PEDIATRIC CANCER IN IDAHO, 2011–2020

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BACKGROUND

Although relatively rare in comparison with cancer in older adults, from 2011–2020 cancer was the fifth leading cause of death in persons aged 1–19 years.[1] 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, cancers diagnosed in children frequently involve the central nervous system or are of hematopoietic or 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).[2,3,4] SEER currently publishes cancer incidence and survival data from population-based cancer registries covering approximately 47.9 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.

METHODS

The data analyzed for this report include cancers diagnosed between 2011 and 2020 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.[5]

A total of 952 cases were diagnosed among Idaho resident children under the age of 20 between 2011 and 2020. This number includes 843 malignant cancers, 96 benign and borderline behavior neoplasms, and 13 in situ tumors. Thirty-six cases were excluded from analyses of malignant cases because they are not defined in the ICCC system (23 cases) or they were in situ (13 cases), which are not included in the ICCC system. 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 2011 through 2020 (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.[6] State rankings were obtained from the NPCR and SEER Incidence Public Use Data File.[3]

RESULTS

A total of 916 cases that met the study criteria were diagnosed among Idaho residents aged less than 20 years between 2011 and 2020, yielding an overall age-adjusted rate of 190.2 cases per million population (Table 1). In comparison, the SEER-12 rate was 214.4 cases per million population during 2011–2020. The distribution of pediatric cancers by ICCC grouping was very similar for Idaho and SEER Regions. For no ICCC major classification category did Idaho show a statistically significantly higher rate of pediatric cancer from SEER-12 data based on the comparisons of 95% confidence intervals.

For all races combined, Idaho ranked 41st highest among states in pediatric (ages 0–19) cancer incidence 2011-2020, with a rate of 190.8 per million population based on USCS data.[3] North Dakota ranked lowest with 167.7 cases per million population and New York ranked highest with 241.2 cases per million population. When restricting to non-Hispanic whites alone, Idaho ranked 45th in pediatric cancer incidence. Pediatric cancer incidence is higher among whites in the United States, and Idaho has a higher proportion of white residents than many states, so the distribution of race drives some of the differences in incidence by state.

About 87% of children aged less than 20 years diagnosed with malignant cancer survived at least 5 years after their diagnosis, both in Idaho and SEER-12 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 2011 to 2020. Idaho incidence rates are lower than or equivalent to SEER-12 rates for most years and show more year-to-year variability due to smaller numbers of cases. Pediatric cancer incidence increased at a rate of about 0.5% per year in Idaho from 1975 to 2020. This parallels the long-term increase observed in SEER-12 Regions from 1975 to 2020 of about 0.8% per year.[4]

Table 4 shows pediatric cancer incidence in Idaho by public health district for the ICCC major classification categories for the period 2011 to 2020. 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 6 had a statistically significantly higher rate of soft tissue and other extraosseous sarcomas. For no other ICCC major classification category was there a statistically significant difference between any health district and the state of Idaho.

During 2011 to 2021, 115 of Idaho's children aged 0–19 died from some form of cancer (Table 5).[7] The leading types of cancer mortality were brain and other central nervous system and leukemia, accounting for almost 50% of pediatric cancer-related mortality, and cancers of the bones and joints and cancers of the soft tissue (including heart), accounting for 23% of cancer-related mortality (data not shown). While pediatric cancer

incidence rates have increased over time, pediatric cancer mortality rates have decreased about 2% per year during 1975–2021 in Idaho and the U.S.[7,8] Figure 3 depicts trends in pediatric cancer mortality rates from 2011 to 2021. 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; although there were large increases in pediatric cancer mortality in Idaho during 2018–2019, the overall trend for the period from 2011–2021 did not show a statistically significant increase. Idaho ranked 45th among states and the District of Columbia in pediatric (ages 0–19) cancer mortality 2011-2020.[8] Nebraska ranked highest, with 3.0 cases per million population, and Wyoming ranked lowest, with 1.4 cases per million population.

CONCLUSIONS

These data demonstrate strong similarity in pediatric cancer incidence and survival patterns between Idaho and SEER Regions. Compared with cancer in adults,[9] there is less geographic variability in pediatric cancer incidence, which is likely related to the distribution of hereditary predispositions to cancer in the pediatric population. 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.[10]

A limitation of this study that may affect interpretation of results is the potential incomplete reporting of pediatric cancers from other states in which Idaho residents are diagnosed or treated for cancer. In particular, this may be the reason why pediatric cancer incidence rates are lower in Public Health District 2. Furthermore, disruptions caused by the COVID-19 pandemic greatly impacted cancer healthcare services and may have impacted reporting from other states of Idaho 2020 pediatric cancer diagnoses and treatment.

Largely because of improvements in therapy for pediatric cancers, there has been a decrease in mortality rates over time. Data collected by CDRI for 2020 show that about 23% of pediatric patients participated in clinical trials (not shown), a much higher proportion than adult patients (1.4%). The 23% participation is an increase over recent years; lower participation in prior years was impacted – in part - by an increase in pediatric cancer therapy knowledge and a subsequent specificity in patient eligibility requirements, e.g., a tumor must have specific biomarkers, or a patient must have received specific therapy to be eligible.

While over 85% of children diagnosed with cancer survive at least five years, studies show 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 childhood cancer.[11,12] Childhood cancer survivors continue to have excess risk of late (after 5 years) mortality through 40 years after diagnosis. Compared to the general population, long-term survivors of childhood cancer are at four times the risk of death. Beyond 10 years from diagnosis, excess deaths are primarily due to health-related causes including subsequent cancers,

heart disease, and cerebrovascular disease.[13] Education, intervention programs, and ongoing follow-up care are important for improving health and economic outcomes associated with cancer survivorship in this population.

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

Site/Type of Cancer	Idaho 2011-2020			SEER 2011-2020		
	Rate	Cases	Pop	Rate	Cases	Pop
All Sites Combined	190.2	916	4,834,282	214.4	21,653	100,678,488
I Leukemias, myeloproliferative & myelodysplastic diseases	43.6	211	4,834,282	50.0	5,056	100,678,488
I(a) Lymphoid leukemias	35.7	173	4,834,282	36.6	3,705	100,678,488
I(b) Acute myeloid leukemias	5.2	25	4,834,282	8.6	870	100,678,488
I(c) Chronic myeloproliferative diseases	0.8	4	4,834,282	2.2	220	100,678,488
I(d) Myelodysplastic syndrome and other myeloproliferative	0.8	4	4,834,282	1.4	145	100,678,488
I(e) Unspecified and other specified leukemias	1.1	5	4,834,282	1.1	116	100,678,488
II Lymphomas and reticuloendothelial neoplasms	29.2	141	4,834,282	29.9	3,016	100,678,488
II(a) Hodgkin lymphomas	12.1	58	4,834,282	11.4	1,147	100,678,488
II(b) Non-Hodgkin lymphomas (except Burkitt lymphoma)	11.1	54	4,834,282	10.8	1,089	100,678,488
II(c) Burkitt lymphoma	1.9	9	4,834,282	2.3	236	100,678,488
II(d) Miscellaneous lymphoreticular neoplasms	3.9	19	4,834,282	5.1	519	100,678,488
II(e) Unspecified lymphomas	0.2	1	4,834,282	0.2	25	100,678,488
III CNS and misc intracranial and intraspinal neoplasms	42.0	203	4,834,282	48.7	4,915	100,678,488
III(a) Ependymomas and choroid plexus tumor	3.7	18	4,834,282	4.1	418	100,678,488
III(b) Astrocytomas	15.5	75	4,834,282	15.5	1,557	100,678,488
III(c) Intracranial and intraspinal embryonal tumors	4.3	21	4,834,282	5.5	560	100,678,488
III(d) Other gliomas	3.7	18	4,834,282	5.7	574	100,678,488
III(e) Other specified intracranial/intraspinal neoplasms	12.5	60	4,834,282	16.6	1,673	100,678,488
III(f) Unspecified intracranial and intraspinal neoplasms	2.3	11	4,834,282	1.3	133	100,678,488
IV Neuroblastoma and other peripheral nervous cell tumors	8.2	39	4,834,282	8.1	826	100,678,488
IV(a) Neuroblastoma and ganglioneuroblastoma	8.0	38	4,834,282	7.9	801	100,678,488
IV(b) Other peripheral nervous cell tumors	0.2	1	4,834,282	0.2	25	100,678,488
V Retinoblastoma	1.7	8	4,834,282	3.1	311	100,678,488
VI Renal tumors	7.9	38	4,834,282	6.2	629	100,678,488
VI(a) Nephroblastoma and other nonepithelial renal tumors	7.3	35	4,834,282	5.6	565	100,678,488
VI(b) Renal carcinomas	0.6	3	4,834,282	0.6	62	100,678,488
VI(c) Unspecified malignant renal tumors	0.0	0	4,834,282	0.0	2	100,678,488
VII Hepatic tumors	2.1	10	4,834,282	3.0	308	100,678,488
VII(a) Hepatoblastoma	1.7	8	4,834,282	2.4	246	100,678,488
VII(b) Hepatic carcinomas	0.4	2	4,834,282	0.6	60	100,678,488
VII(c) Unspecified malignant hepatic tumors	0.0	0	4,834,282	0.0	2	100,678,488
VIII Malignant bone tumors	7.3	35	4,834,282	9.4	939	100,678,488
VIII(a) Osteosarcomas	4.6	22	4,834,282	5.5	552	100,678,488
VIII(b) Chondrosarcomas	0.2	1	4,834,282	0.2	25	100,678,488
VIII(c) Ewing tumor and related sarcomas of bone	1.4	7	4,834,282	3.0	306	100,678,488
VIII(d) Other specified malignant bone tumors	1.0	5	4,834,282	0.4	40	100,678,488
VIII(e) Unspecified malignant bone tumors	0.0	0	4,834,282	0.2	16	100,678,488
IX Soft tissue and other extraosseous sarcomas	11.5	55	4,834,282	12.2	1,226	100,678,488
IX(a) Rhabdomyosarcomas	4.1	20	4,834,282	4.2	423	100,678,488
IX(b) Fibrosarcomas, peripheral nerve & other fibrous	0.6	3	4,834,282	1.3	127	100,678,488
IX(c) Kaposi sarcoma	0.0	0	4,834,282	0.1	6	100,678,488
IX(d) Other specified soft tissue sarcomas	4.4	21	4,834,282	5.2	521	100,678,488
IX(e) Unspecified soft tissue sarcomas	2.3	11	4,834,282	1.5	149	100,678,488
X Germ cell & trophoblastic tumors & neoplasms of gonads	13.0	62	4,834,282	12.7	1,281	100,678,488
X(a) Intracranial & intraspinal germ cell tumors	2.3	11	4,834,282	2.5	250	100,678,488
X(b) Extracranial & extragonadal germ cell tumors	1.5	7	4,834,282	1.4	146	100,678,488
X(c) Malignant gonadal germ cell tumors	8.6	41	4,834,282	8.1	816	100,678,488
X(d) Gonadal carcinomas	0.2	1	4,834,282	0.4	40	100,678,488
X(e) Other and unspecified malignant gonadal tumors	0.4	2	4,834,282	0.3	29	100,678,488

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

Site/Type of Cancer	Idaho 2011-2020			SEER 2011-2020		
	Rate	Cases	Pop	Rate	Cases	Pop
XI Other malignant epithelial neoplasms and melanomas	23.4	112	4,834,282	22.9	2,313	100,678,488
XI(a) Adrenocortical carcinomas	0.6	3	4,834,282	0.2	18	100,678,488
XI(b) Thyroid carcinomas	10.6	51	4,834,282	10.5	1,066	100,678,488
XI(c) Nasopharyngeal carcinomas	0.0	0	4,834,282	0.4	42	100,678,488
XI(d) Malignant melanomas	5.4	26	4,834,282	3.8	381	100,678,488
XI(e) Skin carcinomas	0.0	0	4,834,282	0.1	11	100,678,488
XI(f) Other and unspecified carcinomas	6.7	32	4,834,282	7.9	795	100,678,488
XII Other and unspecified malignant neoplasms	0.4	2	4,834,282	0.7	73	100,678,488
XII(a) Other specified malignant tumors	0.2	1	4,834,282	0.5	53	100,678,488
XII(b) Other unspecified malignant tumors	0.2	1	4,834,282	0.2	20	100,678,488
Not classified by ICCC or in situ	7.5	36	4,834,282	7.5	760	100,678,488

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

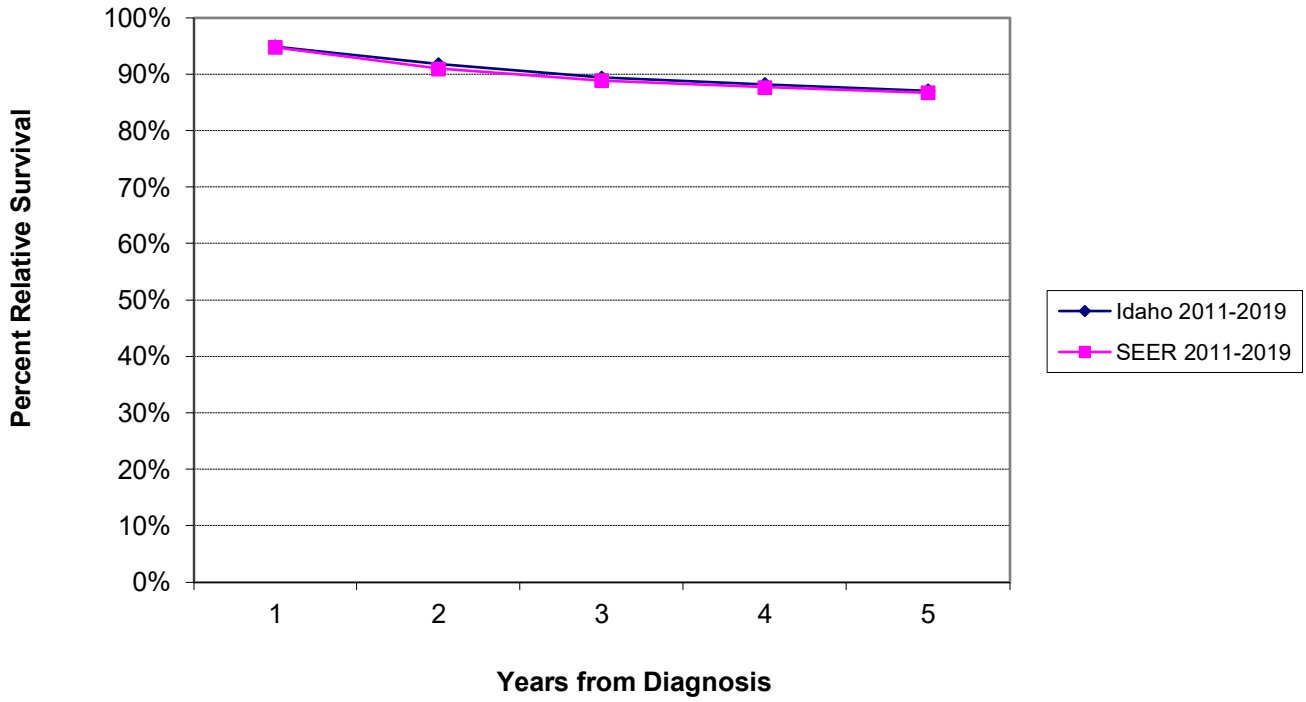

Table 2. Five-Year Relative Cancer Survival by Major ICCC Classification Category

Site/Type of Cancer	Idaho 2011-2019			SEER 2010-2018		
	Cases	% Survival	95% CI	Cases	% Survival	95% CI
All Sites Combined	**758**	**87.1%**	**84.3% - 89.5%**	**12650**	**86.8%**	**86.1% - 87.4%**
I Leukemias, myeloproliferative & myelodysplastic diseases	195	88.4%	82.7% - 92.4%	3419	86.6%	85.3% - 87.8%
II Lymphomas and reticuloendothelial neoplasms	130	94.3%	88.2% - 97.3%	2001	95.0%	93.8% - 95.9%
III CNS and misc intracranial and intraspinal neoplasms	118	81.7%	73.0% - 87.9%	1997	76.0%	73.9% - 77.9%
IV Neuroblastoma and other peripheral nervous cell tumors	36	77.5%	55.9% - 89.5%	521	84.4%	80.6% - 87.5%
V Retinoblastoma	8	100.0%	+	201	94.8%	89.3% - 97.5%
VI Renal tumors	31	84.8%	63.4% - 94.2%	412	93.0%	89.7% - 95.2%
VII Hepatic tumors	9	100.0%	+	190	80.0%	73.1% - 85.3%
VIII Malignant bone tumors	32	59.6%	39.8% - 74.8%	634	70.7%	66.6% - 74.5%
IX Soft tissue and other extraosseous sarcomas	52	71.4%	55.2% - 82.6%	761	75.6%	72.1% - 78.8%
X Germ cell & trophoblastic tumors & neoplasms of gonads	53	92.4%	80.7% - 97.1%	860	93.6%	91.6% - 95.2%
XI Other malignant epithelial neoplasms and melanomas	95	96.6%	89.3% - 98.9%	1658	96.2%	95.0% - 97.1%
XII Other and unspecified malignant neoplasms	1	+	+	46	93.3%	80.5% - 97.8%

+ The statistic could not be calculated.

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

Year of Diagnosis	Idaho 2011-2020			SEER 2011-2020		
	Rate	Cases	Pop	Rate	Cases	Pop
Total	175.6	846	4,834,282	186.7	18,851	100,678,488
2011	170.6	81	473,968	182.3	1,874	10,204,875
2012	191.2	90	472,426	181.3	1,855	10,174,086
2013	189.1	89	473,095	183.7	1,872	10,155,628
2014	158.1	75	475,754	192.0	1,951	10,131,157
2015	188.7	90	478,516	202.3	2,054	10,118,358
2016	193.2	93	483,710	193.8	1,963	10,101,673
2017	188.6	92	489,540	188.0	1,898	10,066,610
2018	154.9	76	492,415	186.4	1,868	10,000,143
2019	171.5	85	496,044	176.1	1,750	9,916,979
2020	150.5	75	498,814	179.9	1,766	9,808,979

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

Figure 2. Trends in Malignant Pediatric Cancer Incidence Rates

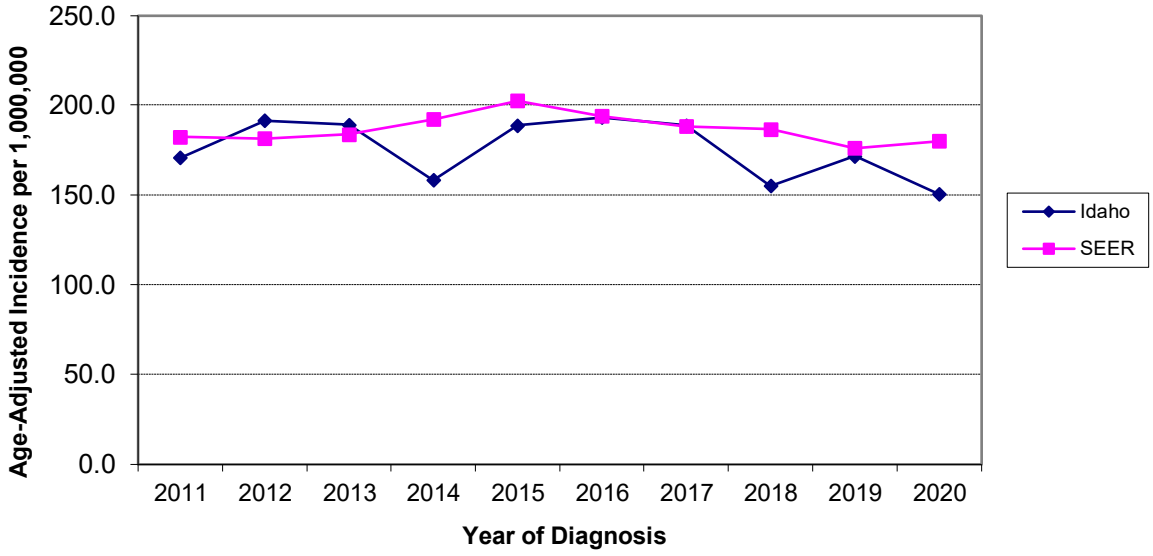

Table 4. Pediatric (Ages 0-19) Cancer Incidence in Idaho by Health District, Major Classification Categories, 2011-2020

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	182.4	148.8 - 221.2	103	152.1	108.3 - 207.8	40	189.6	161.5 - 221.2	162
I Leukemias, myeloproliferative & myelodysplastic diseases	51.5	34.5 - 73.9	29	28.5	11.4 - 58.8	7	52.0	37.9 - 69.6	45
II Lymphomas and reticuloendothelial neoplasms	22.7	12.1 - 39.0	13	25.3	9.3 - 54.8	6	35.2	23.8 - 50.3	30
III CNS and misc intracranial and intraspinal neoplasms	31.6	18.7 - 50.0	18	37.8	18.0 - 70.1	10	41.8	29.3 - 57.9	36
IV Neuroblastoma and other peripheral nervous cell tumors	7.3	2.0 - 18.5	4	12.6	2.6 - 36.4	3	6.0	1.9 - 14.0	5
V Retinoblastoma	0.0	0.0 - 6.6	0	0.0	0.0 - 14.8	0	2.5	0.3 - 8.9	2
VI Renal tumors	7.2	2.0 - 18.4	4	3.2	0.1 - 20.2	1	2.3	0.3 - 8.4	2
VII Hepatic tumors	5.6	1.1 - 16.1	3	0.0	0.0 - 14.8	0	0.0	0.0 - 4.4	0
VIII Malignant bone tumors	5.3	1.1 - 15.6	3	4.3	0.1 - 23.1	1	10.5	4.8 - 19.9	9
IX Soft tissue and other extraosseous sarcomas	10.5	3.9 - 23.0	6	11.6	2.3 - 34.3	3	5.9	1.9 - 13.8	5
X Germ cell & trophoblastic tumors & neoplasms of gonads	12.4	5.0 - 25.5	7	9.6	2.0 - 29.9	3	15.6	8.3 - 26.6	13
XI Other malignant epithelial neoplasms and melanomas	28.3	16.2 - 46.0	16	19.2	7.0 - 43.4	6	17.8	9.9 - 29.3	15
XII Other and unspecified malignant neoplasms	0.0	0.0 - 6.6	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	208.4	184.3 - 234.8	270	181.1	148.4 - 218.9	107	201.0	164.8 - 242.7	108	177.2	147.6 - 211.0	126
I Leukemias…	49.7	38.3 - 63.5	64	41.2	26.6 - 60.9	25	33.0	19.6 - 52.2	18	31.9	20.2 - 47.9	23
II Lymphomas…	41.3	31.0 - 54.0	54	17.1	8.2 - 31.4	10	29.7	17.0 - 48.3	16	17.1	8.8 - 29.8	12
III CNS and…	41.3	31.0 - 53.9	54	52.2	35.4 - 74.1	31	41.1	25.8 - 62.3	22	45.1	30.9 - 63.7	32
IV Neuroblastoma…	10.5	5.6 - 18.0	13	6.5	1.8 - 16.7	4	14.9	6.4 - 29.3	8	2.8	0.3 - 10.0	2
V Retinoblastoma	1.6	0.2 - 5.8	2	1.8	0.0 - 9.6	1	5.6	1.2 - 16.3	3	0.0	0.0 - 5.1	0
VI Renal tumors	10.2	5.4 - 17.5	13	11.3	4.5 - 23.5	7	9.2	3.0 - 21.6	5	8.1	3.0 - 17.8	6
VII Hepatic tumors	3.1	0.8 - 8.0	4	0.0	0.0 - 6.2	0	3.6	0.4 - 13.2	2	1.5	0.0 - 7.9	1
VIII Malignant bone tumors	6.1	2.6 - 12.0	8	8.4	2.7 - 19.6	5	5.7	1.2 - 16.5	3	8.5	3.1 - 18.4	6
IX Soft tissue…	13.1	7.7 - 21.1	17	5.0	1.0 - 14.7	3	22.4	11.6 - 39.1	12	12.2	5.6 - 23.3	9
X Germ cell…	11.5	6.4 - 19.0	15.0	12.4	5.0 - 25.4	7.0	15.2	6.6 - 29.9	8	12.5	5.7 - 23.8	9
XI Other malig epithelial…	19.8	13.0 - 29.1	26.0	25.3	13.8 - 42.3	14.0	18.6	8.9 - 34.2	10	36.0	23.3 - 53.0	25
XII Other/unspecified…	0.0	0.0 - 2.9	0.0	0.0	0.0 - 6.2	0.0	1.9	0.0 - 10.6	1	1.5	0.0 - 7.9	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 2011-2021			U.S. 2011-2020		
	Rate	Deaths	Pop	Rate	Deaths	Pop
Total	21.5	115	5,353,091	24.8	20,411	821,036,910
2011	14.7	7	473,968	25.7	2,135	82,838,469
2012	16.8	8	472,426	26.9	2,221	82,501,478
2013	12.7	6	473,095	25.7	2,116	82,271,238
2014	18.9	9	475,754	24.8	2,038	82,139,198
2015	14.6	7	478,516	24.9	2,047	82,120,410
2016	26.8	13	483,710	25.7	2,118	82,161,437
2017	18.4	9	489,540	24.0	1,977	82,114,364
2018	30.3	15	492,415	24.5	2,010	81,956,393
2019	40.1	20	496,044	23.1	1,889	81,679,568
2020	14.1	7	498,814	22.9	1,860	81,254,355
2021	27.2	14	518,809			

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

Figure 3. Trends in Pediatric Cancer Mortality Rates