

PEDIATRIC CANCER IN IDAHO 2007-2016

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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.

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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>



IDAHO DEPARTMENT OF
HEALTH & WELFARE

Pediatric Cancer in Idaho, 2007-2016

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 2007 and 2016 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 934 cases were diagnosed among Idaho resident children under the age of 20 between 2007 and 2016. This number includes 825 malignant cancers and 89 benign and borderline behavior neoplasms. Forty-one cases were excluded from analysis because it was not possible to assign a group code of the ICCC system (21 cases) or they were in situ, which are not included in the ICCC system (20 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 2007 through 2016 (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 893 cases that met the study criteria were diagnosed among Idaho residents aged less than 20 years between 2007 and 2016, yielding an overall age-adjusted rate of 188.9 cases per million population (Table 1). In comparison, the SEER rate for Whites was 225.6 cases per million population for 2014-2016. The distribution of pediatric cancers by ICCC grouping was very similar for Idaho and SEER Regions. Idaho's pediatric rate of lymphomas and reticuloendothelial neoplasms (ICCC major classification category II) was about 20% lower than the rate for SEER Whites. For no ICCC 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 30th highest among states in pediatric (ages 0-19) cancer incidence 2007-2015.² 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 36th in pediatric cancer incidence.

Over 80% 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 2007 to 2016. 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 0.6% per year in Idaho from 1975 to 2016. This parallels the long-term increase observed in SEER Regions from 1975 to 2016 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 2007 to 2016. Health District 4 had a statistically significantly higher rate of pediatric cancer incidence and Health District 2 had statistically significantly lower rate. Health District 1 had a statistically significantly higher incidence rate of hepatic tumors. Health Districts 3 and 5 had statistically significantly lower rates of ICCC classification category IX – soft tissue and other extraosseous sarcomas, and Health District 6 had a significantly higher rate. For Health District 4, the significantly higher overall rate was due to higher rates for melanomas and thyroid carcinomas. Lower rates of these cancers in Health Districts 2 and 6 may indicate underreporting. CDRI is working to increase reporting of cancer cases by pathology laboratories and physicians statewide. The overall lower rate of pediatric cancer incidence in Health District 2 may be due to cases being treated in Washington State and not being reported to Idaho via interstate data exchange. CDRI is exploring alternate means for capturing information on any such cases. For no other ICCC major classification category was

there a statistically significant difference between any health district and the state of Idaho.

From 2007 to 2017, 104 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 2007 to 2017. 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 1975-2016, 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 2007-2016.⁶

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 80% 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 2007-2016			SEER 2014-2016		
	Rate	Cases	Pop	Rate	Cases	Pop
All Sites Combined	188.9	893	4,729,527	225.6	5,308	23,451,873
I Leukemias, myeloproliferative & myelodysplastic diseases	45.4	217	4,729,527	54.6	1,285	23,451,873
I(a) Lymphoid leukemias	35.5	170	4,729,527	41.0	966	23,451,873
I(b) Acute myeloid leukemias	5.9	28	4,729,527	8.0	189	23,451,873
I(c) Chronic myeloproliferative diseases	1.5	7	4,729,527	2.1	49	23,451,873
I(d) Myelodysplastic syndrome and other myeloproliferative	1.5	7	4,729,527	1.5	35	23,451,873
I(e) Unspecified and other specified leukemias	1.0	5	4,729,527	2.0	46	23,451,873
II Lymphomas and reticuloendothelial neoplasms	25.4	119	4,729,527	31.8	748	23,451,873
II(a) Hodgkin lymphomas	12.1	56	4,729,527	11.6	272	23,451,873
II(b) Non-Hodgkin lymphomas (except Burkitt lymphoma)	9.4	44	4,729,527	11.3	266	23,451,873
II(c) Burkitt lymphoma	1.1	5	4,729,527	2.8	66	23,451,873
II(d) Miscellaneous lymphoreticular neoplasms	2.9	14	4,729,527	5.8	136	23,451,873
II(e) Unspecified lymphomas	0.0	0	4,729,527	0.3	8	23,451,873
III CNS and misc intracranial and intraspinal neoplasms	43.1	204	4,729,527	49.7	1,167	23,451,873
III(a) Ependymomas and choroid plexus tumor	3.5	17	4,729,527	4.8	112	23,451,873
III(b) Astrocytomas	17.7	84	4,729,527	16.7	391	23,451,873
III(c) Intracranial and intraspinal embryonal tumors	5.5	26	4,729,527	5.7	135	23,451,873
III(d) Other gliomas	3.2	15	4,729,527	5.2	122	23,451,873
III(e) Other specified intracranial/intraspinal neoplasms	12.4	58	4,729,527	16.3	382	23,451,873
III(f) Unspecified intracranial and intraspinal neoplasms	0.8	4	4,729,527	1.1	25	23,451,873
IV Neuroblastoma and other peripheral nervous cell tumors	9.7	47	4,729,527	8.6	204	23,451,873
IV(a) Neuroblastoma and ganglioneuroblastoma	9.5	46	4,729,527	8.3	196	23,451,873
IV(b) Other peripheral nervous cell tumors	0.2	1	4,729,527	0.3	8	23,451,873
V Retinoblastoma	2.1	10	4,729,527	3.1	73	23,451,873
VI Renal tumors	6.4	31	4,729,527	7.9	186	23,451,873
VI(a) Nephroblastoma and other nonepithelial renal tumors	5.8	28	4,729,527	7.2	170	23,451,873
VI(b) Renal carcinomas	0.7	3	4,729,527	0.7	16	23,451,873
VI(c) Unspecified malignant renal tumors	0.0	0	4,729,527	0.0	0	23,451,873
VII Hepatic tumors	2.5	12	4,729,527	3.0	70	23,451,873
VII(a) Hepatoblastoma	1.6	8	4,729,527	2.2	53	23,451,873
VII(b) Hepatic carcinomas	0.9	4	4,729,527	0.7	17	23,451,873
VII(c) Unspecified malignant hepatic tumors	0.0	0	4,729,527	0.0	0	23,451,873
VIII Malignant bone tumors	7.7	36	4,729,527	10.8	253	23,451,873
VIII(a) Osteosarcomas	4.5	21	4,729,527	6.0	140	23,451,873
VIII(b) Chondrosarcomas	0.0	0	4,729,527	0.3	8	23,451,873
VIII(c) Ewing tumor and related sarcomas of bone	2.4	11	4,729,527	3.7	86	23,451,873
VIII(d) Other specified malignant bone tumors	0.9	4	4,729,527	0.7	17	23,451,873
VIII(e) Unspecified malignant bone tumors	0.0	0	4,729,527	0.1	2	23,451,873
IX Soft tissue and other extraosseous sarcomas	11.2	53	4,729,527	13.1	307	23,451,873
IX(a) Rhabdomyosarcomas	3.3	16	4,729,527	4.6	109	23,451,873
IX(b) Fibrosarcomas, peripheral nerve & other fibrous	1.3	6	4,729,527	1.5	36	23,451,873
IX(c) Kaposi sarcoma	0.0	0	4,729,527	0.0	0	23,451,873
IX(d) Other specified soft tissue sarcomas	4.3	20	4,729,527	5.4	126	23,451,873
IX(e) Unspecified soft tissue sarcomas	2.3	11	4,729,527	1.5	36	23,451,873
X Germ cell & trophoblastic tumors & neoplasms of gonads	13.8	64	4,729,527	15.1	355	23,451,873
X(a) Intracranial & intraspinal germ cell tumors	1.9	9	4,729,527	2.8	65	23,451,873
X(b) Extracranial & extragonadal germ cell tumors	1.5	7	4,729,527	1.5	36	23,451,873
X(c) Malignant gonadal germ cell tumors	9.9	46	4,729,527	10.0	236	23,451,873
X(d) Gonadal carcinomas	0.4	2	4,729,527	0.5	11	23,451,873
X(e) Other and unspecified malignant gonadal tumors	0.0	0	4,729,527	0.3	7	23,451,873

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

Site/Type of Cancer	Idaho 2007-2016			SEER 2014-2016		
	Rate	Cases	Pop	Rate	Cases	Pop
XI Other malignant epithelial neoplasms and melanomas	21.2	98	4,729,527	27.5	647	23,451,873
XI(a) Adrenocortical carcinomas	0.2	1	4,729,527	0.2	4	23,451,873
XI(b) Thyroid carcinomas	10.0	46	4,729,527	12.6	297	23,451,873
XI(c) Nasopharyngeal carcinomas	0.0	0	4,729,527	0.3	7	23,451,873
XI(d) Malignant melanomas	5.8	27	4,729,527	5.4	126	23,451,873
XI(e) Skin carcinomas	0.0	0	4,729,527	0.1	3	23,451,873
XI(f) Other and unspecified carcinomas	5.2	24	4,729,527	8.9	210	23,451,873
XII Other and unspecified malignant neoplasms	0.4	2	4,729,527	0.6	13	23,451,873
XII(a) Other specified malignant tumors	0.4	2	4,729,527	0.3	8	23,451,873
XII(b) Other unspecified malignant tumors	0.0	0	4,729,527	0.2	5	23,451,873
Not classified by ICCO or in situ	8.8	41	4,729,527	9.1	214	23,451,873

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

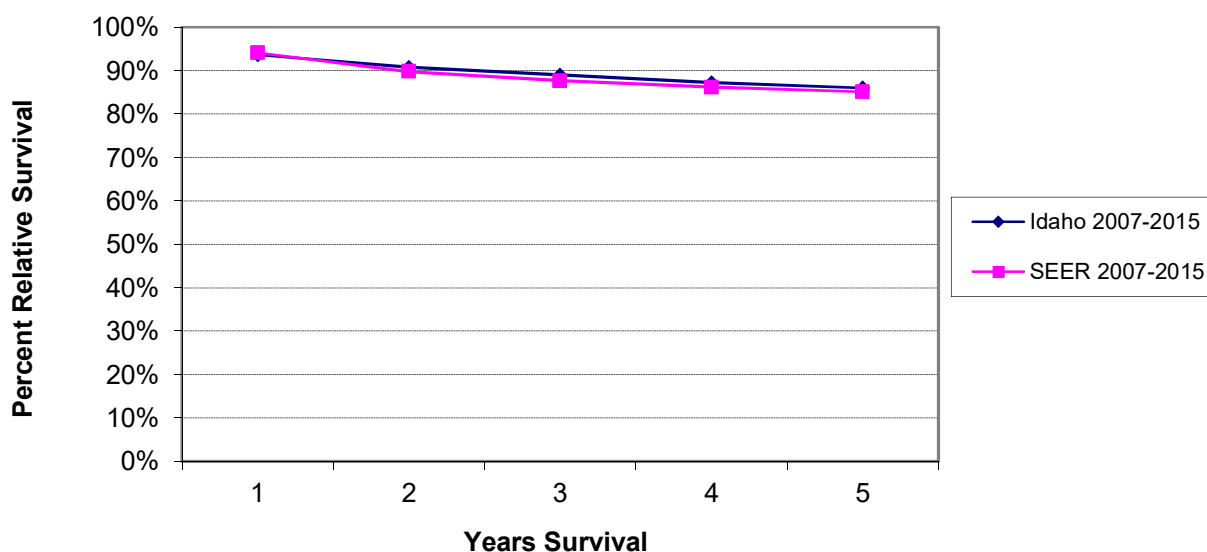


Table 2. Five-Year Relative Cancer Survival by Major ICCC Classification Category

Site/Type of Cancer	Idaho 2007-2015			SEER 2007-2015		
	Cases	% Survival	95% CI	Cases	% Survival	95% CI
All Sites Combined	612	86.0%	82.7% - 88.7%	13,516	85.1%	84.4% - 85.8%
I Leukemias, myeloproliferative & myelodysplastic diseases	94	88.1%	79.4% - 93.3%	3,666	85.8%	84.5% - 87.0%
II Lymphomas and reticuloendothelial neoplasms	89	96.8%	89.8% - 99.0%	1,913	93.7%	92.4% - 94.7%
III CNS and misc intracranial and intraspinal neoplasms	124	80.0%	70.6% - 86.7%	2,263	74.7%	72.7% - 76.6%
IV Neuroblastoma and other peripheral nervous cell tumors	42	78.4%	60.6% - 88.8%	602	81.1%	77.2% - 84.5%
V Retinoblastoma	10	100.9%	+ - +	214	94.1%	88.8% - 96.9%
VI Renal tumors	26	78.2%	54.9% - 90.4%	493	89.9%	86.5% - 92.6%
VII Hepatic tumors	11	63.8%	29.7% - 84.7%	207	77.9%	71.1% - 83.3%
VIII Malignant bone tumors	29	70.4%	49.1% - 84.1%	672	70.1%	66.0% - 73.8%
IX Soft tissue and other extraosseous sarcomas	48	78.4%	63.2% - 87.8%	851	74.9%	71.6% - 78.0%
X Germ cell & trophoblastic tumors & neoplasms of gonads	52	90.6%	78.3% - 96.1%	1,020	93.1%	91.2% - 94.6%
XI Other malignant epithelial neoplasms and melanomas	85	94.9%	86.2% - 98.2%	1,582	94.3%	92.8% - 95.4%
XII Other and unspecified malignant neoplasms	2	+	+ - +	33	93.3%	74.8% - 98.4%

+ The statistic could not be calculated.

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

Year of Diagnosis	Idaho 2007-2016			SEER 2007-2016		
	Rate	Cases	Pop	Rate	Cases	Pop
Total	171.9	813	4,729,527	191.8	15,365	79,606,148
2007	177.9	83	460,456	188.8	1,545	8,099,740
2008	166.5	78	468,822	188.2	1,540	8,093,508
2009	161.5	77	472,822	195.7	1,595	8,075,140
2010	156.6	75	475,120	190.3	1,539	8,032,601
2011	168.8	80	473,574	192.5	1,550	7,996,633
2012	180.9	85	471,823	182.5	1,458	7,949,616
2013	183.2	86	472,060	184.7	1,465	7,907,037
2014	156.5	74	474,910	197.2	1,555	7,859,932
2015	182.9	87	477,185	205.6	1,613	7,815,876
2016	183.1	88	482,755	192.9	1,505	7,776,065

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

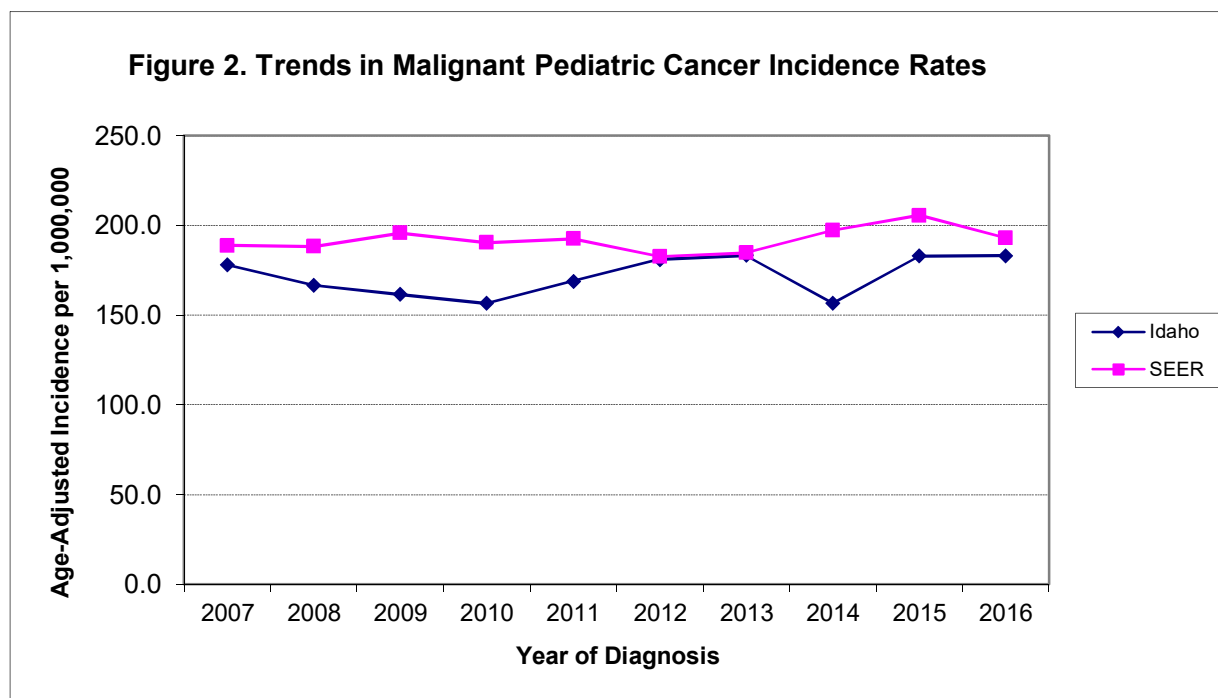


Table 4. Pediatric (Ages 0-19) Cancer Incidence in Idaho by Health District, Major Classification Categories, 2007-2016

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	191.1	156.4 - 231.1	106	123.9	84.9 - 174.9	33	184.5	156.5 - 216.1	154
I Leukemias, myeloproliferative & myelodysplastic diseases	47.7	31.1 - 69.8	26	20.3	6.5 - 47.4	5	45.6	32.4 - 62.3	39
II Lymphomas and reticuloendothelial neoplasms	29.9	17.4 - 48.0	17	16.9	4.6 - 42.8	4	30.5	19.7 - 45.0	25
III CNS and misc intracranial and intraspinal neoplasms	28.6	16.3 - 46.5	16	36.6	17.4 - 68.2	10	43.0	30.1 - 59.5	36
IV Neuroblastoma and other peripheral nervous cell tumors	15.0	6.5 - 29.4	8	12.7	2.6 - 36.6	3	7.0	2.6 - 15.2	6
V Retinoblastoma	0.0	0.0 - 6.7	0	0.0	0.0 - 14.9	0	3.6	0.7 - 10.4	3
VI Renal tumors	9.2	3.0 - 21.5	5	3.1	0.1 - 20.0	1	6.9	2.5 - 15.0	6
VII Hepatic tumors	9.3	3.0 - 21.7	5	0.0	0.0 - 14.9	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	7.3	2.7 - 15.8	6
IX Soft tissue and other extraosseous sarcomas	10.7	3.9 - 23.3	6	8.4	1.0 - 30.0	2	3.5	0.7 - 10.4	3
X Germ cell & trophoblastic tumors & neoplasms of gonads	14.1	6.1 - 27.9	8	9.3	1.9 - 29.3	3	22.4	13.3 - 35.4	18
XI Other malignant epithelial neoplasms and melanomas	19.5	9.7 - 34.9	11	12.4	3.4 - 33.8	4	14.9	7.7 - 25.9	12
XII Other and unspecified malignant neoplasms	0.0	0.0 - 6.7	0	0.0	0.0 - 14.9	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	222.0	196.7 - 249.7	278	162.2	131.0 - 198.5	94	198.8	163.1 - 240.1	108	172.3	142.8 - 206.1	120
I Leukemias...	56.2	43.9 - 71.0	71	49.2	33.0 - 70.8	29	30.8	17.9 - 49.4	17	42.5	28.6 - 60.7	30
II Lymphomas...	34.7	25.1 - 46.7	43	17.7	8.5 - 32.4	10	19.1	9.2 - 35.0	10	14.5	6.9 - 26.6	10
III CNS and...	40.8	30.5 - 53.5	52	51.3	34.6 - 73.3	30	55.5	37.4 - 79.2	30	43.7	29.4 - 62.3	30
IV Neuroblastoma...	11.9	6.7 - 19.6	15	4.8	1.0 - 14.3	3	14.2	6.1 - 28.1	8	5.3	1.4 - 13.8	4
V Retinoblastoma	1.6	0.2 - 5.9	2	1.6	0.0 - 9.2	1	3.5	0.4 - 12.8	2	2.7	0.3 - 9.8	2
VI Renal tumors	4.7	1.7 - 10.3	6	3.3	0.4 - 12.0	2	8.8	2.8 - 20.6	5	8.4	3.1 - 18.3	6
VII Hepatic tumors	3.9	1.3 - 9.2	5	0.0	0.0 - 6.3	0	1.7	0.0 - 9.9	1	1.6	0.0 - 8.3	1
VIII Malignant bone tumors	7.9	3.8 - 14.6	10	10.6	3.9 - 23.0	6	9.6	3.1 - 22.3	5	5.9	1.6 - 15.1	4
IX Soft tissue...	16.0	9.7 - 24.6	20	1.9	0.0 - 10.0	1	23.2	12.4 - 39.8	13	11.2	4.8 - 22.1	8
X Germ cell...	12.3	6.9 - 20.2	15	5.5	1.1 - 15.8	3	21.1	10.5 - 37.6	11	8.3	3.0 - 18.2	6
XI Other malig epithelial...	31.9	22.7 - 43.6	39	16.4	7.5 - 30.9	9	9.5	3.1 - 22.0	5	26.7	15.8 - 42.2	18
XII Other/unspecified...	0.0	0.0 - 2.9	0	0.0	0.0 - 6.3	0	1.8	0.0 - 10.1	1	1.5	0.0 - 8.1	1

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

Confidence intervals (CIs) are 95% for rates.

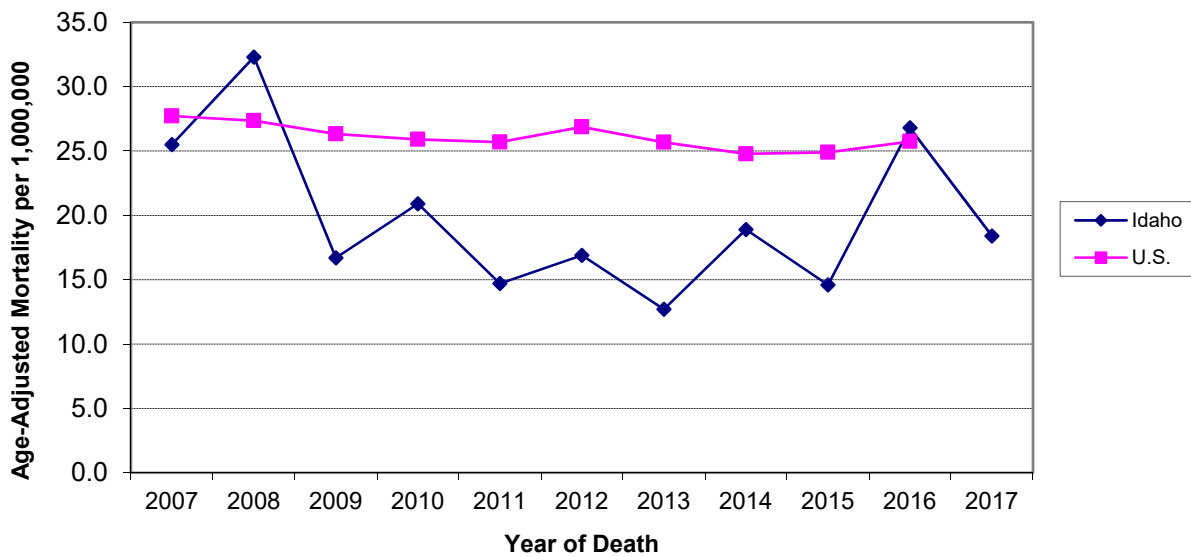
Statistical Note: Rates based upon 10 or fewer cases (numerator) should be interpreted with caution.

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

Year of Death	Idaho 2007-2017			U.S. 2007-2016		
	Rate	Deaths	Pop	Rate	Deaths	Pop
Total	19.9	104	5,219,376	26.1	21,623	826,240,427
2007	25.5	12	460,456	27.7	2,302	82,749,431
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	475,120	25.9	2,160	83,181,970
2011	14.7	7	473,574	25.7	2,135	82,830,017
2012	16.9	8	471,823	26.9	2,221	82,487,297
2013	12.7	6	472,060	25.7	2,116	82,252,861
2014	18.9	9	474,910	24.8	2,038	82,116,071
2015	14.6	7	477,185	24.9	2,047	82,096,458
2016	26.8	13	482,755	25.7	2,118	82,127,667
2017	18.4	9	489,849			

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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