Surgery and Invasive Procedures at the End of Life for Pediatric Patients Diagnosed with Cancer: A Review of the Pediatric Health Information System Database

Mijo Hwang[1], Courtney Harris MD[2], Alexandria Robbins MD[3], Jonathan Roach MD[3,4], Anna Linton PA-C[3,4], Kristine Corkum MD[3,4]

1 University of Colorado School of Medicine; 2 Division of Pediatric Surgery, East Carolina University Brody School of Medicine; 3 Division of Pediatric Surgery, University of Colorado Anschutz Medical Campus; 4 Surgical Oncology Program, Children's Hospital Colorado

University of Colorado Anschutz Medical Campus

Background

- End-of-life (EOL) care for pediatric oncology patients often involves complex decision-making, particularly regarding surgical interventions.
- There is limited data on the frequency of interventions and characteristics of pediatric patients with a cancer diagnosis who undergo surgery near EOL.
- This study aimed to examine these aspects of EOL care using data from the Pediatric Health Information System (PHIS) database.

Methods

- Retrospective review of the PHIS database, spanning January 2015 to December 2023, focusing on pediatric patients (ages 0-21 years) with both a malignancy flag and a discharge mortality flag.
  - EOL was defined as within 72 hours of date of death
  - Timing of surgery and invasive procedures to death was identified using post-operative length of stay data
  - Age groups were categorized using American Academy of Pediatrics (AAP) definitions: infant/toddler, child, and adolescent
  - Utilized the complex chronic condition flags to identify patient co-morbidities
- Conducted descriptive analysis of demographic variables and employed Chi-square and Fisher's exact tests to examine associations between categorical variables.

Results

- 5,232 pediatric patients with cancer died in PHIS hospitals (Table 1).
- 1,648 patients (31.5%) underwent surgery or invasive procedure(s) at EOL (Table 2). 1,049 patients (63.7%) had an intervention on their day of death.
- There were no significant differences between those who did and did not undergo surgery or invasive procedure(s) at EOL by sex, admission category, or race.
- Non-Hispanic patients and infants/toddlers were more likely to undergo surgery or invasive procedure(s) at EOL than Hispanic patients and children/adolescents respectively.

Table 1 Demographic Characteristics of 5232 pediatric-aged patients with a cancer diagnosis who died in PHIS hosptials between 1/2015 and 12/2023

Characteristic	n	%
Sex		
Male	2846	54.4%
Female	2380	45.5%
Unknown	6	0.1%
Age, *years*		
median [IQR]	11	[4-16]
Age Category		
Infant/Toddler	1042	19.9%
Child	1851	35.4%
Adolescent	2339	44.7%
Ethnicity		
Hispanic or Latino	1440	27.5%
Not Hispanic or Latino	3540	67.7%
Other	252	4.8%
Race		
White	2885	55.1%
Black	830	15.9%
Asian	307	5.9%
Pacific Islander	48	0.9%
American Indian	15	0.3%
Other	912	17.4%
Length of Stay, *days*		
median [IQR]	17	[5-46]
Admission Category		
Emergent/Urgent	4084	78.1%
Elective	1005	19.2%
Other	143	2.7%
High-Intensity End of Life Factors		
ICU Stay	3813	72.9%
Mechanical Ventilation	3273	62.6%
ECMO	279	5.3%
TPN	2513	48.0%
Complex Chronic Conditions		
Cardiovascular	1930	36.9%
Gastrointestinal	1292	24.7%
Hematologic/immunologic	2663	50.9%
Metabolic	2292	43.8%
Congenital/genetic defect	379	7.2%
Renal/urologic	1524	29.1%
Respiratory	778	14.9%
Transplant	1443	27.6%
Neurologic/neuromuscular	1823	34.8%
Hospital Region		
Midwest	1284	24.5%
Northeast	846	16.2%
South	1772	33.9%
West	1330	25.4%
Hospital Location		
Urban	4476	85.6%
Not Urban	756	14.4%

Table 2 Description of 4186 operations and invasive procedures experienced by 1648 pediatric-aged patients with a cancer diagnosis within 72 hours of death

Category/Type of Operation or Procedure	n	%
Cardiovascular	1513	36.1%
Central Line Placement	642	
Arterial Line Placement	508	
ECMO	125	
Interventional Procedure	108	
Vascular Bypass/Repair	31	
Pericardial Drain	22	
Other	77	
Resuscitative Efforts	818	19.5%
Endotracheal Intubation	796	
Cardiopulmonary Resuscitation	22	
Neurologic/Neurosurgical	528	12.6%
EEG/EMG	160	
EVD Placement	153	
Intra-cranial Biopsy/Resection	102	
Lumbar Pucture/Drain	66	
Other	38	
VPS Placement	9	
Thoracic	381	9.1%
Chest Tube Placement	196	
Bronchoscopy	173	
Other	12	
Gastrointestinal	321	7.7%
Intra-abdominal Drainage	90	
Laparotomy-other	62	
Bowel Resection/Ostomy	58	
Endoscopy	51	
Feeding Device Insertion	35	
Liver Biopsy/Resection	17	
Other	8	
Renal/Urology	301	7.2%
Renal Replacement Therapy	261	
Foley Placement	22	
Cystoscopy	8	
Other	10	
Musculoskeletal/Soft Tissue	120	2.9%
Soft Tissue Exicision/Repair	65	
Muscle/Bone Biopsy/Resection	27	
Other	16	
Drainage Procedure	12	
ENT	107	2.6%
Excision/drainage	47	
Laryngoscopy	35	
Tracheostomy exchange	13	
Hemorrhage control	9	
Tracheostomy	3	
Hematology/Oncology	68	1.6%
Bone Marrow Biopsy/Aspirate	68	
Other	29	0.7%

Table 3 Complex Chronic Condition (CCC) and high-intensity end-of-life care comparision for pediatric-aged patients with a cancer diagnosis who died in PHIS hospitals between 1/2015 and 12/2023 who underwent an operation and/or procedure at end of life (within 72 hours of death) and those who did not

Complex Chronic Condition:	Operation at End of Life		No Operation at End of Life		p-value
Cardiovascular Flag					*<0.0001
Y	680	35.2%	1250	64.8%	
N	968	29.3%	2334	70.7%	
Gastrointestinal Flag					0.3353
Y	393	30.4%	899	69.6%	
N	1255	31.9%	2685	68.1%	
Hematologic/immunologic Flag					*0.0019
Y	891	33.5%	1772	66.5%	
N	757	29.5%	1812	70.5%	
Metabolic Flag					*<0.0001
Y	826	36.0%	1466	64.0%	
N	822	28.0%	2118	72.0%	
Congenital/genetic defect Flag					*0.0094
Y	142	37.5%	237	62.5%	
N	1506	31.0%	3347	69.0%	
Renal/urologic Flag					*<0.0001
Y	565	37.1%	956	62.9%	
N	1080	29.1%	2628	70.9%	
Respiratory Flag					*<0.0001
Y	199	25.6%	579	74.4%	
N	1449	32.5%	3005	67.5%	
Transplant Flag					0.4043
Y	442	30.6%	1001	69.4%	
N	1206	31.8%	2583	68.2%	
Neurologic/neuromuscular Flag					*<0.0001
Y	632	34.7%	1191	65.3%	
N	1016	29.8%	2393	70.2%	
Greater than 3 CCCs					*<0.0001
Y	768	34.5%	1459	65.5%	
N	880	29.3%	2125	70.7%	
High-Intensity EOL Care	**Operation at End of Life**		**No Operation at End of Life**		**p-value**
Mechanical Ventilation					*<0.0001
Y	1455	44.5%	1818	55.5%	
N	193	9.9%	1766	90.1%	
ECMO					*<0.0001
Y	179	64.2%	100	35.8%	
N	1469	29.7%	3484	70.3%	
TPN					0.9789
Y	792	31.5%	1721	68.5%	
N	856	31.5%	1863	68.5%	
ICU Stay					*<0.0001
Y	1432	37.6%	2381	62.4%	
N	216	15.2%	1203	84.8%	

- Patients with higher-intensity medical interventions, such as ICU admission, mechanical ventilation, and extracorporeal membrane oxygenation (ECMO) were more likely to undergo surgery or invasive procedure(s) at EOL (Table 3).
- Patients with certain complex chronic condition flags were more likely to have interventions near EOL compared to those without these flags (Table 3).
- Patients with a respiratory flag were less likely to undergo interventions at EOL than those without (Table 3).

Conclusions

- Over 30% of pediatric cancer patients who die in the hospital undergo surgery or an invasive procedure within 72 hours of death.
- The likelihood of surgery near EOL varies by co-morbid conditions, with those having complex chronic conditions being more likely to undergo surgery or an invasive procedure, except for those with respiratory conditions.
- Patients receiving high-intensity interventions, such as ICU care, mechanical ventilation, and ECMO, are more likely to have surgery or an invasive procedure near EOL.
- This study highlights the significant role of surgery in the EOL management of pediatric cancer patients, indicating a need for further research to assess the benefits and burdens of these interventions in this population.

References

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Disclosures

- None