abnormalities, dysfunctional elimination or neurological abnormalities. Also not included in these analyses are long-term costs related to the sequelae of repeated pyelonephritis and scarring, such as

hypertension and renal insufficiency. Likewise, because children do not contribute direct economic support in most families, the impact of lost productivity or time off from school cannot be determined. However, an ill child usually means work loss for parents, and, as such, may generate substantial indirect costs. Better tools are needed to assess the parental economic impact of pediatric UTI. Analysis of pediatric health data is made more difficult by the relative scarcity of large databases that include children compared to those recording adult health care utilization. Data regarding pediatric urinary tract infections are also hampered by inherent difficulties in accurate diagnosis in the young child, and variations in definitions and codes used across providers.

Recognizing the magnitude of the societal burden is, of course, only the first step. Further efforts will be needed to assess the costs and effectiveness of UTI diagnosis, treatment and posttreatment imaging evaluation for contributing factors.⁵⁻⁷ Further research is needed to optimize this important evaluation phase following the diagnosis of UTI to improve quality of care and hopefully decrease overall cost. Investigation is needed into which populations are and are not receiving appropriate evaluation to ensure adequate access to care for all children. Efforts to lessen the economic burden on patients, payers and society include decreasing the length and frequency of inpatient hospitalizations, streamlining post-UTI evaluation and developing effective strategies for UTI prevention through risk reduction.

CONCLUSIONS

Urinary tract infections in children are a common illness that adds significantly to the overall economic burden of urological disease. Available data only hint at the true cost, and further research and better tools are necessary to appreciate fully the scope of the burden. However, even the currently measurable costs suggest the value of further study and particularly the need for greater tracking of health care utilization in the pediatric population.

REFERENCES

- Jakobsson, B., Esbjorner, E. and Hansson, S.: Minimum incidence and diagnostic rate of first urinary tract infection. *Pediatrics*, **104**: 222, 1999
- Litwin, M. S., Saigal, C. S., Yano, E. M., Avila, C., Geschwind, S. A., Hanley, J. M. et al: Urologic Diseases in America Project: analytical methods and principal findings. *J Urol*, **173**: 933, 2005
- Litwin, M. S. and Saigal, C. S.: Urologic Diseases in America Interim Compendium. Washington, D. C.: U. S. Department of Health and Human Services, Public Health Service, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, 2004
- Hoberman, A., Wald, E. R., Hickey, R. W., Baskin, M., Charron, M., Majd, M. et al: Oral versus initial intravenous therapy for urinary tract infections in young febrile children. *Pediatrics*, **104**: 79, 1999
- Haycock, G. B.: A practical approach to evaluating urinary tract infection in children. *Pediatr Nephrol*, **5**: 401, 1991
- Hoberman, A., Charron, M., Hickey, R. W., Baskin, M., Kearney, D. H. and Wald, E. R.: Imaging studies after a first febrile urinary tract infection in young children. *N Engl J Med*, **348**: 195, 2003
- Rushton, H. G. and Majd, M.: Dimercaptosuccinic acid renal scintigraphy for the evaluation of pyelonephritis and scarring: a review of experimental and clinical studies. *J Urol*, **148**: 1726, 1992