PEDIATRIC CANCER IN IDAHO 2008-2017

May 2020

A Publication of the

ACKNOWLEDGMENTS

The Idaho Hospital Association (IHA) contracts with, and receives funding from, the Idaho Department of Health and Welfare, Division of Public Health, to provide a statewide cancer surveillance system: the Cancer Data Registry of Idaho (CDRI).

The statewide cancer registry database is a product of collaboration among many report sources, including hospitals, physicians, surgery centers, pathology laboratories, and other states in which Idaho residents are diagnosed or treated for cancer. Their cooperation in reporting timely, accurate, and complete cancer data is acknowledged and sincerely appreciated.

CDRI would also like to thank the Division of Public Health, Idaho Department of Health and Welfare, and the Comprehensive Cancer Alliance for Idaho for their continued partnership and for using CDRI data as a tool in cancer control and prevention.

This report has been funded in whole or in part with Federal funds from the National Cancer Institute, National Institutes of Health, Department of Health and Human Services, under Contract No. HHSN261201800006I and the Centers for Disease Control and Prevention, Department of Health and Human Services, under Cooperative Agreement 1NU58DP006270. 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 or the National Cancer Institute.

SUGGESTED CITATION:
Johnson CJ, Morawski BM, Rycroft RK. *Pediatric Cancer in Idaho, 2008-2017.* Boise, ID: Cancer Data Registry of Idaho; May 2020.

CANCER DATA REGISTRY OF IDAHO
P.O. Box 1278
Boise, Idaho 83701-1278
208-489-1380 (phone)
208-344-0180 (FAX)
http://www.idcancer.org

Pediatric Cancer in Idaho, 2008-2017

Although relatively rare in comparison with cancer in older adults, cancer is the second leading cause of death in persons aged 1-14 years. The epidemiology of cancer among children differs markedly from that of adults, both in the patterns of anatomic sites involved and the predominant histologic types. Most notably, the tumors diagnosed in children frequently involve the hematopoietic and central nervous systems or are of mesenchymal origin. In contrast, malignancies of epithelial tissues, which are predominant in adults, are uncommon in children. Similar to adult cancers, the etiology of many childhood cancers remains unclear.

The Cancer Data Registry of Idaho (CDRI) receives several requests per year from physicians and others for data on pediatric cancer incidence for the state of Idaho. This report describes the incidence of pediatric cancers in Idaho, with comparisons to data from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program and the US Centers for Disease Control and Prevention's National Program of Cancer Registries (NPCR).[1-2] SEER currently publishes cancer incidence and survival data from population-based cancer registries covering approximately 34.6 percent of the US population and is considered the standard for quality among cancer registries around the world. NPCR supports central cancer registries in 46 states, the District of Columbia, Puerto Rico, the U.S. Pacific Island Jurisdictions, and the U.S. Virgin Islands. These data represent 97% of the U.S. population. Together, NPCR and SEER collect data for the entire U.S. population. Combined NPCR and SEER data are used in this report for pediatric cancer incidence rankings by state.

METHODS

The data analyzed for this report include cancers diagnosed between 2008 and 2017 among Idaho residents less than 20 years of age. Cases were grouped according to the International Classification of Childhood Cancer (ICCC) based on site and morphology coded according to ICD-O-3.[3]

A total of 948 cases were diagnosed among Idaho resident children under the age of 20 between 2008 and 2017. This number includes 836 malignant cancers and 91 benign and borderline behavior neoplasms. Forty-three cases were excluded from analysis because it was not possible to assign a group code of the ICCC system (22 cases) or they were in situ, which are not included in the ICCC system (21 cases). Health District was assigned from county of residence at time of diagnosis. All Idaho incidence rates presented were calculated per million population and are averages for the period 2008 through 2017 (rates per million, rather than per 100,000, are commonly used for pediatric cancers). Age-adjustment was performed using the direct method to the 2000 U.S. standard population. Cancer incidence, mortality and survival statistics were calculated using SEER*Stat.[4] State rankings were obtained from the NPCR and SEER Incidence Public Use Data File.[2]

RESULTS

A total of 905 cases that met the study criteria were diagnosed among Idaho residents aged less than 20 years between 2008 and 2017, yielding an overall age-adjusted rate of 190.3 cases per million population (Table 1). In comparison, the SEER rate for Whites was 222.2 cases per million population for 2015-2017. The distribution of pediatric cancers by ICCC grouping was very similar for Idaho and SEER Regions. Idaho's pediatric rate of leukemias, myeloproliferative and myelodysplastic diseases (ICCC major classification category I) was about 20% lower than the rate for SEER Whites. For no other ICCC major classification category did Idaho show a statistically significantly different rate from SEER Regions based on the comparison of 95% confidence intervals.

For all races combined, Idaho ranked 33rd highest among states in pediatric (ages 0-19) cancer incidence 2008-2016.[2] This result is partially related to differences in the distribution of race by state. Pediatric cancer incidence is higher among Whites, and Idaho has a higher proportion of White residents than many states. Among Whites, Idaho ranked 38th in pediatric cancer incidence.

Over 85% of children aged less than 20 years diagnosed with malignant cancer survived at least 5 years after their diagnosis, both in Idaho and SEER Regions (Table 2 and Figure 1). For no ICCC major classification category, nor overall, was there a statistically significant difference in 5-year relative survival between Idaho and SEER cases.

Table 3 and Figure 2 show malignant pediatric cancer incidence in Idaho and SEER Regions by year of diagnosis for 2008 to 2017. Idaho incidence rates are slightly lower than SEER rates for most years and show more variability year-to-year due to smaller numbers of cases. Pediatric cancer incidence increased at a rate of about 0.5% per year in Idaho from 1975 to 2017. This parallels the long-term increase observed in SEER Regions from 1975 to 2017 of about 0.7% per year.

Table 4 shows pediatric cancer incidence in Idaho by health district for the ICCC major classification categories for the period 2008 to 2017. For all sites combined, no health district had a statistically significantly higher or lower rate than the state of Idaho, based on the comparison of 95% confidence intervals. Health District 7 had a statistically significantly lower rate of lymphomas and reticuloendothelial neoplasms. Health District 1 had a statistically significantly higher incidence rate of hepatic tumors. Health District 3 had a statistically significantly lower rate of ICCC classification category IX – soft tissue and other extraosseous sarcomas, and Health District 6 had a significantly higher rate. For no other ICCC major classification category was there a statistically significant difference between any health district and the state of Idaho.

From 2008 to 2018, 107 of Idaho's children aged 0-19 died from some form of cancer (Table 5).[5] The leading types of cancer mortality were brain and other central nervous system and leukemia (data not shown). While pediatric cancer incidence rates have increased over time, mortality rates have decreased. Figure 3

depicts trends in pediatric cancer mortality rates from 2008 to 2018. The annual rates plotted for Idaho demonstrate large year-to-year variability that is expected due to the relatively small numbers of deaths per year. From 1975-2017, pediatric cancer mortality rates decreased about 2% per year, in Idaho and the U.S.[5,6] Idaho ranked 48th highest (fourth lowest) among states and the District of Columbia in pediatric (ages 0-19) cancer mortality 2008-2017.[6]

CONCLUSIONS

These data demonstrate strong similarity in pediatric cancer incidence and survival patterns between Idaho and SEER Regions. Compared with cancer in adults, there is less geographic variability in pediatric cancer incidence. Some children have a hereditary predisposition of cancer. A 2015 study that tested children and adolescents with cancer revealed that 8.5% had predisposing gene mutations: 16.7% in patients with non-CNS solid tumors, 8.6% in patients with CNS tumors, and 4.4% in patients with leukemia.[7]

Largely because of improvements in therapy for pediatric cancers, there has been a decrease in mortality rates over time. Data collected by CDRI for 2016 show that over 20% of pediatric patients participated in clinical trials, a rate much higher than that for adults (2%).

While over 85% of children diagnosed with cancer survive at least five years, it has been shown that adult survivors of childhood cancer have higher prevalence of adverse health outcomes later in life and are at risk for higher health care expenditures and lost productivity, compared to adults without a history of cancer.[8,9] Education, intervention programs, and ongoing follow-up care are important for improving health and economic outcomes associated with cancer survivorship in this population.

Table 1. Pediatric (Ages 0-19) Cancer Incidence in Idaho and SEER Regions

Site/Type of Cancer	Idaho 2008-2017			SEER 2015-2017		
	Rate	Cases	Pop	Rate	Cases	Pop
All Sites Combined	190.3	905	4,763,335	222.2	5,201	23,332,631
I Leukemias, myeloproliferative & myelodysplastic diseases	43.7	210	4,763,335	54.6	1,277	23,332,631
I(a) Lymphoid leukemias	34.7	167	4,763,335	39.8	932	23,332,631
I(b) Acute myeloid leukemias	5.0	24	4,763,335	9.2	215	23,332,631
I(c) Chronic myeloproliferative diseases	1.5	7	4,763,335	2.1	49	23,332,631
I(d) Myelodysplastic syndrome and other myeloproliferative	1.5	7	4,763,335	1.5	36	23,332,631
I(e) Unspecified and other specified leukemias	1.0	5	4,763,335	1.9	45	23,332,631
II Lymphomas and reticuloendothelial neoplasms	27.1	128	4,763,335	31.3	731	23,332,631
II(a) Hodgkin lymphomas	12.0	56	4,763,335	11.5	269	23,332,631
II(b) Non-Hodgkin lymphomas (except Burkitt lymphoma)	10.1	48	4,763,335	11.0	257	23,332,631
II(c) Burkitt lymphoma	1.3	6	4,763,335	2.5	59	23,332,631
II(d) Miscellaneous lymphoreticular neoplasms	3.5	17	4,763,335	5.9	139	23,332,631
II(e) Unspecified lymphomas	0.2	1	4,763,335	0.3	7	23,332,631
III CNS and misc intracranial and intraspinal neoplasms	44.7	213	4,763,335	49.3	1,153	23,332,631
III(a) Ependymomas and choroid plexus tumor	3.5	17	4,763,335	5.0	118	23,332,631
III(b) Astrocytomas	18.4	88	4,763,335	15.6	364	23,332,631
III(c) Intracranial and intraspinal embryonal tumors	5.0	24	4,763,335	6.0	139	23,332,631
III(d) Other gliomas	4.0	19	4,763,335	5.1	119	23,332,631
III(e) Other specified intracranial/intraspinal neoplasms	12.3	58	4,763,335	16.8	393	23,332,631
III(f) Unspecified intracranial and intraspinal neoplasms	1.5	7	4,763,335	0.9	20	23,332,631
IV Neuroblastoma and other peripheral nervous cell tumors	9.1	44	4,763,335	8.0	189	23,332,631
IV(a) Neuroblastoma and ganglioneuroblastoma	8.7	42	4,763,335	7.7	181	23,332,631
IV(b) Other peripheral nervous cell tumors	0.4	2	4,763,335	0.3	8	23,332,631
V Retinoblastoma	2.1	10	4,763,335	3.1	73	23,332,631
VI Renal tumors	5.6	27	4,763,335	7.5	176	23,332,631
VI(a) Nephroblastoma and other nonepithelial renal tumors	4.9	24	4,763,335	7.0	164	23,332,631
VI(b) Renal carcinomas	0.6	3	4,763,335	0.5	12	23,332,631
VI(c) Unspecified malignant renal tumors	0.0	0	4,763,335	0.0	0	23,332,631
VII Hepatic tumors	2.7	13	4,763,335	3.0	71	23,332,631
VII(a) Hepatoblastoma	1.9	9	4,763,335	2.2	51	23,332,631
VII(b) Hepatic carcinomas	0.8	4	4,763,335	0.9	20	23,332,631
VII(c) Unspecified malignant hepatic tumors	0.0	0	4,763,335	0.0	0	23,332,631
VIII Malignant bone tumors	8.3	39	4,763,335	10.4	241	23,332,631
VIII(a) Osteosarcomas	5.5	26	4,763,335	6.3	146	23,332,631
VIII(b) Chondrosarcomas	0.0	0	4,763,335	0.2	4	23,332,631
VIII(c) Ewing tumor and related sarcomas of bone	1.9	9	4,763,335	3.3	77	23,332,631
VIII(d) Other specified malignant bone tumors	0.8	4	4,763,335	0.5	12	23,332,631
VIII(e) Unspecified malignant bone tumors	0.0	0	4,763,335	0.1	2	23,332,631
IX Soft tissue and other extraosseous sarcomas	12.2	58	4,763,335	12.5	292	23,332,631
IX(a) Rhabdomyosarcomas	3.7	18	4,763,335	4.5	106	23,332,631
IX(b) Fibrosarcomas, peripheral nerve & other fibrous	1.3	6	4,763,335	1.1	26	23,332,631
IX(c) Kaposi sarcoma	0.0	0	4,763,335	0.0	1	23,332,631
IX(d) Other specified soft tissue sarcomas	4.9	23	4,763,335	5.2	122	23,332,631
IX(e) Unspecified soft tissue sarcomas	2.3	11	4,763,335	1.6	37	23,332,631
X Germ cell & trophoblastic tumors & neoplasms of gonads	14.1	66	4,763,335	14.3	336	23,332,631
X(a) Intracranial & intraspinal germ cell tumors	1.9	9	4,763,335	2.6	61	23,332,631
X(b) Extracranial & extragonadal germ cell tumors	1.7	8	4,763,335	1.2	29	23,332,631
X(c) Malignant gonadal germ cell tumors	9.9	46	4,763,335	9.7	228	23,332,631
X(d) Gonadal carcinomas	0.4	2	4,763,335	0.4	9	23,332,631
X(e) Other and unspecified malignant gonadal tumors	0.2	1	4,763,335	0.4	9	23,332,631

Table 1. Pediatric (Ages 0-19) Cancer Incidence in Idaho and SEER Regions - continued

Site/Type of Cancer	Idaho 2008-2017			SEER 2015-2017		
	Rate	Cases	Pop	Rate	Cases	Pop
XI Other malignant epithelial neoplasms and melanomas	20.5	96	4,763,335	27.6	646	23,332,631
XI(a) Adrenocortical carcinomas	0.2	1	4,763,335	0.1	3	23,332,631
XI(b) Thyroid carcinomas	10.1	47	4,763,335	11.8	276	23,332,631
XI(c) Nasopharyngeal carcinomas	0.0	0	4,763,335	0.3	7	23,332,631
XI(d) Malignant melanomas	5.1	24	4,763,335	5.0	116	23,332,631
XI(e) Skin carcinomas	0.0	0	4,763,335	0.1	3	23,332,631
XI(f) Other and unspecified carcinomas	5.1	24	4,763,335	10.3	241	23,332,631
XII Other and unspecified malignant neoplasms	0.2	1	4,763,335	0.7	16	23,332,631
XII(a) Other specified malignant tumors	0.2	1	4,763,335	0.5	12	23,332,631
XII(b) Other unspecified malignant tumors	0.0	0	4,763,335	0.2	4	23,332,631
Not classified by ICCC or in situ	9.2	43	4,763,335	8.6	201	23,332,631

Rates are per 1,000,000 and age-adjusted to the 2000 U.S. standard.
SEER data are for White race. Cases and rates are for benign, borderline, and malignant behavior.
Statistical Note: Rates based upon 10 or fewer cases (numerator) should be interpreted with caution.

Figure 1. Pediatric Cancer Relative Survival

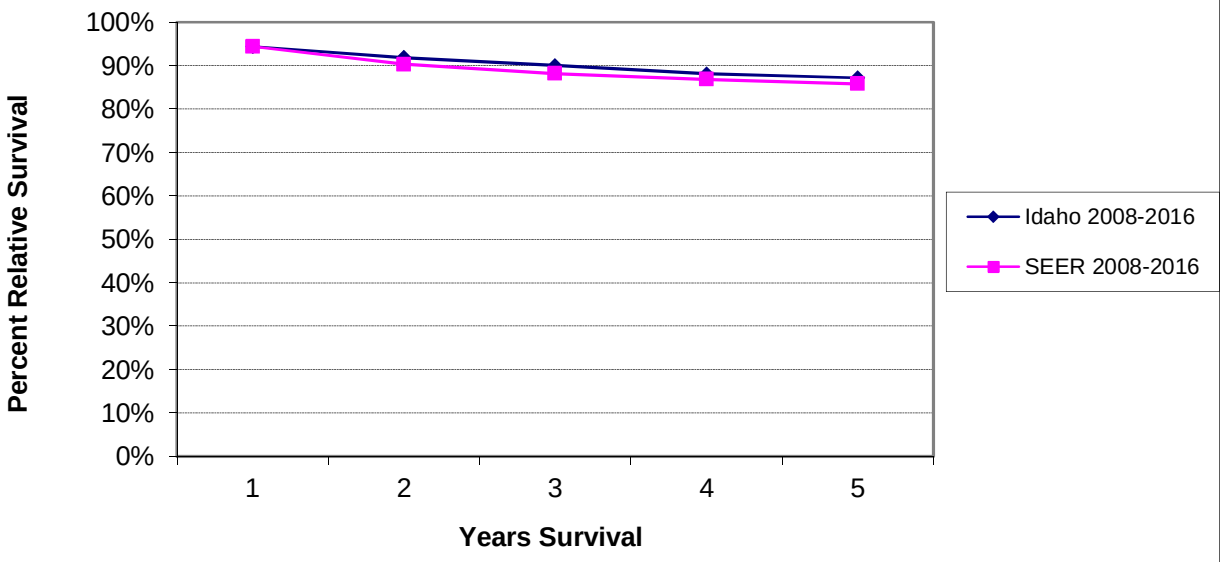


Table 2. Five-Year Relative Cancer Survival by Major ICCC Classification Category

Site/Type of Cancer	Idaho 2008-2016			SEER 2008-2016		
	Cases	% Survival	95% CI	Cases	% Survival	95% CI
All Sites Combined	717	87.2%	84.3% - 89.7%	13,513	85.8%	85.2% - 86.5%
I Leukemias, myeloproliferative & myelodysplastic diseases	189	91.5%	86.1% - 94.9%	3,683	86.1%	84.8% - 87.2%
II Lymphomas and reticuloendothelial neoplasms	99	96.0%	89.3% - 98.6%	1,865	93.5%	92.2% - 94.6%
III CNS and misc intracranial and intraspinal neoplasms	125	81.5%	72.4% - 87.8%	2,212	76.2%	74.2% - 78.0%
IV Neuroblastoma and other peripheral nervous cell tumors	41	79.2%	60.4% - 89.8%	602	82.1%	78.3% - 85.3%
V Retinoblastoma	9	100.0%	+ - +	221	95.1%	90.3% - 97.6%
VI Renal tumors	25	78.7%	51.9% - 91.6%	491	91.5%	88.3% - 93.9%
VII Hepatic tumors	12	64.9%	31.0% - 85.3%	203	80.8%	74.4% - 85.8%
VIII Malignant bone tumors	29	63.7%	42.8% - 78.6%	689	72.6%	68.6% - 76.1%
IX Soft tissue and other extraosseous sarcomas	49	78.8%	62.8% - 88.6%	836	75.6%	72.2% - 78.6%
X Germ cell & trophoblastic tumors & neoplasms of gonads	59	91.5%	80.1% - 96.5%	1,014	93.0%	91.1% - 94.5%
XI Other malignant epithelial neoplasms and melanomas	79	94.9%	83.9% - 98.4%	1,661	94.9%	93.6% - 96.0%
XII Other and unspecified malignant neoplasms	1	+	+ - +	36	93.7%	76.3% - 98.5%

+ The statistic could not be calculated.

Table 3. Malignant Pediatric (Ages 0-19) Cancer Incidence in Idaho and SEER Regions.

Year of Diagnosis	Idaho 2008-2017			SEER 2008-2017		
	Rate	Cases	Pop	Rate	Cases	Pop
Total	172.5	821	4,763,335	191.8	15,286	79,242,999
2008	166.5	78	468,822	188.6	1,543	8,093,508
2009	161.5	77	472,822	195.8	1,596	8,075,140
2010	156.6	75	475,081	190.8	1,543	8,032,329
2011	170.7	81	473,830	192.8	1,552	7,994,376
2012	185.0	87	472,258	182.6	1,458	7,947,346
2013	182.8	86	472,858	185.2	1,469	7,906,453
2014	154.2	73	475,493	197.7	1,559	7,861,216
2015	184.5	88	478,239	206.1	1,617	7,818,327
2016	186.8	90	483,831	194.0	1,514	7,781,995
2017	176.1	86	490,101	185.0	1,435	7,732,309

Rates are per 1,000,000 and age-adjusted to the 2000 U.S. standard.

Figure 2. Trends in Malignant Pediatric Cancer Incidence Rates

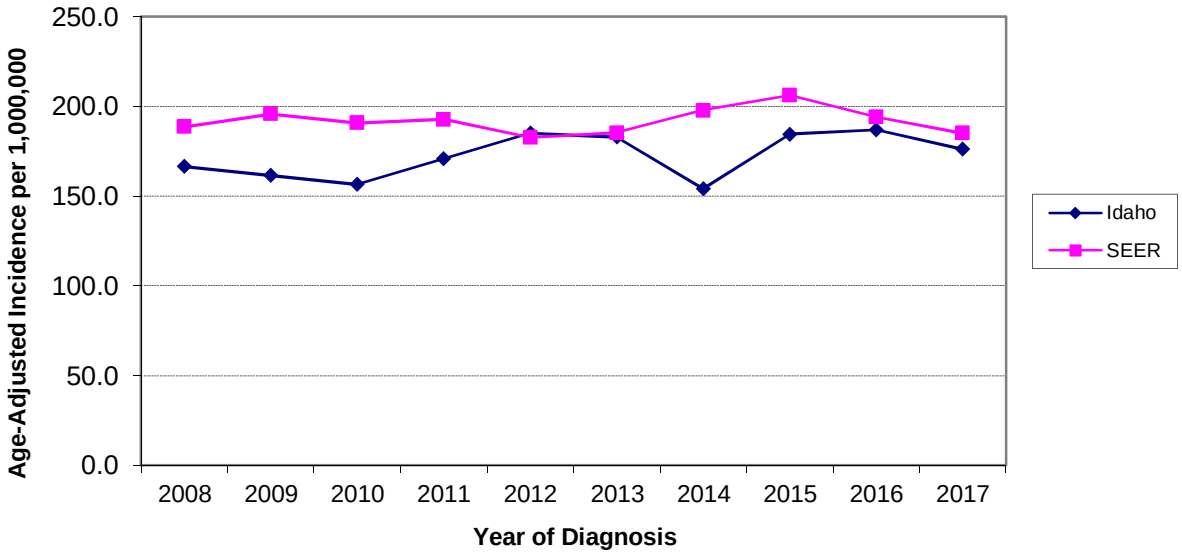


Table 4. Pediatric (Ages 0-19) Cancer Incidence in Idaho by Health District, Major Classification Categories, 2008-2017

Site/Type of Cancer	Health District 1			Health District 2			Health District 3		
	Rate	95% CI	Cases	Rate	95% CI	Cases	Rate	95% CI	Cases
All Sites Combined	190.3	155.8 - 230.2	106	142.4	100.4 - 196.4	38	191.6	163.2 - 223.7	161
I Leukemias, myeloproliferative & myelodysplastic diseases	41.9	26.6 - 62.9	23	20.2	6.5 - 47.2	5	44.2	31.3 - 60.7	38
II Lymphomas and reticuloendothelial neoplasms	35.3	21.6 - 54.6	20	25.3	9.3 - 54.7	6	32.5	21.4 - 47.2	27
III CNS and misc intracranial and intraspinal neoplasms	30.3	17.7 - 48.6	17	43.7	22.4 - 77.3	12	48.6	34.8 - 65.9	41
IV Neuroblastoma and other peripheral nervous cell tumors	13.0	5.2 - 26.7	7	12.6	2.6 - 36.3	3	7.1	2.6 - 15.4	6
V Retinoblastoma	0.0	0.0 - 6.7	0	0.0	0.0 - 14.8	0	2.4	0.3 - 8.7	2
VI Renal tumors	5.5	1.1 - 16.0	3	3.1	0.1 - 20.0	1	4.6	1.2 - 11.8	4
VII Hepatic tumors	9.3	3.0 - 21.6	5	0.0	0.0 - 14.8	0	0.0	0.0 - 4.4	0
VIII Malignant bone tumors	7.1	1.9 - 18.3	4	4.3	0.1 - 23.2	1	9.6	4.2 - 19.0	8
IX Soft tissue and other extraosseous sarcomas	10.7	3.9 - 23.3	6	8.4	1.0 - 29.9	2	3.5	0.7 - 10.4	3
X Germ cell & trophoblastic tumors & neoplasms of gonads	15.9	7.3 - 30.3	9	9.3	1.9 - 29.3	3	20.9	12.2 - 33.4	17
XI Other malignant epithelial neoplasms and melanomas	21.3	11.0 - 37.3	12	15.5	5.0 - 38.1	5	18.3	10.2 - 30.2	15
XII Other and unspecified malignant neoplasms	0.0	0.0 - 6.7	0	0.0	0.0 - 14.8	0	0.0	0.0 - 4.4	0

Site/Type of Cancer	Health District 4			Health District 5			Health District 6			Health District 7		
	Rate	95% CI	Cases	Rate	95% CI	Cases	Rate	95% CI	Cases	Rate	95% CI	Cases
All Sites Combined	213.1	188.5 - 240.2	270	170.7	138.8 - 207.7	100	210.2	173.4 - 252.5	114	165.2	136.5 - 198.2	116
I Leukemias…	53.6	41.6 - 67.9	68	46.9	31.1 - 67.8	28	34.3	20.7 - 53.6	19	40.6	27.2 - 58.4	29
II Lymphomas…	36.5	26.7 - 48.7	46	14.0	6.0 - 27.5	8	20.7	10.3 - 36.9	11	14.3	6.9 - 26.3	10
III CNS and…	43.6	32.9 - 56.6	56	50.5	34.1 - 72.1	30	52.2	34.7 - 75.4	28	41.8	28.0 - 60.0	29
IV Neuroblastoma…	10.3	5.5 - 17.7	13	4.8	1.0 - 14.2	3	16.2	7.4 - 30.8	9	4.1	0.8 - 12.0	3
V Retinoblastoma	2.4	0.5 - 7.1	3	1.6	0.0 - 9.2	1	5.3	1.1 - 15.6	3	1.3	0.0 - 7.6	1
VI Renal tumors	4.7	1.7 - 10.2	6	3.2	0.4 - 11.9	2	10.6	3.9 - 23.1	6	6.9	2.2 - 16.2	5
VII Hepatic tumors	4.7	1.7 - 10.3	6	0.0	0.0 - 6.3	0	1.7	0.0 - 9.9	1	1.5	0.0 - 8.2	1
VIII Malignant bone tumors	7.8	3.7 - 14.4	10	13.9	6.0 - 27.4	8	7.6	2.1 - 19.4	4	5.7	1.6 - 14.6	4
IX Soft tissue…	15.7	9.6 - 24.3	20	6.9	1.9 - 17.6	4	25.4	13.9 - 42.7	14	12.5	5.7 - 23.8	9
X Germ cell…	12.1	6.8 - 20.0	15	9.0	2.9 - 20.8	5	21.1	10.5 - 37.6	11	8.3	3.0 - 18.2	6
XI Other malig epithelial…	21.7	14.3 - 31.5	27	19.9	10.0 - 35.5	11	13.2	5.3 - 27.2	7	28.1	16.9 - 43.7	19
XII Other/unspecified…	0.0	0.0 - 2.9	0	0.0	0.0 - 6.3	0	1.8	0.0 - 10.1	1	0.0	0.0 - 5.2	0

Rates are per 1,000,000 and age-adjusted to the 2000 U.S. standard.

Confidence intervals (CIs) are 95% for rates.

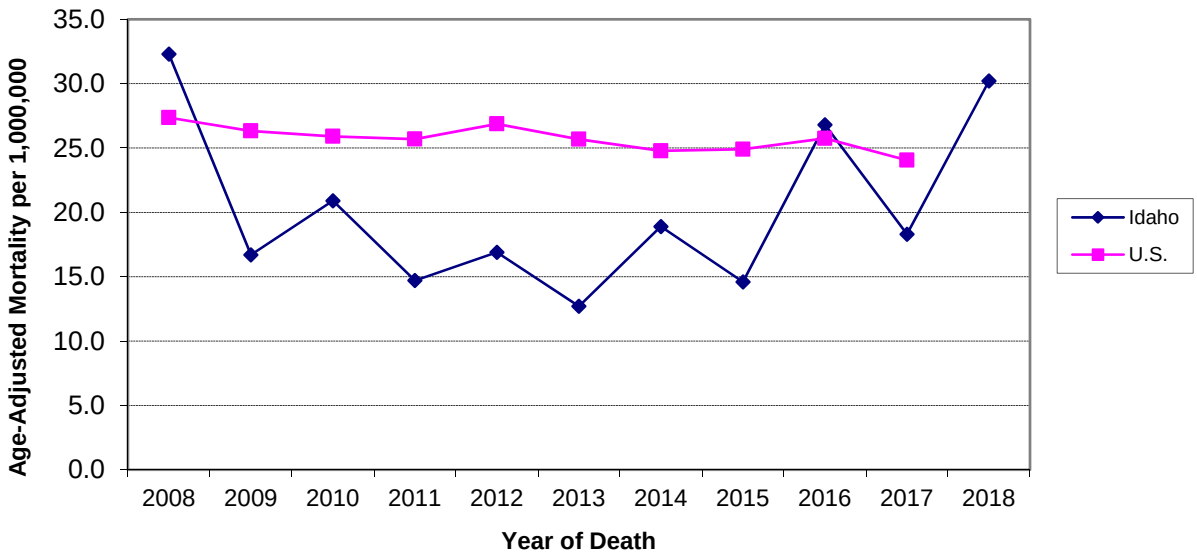
Statistical Note: Rates based upon 10 or fewer cases (numerator) should be interpreted with caution.

Table 5. Pediatric (Ages 0-19) Cancer Mortality in Idaho and the U.S.

Year of Death	Idaho 2008-2018			U.S. 2008-2017		
	Rate	Deaths	Pop	Rate	Deaths	Pop
Total	20.4	107	5,258,181	25.7	21,298	825,506,631
2008	32.3	15	468,822	27.4	2,286	83,118,264
2009	16.7	8	472,822	26.3	2,200	83,280,391
2010	20.9	10	475,081	25.9	2,160	83,181,903
2011	14.7	7	473,830	25.7	2,135	82,827,710
2012	16.9	8	472,258	26.9	2,221	82,483,581
2013	12.7	6	472,858	25.7	2,116	82,246,791
2014	18.9	9	475,493	24.8	2,038	82,108,087
2015	14.6	7	478,239	24.9	2,047	82,082,905
2016	26.8	13	483,831	25.7	2,118	82,110,969
2017	18.3	9	490,101	24.1	1,977	82,066,030
2018	30.2	15	494,846			

Rates are per 1,000,000 and age-adjusted to the 2000 U.S. standard.

Figure 3. Trends in Pediatric Cancer Mortality Rates



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