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Trends in Venous Thromboembolism-Related Hospitalizations, 1994–2009

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Abstract

OBJECTIVE—Information on trends in venous thromboembolism (VTE) in US children is scant and inconsistent. We assessed national trends in VTE-associated pediatric hospitalizations.

METHODS—All nonroutine newborn hospitalizations for children 0 to 17 years of age in the 1994–2009 Nationwide Inpatient Samples were included; routine newborn discharges were excluded. VTE diagnoses were identified by using the *International Classification of Diseases, Ninth Revision, Clinical Modification* codes. Variance weighted least square regression was used to assess trends in patient characteristics and rates of hospitalization per 100 000 population <18 years of age. Multivariable logistic regression models were used to estimate the probability of VTE diagnosis over the study period.

RESULTS—The rate of VTE-associated hospitalization increased for all age subgroups (<1, 1–5, 6–11, and 12–17 years), with the largest increase noted among children <1 year of age (from 18.1 per 100 000 during 1994 to 49.6 per 100 000 during 2009). Compared with 1994–1997, the adjusted odds of hospitalization with a VTE diagnosis were 88% higher during 2006–2009 (adjusted odds ratio: 1.88 [95% confidence interval: 1.64–2.17]). Venous catheter use, mechanical ventilation, malignancy, hospitalization ≥5 days, and VTE-related medical conditions were associated with increased likelihood of VTE diagnosis.

CONCLUSIONS—The rate of VTE-associated hospitalization among US children increased from 1994 through 2009. Increases in venous catheter procedures were associated with and may have contributed to the observed trends. The degree to which increased awareness of VTE influenced the temporal differences could not be determined.

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Dr Boulet conceived and designed the study; acquired, analyzed, and interpreted the data; and drafted the article. Dr Grosse contributed to the study concept, interpreted the data, and critically revised the article for important intellectual content. Drs Thornburg, Yusuf, Tsai, and Hooper interpreted the data and critically revised the article for important intellectual content.

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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Keywords

venous thromboembolism; venous thrombosis; pulmonary embolism; central venous catheterization; infant; child; adolescent

Venous thromboembolism (VTE) comprises deep vein thrombosis (DVT) and pulmonary embolism (PE) and is associated with significant morbidity and mortality in children.[1–3] Estimates of the annual incidence of VTE based on clinically validated diagnoses range from 0.7 to 2.1 per 100 000 children of all ages, with the highest risks noted among neonates and adolescents.[1,4,5] VTE in pediatric populations is frequently a complication of treatment of other chronic conditions.[3,6,7] Important risk factors for VTE in children include inherited or acquired predisposing conditions such as thrombophilia, malignancy, mechanical ventilation, surgery, trauma, congenital heart defects, and sepsis.[1,3–8] The presence of a central venous catheter is also common in association with pediatric VTE, particularly in neonates.[3,5,6,9] High rates of health service use and costs of care documented among children with VTE may be attributed to co-occurring conditions.[10]

To date, 3 studies have documented increases in the frequencies of DVT and PE diagnoses recorded in hospitalized US children,[9,11,12] and 1 study revealed no temporal changes during 1979–2001.[13] An increasing trend in the incidence of pediatric VTE during 2001–2006 was reported in a Danish study; however, the results did not reach statistical significance.[5] Despite evidence of an increasing trend in pediatric VTE, the potential impact of temporal changes in predisposing factors for VTE in US children has not been well described. Thus, the primary aim of the current study was to describe recent national trends in VTE-associated pediatric hospitalizations and concomitant temporal variations in selected factors associated with pediatric VTE.

METHODS

The data for this study were derived from the 1994–2009 Nationwide In-patient Sample (NIS), Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality.[14] The NIS is the largest national all-payer in-patient care database and contains information on hospital use, diagnoses, procedures, and charges for a 20% stratified sample of US community hospitals from participating states.[15] Approximately 5 to 8 million inpatient stays from ~1000 hospitals are included in each year of the NIS. The number of hospitals contributing data has increased over time; during 2009, the NIS was drawn from 44 states and encompassed ~96% of all US hospital discharges. Discharge sample weights were calculated within each sampling stratum; therefore, estimates for a nationally representative population can be computed. Detailed descriptions of the NIS sample design have been published.[16]

Discharges for children 0 to 17 years of age were included for each year (1994–2009). Discharges with VTE were identified by using the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) diagnosis codes (325, 451.11, 451.19, 451.2, 451.81, 451.83, 451.84, 452, 572.1, 453.0–453.3, 453.40–453.42, 453.8, 453.9, 415.1, 415.11, 415.12, and 415.19) in the primary or secondary positions. Pregnancy-

specific codes were not included in this analysis due to low positive predictive value (PPV).[17] Discharges identified as routine newborn care (diagnosis-related group 391 or Medicare severity diagnosis related group 795) were excluded from the analysis; these codes identify newly delivered infants without significant health problems. Selected risk factors for pediatric VTE included venous catheter procedures (38.93), mechanical ventilation (96.70–96.72), malignancy (140.0–172.9, 174.0–209.0), trauma (800.0–904.9, 925–929.0, 940.0–959.9, 733.1x), related medical conditions that have been found to be associated with pediatric VTE[10] (see Appendix), and length of hospitalization ≥5 days. Risk factor diagnoses listed in the primary or secondary positions were included.

Analyses were conducted by using SUDAAN 10 (Research Triangle Institute, Research Triangle Park, NC) with the application of appropriate weights to account for the complex sampling design. All results presented reflect nationally representative estimates. The percent distribution of sociodemographic (age at discharge, gender, and primary payer), medical (disposition of patient), and hospital characteristics (bed size, region, and urban/rural location) was estimated for all pediatric discharges with VTE during 1994–1997, 1998–2001, 2002–2005, and 2006–2009. The prevalence of VTE-associated risk factors during 1994–1997 and 2006–2009 were calculated for various age subgroups (<1 year, 1–5 years, 6–11 years, and 12–17 years) and compared by using 2-tailed Rao-Scott χ^2 tests. Estimates with relative SEs (RSEs) ≥50% were considered unstable and omitted; those with RSEs between 30% and 50% are statistically unreliable and were flagged in the tables.

The US Census Bureau provides annual estimates of the US resident population, which were used as denominators for all rate calculations. Age-specific rates were calculated by dividing the weighted frequencies of VTE-associated hospitalizations for each age group (<1, 1–5, 6–11, and 12–17) by the corresponding population estimates for each respective year. Age standardization was performed by direct standardization to the US population for all years. To validate our estimates of VTE-associated hospitalizations in another nationally representative inpatient database, we calculated age-standardized rates by using the 2000, 2003, and 2006 Kids' Inpatient Databases (KIDs)[18] and compared them with age-standardized rates for the NIS during the same years. The KID contains information on hospital use, outcomes, and charges for pediatric discharges (<20 years of age) from a stratified sample of community, non-rehabilitation hospitals in the United States. Systematic random sampling is used to select 10% of uncomplicated in-hospital births and 80% of other pediatric cases from each hospital in the sampling frame. Discharges are weighted to reflect the sampling scheme and permit the calculation of nationally representative estimates. To facilitate comparison, the 2000, 2003, and 2006 NIS and KID estimates were standardized to the 2000 US Census population <18 years of age by using the aforementioned age categorizes.

Multivariable logistic regression models were used to assess the likelihood of pediatric VTE diagnosis during 1998–2001, 2002–2005, and 2006–2009 compared with 1994–1997 after adjusting for age, gender, primary payer, region of hospital, location of hospital, venous catheter procedures, mechanical ventilation, malignancy, trauma, VTE-related medical conditions, and hospital stay of 5 days or longer.

All temporal trends were assessed by using variance-weighted regression. This method does not assume homogeneity of variance across the sample years; therefore, the computed *P* values take into account differing sample variances for each year. Curvilinear trends were tested but were found to be nonsignificant. Stata 11 (Stata Corp, College Station, TX) was used for this component of the analysis.

RESULTS

During 1994–2009 there were an estimated 56 147 044 discharges for children <18 years of age, after excluding routine newborn discharges; of those, 78 685 (0.14%) had a VTE diagnosis recorded (unweighted sample consisted of 11 335 454 and 15 940 discharges, respectively). No statistically significant temporal variations were noted in the distribution of total discharges stratified by age or in the distribution of extreme prematurity (ICD-9 code 765.0x) for discharges <1 year of age with and without VTE diagnosis, and the frequency of severe birth asphyxia (ICD-9 code 768.5) declined over the study period (data not shown). Overall, the age-adjusted rate of VTE-associated hospitalization increased from 4.7 per 100 000 during 1994 to 9.5 per 100 000 during 2009. Between 1994 and 2009, the rate of DVT-associated hospitalization increased from 4.4 to 9.2 per 100 000, and the rate of PE-associated hospitalization increased from 0.7 to 1.5 per 100 000. Increasing trends were also noted in the age-specific rates of VTE-associated hospitalization (Fig 1). The rate was highest among children <1 year of age and ranged from 18.1 per 100 000 during 1994 to 49.6 per 100 000 during 2009. The age-standardized rates of VTE-associated pediatric hospitalizations were comparable between the NIS and the KID with similar increases noted over time (Fig 2). For the NIS, the age-standardized rate increased from 5.1 per 100 000 during 2000 to 8.5 per 100 000 during 2006. Similarly, the corresponding rate of hospitalization in the 2000 and 2006 KID increased from 6.3 per 100 000 to 9.4 per 100 000, respectively.

Among those discharges with a VTE diagnosis, the proportion of renal vein thrombosis (RVT) and upper extremity DVT decreased by 60% and 15%, respectively, between 1994–1997 and 2006–2009 (Table 1). Reporting of lower extremity DVT increased from 7.8% of VTE-associated pediatric discharges during 1994–1997% to 30.2% during 2006–2009. A concurrent decline was noted in unspecified DVT during the same time period.

Table 2 depicts the distribution of patient and hospital characteristics of VTE-associated discharges in children. Between 1994–1997 and 2006–2009, the proportion of discharges <1 month of age increased from 12.7% to 16.2%. A temporal increase was also noted for the proportion of VTE-associated discharges whose primary payer was public insurance. The proportion of VTE-associated discharges transferred to home health care increased nearly twofold between 1994–1997 and 2006–2009, and a 55% decline was noted in the proportion of discharges admitted to a hospital in a rural location.

For all age subgroups, the proportion of VTE-associated discharges with report of venous catheter procedures increased approximately twofold between 1994–1997 and 2006–2009 (Table 3). Report of mechanical ventilation was highest for children <1 year of age (47.9% of VTE-associated discharges in 2006–2009) and increased significantly between 1994–

1997 and 2006–2009 for all age subgroups except those 6 to 11 years of age. Co-occurring malignancy increased from 9.7% to 16.7% among children discharged from the hospital who were 1 to 5 years of age and from 8.9% to 13.9% among children discharged from the hospital who were 12 to 17 years of age. The frequency of concurrent medical conditions and hospitalization ≥5 days increased significantly between 1994–1997 and 2006–2009 for children discharged from the hospital who were <1 year of age.

In the unadjusted and adjusted logistic regression models, the likelihood of pediatric VTE diagnosis was higher during 1998–2001, 2002–2005, and 2006–2009 compared with 1994–1997 (Table 4). The likelihood of VTE diagnosis increased with increasing age, and adolescents had the highest odds of having a VTE diagnosis when compared with children <1 year of age (adjusted odds ratio [aOR]: 6.25 [95% confidence interval (CI): 5.66–6.89]). Hospitalizations with coding indicative of venous catheter use were 3.5 times more likely to have a VTE diagnosis than those without such coding (aOR: 3.50 [95% CI: 3.28–3.73]), and those lasting 5 days or more were nearly 6 times more likely to have a VTE diagnosis compared with those lasting <5 days (aOR: 5.71 [95% CI: 5.38–6.05]). Mechanical ventilation, malignancy, and related medical conditions were also positively associated with pediatric VTE.

DISCUSSION

Our findings indicate that the rate of VTE-associated hospitalization in US children increased between 1994 and 2009 overall and among all age subgroups. Although other studies have documented increasing rates of pediatric VTE in hospitalized children,[9,11] the current study used a large, nationally representative data set to assess trends, as well as factors that may have contributed to temporal differences. A previous nationally representative study of VTE trends in US children used data from the 1979–2001 National Hospital Discharge Survey and revealed no significant patterns in the rate of hospitalization.[13] However, our findings and those from other more recent analyses indicate that the increase in pediatric VTE was most evident after 2001 and therefore may not have been captured in earlier years of data. Furthermore, we report a 102% increase in the rate of VTE-associated hospitalization between 1994 and 2009, which is consistent with the 73% increase reported by Raffini et al[11] during 2001–2007 for a sample of children's hospitals.

We found significant declines in the proportion of RVT, upper extremity DVT, and unspecified or other DVT during the study period. The reason for the 60% decline in RVT is unclear. RVT is more prevalent in neonates than older children[19]; therefore, an increase in prevalence would be expected given the substantial increase in the rate of VTE-associated hospitalization among children <1 year of age. However, because RVTs are less commonly catheter related,[19] the observed rise in venous catheter procedures among infants would not have impacted the prevalence of this condition. When stratified by age, there was a significant decrease in RVT among infants, whereas the proportion for all other ages remained stable (data not shown). One potential explanation may be that improvements in antenatal care led to decreases in other risk factors for RVT and thus a consequent decline in RVT prevalence. Other contributing factors may include improvements in the management of gestational diabetes and polycythemia or changes in practice related to positioning of the

umbilical venous catheter. The decline in upper extremity DVT was small (15%) and only significant among children 6 years and older (data not shown); changes in central venous line location and insertion techniques or coding practices may explain the decline. The decrease in unspecified or other DVT is likely explained by the addition of new ICD-9-CM codes for lower extremity VTE (453.40–453.42) in 2004. The concomitant increase in lower extremity DVT substantiates this hypothesis.

Consistent with other studies,[1,4,7,9,12] the majority of children with a VTE-associated hospitalization between 1994 and 2009 had a concurrent risk factor. Although the prevalence of related medical conditions was higher than the prevalence of venous catheter use in all age strata, the relative increase in the use of venous catheter procedures over the study period was greater, with an approximate twofold increase observed for all ages. Between 2006 and 2009, we found 19% to 47% of VTE-associated hospitalizations had concurrent report of venous catheter procedures. A previous study revealed short-term central venous catheters in 49% of VTE cases and 27% of controls, suggesting that an increase in venous catheter procedures would be directly related to an increase in VTE-associated hospitalizations.[8]

Our findings should be interpreted in the context of several limitations. First, because VTE diagnoses were identified byICD-9-CM codes and were not validated by using medical records, it is likely that some misclassification occurred. Although the validity of ICD-9-CM codes for identifying VTE in US children has not been established, studies in adults reveal a PPV of ~75%.[20] The authors of a Danish study evaluated the validity of code-based pediatric VTE diagnoses and compared *International Classification of Diseases, 10th Revision* codes with medical records and found an overall PPV of 54%.[21] The implication is that roughly half of pediatric VTE diagnoses in administrative hospital discharge data may be false-positives. That implication is supported by the fact that the apparent incidence of VTE using hospital discharge data, 5 to 9 per 100 000, is higher than the rate of validated pediatric VTE diagnoses, 0.7 to 2.1 per 100 000.[1,4,5] Although the specificity of ICD-9 codes for identifying VTE in children is suboptimal for surveillance, the sensitivity has been estimated to be 77%[22]; thus, administrative data can still provide valuable information on long-term trends in diagnosis. It should be noted that false-negatives may also impact estimates of pediatric VTE derived from ICD-9 codes, particularly for children with multiple comorbid conditions. In the Danish study, higher predictive values were associated with diagnoses assigned by wards, primary diagnoses, a hospital stay of 3 or more days, and diagnoses in neonates and adolescents.[21]

Second, the NIS includes information on hospital discharges, not individuals. As such, there is no way to account for multiple hospitalizations for the same child, and the results may represent overestimates of the actual trends in VTE-associated hospitalizations in children. However, given the significance of our findings (*P* values for trend <.001) and the consistency with results from other studies, it is unlikely that adjustment for multiple hospitalizations would substantially alter our conclusions about increasing trends in pediatric VTE.

Third, it is possible that changes or improvements in coding practices resulted in increased reporting of pediatric VTE over the study period. A substantial increase in the rate of VTE was noted during 2004 and 2005, which may be due to improved awareness of the condition as a result of ICD-9 coding changes implemented in 2004. Increased awareness of VTE in children and greater use of non-invasive imaging tests for suspected VTE may have also contributed to the observed trends. For example, studies in adults have indicated significant increases in the reported incidence of PE in hospitalized patients after the introduction of computed tomographic pulmonary angiography to test individuals with symptoms suggestive of PE.[23]

Finally, because several states included in the NIS did not report information on race, we were unable to assess the potential contribution of this factor to the observed trends. In addition, we were not able to examine the influence of change over time in the participation of pediatric tertiary care centers in the NIS sample because this information is not available on the public use files. Recent NIS comparison reports issued by the Agency for Healthcare Research and Quality indicate that there is evidence of fluctuation in the composition of the sample of hospitals but no apparent trend in the share of pediatric specialty hospitals, which varied between 1.0% and 1.8% of hospitals during the 2002 to 2007 period.[24–28] In any single year, such hospitals may be under or overrepresented, but this is unlikely to have any effect on the 4-year averages used in our analysis.

CONCLUSIONS

Using data from a large, nationally representative sample, we demonstrated an increasing trend in the rate of VTE-associated hospitalization among US children, with the highest relative increases noted among children <1 year of age and those 12 to 17 years of age. Compared with 1994–1997, there was a 1.9-fold increase in the likelihood of VTE-associated hospitalization during 2006–2009; however, it is not possible to determine whether the increase represented a true increase in pediatric VTE or increased awareness of the condition.

Although it could not be directly quantified in the current study, advances in the care and survival of critically ill children almost certainly contributed to the reported increases in VTE diagnosis; indeed, we found that the proportion of infants hospitalized for 5 days or longer increased over the study period. Corresponding improvements in awareness of VTE and use of non-invasive tests for the diagnosis of VTE in pediatric populations likely account for a substantial proportion of the observed trends. Concomitant increases in the use of venous catheter procedures may also partially explain the increased rate of VTE diagnosis.

Additional research is needed to evaluate and monitor trends in inherited and acquired risk factors for pediatric VTE. Although administrative data can provide some insight in this regard, there is a growing need for US studies that use medical records to validate the presence of VTE codes in large samples of pediatric hospital discharges. In addition, collaborative cohort studies are needed to assess temporal variations in pediatric VTE and to

inform preventive and therapeutic approaches for optimizing immediate and long term health outcomes.

Acknowledgments

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ABBREVIATIONS

aOR	adjusted odds ratio
CI	confidence interval
DVT	deep vein thrombosis
ICD-9	*International Classification of Diseases, Ninth Revision*
ICD-9-CM	*International Classification of Diseases, Ninth Revision, Clinical Modification*
KID	Kids' Inpatient Database
NIS	Nationwide Inpatient Sample
PE	pulmonary embolism
PPV	positive predictive value
RSE	relative SE
RVT	renal vein thrombosis
VTE	venous thromboembolism

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WHAT'S KNOWN ON THIS SUBJECT

Findings from 3 studies suggest that the diagnosis of venous thromboembolism in hospitalized US children has increased in recent years.

WHAT THIS STUDY ADDS

This study provides additional evidence of an increasing trend in the rate of venous thromboembolism-associated hospitalization in US children, as well as a concurrent increase in the prevalence of venous catheter procedures.

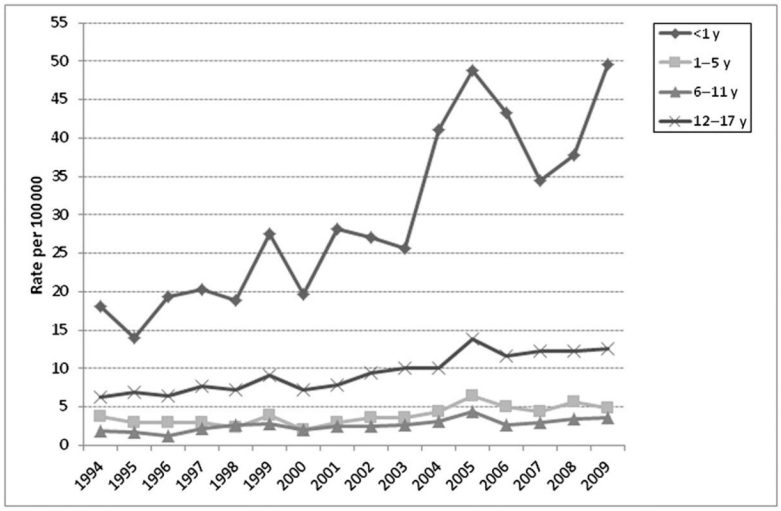

FIGURE 1.

Age-specific rates of VTE-associated hospitalization among US children <1 year, 1–5 years, 6–11 years, and 12–17 years, 1994–2009 NIS. *P* value for trend <.001 for all age strata.

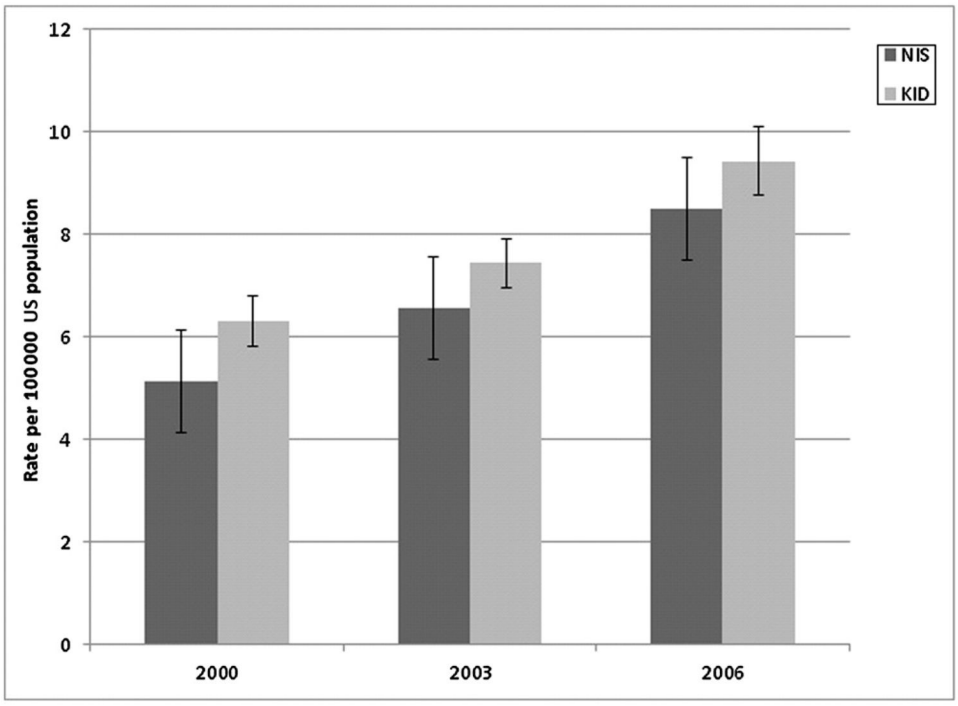

FIGURE 2.

Comparison of age-standardized rates of VTE-associated hospitalizations among US children <18 years of age, 2000, 2003, and 2006 NIS and KID. Standardized to 2000 US Census population <18 years of age; error bars represent SE of estimates. *P* value for 3-year trend was .02 for NIS and <.001 for KID. No significant difference ($P \geq .05$) between rates of hospitalization for NIS and KID during 2000, 2003, and 2006.

TABLE 1

Trends in VTE Type Among VTE-Related Discharges, US Children <18 Years of Age, 1994–2009 NIS

ICD-9-CM Code(s)	VTE Type	1994–1997, *N* = 13 040, %	1998–2001, *N* = 15 889, %	2002–2005, *N* = 23 347, %	2006–2009, *N* = 26 408, %	*P*[a]
DVT						
325	Intracranial venous sinuses	6.6	7.8	8.1	7.3	.26
452, 572.1	Portal vein	7.1	5.1	5.9	6.5	.39
453.3	Renal vein	4.7	2.8	2.4	1.9	<.001
453.2	Vena cava	9.0	8.3	8.0	7.6	.26
451.83, 451.84	Upper extremities	7.5	8.9	7.0	6.0	.005
451.1, 451.11, 451.19, 453.40, 453.41, 453.42	Lower extremities	7.8	5.9	13.0	30.2	<.001
451.81, 451.89, 451.9, 453.0, 453.1, 453.8x, 453.9	Unspecified or other	49.3	53.7	50.0	35.4	<.001
PE						
415.11, 415.12, 415.19	PE	14.0	14.3	13.8	15.1	.37

[a] *P* value for trend.

TABLE 2

Patient and Hospital Characteristics of VTE-Associated Discharges, US Children <18 Years of Age, 1994–2009 NIS

	1994–1997, *N* = 13 040, %	1998–2001, *N* = 15 889, %	2002–2005, *N* = 23 347, %	2006–2009, *N* = 26 408, %	*P*[a]
Age categories					
<1 mo	12.7	15.5	16.9	16.2	.006
1 mo–11 mo	8.2	7.4	7.5	9.2	.35
1–5 y	19.0	13.8	15.2	15.3	.55
6–11 y	12.5	15.5	13.0	11.4	.55
12–17 y	47.7	47.8	47.4	47.8	.99
Gender					
Boy	52.7	52.9	51.3	52.9	.98
Girl	47.3	47.1	48.9	47.1	.98
Primary payer					
Public	40.5	34.8	43.2	43.7	.01
Private	50.2	58.5	50.0	49.4	.05
Self-pay	3.9	3.0	2.2	2.4	.03
Other	5.4	3.7	4.6	4.5	.85
Disposition of patient					
Death in hospital	5.8	4.5	4.4	4.7	.58
Routine discharge	73.4	74.9	71.5	68.0	.002
Transfer to short-term hospital	5.7	6.7	5.2	6.5	.76
Other transfers[b]	5.9	4.3	4.3	4.4	.20
Home health care	8.7	9.5	14.3	16.2	<.001
Other[c]	0.5	0.1[d]	0.3	0.1[d]	.38
Hospital bed size					
Small	14.7	18.9	14.0	13.5	.50
Medium	18.6	24.3	26.1	19.3	.50
Large	66.7	56.7	59.9	67.2	.79
Region of hospital					
Northeast	17.3	20.8	17.1	19.3	.88
Midwest	26.3	23.5	21.5	20.3	.28

	1994–1997, *N* = 13 040, %	1998–2001, *N* = 15 889, %	2002–2005, *N* = 23 347, %	2006–2009, *N* = 26 408, %	*P*[a]
South	39.1	32.6	42.3	36.0	.85
West	17.3	23.1	19.0	24.4	.36
Hospital location					
Urban	92.4	94.2	96.2	96.6	.002
Rural	7.6	5.8	3.8	3.4	.002

[a] *P* value for trend.

[b] Other transfers include skilled nursing facility, intermediate care, and another type of facility.

[c] Other disposition includes left against medical advice and discharged alive, destination unknown.

[d] 50% > RSE > 30%.

TABLE 3

Concurrent Medical Conditions and Procedures Among VTE-Associated Discharges, US Children <18 Years of Age, 1994–1997 and 2006–2009 NIS

	<1 y		1–5 y		6–11 y		12–17 y	
	1994–1997, *N* = 2715, %	2006–2009, *N* = 6729, %	1994–1997, *N* = 2472, %	2006–2009, *N* = 4044, %	1994–1997, *N* = 1628, %	2006–2009, *N* = 3014, %	1994–1997, *N* = 6222, %	2006–2009, *N* = 12 619, %
Venous catheter procedures	22.8	46.6[a]	20.4	34.2[a]	14.0	29.1[a]	10.4	19.2[a]
Mechanical ventilation	40.4	47.9[a]	14.4	21.1[a]	9.9	14.1	6.2	8.2[a]
Malignancy	—	1.4[b]	9.7	16.7[a]	17.5	22.1	8.9	13.9[a]
Trauma	2.0	2.9	5.4	6.3	7.6	6.0	12.2	10.8
Related medical conditions[c]	46.8	57.5[a]	49.2	52.9	45.2	44.3	30.6	34.4
Hospitalized ≥ 5 d	84.7	89.4[a]	71.2	76.3	68.9	69.0	72.8	63.0[a]

Em dash indicates RSE ≥ 50%, estimate unstable.

[a] Rao-Scott χ^2 $P < .05$ comparing distribution of variable during 1994–1997 versus distribution during 2006–2009.

[b] 50% > RSE > 30%.

[c] Related medical conditions include septicemia, Behçet syndrome, polycythemia, cystic fibrosis, sickle cell disease, motor neuron disease, quadriplegia, paraplegia, hemiplegia, cerebral palsy, monoplegia of lower limb, peroneal muscular atrophy, otitis media, mastoiditis, pneumonia, influenza, regional enteritis, ulcerative colitis, nephrotic syndrome, chronic renal disease, urinary tract infection, systemic lupus erythematosus, rheumatoid arthritis, and congenital heart disease.

TABLE 4

Estimated ORs for VTE-Associated Discharge, US Children, 1994–2009 NIS

	OR	95% CI
Unadjusted model		
Year of discharge		
1994–1997	Referent	Referent
1998–2001	1.29	1.07–1.54
2002–2005	1.85	1.54–2.22
2006–2009	2.19	1.79–2.68
Adjusted model (adjusted for all covariates)		
Year of discharge		
1994–1997	Referent	Referent
1998–2001	1.19	1.05–1.35
2002–2005	1.55	1.36–1.76
2006–2009	1.88	1.64–2.17
Age, y		
<1	Referent	Referent
1–5	2.32	2.12–2.54
6–11	2.95	2.68–3.25
12–17	6.25	5.66–6.89
Gender		
Boy	1.05	1.01–1.09
Girl	Referent	Referent
Primary payer		
Public	1.14	1.08–1.20
Private	Referent	Referent
Self/other	0.98	0.89–1.08
Region of hospital		
Northeast	Referent	Referent
Midwest	1.07	0.91–1.25
South	1.08	0.92–1.26
West	1.10	0.92–1.32
Location of hospital		
Urban	1.61	1.33–1.95
Rural	Referent	Referent
Venous catheter procedures		
Yes	3.50	3.28–3.73
No	Referent	Referent
Mechanical ventilation		
Yes	2.21	2.08–2.36
No	Referent	Referent
Malignancy		

	OR	95% CI
Yes	2.41	2.20–2.64
No	Referent	Referent
Trauma		
Yes	0.96	0.89–1.03
No	Referent	Referent
Related medical conditions[a]		
Yes	2.13	2.03–2.24
No	Referent	Referent
Hospitalized ≥5 d		
Yes	5.71	5.38–6.05
No	Referent	Referent

[a]Related medical conditions include septicemia, Behçet syndrome, polycythemia, cystic fibrosis, sickle cell disease, motor neuron disease, quadriplegia, paraplegia, hemiplegia, cerebral palsy, monoplegia of lower limb, peroneal muscular atrophy, otitis media, mastoiditis, pneumonia, influenza, regional enteritis, ulcerative colitis, nephrotic syndrome, chronic renal disease, urinary tract infection, systemic lupus erythematosus, rheumatoid arthritis, and congenital heart disease.

APPENDIX

Frequency of Selected Medical Conditions Among Pediatric Discharges With and Without VTE, 1994–2009 NIS

ICD-9-CM Code(s)	Related Medical Condition	Discharges With VTE, % (SE)	Discharges Without VTE, % (SE)
038.x, 995.91–995.92	Septicemia	11.45 (0.40)	1.68 (0.04)
136.1	Behcet syndrome	0.09 (0.03)[a]	0.003 (0.0005)
238.4	Polycythemia	0.12 (0.03)[a]	0.01 (0.0005)
277.0	Cystic fibrosis	1.04 (0.12)	0.28 (0.02)
282.6, 282.41–282.42	Sickle cell disease	1.92 (0.21)	0.85 (0.05)
335.2	Motor neuron disease	—	0.006 (0.0009)
344.0, 344.1	Quadriplegia/paraplegia	1.06 (0.11)	0.12 (0.006)
342.x, 438.2	Hemiplegia	1.27 (0.10)	0.15 (0.009)
343.x	Cerebral palsy	1.74 (0.12)	0.98 (0.04)
344.3, 438.4	Monoplegia of lower limb	—	0.003 (0.0002)
356.1	Peroneal muscular atrophy	—	0.007(0.0005)
381.0x–381.2x, 381.3–381.4, 382.0x, 382.1–382.9	Otitis media	1.78 (0.11)	4.10 (0.07)
383.0x–383.1x, 383.9	Mastoiditis	1.37 (0.09)	0.10 (0.003)
480.x–483.x, 485.x–486.x, 487.x	Pneumonia, influenza (±pneumonia)	9.24 (0.29)	7.16 (0.09)
555.x	Regional enteritis	0.50 (0.06)	0.14 (0.006)
556.x	Ulcerative colitis	0.57 (0.08)	0.09 (0.004)
581.x, 585.x	Nephrotic syndrome, chronic renal disease	2.72 (0.18)	0.25 (0.02)
599.0	Urinary tract infection	5.20 (0.22)	1.74 (0.03)
710.0	Systemic lupus erythematosus	1.59 (0.14)	0.09 (0.005)
714.0	Rheumatoid arthritis	0.17 (0.03)	0.06 (0.002)
745.0–747.4	Congenital heart disease	12.47 (0.60)	3.79 (0.09)

Em dash indicates RSE ≥ 50%, estimate unstable.

[a] 50% > RSE > 30%.