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Pediatric urinary tract infections: an analysis of hospitalizations, charges, and costs in the USA

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Abstract

This study evaluates the impact of pediatric uninary tract infection (UTI)s on the economy and inpatient healthcare utilization in the USA. A retrospective analysis of patient demographics and hospital economics was performed on children less than 18 years of age admitted with a UTI between 2000 and 2006 using the Healthcare Cost and Utilization Project Kids' Inpatient Database. Our results were stratified as follows. Hospital admissions—nearly 50,000 children/year were admitted with a UTI. Pediatric UTIs represented 1.8% of all pediatric hospitalizations. Seventy-three percent of patients were female and 40% were under 1 year of age. Payer information—from 2000 to 2006, pediatric insurance coverage shifted from the private sector to the public sector. Hospital cost—in 2000, estimated hospital costs for UTIs were $2,858 per hospitalization and rose to $3,838 by 2006. Mean hospital charges increased from $6,279 to $10,489 per stay. By 2006, aggregate hospital charges exceeded $520 million. Our results indicate that UTIs are among the most common pediatric admission diagnoses. Hospitalization is more common in females and younger children. Since 2000, hospital charges for UTIs increased disproportionately to hospital costs. Over time, more children hospitalized with a UTI depend on public agencies to cover healthcare expense. More efforts are needed to evaluate cost-effective strategies for evaluation and treatment of UTIs.

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Financial disclosure and conflict of interest

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Keywords

Urinary tract infection; Pediatrics; Epidemiology; Economics; Utilization review

Introduction

Urinary tract infections (UTI) are one of the most common and most serious bacterial infections in children [1–3]. Estimates on the cumulative incidence of UTIs in American children indicate that up to 180,000 of the annual birth cohort will be diagnosed with a UTI by 6 years of age (3–7% of girls and 1–2% of boys) [4, 5]. Children diagnosed with UTIs account for over 1 million annual office visits and 500,000 emergency department (ED) visits. Although most UTIs are uncomplicated, some children require inpatient management. Inpatient hospitalization is required in up to 2–3% of cases [6]. As a result, inpatient UTI management is a major contributor to the American healthcare expense.

In the United States, healthcare is provided by many separate legal entities. Healthcare facilities are largely owned and operated by the private sector. Health insurance is primarily provided by the private sector, with the exception of programs like Medicare, Medicaid, TRICARE, and the Children's Health Insurance Program. In the United States, more money per person is spent on healthcare than in any other nation in the world. Moreover, in the United States, a greater percentage of the gross domestic product is spent on healthcare than nearly any other country [7].

The economic burden of inpatient pediatric UTI management has not been recently quantified in the United States. Therefore, the objective of this study was to evaluate the impact of pediatric UTIs on the economy and inpatient healthcare utilization over the last decade. To accomplish this objective, we first examined the demographics of children admitted to the hospital with a UTI and second evaluated their economic burden by analyzing hospital characteristics, the structure of pediatric insurance coverage, and hospital charges and costs.

Materials and methods

Study design and inclusion criteria

A retrospective analysis was performed using the Healthcare Cost and Utilization Project (HCUP) Kids' Inpatient Database in 2000, 2003, and 2006 for children less than 18 years of age admitted to the hospital with the primary diagnosis of a UTI in the USA.

Use of the Kids' Inpatient Database

The Kids's Inpatient Database (KID), sponsored by the Agency for Healthcare Research and Quality (AHRQ), was designed to identify and track trends in hospital utilization, access, cost, and outcome across the United States [8]. The KID, the AHRQ's only pediatric-specific database, captures a sample of pediatric discharges from over 2,500 to 4,000 community hospitals (defined as short-term, non-federal, general, and specialty hospitals, excluding hospital units of other institutions). In 2000, the KID included 27 states

(representing 6.3 million discharges). In 2003 and 2006, the KID included 36 and 38 states respectively (6.4 and 6.5 million hospitalizations). National estimates were weighted to reflect all 50 states. Detailed information on the content and design of the HCUP-KID is published elsewhere [8].

Patient identification

Children admitted with the primary diagnosis of a UTI were identified using the AHRQ's Clinical Classification Software (CCS), a system that groups over 12,000 ICD-9-CM diagnosis codes into 260 clinically meaningful categories. Our cohort was identified using the CCS diagnosis code for urinary tract infection (CCS 159); which includes the ICD-9-CM diagnosis codes for kidney infection not otherwise specified, urinary tract infection, cystitis, urethritis, and pyelonephritis [9].

Demographics data collection

Demographic data collected from the KID included number of hospital discharges, age at admission, gender, length of hospitalization, hospital location (rural vs metropolitan), geographic location, and hospital type (general inpatient facility vs pediatric facility). Pediatric facilities were defined by the National Association of Children's Hospitals and Related Institutions to include pediatric referral centers and a children's unit located in a general hospital [8].

Financial data collection

Financial data collected from the KID included median household income, insurance payer type (Medicare/Medicaid, private insurance, or uninsured), hospital charges, hospital costs, and hospital charge-to-cost ratios. Hospital costs reflect the actual costs of production, while charges represent what the hospital billed the patient for services rendered during the admission. Total charges were converted to costs using charge-to-cost ratios based on hospital accounting reports from the Centers for Medicare and Medicaid Services (CMS) [8].

Data analysis

To report national estimates, the KID developed discharge weights using the American Hospital Association universe as the standard. With each national estimate, the KID reported standard errors that were calculated using SUDAAN software (RTI International, Research Triangle Park, NC, USA). Statistical significance was determined using a two-tailed p value. A p value<0.05 was considered statistically significant. The analytical methods used to generate these results are described elsewhere [8].

Results

Urinary tract infections are a common illness in infants and young children

From 2000 to 2006, UTIs were one of the most common pediatric admission diagnoses—9th most common in 2000, 10th most common in 2003, and 11th most common in 2006. From 2000–2006, roughly 50,000 children per year were admitted to the hospital with the

diagnosis of a UTI. During this period, children with UTIs represented nearly 1.8% of all hospital admissions (Table 1).

Children less than 1 year of age represented 40% of all UTI hospitalizations (Fig. 1). Overall, girls were 2.5 times more likely to be admitted with a UTI than males. Children were also more likely to be admitted if they lived in an urban setting. Children living in households with a median income in the fourth quartile were more likely to require hospitalization than children from wealthier families. The average hospital stay for a UTI was 3.1±0.1 days. Average hospitalization length did not significantly vary by year, hospital type (general hospital vs pediatric hospital), age group, or gender (p value>0.05).

Pediatric insurance coverage has shifted from the private to the public sector

In 2000, 50% of children admitted with a UTI had private insurance as their primary payer. By 2006, only 31% of children admitted with a UTI had private insurance—representing a 19% decrease (p value<0.01). On the other hand, the number of children covered by government agencies (i.e. Medicaid) increased nearly 22% (Fig. 2). In 2000, 42.3% of children with UTIs depended on government insurance; by 2006 this had increased to 51.5% (p value< 0.01). During this period, the percentage of self-payers (i.e. uninsured) remained relatively constant.

Hospital costs and charge-to-cost ratios have increased over time

From 2000–2006, hospital costs increased (Fig. 3). In 2000, the mean estimated hospital cost for a child admitted with a UTI was $2,858 per hospital stay. In 2006, this rose to $3,838. Costs were significantly higher in boys, children's hospitals, and metropolitan medical centers (p value<0.05). During this same period, mean hospital charges (the hospital bill) increased from $6,279 to $10,489 per hospitalization—representing a 67% increase. By 2006, aggregate hospital charges exceeded $520 million. In 2000, the average hospital charge/cost ratio was ~2.1. In 2006, this ratio rose to ~2.7. This increase was more pronounced in children's hospitals than in general inpatient facilities—with a 29.95% increase in pediatric hospitals versus a 23.8% increase in general hospitals.

Discussion

The socioeconomic burden of pediatric UTIs is large and increasing at a rapid rate in the United States. Recently, the National Institute of Diabetes and Digestive Kidney Diseases completed a project entitled "Urologic Diseases in America", to quantify the financial burden of urological disease on the American public [10]. As part of this project, Freedman published a comprehensive evaluation of the influence of pediatric UTIs on healthcare expenditure [6]. This detailed study also accessed a HCUP database, the Nationwide Inpatient Sample (NIS), to analyze trends in inpatient UTI management during the mid- to late-1990s and 2000. As a complimentary follow-up to this study, we accessed an alternative HCUP database, the KID, to analyze trends in inpatient pediatric UTI management and healthcare expense over the last decade. Although the NIS and KID are both powerful databases that capture a large national sample size, the KID is unique in that it serves as the only all-payer inpatient care database for children in the United States [8]. Therefore, our

results, when used in conjunction with the findings published by Freedman, offer additional insight into the socioeconomic impact of pediatric UTIs.

Like Freedman, our data indicate that children with UTIs frequently seek medical attention. Over the last 20 years, both NIS and KID data indicate that UTIs are one of the most common pediatric infections that require hospitalization. When comparing the number of admissions for UTIs with the number of admissions for the most common infection-related diagnoses in the KID, annual UTI admissions do not trail far behind admissions for respiratory infections (i.e. pneumonia and bronchiolitis) or soft tissue infections. Since 2000, inpatient admission rates (50,000 admissions/year) and lengths of hospitalization (3.1 days± 0.1 days) have remained fairly consistent.

Our data indicate that age and gender define differences in inpatient UTI management. The KID data suggest that girls are more likely to require hospitalization than boys. These results are consistent with historical UTI demographics that date back to the 1960s [11, 12]. Moreover, KID data suggest that children less than 1 year of age are nearly 2.5 times more likely to receive inpatient care than older children. This finding is reinforced in several community studies that indicate children less than 1 year of age are at greater risk of developing UTIs than older children [12, 13]. Multiple underlying factors may contribute to this age group discrepancy. Because infants do not typically present with the classic symptoms of a UTI and/or pyelonephritis, there may be a delay in their diagnosis. Consequently, younger patients may be more likely to develop complicated UTIs, bacteremia, or sepsis that necessitates aggressive inpatient management. Moreover, infants with UTIs are more likely than older children to present with underlying congenital genitourinary malformations that require additional inpatient evaluation [14, 15]. In boys, this difference may be a reflection of whether or not the child is circumcised. Uncircumcised infants have been shown to be at greater risk of developing UTIs that require hospitalization than circumcised boys [16, 17]. Although infants are more likely to be admitted with a UTI than older children, it should be noted that approximately 5,000 to 10,000 children in each of the older age groups are admitted annually with a UTI. Therefore, UTIs definitely contribute to patient morbidity and healthcare expense across the entire pediatric age range.

The KID data also suggest that children living in urban environments or impoverished households have higher hospitalization rates for UTIs. This trend is depicted in a 1988 AHRQ report by Millman et al. that indicates that persons living in low-income zip codes have nearly three times more UTI admissions per capita than wealthier zip codes [18]. In part, this may be a reflection of inadequate access to outpatient healthcare in impoverished communities. Because a larger proportion of hospital EDs are located near/in underserved urban environments, they may be more accessible to impoverished families than suburban office-based practices [19, 20]. In 2000, Freedman indicated that children with Medicaid visited EDs for UTI-related care 2.8 times more frequently than children with commercial insurance [6]. As outlined in prior studies, when larger volumes of patients are evaluated in hospital EDs, admission rates tend to increase [19, 21]. Unfortunately, overuse of EDs has been identified as a major factor contributing to increased federal healthcare expense [22, 23].

In attempt to offset rising healthcare expense, the United States federal government massively expanded Medicare and Medicaid coverage. In 1985, roughly 10 million children were enrolled in Medicaid; by 2000, this number had nearly doubled [24]. This trend is depicted in our data. Since 2000, there has been a 22% relative increase in the number of children admitted with UTIs who rely on Medicare/Medicaid as their primary payer. Conversely, there has been a rather pronounced reduction in the number of children who have commercial/private insurance. Several explanations may account for this significant shift in insurance coverage, but they cannot be justified by the KID data.

Even though Medicare/Medicaid expansions may limit the financial burden to its recipients, hospital charges continue to increase. From 2000 to 2006, KID data indicate that hospital charges for UTI management outpaced hospital CMS-allowable costs. In 2006, national aggregate hospital charges exceeded $520 million. While these increases do not imply that hospital reimbursements have increased, they do reflect inflation in pediatric hospital charges relative to CMS-allowable costs. When coupling increased hospital costs with national insurance coverage changes, important questions arise about healthcare policy in the USA—primarily whether the composition of insurance coverage affects hospital-charging practices.

In an attempt to offset rising hospital charges for UTI admissions, physicians need to promptly recognize, evaluate, and appropriately treat a suspected UTI. A complete history and physical examination are just as critical in the evaluation of a child with a suspected UTI as laboratory studies. Recent studies have focused on understanding the patient population and assessing the likelihood of the patient having a UTI [15, 25]. If this is done, an appropriate and timely evaluation can be implemented that minimizes morbidity, excessive testing, treatment delay, and/or unnecessary hospitalization.

Delayed treatment, inappropriate treatment, and unnecessary treatment/hospitalization are major factors contributing to increased healthcare costs [25, 26]. Potential methods of reducing costs for pediatric UTI healthcare include:

1. Increased dependence on outpatient management
2. More appropriate utilization of oral antibiotic therapy (compared with more expensive parenteral therapy)
3. Limiting unnecessary usage of prolonged courses of antibiotic therapy
4. Minimizing the use of prophylactic antibiotics

Studies of children with UTIs greater than 1 month of age have demonstrated that treatment with parenteral antibiotics in an outpatient setting is safe and effective [27–30]. Moreover, several multicenter, randomized trials have concluded that treatment with oral antibiotics is equally as effective as treatment with intravenous antibiotics [31–33]. To this end, Hoberman et al. demonstrated that mean charges and costs for inpatient UTI therapy are at least twice as high as those for outpatient therapy [31]. Therefore, inpatient UTI management should be reserved for young infants, children with unstable vital signs, severe dehydration, and/or concerns regarding sepsis.

A number of studies have compared short-course and/or single-dose antibiotic therapy with standard therapy for UTIs with mixed results [34–37]. The American Academy of Pediatrics currently recommends a 7- to 14-day course of antibiotic therapy for all children 2 months to 2 years of age with a UTI [38]. However, we were unable to find any evidence that suggests a longer course of antibiotic therapy (11–14 days) is more effective than a shorter course of therapy (7–10 days) in the treatment of pediatric UTIs. Multiple studies demonstrate that a short course of antibiotic therapy has low rates of reinfection and treatment failure [39–41]. Thus, in many situations, widespread adoption of a shorter treatment course would deliver effective and less costly care. Further research to identify the efficacy of even shorter treatment courses in other subsets of children will help determine the most cost-effective and safe treatment regimen.

For many years, long-term antibiotic prophylaxis has been recommended for children at risk of UTIs [38, 42]. This standard has recently been challenged. Within the last 5 years, four published multicenter trials evaluated the efficacy of continuous antimicrobial prophylaxis and showed no reduction in the incidence of recurrent UTIs [43–46]. However, two recent multicenter trials from Australia and Sweden demonstrated a limited effectiveness of antibiotic prophylaxis in reducing the incidence of recurrent UTIs. These results suggest that prophylactic antibiotics may be useful only in particular subsets of children with UTIs [47, 48]. Broad use of antibiotic prophylaxis for all children with a UTI and vesicoureteral reflux (VUR; e.g. low-grade VUR) is not supported by published data and suggests that this area can be another possible avenue for reducing unnecessary healthcare costs [45–47, 49].

Although the KID is a comprehensive and powerful database that captures over 6.5 million annual pediatric hospitalizations, we acknowledge that this study has several limitations. First, the KID does not provide complete financial and demographic data for participating hospitals, and it includes hospitals in only ~70% of states. Because our study population was identified using the AHRQ's CCS, we may have captured patients who were admitted to the hospital with additional and/or different presenting conditions (i.e. febrile neonates, admission to rule out sepsis, etc.). Also, there is a lack of appropriate data on race and ethnicity. The AHRQ notes that statewide reporting is inconsistent, making national racial/ethnic estimates unreliable. Additionally, financial data on hospital costs for medical services rendered are not readily available; thus, the total costs reported are estimated using hospital accounting reports from the CMS. Moreover, the costs reported only reflect the immediate costs of inpatient treatment and do not account for costs related to the management of underlying abnormalities, chronic sequelae, or loss of societal productivity. Finally, KID data are not available for primary payer reimbursements.

In conclusion, this study was designed to quantify and highlight the socioeconomic impact of pediatric UTIs in the USA. Our data confirm that UTIs are one of the most common pediatric infections that require hospitalization. Since 2000, UTIs represent nearly 2% of all pediatric hospitalizations. Hospitalization is more common in females and younger children. Over the last decade, hospital charges for inpatient UTI management have increased disproportionate to hospital costs. In 2006, US hospital charges for pediatric UTIs exceeded $520 million. As healthcare costs rise, more children are relying on public insurance

agencies to cover healthcare expense. These findings emphasize the need for continued research in the area of cost-effective strategies for the management of pediatric UTIs.

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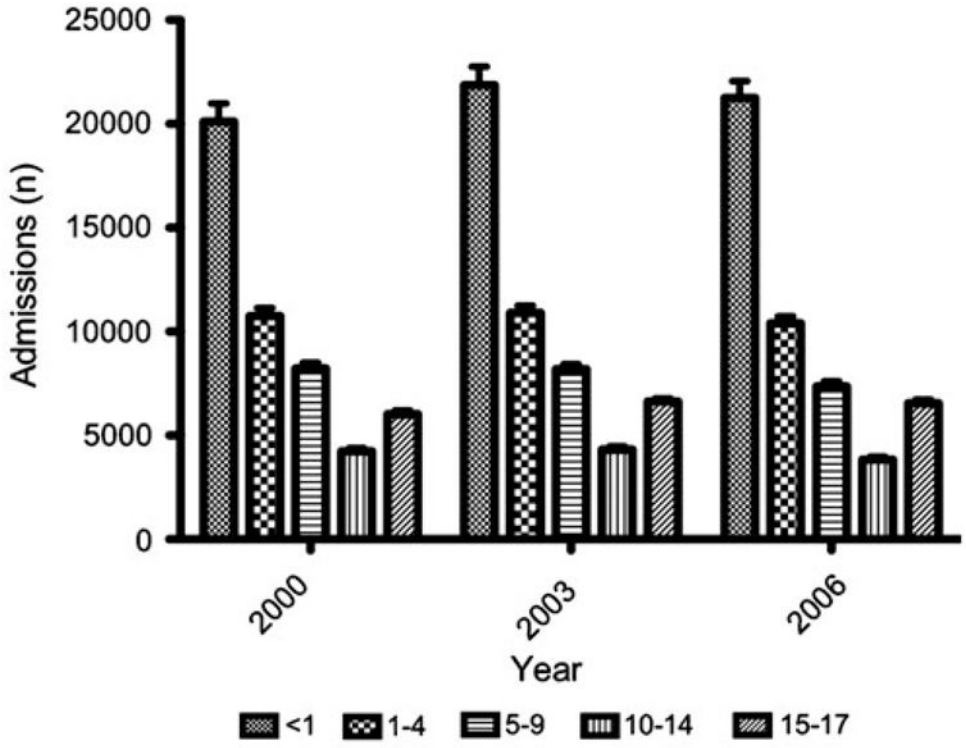

Fig. 1.
Number of annual urinary tract infection (UTI) admissions by age group

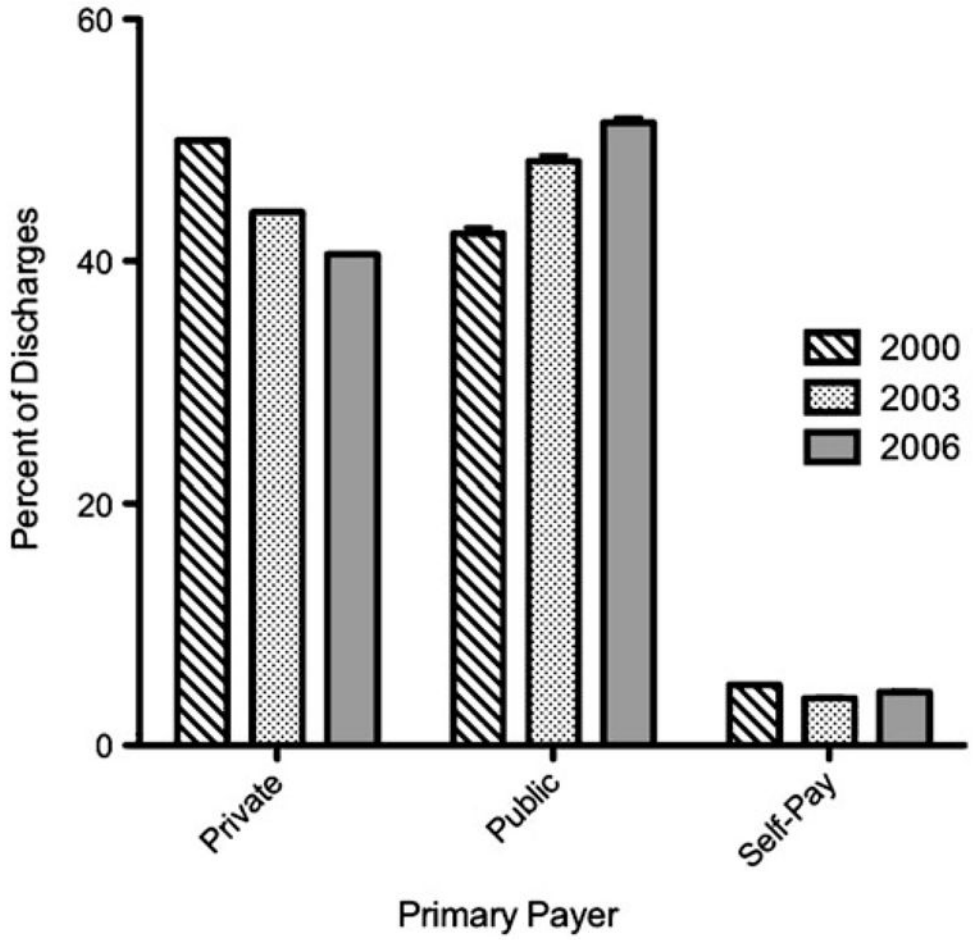

Fig. 2.
Coverage composition by primary payer

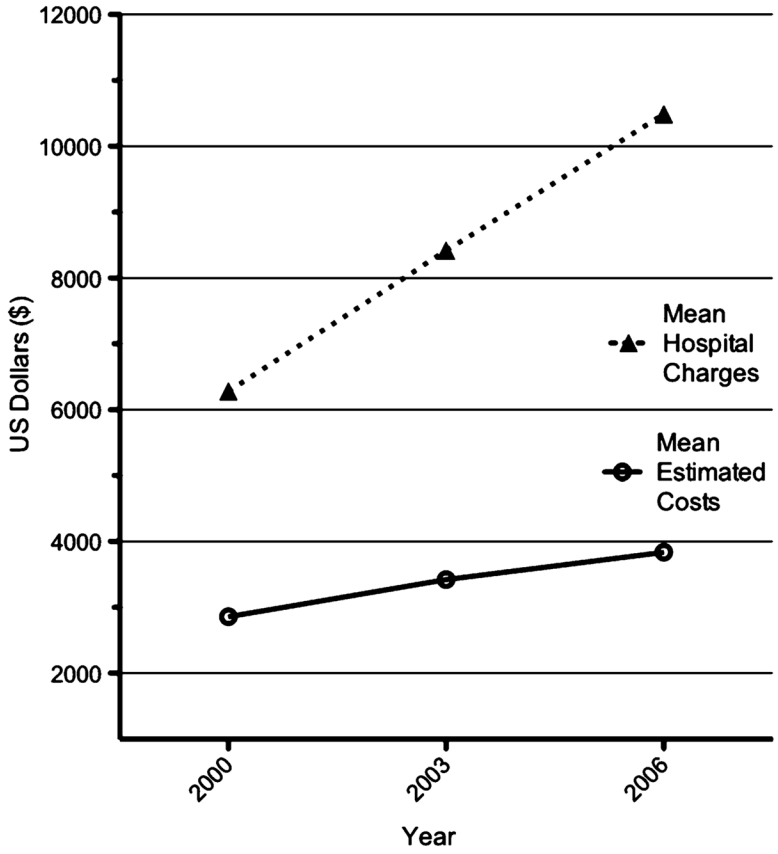

Fig. 3.
Trends in hospital charges and estimated costs from 2000 to 2006

Table 1

Number of hospitalizations for pediatric urinary tract infections (UTIs) by category

		2000	2003	2006
All admissions (SE)[a]		6,351,345 (122,677)	6,468,292 (109,915)	6,578,069 (112,712)
UTI admissions		49,338 (1,630)	51,899 (1,555)	49,397 (1,480)
Age group (years)	<1	20,114 (877)	21,863 (884)	21,255 (804)
	1–4	10,746 (396)	10,903 (351)	10,400 (328)
	5–9	8,222 (278)	8,186 (242)	7,355 (242)
	10–14	4,239 (157)	4,320 (146)	3,837 (138)
	15–17	6,016 (183)	6,627 (157)	6,549 (171)
Gender	Male	12,906 (643)	14,269 (651)	13,348 (573)
	Female	36,426 (1,131)	37,223 (996)	35,743 (984)
Region	Northeast	8,969 (763)	8,867 (633)	8,731 (574)
	Midwest	7,986 (788)	10,722 (767)	10,559 (808)
	South	20,963 (1442)	20,934 (1,364)	19,549 (1,293)
	West	11,420 (1,033)	11,378 (965)	10,557 (895)
Location	Rural	8,448 (301)	8,064 (302)	6,519 (233)
	Metropolitan	40,759 (1,602)	42,729 (1,557)	41,727 (1,491)

[a] Standard error reported by the Healthcare Cost and Utilization Project—Kids' Inpatient Database (HCUP-KID)