

Acute Lymphocytic Leukemia–Related Inpatient Care Among Pediatric Patients in the United States

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BACKGROUND

- Acute lymphocytic leukemia (ALL), a cancer of the white blood cells, is the most common form of leukemia in children.¹
- The annual incidence rate of ALL in children is approximately 9 to 10 per 100,000, and the incidence peaks between the ages of 2 and 5 years.²
- Due to advances in therapy options, the overall survival rate after chemotherapy continues to increase, and the overall cure rate is approximately 80%.³
- Although prognosis has improved significantly over time, ALL likely continues to impose a significant economic burden on the health care system.

OBJECTIVE

- To document recent trends in pediatric ALL-related hospitalizations in the United States (US).

METHODS

Study Design

- Retrospective database analysis

Data Source

- Discharge data from the 1997, 2000, 2003, and 2006 Healthcare Cost and Utilization Project (HCUP) Kids' Inpatient Database (KID)
- KID is the largest all-payer pediatric (≤ 20 years of age) inpatient care database in the US
- KID is the only national pediatric hospital database with charge information on all patients, regardless of payer
- KID includes many clinical and nonclinical variables for each inpatient stay, including patient demographics, diagnosis codes, length of stay, total charges, admission and discharge status, and hospital-specific characteristics
- Sampling weights allow for generating nationally representative estimates

Inclusion Criteria

- Aged 20 years or younger
- A primary diagnosis of ALL (ICD-9-CM codes 204.0x)
- Unique patient identifiers were not provided, so patients who moved from facility to facility were not followed

Study Measures and Analytical Methods

For each of the 4 years:

- Weighted estimates of the number of hospitalizations related to ALL
 - Characteristics of ALL-related hospitalizations
 - Percentage of ALL-related hospitalizations with evidence of stem cell transplants (primary or nonprimary procedure)
 - Per-discharge total costs and length of stay (LOS) for ALL-related hospitalizations
 - Cost-to-charge ratios are not available for the 1997 and 2000 KID files
 - Charge data for all 4 years converted to costs by multiplying by 0.50⁴
 - Top procedures performed during ALL-related hospitalizations
- All results were compared against hospitalizations not related to ALL. Analyses carried out using SAS® (Version 9) statistical software.

RESULTS

Incidence and Patient Characteristics (Table 1)

- Discharges related to ALL in the US (weighted):
 - 5,029 in 1997 (6.10/100,000 US pediatric population in 2010)
 - 5,504 in 2000 (6.61/100,000 US pediatric population in 2010)
 - 5,546 in 2003 (6.60/100,000 US pediatric population in 2010)
 - 5,611 in 2006 (6.62/100,000 US pediatric population in 2010)
- More male patients had ALL-related discharges (> 56% in each of the 4 years) than female patients. In comparison, more female patients had discharges unrelated to ALL than male patients.
- Nearly 70% of patients with ALL-related hospitalizations were younger than 10 years, with almost equal distribution between patients younger than 5 years and those between the ages of 5 and 10 years. On the other hand, 70% of hospitalizations unrelated to ALL were among patients younger than 5 years.
- Black patients accounted for 5.5% to 7.0% of ALL-related hospitalizations but 10.9% to 13% of hospitalizations unrelated to ALL.
- The proportion of ALL-related discharges was the greatest in the West, whereas the proportion of discharges unrelated to ALL was greatest in the South.
- A greater percentage of ALL-related hospitalizations had private insurance in each of the 4 years compared with discharges unrelated to ALL.
- The proportion of ALL-related hospitalizations with evidence of stem cell transplant remained unchanged at roughly 60% until a sharp increase in 2006 to 64.9%. Less than 25% of discharges unrelated to ALL had any evidence of stem cell transplants.

Admission Source and Discharge Disposition (Table 2)

- A slightly greater proportion of ALL-related hospitalizations originated in the emergency department (20.6%-29.5%) compared with hospitalizations unrelated to ALL (17.0%-19.7%).
- Approximately 94% of discharges unrelated to ALL and 84% of discharges related to ALL were routine discharges.
- The rate of death seen in ALL-related stays decreased from 4.10% in 1997 to 2.90% in 2006. The rate of death in stays unrelated to ALL was significantly less, and remained under 0.5% through the years.

Table 1. Characteristics, by ALL Status

Hospitalization Characteristics	1997				2000				2003				2006			
	Without ALL (N = 6,652,297)		With ALL (N = 5,029)		Without ALL (N = 7,285,533)		With ALL (N = 5,504)		Without ALL (N = 7,403,615)		With ALL (N = 5,546)		Without ALL (N = 7,553,202)		With ALL (N = 5,611)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Sex																
Male	3,311,398	49.78	2,893	57.53	3,408,654	46.79	3,199	58.12	3,474,851	46.93	3,128	56.40	3,535,348	46.81	3,239	57.72
Female	3,339,689	50.20	2,136	42.47	3,874,423	53.18	2,304	41.85	3,855,402	52.07	2,398	43.23	3,951,099	52.31	2,355	41.97
Missing/invalid	1,210	0.02	—	—	2,456	0.03	1	0.03	73,362	0.99	20	0.37	66,754	0.88	17	0.31
Age (years)																
< 5	5,066,007	76.15	1,873	37.24	5,079,650	69.72	1,970	35.78	5,184,987	70.03	2,005	36.15	5,332,146	70.59	2,036	36.29
5-10	447,806	6.73	1,786	35.51	406,815	5.58	1,710	31.07	426,215	5.76	1,795	32.36	400,212	5.30	1,596	28.45
11-15	460,289	6.92	942	18.73	446,376	6.13	995	18.07	459,292	6.20	947	17.07	436,144	5.77	1,032	18.40
16-20	678,194	10.19	429	8.52	1,345,752	18.47	828	15.04	1,293,401	17.47	788	14.21	1,347,845	17.84	930	16.57
Missing/invalid	—	—	—	—	6,940	0.10	2	0.04	39,721	0.54	12	0.21	36,854	0.49	16	0.29
Race																
White	2,842,079	42.72	2,252	44.77	3,399,044	46.65	2,685	48.77	2,744,654	37.07	2,160	38.95	2,832,286	37.50	2,258	40.24
Black	861,038	12.94	284	5.64	935,555	12.84	385	7.00	806,723	10.90	332	5.98	841,985	11.15	346	6.16
Hispanic	783,598	11.78	993	19.75	1,212,811	16.65	1,376	25.00	1,260,461	17.02	1,293	23.32	1,359,043	17.99	1,337	23.83
Other	335,706	5.04	314	6.23	497,331	6.83	372	6.77	508,446	6.86	454	8.16	527,013	6.98	472	8.41
Missing/invalid	1,829,875	27.51	1,186	23.59	1,240,792	17.03	686	12.46	2,083,331	28.14	1,308	23.58	1,992,876	26.38	1,198	21.36
Region																
Northeast	1,276,337	19.19	931	18.52	1,317,421	18.08	956	17.36	1,265,202	17.09	798	14.38	1,277,173	16.91	841	14.99
Midwest	1,499,348	22.54	892	17.74	1,542,606	21.17	785	14.27	1,663,746	22.47	1,191	21.47	1,646,593	21.80	1,119	19.94
South	2,329,234	35.01	1,229	24.44	2,716,139	37.28	1,863	33.85	2,786,963	37.64	1,816	32.74	2,895,014	38.33	1,947	34.70
West	1,547,377	23.26	1,976	39.30	1,709,368	23.46	1,901	34.52	1,687,703	22.80	1,742	31.41	1,734,421	22.96	1,703	30.36
Payer type																
Medicare	13,759	0.21	—	—	19,102	0.26	2	0.04	16,042	0.22	2	0.03	17,649	0.23	8	0.14
Medicaid	2,456,235	36.92	1,403	27.89	2,775,838	38.10	1,729	31.41	3,137,693	42.38	1,929	34.78	3,431,484	45.43	2,146	38.24
Private insurance	3,530,361	53.07	3,138	62.41	3,843,671	52.76	3,289	59.74	3,607,343	48.72	3,039	54.80	3,434,518	45.47	2,962	52.79
Other	629,882	9.47	475	9.43	613,986	8.43	470	8.52	629,944	8.51	561	10.11	656,046	8.69	490	8.76
Missing/invalid	22,059	0.33	14	0.27	32,937	0.45	16	0.30	12,593	0.17	16	0.30	13,505	0.18	3	0.06
Had stem cell transplant	15,454	0.23	3,029	60.23	16,576	0.23	3,343	60.72	16,358	0.22	3,350	60.41	17,079	0.23	3,644	64.95

Notes: Due to rounding, percentages and counts across categories may not sum correctly. Counts were weighted to obtain nationally representative estimates.

Table 2. Admission Source and Discharge Disposition, by ALL Status

Admission Source and Discharge Disposition	1997				2000				2003				2006			
	Without ALL (N = 6,652,297)		With ALL (N = 5,029)		Without ALL (N = 7,285,533)		With ALL (N = 5,504)		Without ALL (N = 7,403,615)		With ALL (N = 5,546)		Without ALL (N = 7,553,202)		With ALL (N = 5,611)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Admission source																
Emergency department	1,133,950	17.05	1,038	20.64	1,241,757	17.04	1,148	20.86	1,456,862	19.68	1,424	25.67	1,439,517	19.06	1,653	29.45
Another hospital	145,639	2.19	320	6.37	155,525	2.13	421	7.64	192,223	2.60	412	7.43	220,259	2.92	557	9.93
Other health facility, including long-term care	36,859	0.55	29	0.58	33,885	0.47	70	1.26	36,938	0.50	61	1.10	32,901	0.44	72	1.28
Court/law enforcement	7,039	0.11	—	—	8,635	0.12	—	—	7,000	0.09	—	—	6,239	0.08	—	—
Routine, including births and other sources	5,020,013	75.46	3,567	70.92	4,941,432	67.83	3,642	66.15	5,460,511	73.75	3,628	65.40	5,580,958	73.89	3,322	59.20
Unknown/missing	308,796	4.64	75	1.48	904,299	12.41	225	4.08	250,082	3.38	21	0.39	273,328	3.62	7	0.13
Disposition at discharge																
Routine	6,258,795	94.08	4,211	83.73	6,857,846	94.13	4,590	83.38	6,948,174	93.85	4,523	81.55	7,078,778	93.72	4,617	82.30
Transfer to short-term hospital	105,231	1.58	136	2.71	114,611	1.57	163	2.96	118,308	1.60	164	2.96	115,844	1.53	154	2.75
Transfer to other facility	58,616	0.88	27	0.54	65,521	0.90	40	0.73	63,549	0.86	29	0.52	72,787	0.96	38	0.69
Home health care	190,175	2.86	449	8.92	201,348	2.76	459	8.35	224,451	3.03	623	11.23	239,271	3.17	627	11.17
Against medical advice	10,736	0.16	—	—	16,606	0.23	10	0.18	17,334	0.23	5	0.09	16,730	0.22	8	0.14
Died	27,777	0.42	206	4.10	28,267	0.39	253	4.59	49,134	0.66	200	3.60	28,114	0.37	162	2.90
Unknown/missing	967	0.01	—	—	1,336	0.02	—	—	4,041	0.05	3	0.06	1,677	0.02	3	0.06

Notes: Due to rounding, percentages and counts across categories may not sum correctly. Counts were weighted to obtain nationally representative estimates.

Total Costs and LOS (Figures 1 and 2)

- Mean LOS remained consistent between 1997 and 2003 (12.07 days in 1997, 12.38 days in 2000, and 12.45 days in 2003) but increased to 13.63 days in 2006.
- In comparison, the mean LOS for discharges not related to ALL was significantly lower and ranged from 3.43 days in 1997 to 3.68 days in 2006.

Figure 1. Average Total Costs, by ALL Status

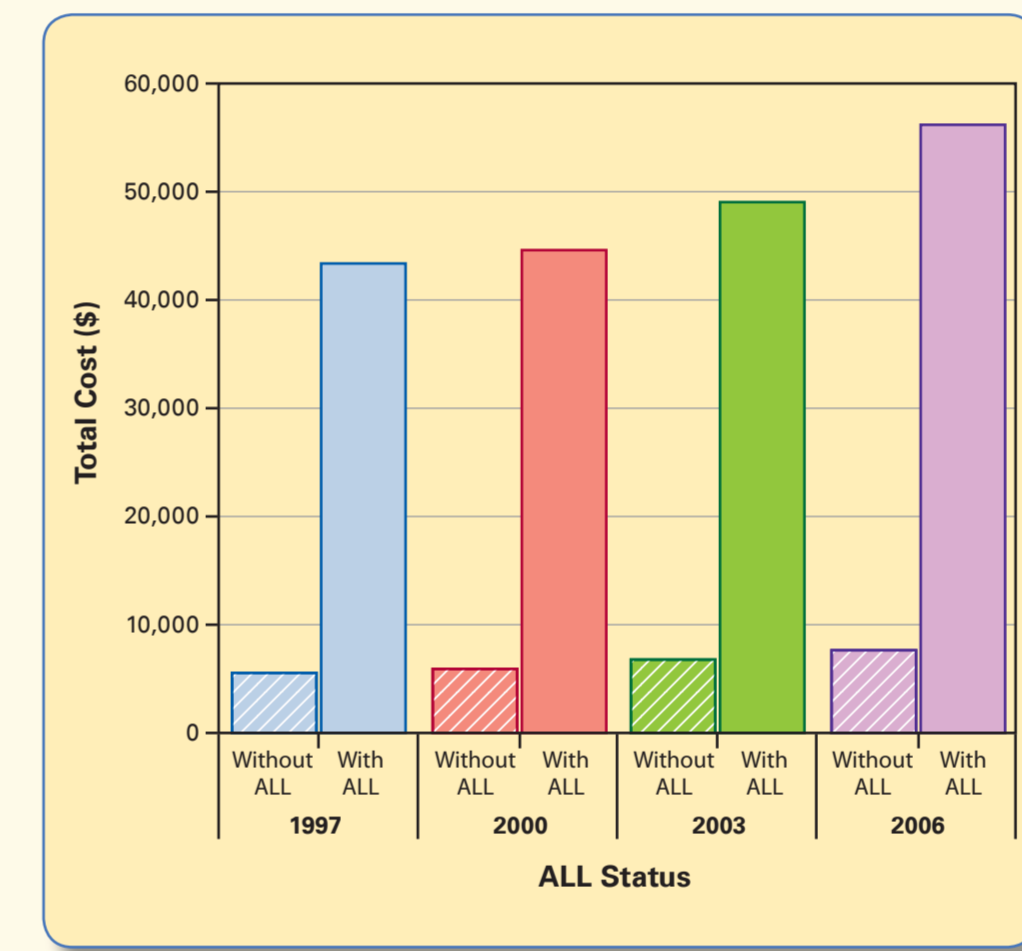
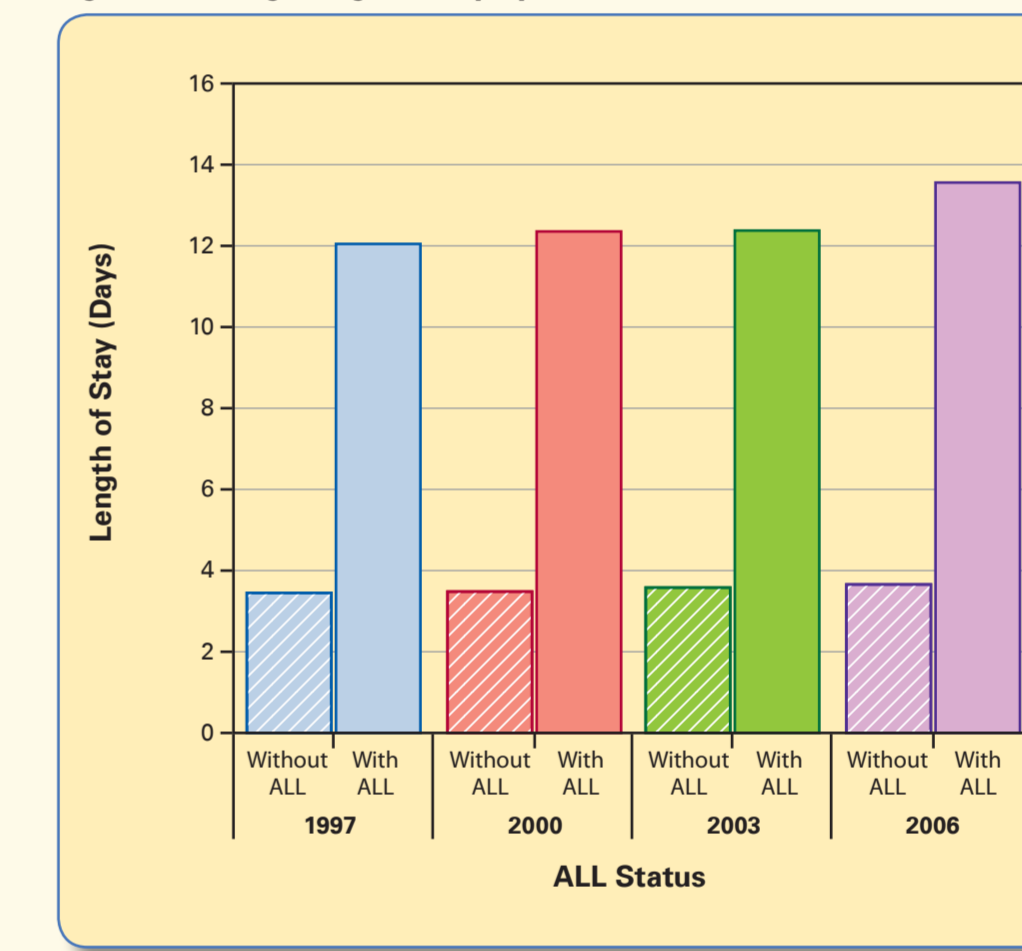


Figure 2. Average Length of Stay, by ALL Status



Top Five Procedures Performed During ALL-Related Hospitalizations (Table 3)

- Bone marrow biopsies were the top primary procedure observed during ALL-related hospitalizations across all 4 years (> 25% of discharges).
- Implantation of ports and chemotherapy infusions were the next most common procedures, and remained consistent across the 4 years.

Table 3. Top Five Primary Procedures Conducted During ALL-Related Hospitalizations

Procedure	1997 (N = 5,029)		2000 (N = 5,504)		2003 (N = 5,546)		2006 (N = 5,611)	
	Procedure	%	Procedure	%	Procedure	%	Procedure	%
Biopsy of bone marrow	Biopsy of bone marrow	25.95	Biopsy of bone marrow	27.86	Biopsy of bone marrow	26.36	Biopsy of bone marrow	27.75
Insertion of totally implantable vascular access device	Insertion of totally implantable vascular access device	19.81	Insertion of totally implantable vascular access device	15.00	Insertion of totally implantable vascular access device	15.90	Insertion of totally implantable vascular access device	13.87
Injection or infusion of cancer chemotherapeutic substance	Injection or infusion of cancer chemotherapeutic substance	13.24	Injection or infusion of cancer chemotherapeutic substance	14.09	Injection or infusion of cancer chemotherapeutic substance	11.81	Injection or infusion of cancer chemotherapeutic substance	12.38
Allogeneic bone marrow transplant without purging	Venous catheterization, not elsewhere classified	6.54	Venous catheterization, not elsewhere classified	6.13	Venous catheterization, not elsewhere classified	6.80	Transfusion of packed cells	6.94
Venous catheterization, not elsewhere classified	Injection of destructive agent into spinal canal	5.46	Incision of lung	4.77	Other shunt or vascular bypass	5.52		6.22

Note: Counts were weighted to obtain nationally representative estimates.

CONCLUSIONS

- Stem cell transplants were observed in most ALL-related hospitalizations.
- There was a slight increase in the rate of hospitalizations over time.
- An increase in LOS was seen in 2006, with a commensurate increase in total costs, possibly owing to a marked increase in the rate of stem cell transplant.
- These findings may be used to support access strategies (e.g., economic modeling efforts) for current ALL therapies, as well as for those in the developmental stage.