



# Cancer Incidence in Children and Adolescents in Massachusetts, 2000-2009

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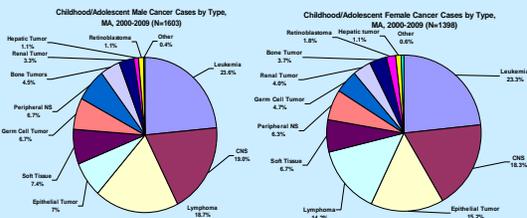
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**OBJECTIVE: To examine the epidemiology of invasive cancer incidence in Massachusetts children and adolescents diagnosed from 2000-2009.**

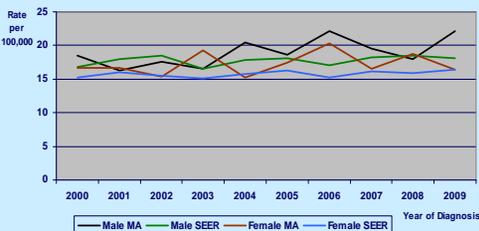
## INTRODUCTION:

- From 2000 to 2009, there were 3,001 cases of invasive cancer diagnosed among children and adolescent residents of Massachusetts (birth to age 19). Males represented 53.4% of the cancer cases and females 46.6%.
- The three most common cancers diagnosed among male children and adolescents, accounting for 61.3% of all cases, were leukemia, cancer of the brain and central nervous system, and lymphomas.
- The three most common cancers for females, accounting for 55.8% of all cases, were leukemia, cancer of the brain and central nervous system, and malignant epithelial neoplasm, the most common of which were thyroid cancer and melanoma.



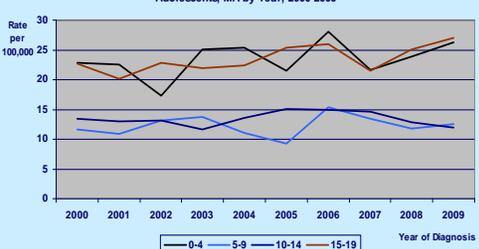
- For both males and females, the age-adjusted incidence rate of all cancers combined among children and adolescents did not change significantly with annual percent changes (APC) of 1.0% and 0.8%, respectively, comparable to US trends.

Age-Adjusted Incidence Rate per 100,000 for All Cancers\* among Children and Adolescents by Sex by Year, MA and US SEER, 2000-2009



- Children under the age of 5 and adolescents ages 15 to 19 had higher cancer rates than the groups 5 to 14. The age group 15-19 was the only one with a significant increasing trend with an APC of 2.1%.

Cancer Age-Specific Incidence Rate per 100,000 among Children and Adolescents, MA by Year, 2000-2009



## AGE GROUP:

- The age-specific incidence rate of childhood cancer was highest among Massachusetts males and females 15-19 years old, followed by males and females 0-4 years old. The rates for both males and females in these two groups were both statistically significantly elevated when compared to the other two groups (5-9 and 10-14).
- The most common cancer groupings among children and adolescents varied by age group and sex.
- Leukemia ranked number one among 0-4 year old for both males and females, with significantly higher rates than any other cancer. Additionally, females in this age group had a significantly higher incidence rate of leukemia compared to males.
- Central nervous system tumors ranked number one among 5 to 9-year-olds for both males and females.
- Lymphomas ranked number one for males and central nervous system tumors rank number one for females in the 10-14 years old group. Lymphomas ranked number one for males and malignant epithelial neoplasm ranked number one for females in the 15-19 years old group.

Age-Specific Incidence Rates per 100,000 and 95% Confidence Intervals of Leading Cancers among Children and Adolescents by Age Group and Sex, MA, 2000-2009

Age 00-04 years			Age 05-09 years		
Rank	Males	Females	Rank	Males	Females
	All Cancers 23.1 (20.9, 25.2)	All Cancers 33.0 (29.9, 36.0)		All Cancers 13.6 (12.0, 15.2)	All Cancers 14.7 (12.7, 16.6)
1	Leukemia 8.0 (6.7, 9.2)	Leukemia 12.4 (10.6, 14.3)	1	Central Nervous System 4.6 (3.7, 5.5)	Central Nervous System 4.8 (3.6, 5.9)
2	Central Nervous System 4.6 (3.6, 5.5)	Leukemia 6.5 (5.2, 7.9)	2	Leukemia 3.6 (2.7, 4.4)	Leukemia 4.0 (3.0, 5.0)
3	Peripheral Nervous System 4.3 (3.4, 5.2)	Peripheral Nervous System 5.3 (4.1, 6.5)	3	Lymphoma 2.4 (1.7, 3.0)	Soft Tissue Sarcoma 1.3 (0.7, 1.9)
4	Renal Tumor 1.8 (1.2, 2.3)	Renal Tumor 2.3 (1.6, 3.2)	4	Soft Tissue Sarcoma 0.9 (0.5, 1.3)	Lymphoma 1.0 (0.5, 1.5)
5	Soft Tissue Sarcoma 1.3 (0.8, 1.9)	Retinoblastoma 1.7 (1.0, 2.4)	5	Renal Tumor 0.6 (0.3, 0.9)	Primary Bone 0.7 (0.3, 1.1)

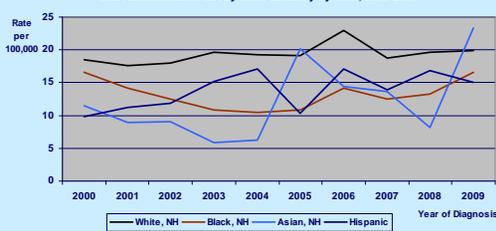
  

Age 10-14 years			Age 15-19 years		
Rank	Males	Females	Rank	Males	Females
	All Cancers 14.4 (12.8, 16.0)	All Cancers 16.3 (14.3, 18.3)		All Cancers 25.2 (23.1, 27.2)	All Cancers 24.2 (26.6, 31.8)
1	Lymphoma 4.2 (3.3, 5.0)	Central Nervous System 3.3 (2.4, 4.2)	1	Lymphoma 6.6 (5.5, 7.7)	Epithelial Tumor 10.2 (8.7, 11.9)
2	Leukemia 3.1 (2.4, 3.8)	Lymphoma 3.2 (2.4, 4.2)	2	Germ cell 4.0 (3.2, 4.9)	Lymphoma 7.6 (6.3, 8.9)
3	Central Nervous System 2.8 (2.1, 3.5)	Leukemia 3.1 (2.2, 3.9)	3	Epithelial Tumor 4.0 (3.2, 4.9)	Leukemia 3.0 (2.2, 3.8)
4	Primary Bone 1.5 (1.0, 2.0)	Epithelial Tumor 2.5 (1.7, 3.3)	4	Leukemia 3.6 (2.8, 4.4)	Central Nervous System 2.8 (2.0, 3.6)
5	Epithelial Tumor 1.2 (0.8, 1.7)	Primary Bone 1.4 (0.8, 2.0)	5	Central Nervous System 2.8 (2.1, 3.5)	Soft Tissue Sarcoma 2.3 (1.5, 3.0)

## RACE:

- The rates for white, non-Hispanics (NH) (n=2387) and Asian, NHs (n=108) increased non-significantly with APCs of 1.3% and 7.4%, respectively.
- The APC for black, NHs (n=175) decreased significantly with an APC of -11% from 2000-2004 and then increased significantly with an APC of 9.1% from 2005-2009.
- The APC for Hispanics (n=272) increased significantly with an APC of 4.6% from 2000-2009.
- From 2000-2009, Massachusetts white, NH children and adolescents had a significantly higher age adjusted incidence rate for all cancers combined and CNS cancers compared to three other racial/ethnic groups. There were no significant differences between black, NHs, Asian, NHs, and Hispanics.

Age-Adjusted Incidence Rate per 100,000 for All Cancers\* among Children and Adolescents in MA by Race/Ethnicity by Year, 2000-2009



Age-Adjusted Incidence Rates per 100,000\* and 95% Confidence Intervals of the Top Five Cancers among Children and Adolescents by Race/Ethnicity, MA, 2000-2009

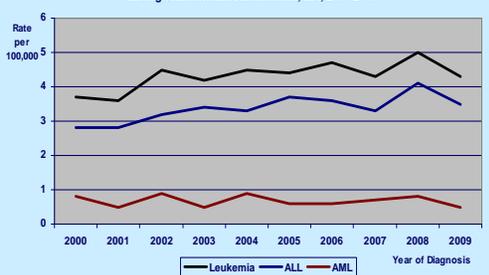
Age 00-19 years				
Rank	White, NH	Black, NH	Asian, NH	Hispanic
	All Cancers 19.3 (18.5, 20.1)	All Cancers 13.2 (11.3, 15.2)	All Cancers 12.4 (10.1, 14.7)	All Cancers 14.0 (12.4, 15.7)
1	Leukemia 4.6 (4.2, 5.0)	Leukemia 2.6 (1.8, 3.5)	Leukemia 3.5 (2.3, 4.8)	Leukemia 4.1 (3.2, 5.0)
2	Central Nervous System 3.8 (3.5, 4.2)	Leukemia 2.5 (1.6, 3.3)	Lymphoma 2.2 (1.2, 3.3)	Central Nervous System 2.3 (1.7, 3.0)
3	Lymphoma 3.1 (2.8, 3.4)	Central Nervous System 1.8 (1.0, 2.5)	Soft Tissue Sarcoma 2.1 (1.2, 3.3)	Lymphoma 2.3 (1.6, 3.0)
4	Epithelial Tumor 2.0 (1.8, 2.3)	Soft Tissue Sarcoma 1.7 (1.0, 2.4)	Soft Tissue Sarcoma 1.0 (0.3, 1.6)	Epithelial Tumor 1.4 (0.8, 1.9)
5	Peripheral Nervous System 1.4 (1.1, 1.6)	Renal Tumor 0.9 (0.4, 1.4)	Germ Cell 0.8 (0.2, 1.4)	Soft Tissue Sarcoma 1.1 (0.6, 1.6)

\* Rates were age-adjusted to the US standard 2000 population for ages 0-19

## LEUKEMIA:

- Leukemia accounted for 23.5% of childhood/adolescent cancer cases (n=705)
- There were significant increases in the incidence trends for childhood and adolescent leukemia in Massachusetts (APC=2.3%)
  - Acute lymphoid leukemia (ALL)** (n=548) is an acute (fast growing) leukemia that starts in the lymphoid cells of the bone marrow. It accounted for 77.7% of all childhood and adolescent leukemia cases. A significantly larger percentage of males were diagnosed than females (56.4% vs. 43.6%). ALL was more likely to be diagnosed in the younger age groups with 72.5% of cases diagnosed before the age of 10 and 51.3% before the age of 5. There was a significant increase in the incidence trends for ALL (APC=3.2%)
  - Acute myeloid leukemia (AML)** (n=115) starts in myeloid cells that form white cells (other than lymphocytes), red blood cells, or platelets. It accounted for 16.3% of all childhood and adolescent cases. 44.4% of cases were male and 55.7% female, no significant difference. 29.6% were diagnosed before the age of five and 61.8% were diagnosed between 10 and 19. The incidence trend for AML decreased non-significantly with an APC of -1.2%.

Age-Adjusted Leukemia Incidence Rates per 100,000\* by Subtype and Year among Children and Adolescents, MA, 2000-2009

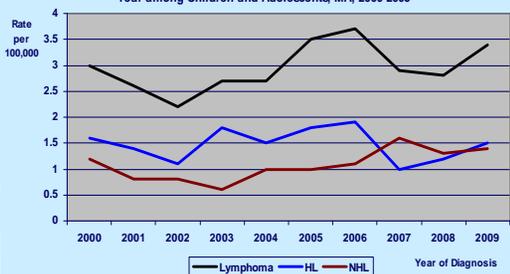


\* Rates were age-adjusted to the US standard 2000 population for ages 0-19

## LYMPHOMA:

- Lymphoma accounted for 16.6% of childhood/adolescent cancer cases (n=499). The incidence trends for all lymphomas from 2000 to 2009 was not significant (APC= -1.1%).
  - Hodgkin lymphoma (HL)** (n=252) is a type of lymphoma that involves the Reed-Sternberg cells. Those lymphomas that don't involve these cells are referred to as non-Hodgkin lymphoma. Among children and adolescents diagnosed with lymphoma, 50.5% of lymphoma cases were HL (n=252). 92.5% were diagnosed after the age of 9, with 65.5% diagnosed after the age of 14. 51.2% of HL cases were male and 48.8% female, a non-significant difference. The incidence trend was not significant (APC= -1.1%).
  - Non-Hodgkin lymphoma (NHL)** (n=182) in children comprises three main types. Lymphoblastic and large cell lymphomas are categorized as NHL, separate from Burkitt lymphoma (n=55). 36.5% of Massachusetts childhood and adolescent lymphoma cases were NHL (n=182). A significantly larger percentage of males were diagnosed with NHL compared to females (67.0% vs. 33.0%). Of the NHL cases, 77.5% were diagnosed after the age of 14. The incidence trend was statistically significant (APC= 6.0%).

Age-Adjusted Lymphoma Incidence Rates per 100,000\* by Subtype and Year among Children and Adolescents, MA, 2000-2009

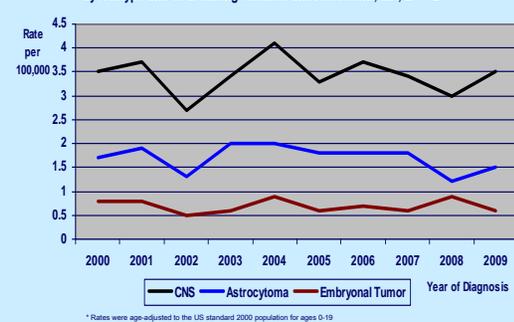


\* Rates were age-adjusted to the US standard 2000 population for ages 0-19

## CENTRAL NERVOUS SYSTEM:

- CNS cancer accounted for 18.7% of childhood and adolescent cancer cases (n=560). The trend from 2000 to 2009 was not statistically significant (APC= -0.2%).
  - Astrocytomas** (n=280) for the most part can spread widely throughout and mingle with normal brain tissue. There are three grades: low-slow growing and the most common type in children, anaplastic-moderate growing, and glioblastoma - the highest grade and the fastest growing. They accounted for 50.0% of CNS childhood and adolescent cancers. There was no significant difference in among males and females (53.6% vs. 46.4%), no predominant age group, and the trend was not statistically significant (APC= -1.9%).
  - Embryonal tumors** (n=111) begin in embryonic (fetal) cells in the brain and spinal cord. They accounted for 19.8% of CNS childhood and adolescent cancers. There was no significant difference in incidence among males and females (51.4% vs. 48.7%) and 39.6% of the cases were diagnosed before the age of 5 compared to 31.5% from age 10-19. The trend was not significant (APC= -0.5%).

Age-Adjusted Central Nervous System Cancer Incidence Rates per 100,000\* by Subtype and Year among Children and Adolescents, MA, 2000-2009



\* Rates were age-adjusted to the US standard 2000 population for ages 0-19

## OTHER CHILDHOOD/ADOLESCENT CANCERS IN MASSACHUSETTS:

- Neuroblastoma** (n=193), the major cancer of the peripheral nervous system, accounted for 6.4% of childhood and adolescent cancer cases. The incidence trend during this period was not statistically significant (APC= -0.7%). 81.9% of these cases were diagnosed before the age of 5.
- Epithelial tumors** (n=333), usually seen among adolescents, include thyroid cancer (n=146) and melanoma (n=107). Of the epithelial carcinomas, 96.6% were diagnosed after the age of 14. These cancers accounted for 11.1% of childhood and adolescent cancers. There was a statistically significant increase of cases (APC=3.7%), fueled mainly by a significant increase in thyroid cancer (APC=8.0%). This increase mirrors a significant increase in thyroid cancer among adults.
- Soft tissue sarcomas** (n=212), are cancers that develop in the supporting tissues such as muscle, fat, and blood vessels. This cancer accounted for 7.1% of childhood and adolescent cancers and the incidence rate decreased non-significantly (APC= -2.2%). Rhabdomyosarcoma (n=73) was most commonly diagnosed in the youngest and oldest age groups, with 42.5% of the cases diagnosed before the age of five and 24.7% diagnosed between 15 and 19 years as was fibrosarcoma (n=21), with 61.9% of cases diagnosed in the 15-19 age group.
- Germ cell tumors** (n=174), mainly egg and sperm cells, were most commonly diagnosed after the age of 14 (66.2%). This cancer accounted for 5.8% of childhood and adolescent cancer cases. The incidence trend was not statistically significant (APC= -2.8%).
- Primary bone cancer** (n=124) accounted for 4.1% of childhood and adolescent cancer cases. The incidence trend during that period was not statistically significant (APC= -2.8%). The two most common types of bone cancer were osteosarcoma (n=72), which accounted for 58.1% of childhood and adolescent bone cancers diagnosed and Ewing sarcoma (n=45), which accounted for 36.3%. Nearly 80% of these bone cancers occurred between 10 and 19.
- Renal tumors** (n=109) diagnosed among children and adolescents from 2000 to 2009, represented 3.6% of all childhood and adolescent cancers. Wilms' tumor (n=97) was the most common type of renal tumor, accounting for 89.0% of malignant renal tumors. The majority of Wilms' tumor cases were diagnosed either before the age of five (66.0%) or from five to nine years (27.8%). The incidence trend was not statistically significant (APC= -0.1%).

## DISCUSSION

- From 2000-2009, there were 3,001 cases of invasive cancer diagnosed among children and adolescent residents of Massachusetts. In the same time period, there were 359,058 cancer cases among the entire Massachusetts population. While the overall cancer burden among children and adolescents was disproportionate compared to their representation in the total population (0.8% versus 3.0%), there were specific cancers disproportionately affecting 0-19-year olds.
  - 8.4% of all leukemia cases, 11.5% of all Hodgkin lymphoma cases, and 11.3% of all CNS cases occurred in this age group, much larger than their representation of the total population (3.0%).
  - In the total state population, 2.7% of all male and 2.4% of all female cases were leukemia, 23.6% of childhood and adolescent male cases and 23.3% of childhood and adolescent female cases were leukemia.
  - In the total state population, 5.0% of all male and 4.2% of all female cases were lymphomas; 18.7% of childhood and adolescent male cases and 14.2% of childhood and adolescent female cases were leukemia.
  - In the total state population, 1.4% of all male and 1.3% of all female cases were CNS cancers; 19.0% of childhood and adolescent male cases and 18.3% of childhood and adolescent female cases were CNS cancers.
- The incidence rate of leukemia in Massachusetts increased significantly from 2000 to 2009, driven mainly by a significant increase in the incidence of acute lymphocytic leukemia. Data from US SEER 18 Registries also showed a significantly increased trend (APC=1.2%). The significant trend was not seen among either white, NHs or Hispanics, the only two racial/ethnic groups with enough cases to perform a trend analysis for leukemia.
- The incidence rates for lymphoma and Hodgkin lymphoma remained steady from 2000 to 2009, however, the incidence rate for non-Hodgkin lymphoma increased significantly. While the overall trend is significant, examination of the trend line indicated that there was a decrease in the rate until 2003 (1.2 to 0.6/100,000), followed by an increase from 2003 to 2007 (0.6 to 1.6/100,000), followed by a relative steadying of the trend in 2008 and 2009. The 2009 rate (1.4 per 100,000) was similar to the 2000 rate (1.2 per 100,000).
- When examining data over ten years, trends for groups with smaller numbers, such as the three non-white racial/ethnic groups and certain cancer subtypes, can fluctuate more and be less stable. In other words, when there are 6 cases in a given year, an increase of even 2 or 3 cases the following year can possibly indicate a trend when there isn't one, especially if the number falls back to 5 the following year.

The data source for all graphs and tables in this poster was the MCR, except for the general population data, which was derived from US Census estimates and the national data which came from the SEER 18 Registries. We acknowledge the Centers for Disease Control and Prevention for its support of the staff and printing of this poster under cooperative agreement #5U49CE000201 awarded to the Massachusetts Department of Public Health. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Centers for Disease Control and Prevention.