FACTS 2017-2018

UPDATED DATA ON BLOOD CANCERS

LEUKEMIA & LYMPHOMA SOCIETY®

Table of Contents

Executive Summary

Facts 2017-2018 is an update of data available for leukemia, lymphoma, myeloma, myelodysplastic syndromes and myeloproliferative neoplasms (blood cancers). Blood cancers are diseases that can affect the bone marrow, the blood cells, the lymph nodes and other parts of the lymphatic system.

Facts 2017-2018 provides updates from the American Cancer Society's *Cancer Facts and Figures 2018* (published online in 2018, https://www.cancer.org/research/cancer-facts-statistics.html) for estimated numbers of new blood cancer cases and estimated numbers of deaths due to blood cancers. The incidence rates, prevalence and mortality data in *Facts 2017-2018* reflect the statistics from the National Cancer Institute's Surveillance, Epidemiology and End Results (SEER) Program, *Cancer Statistics Review* (CSR) 1975-2014 (published online in April 2017, www.seer.cancer.gov). National incidence counts are generated from the United States Cancer Statistics (USCS) Public Use Database for 2001-2014 (https://www.cdc.gov/cancer/npcr/public-use/). Incidence rates, by state, are provided by the North American Association of Central Cancer Registries, *Cancer in North America: 2010-2014* (published online in June 2017, www.naaccr.org).

About Blood Cancers

Leukemia, Hodgkin lymphoma (HL), non-Hodgkin lymphoma (NHL), myeloma, myelodysplastic syndromes (MDS) and myeloproliferative neoplasms (MPNs) are types of blood cancer that can affect the bone marrow, the blood cells, the lymph nodes and other parts of the lymphatic system. These diseases are related in the sense that they may all result from acquired mutations to the DNA of a single lymph- or blood-forming stem cell. With blood cancers, abnormal cells multiply and survive without the usual controls that are in place for healthy cells. The accumulation of these cells in the marrow, blood and/or lymphatic tissue interferes with production and functioning of red blood cells, white blood cells and platelets. The disease process can lead to severe anemia, bleeding, an impaired ability to fight infection, or death. Figure 1 shows the percentage of estimated new cases for leukemia, lymphoma and myeloma in 2018.

Estimated New Cases (%) of Leukemia, Lymphoma, and Myeloma, 2018

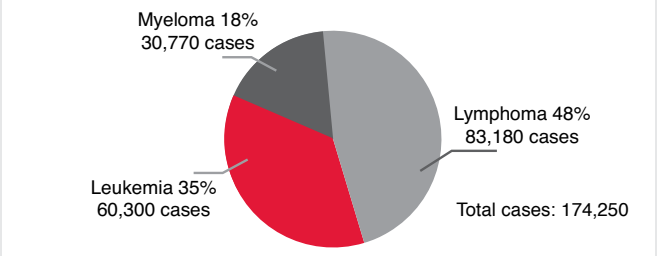

Figure 1. Source: *Cancer Facts & Figures, 2018.* American Cancer Society; 2018.

Highlights from *Facts 2017-2018*

Prevalence

Prevalence is the estimated number of people alive on a certain date in a population who previously had a diagnosis of the disease.

An estimated 1,345,123 people in the United States (US) are living with or in remission from leukemia, lymphoma or myeloma (see Table 1).

Approximate US Prevalence of the Four Major Types of Blood Cancers as of January 1, 2014

Type	Prevalence
Myeloma	118,273
Hodgkin Lymphoma	191,423
Non-Hodgkin Lymphoma	653,653
Leukemia	381,774

Table 1. Source: *SEER (Surveillance, Epidemiology and End Results)* Cancer Statistics Review, 1975-2014, National Cancer Institute; 2017.

New Cases

Approximately every 3 minutes, one person in the United States (US) is diagnosed with a blood cancer*.

- An estimated combined total of 174,250 people in the US are expected to be diagnosed with leukemia, lymphoma or myeloma in 2018.
- New cases of leukemia, lymphoma and myeloma are expected to account for 10.0 percent of the estimated 1,735,350 new cancer cases that will be diagnosed in the US in 2018.

**Data specified for "blood cancers" include leukemia, lymphoma and myeloma, and do not include data for myelodysplastic syndromes (MDS) or myeloproliferative neoplasms (MPNs).*

Incidence

Incidence rates are the number of new cases in a given year, not counting the preexisting cases. Incidence rates are usually presented as a specific number per 100,000 population. Age-adjusted rates provide more reliable rates for comparison by reducing the bias of age in the makeup of the populations that are being compared.

Overall age-adjusted incidence rates per 100,000 population reported in 2017 for leukemia, lymphoma and myeloma are either close to, or the same as, data reported in 2016: leukemia 13.7 in 2017 vs 13.5 in 2016; non-Hodgkin lymphoma (NHL) 19.5 in both 2017 and 2016; Hodgkin lymphoma (HL) 2.6 in both 2017 and 2016; myeloma 6.6 in 2017 vs 6.5 in 2016.

Survival

Relative survival compares the survival rate of a person diagnosed with a disease to that of a person without the disease. The most recent survival data available may not fully represent the impact of all current therapies and, as a result, may underestimate current survival. Figure 2 shows the 5-year relative survival rates.

Five-Year Relative Survival Rates by Year of Diagnosis

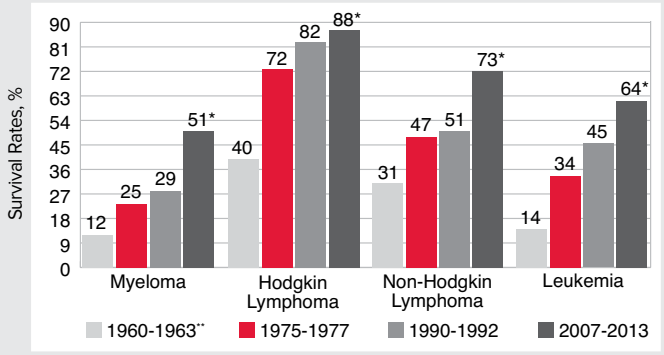

Figure 2. Source: *SEER (Surveillance, Epidemiology and End Results) Cancer Statistics Review, 1975-2014*. National Cancer Institute; 2017.

*The difference in rates between 1975-1977 and 2007-2013 is statistically significant (p<.05).

**Survival rate among whites.

Deaths

Approximately every 9 minutes, someone in the US dies from a blood cancer*. This statistic represents approximately 160 people each day or more than 6 people every hour.

- Leukemia, lymphoma and myeloma are expected to cause the deaths of an estimated 58,100 people in the US in 2018.
- These diseases are expected to account for 9.5 percent of the deaths from cancer in 2018, based on the estimated total of 609,640 cancer deaths.
- Overall, the likelihood of dying from most types of leukemia, lymphoma or myeloma decreased from 2005 to 2014 (the most recent data available).

Data specified for "blood cancers" include leukemia, lymphoma and myeloma, and do not include data for myelodysplastic syndromes (MDS) or myeloproliferative neoplasms (MPNs).

Leukemia

- An estimated 381,774 people are living with or in remission from leukemia in the US.
- In 2018, 60,300 people are expected to be diagnosed with leukemia.
- In 2018, 24,370 people are expected to die from leukemia.
- Approximately 32.3 percent more males than females are living with leukemia. More males than females are diagnosed with leukemia and die of leukemia.

Hodgkin and Non-Hodgkin Lymphoma

- An estimated 845,076 people are living with or in remission from lymphoma in the US.
- An estimated 191,423 people are living with or in remission from HL.
- An estimated 653,653 people are living with or in remission from NHL.
- In 2018, 83,180 new cases of lymphoma are expected to be diagnosed in the US (8,500 cases of HL, 74,680 cases of NHL).
- In 2018, 20,960 people are expected to die from lymphoma (1,050 from HL, 19,910 from NHL).
- NHL is the seventh most common cancer in the US, and the age-adjusted incidence rate rose by 80.5 percent from 1975 to 2014.

Myeloma

- An estimated 118,273 people are living with or in remission from myeloma in the US.
- In 2018, 30,770 people are expected to be diagnosed with myeloma.
- In 2018, approximately 12,770 people are expected to die from myeloma.
- From 1975 to 2014, the age-adjusted incidence rate of myeloma increased by 33.0 percent.
- The age-adjusted incidence rate of myeloma in black males and females was 120 percent greater than that of white males and females from 2010 to 2014.
- Overall, mortality from myeloma has been decreasing slightly from 2005 to 2014 (the most recent data available).

Myelodysplastic Syndromes

- An average of 14,275 new cases of myelodysplastic syndromes (MDS) were diagnosed in the US each year from 2010 to 2014.
- The estimated overall age-adjusted incidence rate of MDS is 4.8 cases per 100,000 population. White males have the highest rate (6.9 per 100,000 population).

Myeloproliferative Neoplasms

- An average of 9,204 new cases of myeloproliferative neoplasms (MPNs) were diagnosed in the US each year from 2010 to 2014.
- The estimated overall age-adjusted incidence rate of MPNs is 2.6 cases per 100,000 population. White males have the highest rate (2.9 per 100,000 population).

Childhood Blood Cancers

- Leukemia is the most common cancer diagnosed in children, adolescents and young adults younger than 20 years.
- The most common types of cancer in children, adolescents and young adults younger than 20 years are leukemia (26.4 percent), cancers of the brain and other nervous tissue (17.4 percent), NHL (7.3 percent), HL (6.7 percent), and soft tissue (6.2 percent).
- From 2010 to 2014, the most recent 5 years for which data are available, leukemia and lymphoma accounted for 40.4 percent of all cancer types in children, adolescents and young adults younger than 20 years.
- The age-adjusted incidence rate of leukemia and lymphoma in children, adolescents and young adults younger than 20 years was 7.2 per 100,000 (leukemia, 4.7 and lymphoma, 2.5).
- Leukemia is the second leading cause of cancer deaths (after cancers of the brain and other nervous tissue) among children, adolescents and young adults younger than 20 years. This accounts for 26.1 percent of all cancer-related deaths among this age group.

Childhood statistics are not available for myeloma, MDS or MPNs, as they are not commonly diagnosed in children, adolescents and young adults younger than age 20.

Leukemia

"Leukemia" is the term used to describe the four major types of leukemia (see Table 2).

The Four Major Types of Leukemia	
Acute Lymphoblastic Leukemia (ALL)	Chronic Lymphocytic Leukemia (CLL)
Acute Myeloid Leukemia (AML)	Chronic Myeloid Leukemia (CML)

Table 2. Source: The Leukemia & Lymphoma Society.

The terms "myeloid" or "myelogenous" and "lymphoid," "lymphocytic" or "lymphoblastic" denote the cell types involved. In general, leukemia is characterized by the uncontrolled accumulation of blood cells. However, the natural history of each type, and the therapies used to treat people with each type, are different.

Prevalence

An estimated 381,774 people in the United States (US) are living with or in remission from leukemia (see Table 3). Thirty-two percent more males than females are living with leukemia.

Acute lymphoblastic leukemia (ALL) and acute myeloid leukemia (AML) are diseases that progress rapidly without treatment. They result in the accumulation of immature, nonfunctional cells in the marrow and blood. The marrow often stops producing enough normal platelets, red blood cells and white blood cells. Anemia, a deficiency of red blood cells, develops in virtually everybody who has leukemia. The lack of normal white blood cells impairs the body's ability to fight infections. A shortage of platelets results in bruising and easy bleeding.

The progression of chronic lymphoblastic leukemia (CLL) and chronic myeloid leukemia (CML) is usually slower than that of acute types of leukemia. The slower disease progression of chronic leukemia allows greater numbers of more mature, functional cells to be made.

Approximate US Prevalence of the Four Major Types of Leukemia as of January 1, 2014	
Type	Prevalence
Acute Lymphoblastic Leukemia	78,275
Chronic Lymphocytic Leukemia	170,626
Acute Myeloid Leukemia	51,172
Chronic Myeloid Leukemia	47,583

Table 3. Source: Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov). Prevalence database: "US Estimated 39-Year L-D Prevalence Counts on 1/1/2014". National Cancer Institute, DCCPS, Surveillance Research Program, Data Modeling Branch, released April 2017, based on the November 2016 SEER data submission.

New Cases

An estimated 60,300 new cases of leukemia are expected to be diagnosed in the US in 2018 (see Figure 3 and Table 4). Chronic leukemia is expected to account for 15.3 percent more cases than those of acute leukemia.

Estimated Proportion of New Cases (%) in 2018 for Types of Leukemia, Adults and Children

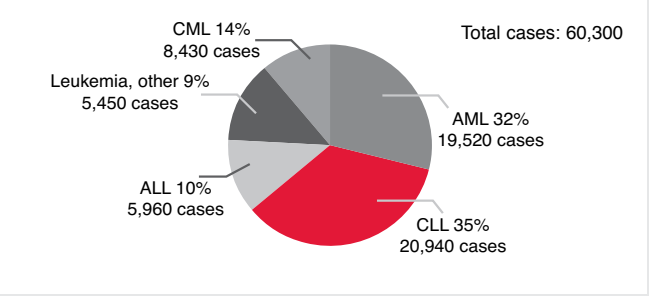

Figure 3. Source: *Cancer Facts & Figures, 2018*. American Cancer Society; 2018.

- Most cases of leukemia occur in older adults; the median age at diagnosis is 66 years.
- In 2018, leukemia is expected to strike approximately 11.5 times as many adults (55,476) as children, adolescents and young adults younger than 20 years (4,824).
- The most common types of leukemia in adults are AML and CLL.
- The most common type of leukemia in children, adolescents and young adults younger than 20 years is ALL.
- From 2010 to 2014, the latest 5 years for which data are available, ALL accounted for 74.5 percent of the new leukemia cases in children, adolescents and young adults younger than 20 years.
- From 2010 to 2014, the most recent 5 years for which data are available, CML accounted for about 3.1 percent of new cases of leukemia in children, adolescents and young adults younger than 20 years.
- Most cases of CML occur in adults. Approximately 2.1 percent of all cases of CML are in adolescents and young adults younger than 20 years.

Estimated New Cases of Leukemia, by Gender, 2018

Type	Total	Male	Female
Acute Lymphoblastic Leukemia	5,960	3,290	2,670
Chronic Lymphocytic Leukemia	20,940	12,990	7,950
Acute Myeloid Leukemia	19,520	10,380	9,140
Chronic Myeloid Leukemia	8,430	4,980	3,450
Other Leukemia	5,450	3,390	2,060
Total Estimated New Cases	60,300	35,030	25,270

Table 4. Source: *Cancer Facts & Figures 2018*. American Cancer Society; 2018.

Incidence

Since 1975, the incidence of leukemia has increased slightly. In 1975 the incidence rate was 12.8 per 100,000 population and in 2014, it was 13.9 per 100,000 population.

Gender. Incidence rates for all types of leukemia are higher among males than among females. In 2018, approximately 58 percent of the new cases of leukemia are expected to occur in males.

Race and Ethnicity. Leukemia is the tenth most frequently occurring type of cancer in all races or ethnicities.

- Age-adjusted incidence of leukemia is highest among non-Hispanic whites (14.9 per 100,000 population); it is lowest among Asian and Pacific Islander populations (7.8 per 100,000 population) and American Indian and Alaska Native populations (8.1 per 100,000 population).
- Leukemia is the tenth most common cancer in whites, eleventh most common cancer in blacks, and twelfth most common cancer in Hispanics.
- In children, adolescents and young adults younger than 20 years, leukemia incidence rates are highest among Hispanics (5.9 per 100,000 population) and lowest among blacks (3.1 per 100,000 population). The incidence rate in whites is 5.4 per 100,000 population.

Children, Adolescents and Young Adults. From 2010 to 2014, leukemia represented 26.4 percent of all of the types of cancer occurring among children, adolescents and young adults younger than 20 years.

- In 2018, about 4,824 children, adolescents and young adults younger than 20 years are expected to be diagnosed with leukemia throughout the US.
- About 32.1 percent of cancer cases in children and adolescents younger than 15 years are leukemia.
- An average of 3,679 children, adolescents and young adults younger than 20 years were diagnosed with leukemia each year (including 2,471 diagnosed with ALL) in the US from 2010 to 2014.
- ALL is the most common cancer in children, adolescents and young adults younger than 20 years.
- From 1975 to 2014, incidence rates increased for childhood and adolescent ALL (1.9 in 1975 vs 3.1 in 2014) and AML (0.6 in 1975 vs 0.8 in 2014).
- The highest incidence rates for ALL are seen in children and adolescents younger than 15 years. Within this group, the highest rate is in children ages 1 to 4 years (7.7 per 100,000).

- The incidence of ALL in children ages 1 to 4 years (7.7 per 100,000) is more than 12 times greater than the rate for young adults ages 30 to 34 years (0.6 per 100,000).
- In children, adolescents and young adults younger than 20 years, AML incidence is highest in children under 1 year and lowest in children ages 5 to 9 years.
- From 2010 to 2014, among children ages 5 to 9 years, ALL incidence was nine times greater than that of AML (3.6 per 100,000 for ALL and 0.4 per 100,000 for AML).
- In young adults ages 25 to 29 years, AML incidence was more than twice that of ALL (1.5 per 100,000 for AML and 0.6 per 100,000 for ALL).

Adults. AML, CLL and CML are most prevalent in the sixth through ninth decades of life. Incidence rates begins to increase notably among people with

- AML – at age 60 years and older (see Figure 4)
- CLL – at age 50 years and older
- CML – at age 60 years and older.

Signs and Symptoms

Signs of acute leukemia may include easy bruising or bleeding (because of platelet deficiency), paleness or easy fatigue (because of anemia), recurrent minor infections or poor healing of minor cuts (because of a low white blood cell count). These signs are not unique to leukemia and may be caused by other, more common conditions. Nonetheless, they do warrant medical evaluation. The diagnosis of leukemia requires specific blood tests, including an examination of cells in the blood and marrow. People who have chronic leukemia may not have major symptoms; they may be diagnosed as a result of a periodic physical examination and testing.

Possible Causes

The cause of most cases of leukemia is not known. Extraordinary doses of radiation and certain cancer therapies are possible causes. As previously noted, repeated exposure to the chemical benzene may cause AML. Automobile exhaust and industrial emissions account for about 20 percent of the total national benzene exposure. About half of US benzene exposure results from tobacco smoking or from exposure to tobacco smoke. The average smoker is exposed to about 10 times the daily intake of benzene compared to nonsmokers.

Treatment

The goal of leukemia treatment is to bring about a complete remission. There are two categories of leukemia, acute and chronic. Patients with acute myeloid leukemia (AML) and acute lymphoblastic leukemia (ALL) need to start treatment soon after diagnosis. Treatment may include chemotherapy, targeted therapies, monoclonal antibody therapy and stem cell transplantation. Patients diagnosed with chronic myeloid leukemia (CML) are usually treated with tyrosine kinase inhibitors, oral dugs that need to be taken indefinitely to keep CML under control. Some patients diagnosed with chronic lymphocytic leukemia (CLL) do not need treatment for long periods of time after diagnosis, sometimes called

Age-Specific Incidence Rates for Acute Myeloid Leukemia (All Races), 2010-2014

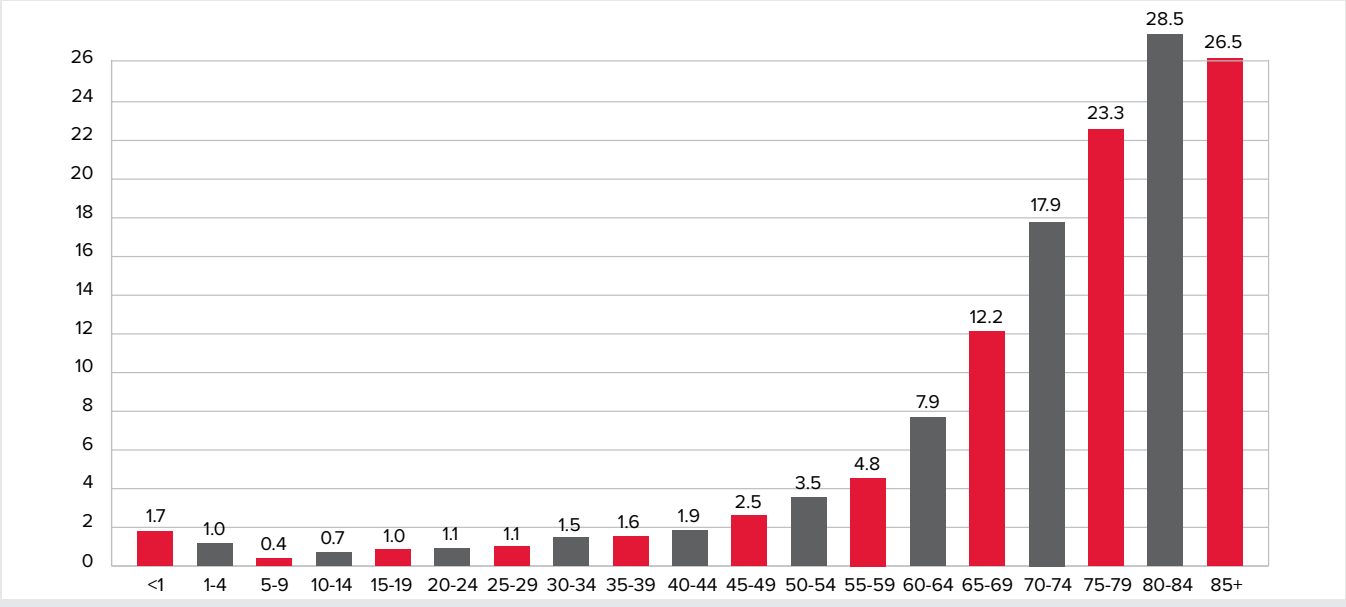

Figure 4. Source: *SEER (Surveillance, Epidemiology and End Results) Cancer Statistics Review, 1975-2014*. National Cancer Institute; 2017.

watch and wait. Patients who need treatment may receive chemotherapy, targeted therapy, monoclonal antibody therapy or treatments in combination. All patients should consider new approaches under study (clinical trials).

Survival

Relative survival rates vary according to a person's age at diagnosis, gender, race and type of leukemia. Data suggests that the overall 5-year relative survival rate for leukemia has more than quadrupled since 1960. From 1960 to 1963, the 5-year relative survival rate among whites (only data available) with leukemia was 14 percent. From 1975 to 1977, the 5-year relative survival rate for the total population with leukemia was 34.1 percent, and from 2007 to 2013, the overall relative survival rate was 63.7 percent (see Figure 5; percentages in Figure 5 are rounded to the nearest integer).

Five-Year Relative Survival Rates for All Ages, All Types of Leukemia, Diagnosed 1975-2013

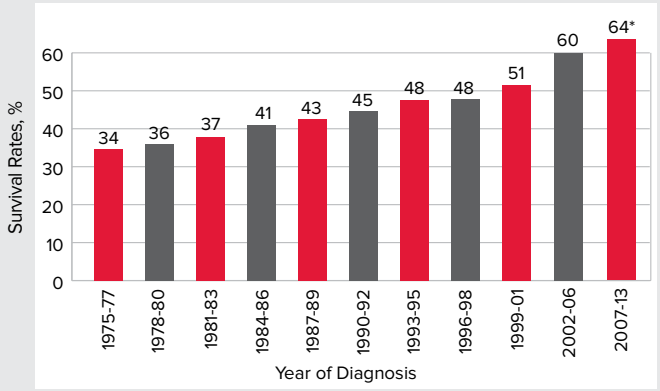

Figure 5. Source: *SEER (Surveillance, Epidemiology and End Results) Cancer Statistics Review, 1975-2014*. National Cancer Institute; 2017.

*The difference between 1975-1977 and 2007-2013 is statistically significant (P<.05).

From 2007 to 2013, the 5-year relative survival rates overall were

- ALL – 71.0 percent overall, 91.8 percent for children and adolescents younger than 15 years, and 94.0 percent for children younger than 5 years
- AML – 27.4 percent overall and 66.4 percent for children and adolescents younger than 15 years
- CLL – 86.2 percent
- CML – 68.0 percent*.

Figure 6 shows that childhood ALL 5-year survival rates have improved significantly over the past 5 decades. Most children, adolescents and young adults younger than 20 years who have ALL are expected to become 5-year survivors of the disease. However, significant treatment-related long-term morbidity and mortality for childhood cancer has been well established by several studies. Long-term treatment-related effects among ALL and other childhood cancer survivors may include subsequent cancer, cardiac disease, pulmonary disease or other diseases.

Five-Year Relative Survival Rates for Acute Lymphoblastic Leukemia in Children under 15, Diagnosed 1964-2013

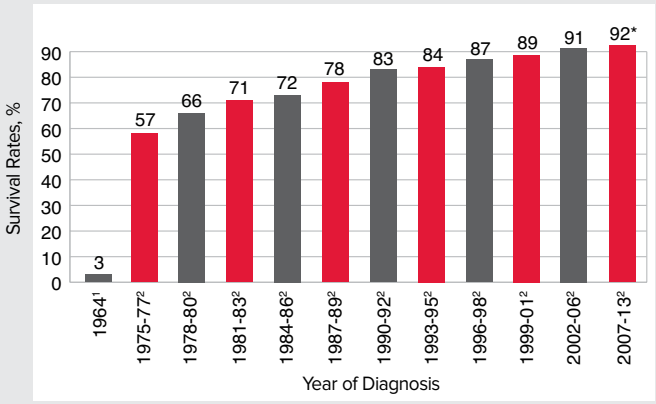

Figure 6. Sources: 1. Zuelzer WW. *Blood*. 1964:24:477-494. 2. *SEER (Surveillance, Epidemiology and End Results) Cancer Statistics Review, 1975-2014*. National Cancer Institute; 2017.

* The difference in rates between 1975-1977 and 2007-2013 is statistically significant (p<.05).

Deaths

Approximately 24,370 deaths (14,270 males and 10,100 females) in the US are expected to be attributed to leukemia in 2018. Estimated deaths for the four major types of leukemia in 2018 are

- ALL – 1,470 deaths
- AML – 10,670 deaths
- CLL – 4,510 deaths
- CML – 1,090 deaths
- Other leukemia - 6,630 deaths.

In general, mortality rates for leukemia decreased from 1975 (8.1 per 100,000) to 2014 (6.6 per 100,000).

Gender. From 2010 to2014, leukemia was the sixth most common cause of cancer deaths in both men and women in the US. In 2018, the estimated number of deaths attributed to leukemia in the US is 41.3 percent higher for males than for females. Expected deaths from leukemia in 2018, according to gender, are shown in Table 5 (on page 7).

**The survival rate of CML in clinical trials is higher than the survival rate reported here, based on SEER data. It is speculated that close clinical monitoring and better medication adherence in clinical trials are associated with a lower risk of disease progression and higher rates of survival.*

Estimated Deaths from Leukemia, by Gender, 2018			
Type	Total	Male	Female
Acute Lymphoblastic Leukemia	1,470	830	640
Chronic Lymphocytic Leukemia	4,510	2,790	1,720
Acute Myeloid Leukemia	10,670	6,180	4,490
Chronic Myeloid Leukemia	1,090	620	470
Other Leukemia	6,630	3,850	2,780
Total	24,370	14,270	10,100

Table 5. Source: *Cancer Facts & Figures 2018.* American Cancer Society; 2018.

Race and Ethnicity. For leukemia, the highest age-adjusted rates of death from 2010 to 2014 were in non-Hispanic whites at 7.2 per 100,000 population, followed by blacks at 5.7 per 100,000 population and Hispanic whites at 5.2 per 100,000 population.

- Leukemia is the fifth most common cause of cancer deaths in white males and the sixth most common in white females.
- Leukemia is the eighth most common cause of cancer deaths in both black males and black females.
- From 2010 to 2014, black males between the ages of 30 and 59 years had a higher death rate from leukemia than white males.

Children, Adolescents and Young Adults. The leukemia age-adjusted death rate for children, adolescents and young adults younger than 20 years in the US has declined by 78.6 percent from 2.8 per 100,000 population in 1969 to 0.6 per 100,000 population in 2014. Despite this decline, leukemia is the second leading cause of cancer death among children, adolescents and young adults younger than 20 years.

Hodgkin and Non-Hodgkin Lymphoma

"Lymphoma" is a general term for many blood cancers that originate in the lymphatic system. Lymphoma results when a lymphocyte (a type of white blood cell) undergoes a malignant change and multiplies out of control. Eventually, healthy cells are crowded out and malignant lymphocytes amass in the lymph nodes, liver, spleen and/or other sites in the body.

Hodgkin Lymphoma. Hodgkin lymphoma (HL) represents 10.2 percent of all types of lymphoma expected to be diagnosed in 2018. This disease has characteristics that distinguish it from other diseases classified as lymphoma, including the presence of the Reed-Sternberg cell, a large, malignant cell found in HL tissues.

Non-Hodgkin Lymphoma. Non-Hodgkin lymphoma (NHL) represents 89.8 percent of all types of lymphoma expected to be diagnosed in 2018. This disease comprises a diverse group of diseases that are distinguished by the characteristics of the cancer cells associated with each disease type. The designations "indolent" and "aggressive" are often applied to types of NHL. Each type is associated with factors that categorize the prognosis as either more or less favorable.

Prevalence

An estimated total of 845,076 people in the United States (US) population are living with or in remission from lymphoma.

- There are 191,423 people living with or in remission from Hodgkin lymphoma.
- There are 653,653 people living with or in remission from non-Hodgkin lymphoma.

New Cases

About 83,180 people in the US are expected to be diagnosed with lymphoma in 2018 (8,500 cases of HL and 74,680 cases of NHL). The incidence of HL is consistently and considerably lower than that of NHL. Table 6 shows estimated new cases of lymphoma in 2018, by gender.

Estimated New Cases of Lymphoma, by Gender, 2018			
Type	Total	Male	Female
Hodgkin Lymphoma	8,500	4,840	3,660
Non-Hodgkin Lymphoma	74,680	41,730	32,950
Total	83,180	46,570	36,610

Table 6. Source: *Cancer Facts & Figures 2016.* American Cancer Society; 2018.

Incidence

From 2010 to 2014, the age-adjusted incidence rate for lymphoma was 22.0 per 100,000.

- The age-adjusted incidence rate for HL was 2.6 per 100,000.
- The age-adjusted incidence rate for NHL was 19.5 per 100,000.

The age-adjusted incidence rate of HL declined by 10.0 percent from 1975 to 2014, an annual percentage decrease of 0.3 percent. The age-adjusted incidence rate of NHL rose by 80.5 percent from 1975 to 2014, an average annual percentage increase of 2.1 percent.

Gender. Incidence rates for HL and NHL tend to be higher among males than among females. For NHL, incidence rates are higher in males than females across all age groups.

- In 2018, it is expected that 32.2 percent more males than females will be diagnosed with HL and about 26.6 percent more males than females will be diagnosed with NHL.
- NHL is the sixth most common cancer in males and the seventh most common cancer in females in the US.

Race and Ethnicity. The highest age-adjusted incidence rate of lymphoma is in non-Hispanic whites (23.8 per 100,000), followed by Hispanic whites (20.7 per 100,000), and blacks (17.2 per 100,000).

- The highest age-adjusted incidence rate of HL is in non-Hispanic whites (3.0 per 100,000), followed by blacks (2.6 per 100,000), and Hispanic whites (2.3 per 100,000).
- The highest age-adjusted incidence rate of NHL is in non-Hispanic whites (20.8 per 100,000), followed by Hispanic whites (18.4 per 100,000), and blacks (14.6 per 100,000).

Blacks, from their early-20s to their late-40s, have higher incidence rates of NHL than whites. However, beginning at age 50 years, whites generally have considerably higher incidence rates of NHL than blacks.

NHL is the fifth most common cancer in Hispanics, constituting 5.2 percent of all types of cancer cases in Hispanics.

Children, Adolescents and Young Adults. Lymphoma (HL, 6.7 percent; NHL, 7.3 percent) is the third most common cancer in children, adolescents and young adults younger than 20 years.

- In 2018, lymphoma will account for 8 percent (HL, 3 percent; NHL, 5 percent) of all cancers expected to be diagnosed in children and adolescents younger than 15 years. The number of cases expected to be diagnosed in children and adolescents younger than 15 years is 318 for HL and 530 for NHL.
- Older children and adolescents are more commonly diagnosed with HL than younger children.
- NHL is more common than HL in children under 15. HL is more common than NHL in adolescents and young adults between the ages of 15 and 29.
- The lymphoma age-adjusted incidence rates (HL and NHL), for the years 2010 to 2014, were higher for the 20- to 24-year-old age-group (6.7 per 100,000 population) than for the 15- to 19-year-old age-group (4.9 per 100,000 population).

The following data is based on age-adjusted incidence rates for children, adolescents and young adults younger than 20 years:

- Lymphoma is most commonly diagnosed in non-Hispanic whites (2.7 per 100,000 population), followed by blacks (2.2 per 100,000 population), and Hispanic whites (2.2 per 100,000 population).
- Lymphoma is least commonly diagnosed among American Indian and Alaska Native children, adolescents and young adults (1.4 per 100,000 population).

Adults. HL incidence rates are higher in adolescents and young adults ages 15 to 34 years than in adults ages 35 to 64 years. Incidence peaks at ages 75 to 79 years (see Figure 7 on page 9). In contrast, the incidence rates of NHL increase with age (see Figure 8 on page 9).

- From ages 20 to 24 years, the incidence rate of NHL is about 2.6 cases per 100,000 population.
- From ages 60 to 64 years, the incidence rate increases almost 17 times to 43.8 cases per 100,000 population.
- From ages 80 to 84 years, the incidence rate increases 46 times to 119.7 cases per 100,000 population.

Signs and Symptoms

A common early sign of HL or NHL is a painless enlargement of one or more lymph nodes. However, enlarged lymph nodes may be the result of inflammation in the body and are not necessarily a sign of cancer.

Other HL signs and symptoms may include recurrent high fever, persistent cough and shortness of breath, drenching night sweats of the whole body, itching and weight loss.

Other signs and symptoms of NHL may include bone pain, cough, chest pain, abdominal pain, rash, fever, night sweats, enlarged spleen, unexplained fatigue or weight loss. Some individuals may have no symptoms, and a diagnosis of NHL is made as a result of a periodic physical examination and testing.

Age-Specific Incidence Rates for Hodgkin Lymphoma, 2010-2014

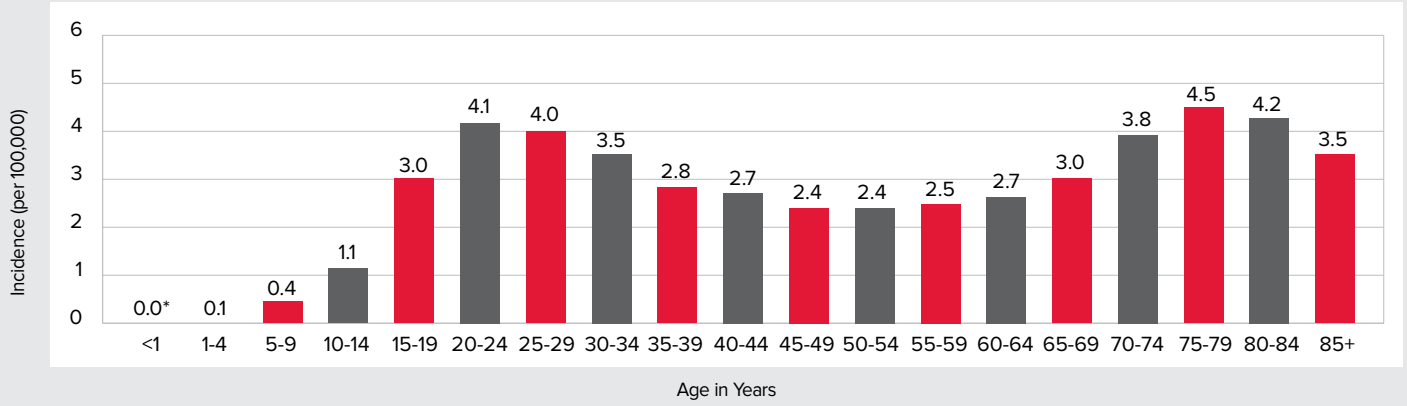

Figure 7. Source: *SEER (Surveillance, Epidemiology and End Results) Cancer Statistics Review, 1975-2014*. National Cancer Institute; 2017.
*<16 cases for age and time interval, SEER 18 areas.

Age-Specific Incidence Rates for Non-Hodgkin Lymphoma, 2010-2014

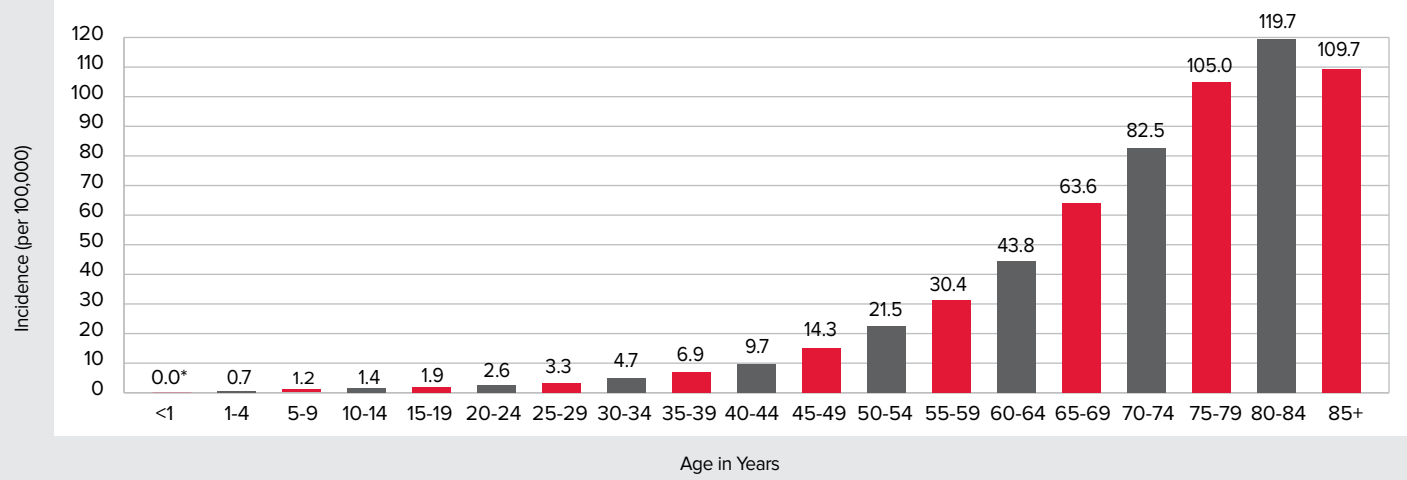

Figure 8. Source: *SEER (Surveillance, Epidemiology and End Results) Cancer Statistics Review, 1975-2014*. National Cancer Institute; 2017.
*<16 cases for age and time interval, SEER 18 areas.

Possible Causes

The results of certain studies about causes of HL have not been definitive—many studies of links between HL and environmental exposures have been conducted, with unclear results. Although Epstein-Barr virus (EBV) has been associated with nearly half of HL cases, EBV has not been conclusively established as a cause. Most cases of HL occur in people who do not have identifiable risk factors; most people with identifiable risk factors do not develop HL.

The reasons for the development of NHL are not known. Immune suppression plays a role in some cases. People infected with the human immunodeficiency virus (HIV) have a higher risk of developing lymphoma. Studies suggest that specific ingredients in herbicides and pesticides may be linked to NHL. Exposure to certain viruses, such as EBV and human T-lymphotropic virus (HTLV), are also associated with NHL. The bacterium *Helicobacter pylori* causes ulcers in the stomach, and it is associated with the development of mucosa-associated lymphoid tissue (MALT) lymphoma in the stomach wall. About a dozen uncommon, inherited syndromes can predispose individuals to later develop NHL. These risk factors explain only a small proportion of cases.

Treatment

The goal of treatment for HL is to cure the disease. Chemotherapy, either alone or combined modality therapy (chemotherapy and radiotherapy), are commonly administered treatment approaches for HL. Involved field radiation therapy (IFRT) and involved site radiation therapy (ISRT) are the most common types of radiotherapy used to treat HL. The radiation targets primarily the lymph node

regions involved by disease. Chemotherapy is used to kill neighboring lymphoma cells.

In general, the goal of treatment for NHL is to destroy as many lymphoma cells as possible and to induce a complete remission. Treatment protocols vary according to the type of disease. Chemotherapy and radiation therapy are the two principal forms of treatment. Although radiation therapy is often neither the sole nor the principal curative therapy, it is an important additional treatment in some cases. Stem cell transplantation and a watch-and-wait strategy are also used to treat some NHL subtypes. Immunotherapy is indicated to treat individuals with specific types of NHL.

Survival

HL is now considered to be one of the most curable forms of cancer.

- The 5-year relative survival rate for people with HL has more than doubled, from 40 percent in whites from 1960 to 1963 (the only data available) to 88.3 percent for all races from 2007 to 2013.
- The 5-year relative survival rate is 94.0 percent for all people with HL who were younger than 45 years at diagnosis.

The 5-year relative survival rate for people with NHL has risen from 31 percent in whites from 1960 to 1963 (the only data available) to 73.3 percent for all races from 2007 to 2013.

Race and Ethnicity. Table 7 shows the HL and NHL 5-year relative survival rates, rounded to the nearest integer, for all races and for blacks and whites, spanning four decades.

Trends in Five-Year Relative Survival Rates by Race for Hodgkin Lymphoma and Non-Hodgkin Lymphoma, by Year of Diagnosis

Hodgkin Lymphoma	1975-1977	1984-1986	1996-1998	2007-2013
All Races	72%	78%	85%	88%*
Whites	72%	79%	86%	89%*
Blacks	70%	75%	81%	85%*
Non-Hodgkin Lymphoma	**1975-1977**	**1984-1986**	**1996-1998**	**2007-2013**
All Races	47%	52%	59%	73%*
Whites	47%	52%	59%	74%*
Blacks	49%	47%	55%	67%*

Table 7. Source: *SEER (Surveillance, Epidemiology and End Results) Cancer Statistics Review, 1975-2014*. National Cancer Institute; 2017.
* The difference between 1975-1977 and 2007-2013 is statistically significant (p<.05).

Children, Adolescents and Young Adults. Five-year relative survival is 97.3 percent for HL in children, adolescents and young adults younger than 20 years.

In children, adolescents and young adults younger than 20 years, 5-year relative survival for NHL is 88.7 percent. This represents a significant improvement in the rate of survival. As recently as the mid-1970s, most children and adolescents with NHL did not survive 5 years after they were diagnosed.

Subsequent Primary Cancers. The growing US cancer survivor population has a need for medical follow-up. Efforts are under way to provide information about survivors' risks for developing multiple primary cancers. The information will help physicians and patients discuss the risks and any established prevention and screening guidelines. Tables 8 and 9 (on page 11) show the observed-to-expected ratio (O/E) for subsequent primary cancer development in HL and NHL survivors (see *Notes and Definitions*, page 21). Subsequent cancers among HL survivors have been well studied because of the high long-term survival rates and the relatively young age at diagnosis for many people with this disease. NHL represents a broad range of diseases, with varying risk factors and treatments; the relative risk for subsequent cancers depends on the NHL subtype and the treatment. The SEER data show that as a group, survivors of NHL have an increased O/E for developing subsequent cancers (O/E = 1.27), but their risk is lower than the risk of HL survivors (O/E = 2.12).

Observed-to-Expected Ratio for Developing Subsequent Primary Cancer after Hodgkin Lymphoma (HL) by Attained Age, SEER 1973-2014								
Second Primary Site	Birth to 19 (N=3,770)	20 to 39 (N=16,506)	40 to 59 (N=15,359)	60 and older (N=8,584)	All Ages (N=27,797)	All Ages		
						Observed	Expected	EAR**
Lung and Bronchus	0	6.35*	4.30*	2.28*	2.89*	605	209	11.25
Female Breast	0	5.75*	2.64*	1.17	2.35*	561	239	19.67
Non-Hodgkin Lymphoma	4.58	8.26*	6.34*	4.98*	5.87*	430	73	10.13
Acute Non-Lymphocytic Leukemia (ANLL)	61.72*	24.27*	12.84*	6.51*	11.16*	165	15	4.27
All Sites Excluding Non-Melanoma Skin	6.97*	3.95*	2.57*	1.56*	2.12*	3,644	1,720	54.65

Table 8. Source: *Surveillance, Epidemiology, and End Results (SEER)* Program (www.seer.cancer.gov) SEER*Stat Database: Incidence - SEER 9 Regs Research Data, Nov 2016 Sub (1973-2014) <Katrina/Rita Population Adjustment> - Linked To County Attributes - Total U.S., 1969-2015 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, released April 2017, based on the November 2016 submission.

*p<.05.

**EAR=Estimated absolute risk (see *Notes and Definitions*, page 21).

Observed-to-Expected Ratio for Developing Subsequent Primary Cancer after Non-Hodgkin Lymphoma (NHL) by Attained Age, SEER 1973-2014								
Second Primary Site	Birth to 19 (N=3,090)	20 to 39 (N=14,555)	40 to 59 (N=46,945)	60 and older (N=99,273)	All Ages (N=135,745)	All Ages		
						Observed	Expected	EAR**
Lung and Bronchus	0	3.90*	2.09*	1.25*	1.32*	2,581	1,951	6.95
Hodgkin Lymphoma	6.14	8.60*	7.27*	6.54*	6.90*	228	33	2.15
Acute Non-Lymphocytic Leukemia (ANLL)	65.01*	16.74*	11.81*	3.46*	4.34*	521	120	4.43
Melanoma of the Skin	0	2.06	1.50*	1.24*	1.30*	621	479	1.57
Kaposi Sarcoma	0	19.04*	13.59*	1.99*	9.45*	138	15	1.36
All Sites Excluding Non-Melanoma Skin	9.44*	4.18*	1.79*	1.18*	1.27*	16,392	12,941	38.1

Table 9. Source: *Surveillance, Epidemiology, and End Results (SEER)* Program (www.seer.cancer.gov) SEER*Stat Database: Incidence - SEER 9 Regs Research Data, Nov 2016 Sub (1973-2014) <Katrina/Rita Population Adjustment> - Linked To County Attributes - Total U.S., 1969-2015 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, released April 2017, based on the November 2016 submission.

*p<.05.

**EAR=Estimated absolute risk (see *Notes and Definitions*, page 21).

Deaths

In 2018, an estimated 20,960 members of the US population are expected to die from lymphoma (1,050 HL and 19,910 NHL), as shown in Table 10.

Estimated Deaths from Hodgkin Lymphoma and Non-Hodgkin Lymphoma, by Gender, 2018			
Type	Total	Male	Female
Hodgkin Lymphoma	1,050	620	430
Non-Hodgkin Lymphoma	19,910	11,510	8,400
Total	20,960	12,130	8,830

Table 10. Source: *Cancer Facts & Figures 2018*. American Cancer Society; 2018.

Gender. NHL is the eighth most common cause of cancer death in males and the seventh most common in females in the US. Death rates for HL are much lower than those for NHL for both males and females.

- From 2010 to 2014, for males, the age-adjusted death rate for HL was 0.4 per 100,000 and for NHL, 7.6 per 100,000.
- For females, the age-adjusted death rate for HL was 0.3 per 100,000 and for NHL, 4.6 per 100,000.

Race and Ethnicity. For NHL, the highest age-adjusted rates of death from 2010 to 2014 were in non-Hispanic whites at 6.2 per 100,000 population, followed by Hispanic whites at 5.3 per 100,000 population and blacks at 4.3 per 100,000 population.

Children, Adolescents and Young Adults. For children, adolescents and young adults under 20 years, age-adjusted death rates for HL and NHL per 100,000 population declined from 1975 to 2014.

- For HL, the rate was 0.1 in 1975 vs 0.0* in 2014
- For NHL, the rate was 0.4 in 1975 vs 0.1 in 2014.

**Statistic not reported due to fewer than 16 deaths.*

Myeloma

Myeloma is a cancer of the plasma cells (a type of white blood cell). Plasma cells are found primarily in the bone marrow. About 90 percent of people with myeloma have disease involving multiple sites at the time of diagnosis. Some individuals have myeloma that progresses very slowly (sometimes referred to as "smoldering" or "indolent" myeloma).

In myeloma, a B lymphocyte (the cell type that forms plasma cells) becomes malignant. Eventually, malignant plasma cells (myeloma cells) amass in the marrow and sometimes in other sites in the body. The myeloma cells disrupt normal blood production, destroy normal bone tissue and cause pain. Healthy plasma cells produce immunoglobulins (antibodies) that protect the body against certain types of infection. The onset of myeloma interferes with antibody production, making people with myeloma susceptible to infection and other serious complications.

Prevalence

An estimated 118,273 people in the United States (US) are living with or in remission from myeloma.

New Cases

An estimated 30,770 new cases of myeloma (16,400 males and 14,370 females) are expected to be diagnosed in the US in 2018 (see Table 11).

Estimated New Cases of Myeloma, by Gender, 2018

Type	Total	Male	Female
Myeloma	30,770	16,400	14,370

Table 11. Source: *Cancer Facts & Figures 2018*. American Cancer Society; 2018.

The median age at diagnosis is 69 years; myeloma is seldom diagnosed in people younger than 40 years.

Incidence

For the years 2010 to 2014, the age-adjusted incidence rate for myeloma was 6.6 per 100,000.

Gender. The age-adjusted incidence rate for the years 2010 to 2014 was 59.6 percent higher in males (8.3 per 100,000 population) than it was in females (5.2 per 100,000 population).

Race and Ethnicity. From 2010 to 2014, myeloma was the ninth most commonly diagnosed cancer among black males and black females.

- The median age at diagnosis is 66 years for blacks and 70 years for whites.
- Blacks have more than twice the age-adjusted incidence rate (13.2 per 100,000 population) of myeloma than whites (6.0 per 100,000 population).
- Black males have a higher age-adjusted myeloma incidence rate than males or females of any other race or ethnicity.
- The highest incidence rates are found in black males who are ages 80 to 84 (108.8 per 100,000 population).

Age. Figure 9 shows the age-specific incidence rates for myeloma for the years 2010 to 2014.

Age-Specific Incidence Rates for Myeloma, 2010-2014

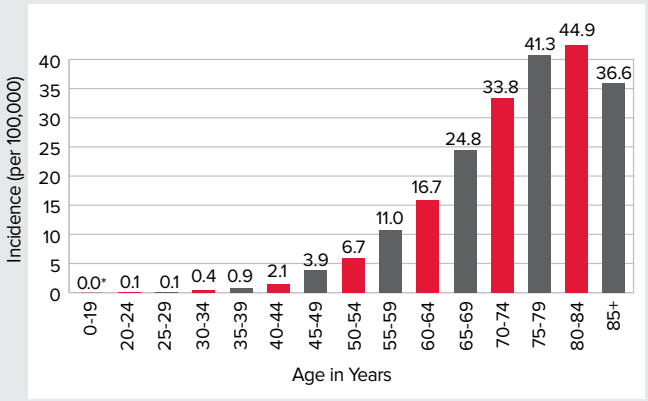

Figure 9. Source: *SEER (Surveillance, Epidemiology and End Results) Cancer Statistics Review, 1975-2014*, National Cancer Institute; 2017.
*<16 cases for age and time interval, SEER 18 areas.

Signs and Symptoms

The first symptom of myeloma is often bone pain from the effects that myeloma cells are having on the marrow. Fractures may occur as a result of the weakened bones. Anemia, recurrent infections, or numbness or pain in the hands and/or feet (caused by a condition called "peripheral neuropathy") can also be early signs of the disease. People with myeloma may also tire more easily and feel weak, or they may have no symptoms.

Possible Causes

The cause of myeloma is unknown in most cases. Long-term exposure to certain chemicals seems to increase the risk of developing myeloma, but most people who have myeloma do not have any history of such exposure, indicating that other factors must play a major role.

Treatment

The goals of treatment for people with myeloma are to reduce symptoms, to slow disease progression and to provide prolonged remission. There have been significant treatment advances in recent years. The approach for treating each person is customized, based on the extent of disease and the rate of disease progression. People who have a slow-growing myeloma and no symptoms may not need treatment immediately. Some people need only supportive care to reduce symptoms of anemia, high blood calcium levels, infections and/or bone damage or osteoporosis. Patients who require myeloma-specific therapies may receive combination drug therapy, high-dose chemotherapy with stem cell transplantation (autologous, allogeneic or reduced-intensity allogeneic), radiation therapy for local disease and/or new and emerging drug therapies as part of clinical trials.

Survival

Current statistical databases show that overall 5-year relative survival in people with myeloma has improved significantly since the 1960s.

- Five-year relative survival has increased from 12 percent from 1960 to 1963 (for whites, the only data available) to 51.0 percent from 2007 to 2013 (for all races and ethnicities).
- Five-year survival from 2007 to 2013 is highest for black females (54.0 percent) compared to 50.5 percent for black males, 50.1 percent for white males and 51.1 percent for white females.
- The 3-year survival rate as of January 1, 2014, was 64.7 percent (for all races and ethnicities).

Deaths

Approximately 12,770 deaths from myeloma are expected in 2018 (see Table 12).

Estimated Deaths from Myeloma, by Gender, 2018

Type	Total	Male	Female
Myeloma	12,770	6,830	5,940

Table 12. Source: *Cancer Facts & Figures 2018*. American Cancer Society; 2018.

Gender. Myeloma was the seventh most common cause of cancer death for black females and the twelfth most common cause of cancer death for white females from 2010 to 2014.

Myeloma was the seventh leading cause of cancer death for black males and the thirteenth most common cause of cancer death for white males from 2010 to 2014.

Race and Ethnicity. As reported in *Cancer Facts & Figures for African Americans 2016-2018*, the American Cancer Society estimated that approximately 3 percent of all cancer-related deaths among blacks are expected to be caused by myeloma.

- The age-adjusted mortality rate for myeloma from 2010 to 2014 for black males was nearly double the rate for white males (7.5 per 100,000 population vs 4.0 per 100,000 population).
- For black females, the age-adjusted mortality rate from myeloma was more than twice the rate for white females (5.5 per 100,000 population vs 2.4 per 100,000 population).
- The US median age at death from myeloma is 75 years. It is 76 years for whites, 71 years for blacks and 72 years for Hispanics.

Myelodysplastic Syndromes

Myelodysplastic syndromes (MDS) comprise a group of diseases of the blood and marrow, with varying degrees of severity and life expectancy. A myelodysplastic syndrome begins with a change to a normal stem cell in the marrow. The marrow becomes filled with an increased number of developing blood cells. However, the blood is usually deficient in cell numbers because the cells in the marrow die before they can be released into the blood. Normally, immature cells known as “blasts” make up less than 5 percent of all cells in the marrow. In a person with MDS, blasts often constitute more than 5 percent of the cells and in a person with acute myeloid leukemia (AML), blasts constitute more than 20 percent of the cells in the marrow. MDS has been known as “smoldering leukemia” or “preleukemia.” These terms may be misleading because they imply that MDS is only serious and problematic if it evolves into AML; this is not the case.

The most common MDS subtype is refractory anemia with excess blasts, 15.1 percent, followed by refractory anemia, 7.3 percent. People diagnosed with MDS, not otherwise specified (MDS NOS) constitute 60.5 percent of all MDS cases.

Prevalence

The SEER program only recently began maintaining statistics for MDS. Prevalence statistics were not reported by SEER for MDS in 2018 at the time of this publication.

New Cases

For the 5-year period from 2010 to 2014, there were 71,373 new cases of MDS throughout the US, averaging 14,275 cases per year.

Incidence

The overall age-adjusted incidence rate of MDS is 4.8 cases per 100,000 population (see Table 13).

Myelodysplastic Syndromes Age-Adjusted Incidence Rates, per 100,000 Population, 2010-2014

By Race	Rate
All Races	4.8
White	5.0
Black	4.1
Asian/Pacific Islander	3.5
American Indian/Alaska Native*	3.1
Hispanic**	3.4
By Age	**Rate**
Ages <40	0.1
Ages 40-49	0.7
Ages 50-59	2.3
Ages 60-69	8.9
Ages 70-79	29.4
Ages 80+	59.1

Table 13. Source: *SEER (Surveillance, Epidemiology and End Results) Cancer Statistics Review, 1975-2014*, National Cancer Institute; 2017.

*Incidence data for American Indians and Alaska Natives are based on the CHSDA (Contract Health Service Delivery Area) counties.

**Hispanics are not mutually exclusive from whites, blacks, Asian/Pacific Islanders, and American Indians/Alaska Natives. Incidence data for Hispanics are based on NAACCR Hispanic Identification Algorithm (NHIA) and exclude cases from the Alsaka Native Registry.

Gender. In the United States (US), for the 5-year period from 2010 to 2014, approximately 41,174 MDS cases were diagnosed in males (averaging 8,235 per year) and approximately 30,199 MDS cases were diagnosed in females (averaging 6,040 per year). The overall age-adjusted incidence rates of MDS by gender are 6.6 per 100,000 in males and 3.5 per 100,000 in females.

Race and Ethnicity. White males have the highest age-adjusted incidence rates (6.9 per 100,000 population), while the lowest occur among Asian and Pacific Islander females (2.7 per 100,000 population) and American Indian and Alaska Native females (2.7 per 100,000 population).

Age. The age-adjusted incidence rate for MDS is highest for males ages 80 years and older (89.1 per 100,000) and lowest for both males and females younger than 40 years (0.1 per 100,000).

Signs and Symptoms

Most often, people diagnosed with MDS first seek medical attention because they are experiencing fatigue and shortness of breath (from anemia). Some individuals have no symptoms, and a diagnosis of MDS is made as a result of a periodic physical examination and testing.

Possible Causes

Most people with MDS have “primary MDS,” for which there is usually no clear-cut triggering event. A possible cause of MDS is repeated exposure to the chemical benzene. Automobile exhaust and industrial emissions account for about 20 percent of the total national exposure to benzene. About half of the exposure to benzene in the US results from smoking tobacco or from exposure to tobacco smoke. The average smoker is exposed to about 10 times the daily intake of benzene compared to nonsmokers. Secondary MDS is caused by previous cancer treatments such as chemotherapy or radiation.

Treatment

The goal of therapy for a person with lower-risk MDS is to manage the disease by reducing transfusion needs and infection risk. Currently, the only potentially curative therapy is high-dose chemotherapy with allogeneic stem cell transplantation. This may be a practical option for certain younger people with higher-risk MDS (individuals whose life expectancy without successful treatment warrants the risk associated with transplantation). Other general approaches to treatment (either used alone or in combination) include transfusion; a watch-and-wait strategy; administration of blood cell growth factors; drug therapy with newer agents; or chemotherapy used to treat AML.

Survival

Because the SEER program only recently began maintaining statistics for MDS, survival statistics were not reported in 2018 at the time of this publication.

Deaths

Because the SEER program only recently began maintaining statistics for MDS, mortality statistics were not reported in 2018 at the time of this publication.

Myeloproliferative Neoplasms

Myeloproliferative neoplasms (MPNs) make up a group of blood cancers characterized by the overproduction of one or more types of blood cells—red blood cells, white blood cells and/or platelets. MPNs usually develop slowly over time, and different MPNs affect different blood cells. Many people with MPNs can experience few or no symptoms for extended periods of time with proper monitoring and treatment.

There are several types of MPNs. The following three classic types are traditionally grouped together because of their overlapping features:

- Essential thrombocythemia (ET), which accounted for 43.2 percent of MPNs from 2010 to 2014
- Polycythemia vera (PV), which accounted for 42.4 percent of MPNs from 2010 to 2014
- Myelofibrosis (MF), which accounted for 13.1 percent of MPNs from 2010 to 2014.

Prevalence

The SEER program only recently began maintaining statistics for MPNs. Prevalence statistics were not reported by SEER for MPNs in 2018 at the time of this publication.

New Cases

For the 5-year period from 2010 to 2014, there were 46,020 new cases of MPNs throughout the US, averaging 9,204 cases per year.

Incidence

The overall age-adjusted incidence rate of MPNs is 2.6 cases per 100,000 population (see Table 14).

Gender. In the United States (US), for the 5-year period from 2010 to 2014, 22,730 MPN cases were diagnosed in males (averaging 4,546 per year) and 23,290 MPN cases were diagnosed in females (averaging 4,658 per year). The overall age-adjusted incidence rates of MPNs by gender are 2.9 per 100,000 in males and 2.4 per 100,000 in females.

Race and Ethnicity. White males have the highest age-adjusted incidence rates of MPNs (2.9 per 100,000 population), while the lowest occur among Hispanic females (1.4 per 100,000 population) and American Indian and Alaska Native females (1.5 per 100,000 population).

Age. The age-adjusted incidence rate for MPNs is highest for males ages 80 years and older (18.1 per 100,000) and lowest for males younger than 40 years (0.3 per 100,000) and females younger than 40 years (0.4 per 100,000).

Myeloproliferative Neoplasms Age-Adjusted Incidence Rates, per 100,000 Population, 2010-2014

By Race	Rate
All Races	2.6
White	2.7
Black	2.5
Asian/Pacific Islander	1.8
American Indian/Alaska Native*	1.6
Hispanic**	1.5
By Age	**Rate**
Ages <40	0.4
Ages 40-49	1.8
Ages 50-59	3.4
Ages 60-69	7.0
Ages 70-79	12.2
Ages 80+	16.2

Table 14. Source: *SEER (Surveillance, Epidemiology and End Results) Cancer Statistics Review, 1975-2014*. National Cancer Institute; 2017.

*Incidence data for American Indians/Alaska Natives are based on the CHSDA (Contract Health Service Delivery Area) counties.

**Hispanics are not mutually exclusive from whites, blacks, Asian/Pacific Islanders, and American Indians/Alaska Natives. Incidence data for Hispanics are based on NAACCR Hispanic Identification Algorithm (NHIA), and exclude cases from the Alsaka Native Registry.

Signs and Symptoms

Many people with MPNs can experience few or no symptoms for extended periods with proper monitoring and treatment. Each type of MPN may show different signs and symptoms.

ET is often detected during a routine blood test, before an individual has any symptoms. One of the first indications of ET may be the development of a blood clot (thrombus). In a small subset of patients, ET may cause bleeding. This may occur in patients with an extremely high platelet count.

PV develops slowly, and it may not cause symptoms for many years. The condition is often diagnosed during a routine blood test, before severe symptoms occur.

MF usually develops slowly. Often, MF does not cause early symptoms and it may be found during a routine blood test. However, as disruption of normal blood cell production increases, people may experience symptoms such as fatigue, weakness, shortness of breath or pale skin.

Possible Causes

MPNs are considered "clonal disorders." Clonal disorders begin with one or more changes to the DNA of a single stem cell in the bone marrow.

In most cases, the cause of the change to the stem cell is unknown. Mutations may be caused by environmental factors or by an error during cell division. While family clusters of ET, PV and MF have been reported, these are generally not inherited diseases. They arise from gene mutations that occur during a person's lifetime.

Researchers believe that proteins known as "Janus kinases" (JAKs) are involved. JAKs send signals that affect the production of blood cells in the bone marrow. These proteins help control the numbers of red blood cells, white blood cells and platelets. When JAKs send too many signals, they cause the bone marrow to make too many blood cells. This chain of events is referred to as "overactive JAK signaling." JAK signaling may become overactive in many ways. One way is a mutation of the *JAK2* gene.

Most cases of ET are associated with one or more acquired genetic mutations to a hematopoietic stem cell that results in the overproduction of megakaryocytes, the precursor cells of platelets in the bone marrow. The vast majority of patients with ET have a mutation of the *JAK2*, *MPL*, or *CALR* gene.

Approximately 95 percent of PV patients have a mutation of the *JAK2* gene. Mutations in genes of hematopoietic stem cells are thought to be responsible for the overactive JAK signaling that causes MF. The mutations may be in the genes that make JAKs, or the mutations may be in genes that affect how JAKs work. The vast majority of patients with MF have either a mutation of the *JAK2*, *MPL*, or *CALR* gene.

Treatment

Treatment for MPNs can vary based on specific diagnosis. Patients have symptoms and circumstances that require different treatments. There is no single treatment that is effective for all patients. Treatment for patients may include low-dose aspirin, therapeutic phlebotomy, drug therapy or allogeneic stem cell transplantation. The doctor will monitor the patient closely through regular examinations, watching for any signs of disease progression. All patients, however, need to be closely monitored.

Survival

Because the SEER program only recently began maintaining statistics for MPNs, survival statistics were not reported at the time of this publication.

Deaths

Because the SEER program only recently began maintaining statistics for MPNs, mortality statistics were not reported at the time of this publication.

Incidence Rates: Leukemia, Lymphoma, Myeloma, Myelodysplastic Syndromes and Myeloproliferative Neoplasms

Tables 15, 16 and 17 show incidence rates for leukemia, NHL, HL, myeloma, MDS and MPN using data figures from 2010 to 2014 (the most recent data available). Rates are per 100,000 population and are age-adjusted to the 2000 US standard population.

Age-Adjusted Incidence Rates, by Gender, All Races, per 100,000 Population, 2010-2014

Type	Total	Male	Female
Leukemia	13.7	17.6	10.7
Non-Hodgkin Lymphoma	19.5	23.7	16.0
Hodgkin Lymphoma	2.6	2.9	2.3
Myeloma	6.6	8.3	5.2
Myelodysplastic Syndromes	4.8	6.6	3.5
Myeloproliferative Neoplasms	2.6	2.9	2.4

Table 15. Source: *SEER (Surveillance, Epidemiology and End Results) Cancer Statistics Review, 1975-2014*. National Cancer Institute; 2017.

Age-Adjusted Incidence Rates, by Gender, for Blacks, per 100,000 Population, 2010-2014

Type	Total	Male	Female
Leukemia	10.9	14.0	8.8
Non-Hodgkin Lymphoma	14.6	17.6	12.2
Hodgkin Lymphoma	2.6	3.1	2.2
Myeloma	13.2	15.9	11.4
Myelodysplastic Syndromes	4.1	5.3	3.3
Myeloproliferative Neoplasms	2.5	2.7	2.3

Table 16. Source: *SEER (Surveillance, Epidemiology and End Results) Cancer Statistics Review, 1975-2014*. National Cancer Institute; 2017.

Age-Adjusted Incidence Rates, by Gender, for Whites, per 100,000 Population, 2010-2014

Type	Total	Male	Female
Leukemia	14.5	18.5	11.3
Non-Hodgkin Lymphoma	20.4	24.8	16.9
Hodgkin Lymphoma	2.7	3.1	2.4
Myeloma	6.0	7.8	4.6
Myelodysplastic Syndromes	5.0	6.9	3.6
Myeloproliferative Neoplasms	2.7	2.9	2.5

Table 17. Source: *SEER (Surveillance, Epidemiology and End Results) Cancer Statistics Review, 1975-2014*. National Cancer Institute; 2017.

Estimated New Cases and Estimated Deaths, by State

Estimated New Cases of Blood Cancers, by State, 2018

State	Leukemia	Non-Hodgkin Lymphoma	Myeloma	Hodgkin Lymphoma
Alabama	830	990	440	110
Alaska	110	140	50	*
Arizona	1,150	1,480	540	160
Arkansas	510	650	260	70
California	6,220	8,190	2,910	890
Colorado	910	1,100	410	140
Connecticut	760	970	390	110
Delaware	180	250	110	*
Dist. of Columbia	70	120	60	*
Florida	4,770	5,990	2,470	560
Georgia	1,590	1,970	1,000	250
Hawaii	200	270	100	*
Idaho	310	390	130	*
Illinois	2,170	2,830	1,120	340
Indiana	1,210	1,600	590	190
Iowa	700	810	300	80
Kansas	590	640	270	70
Kentucky	960	1,060	410	110
Louisiana	740	1,040	450	130
Maine	320	400	130	*
Maryland	910	1,290	600	170
Massachusetts	1,150	1,650	1,090	210
Michigan	1,820	2,590	900	270
Minnesota	1,270	1,420	570	150
Mississippi	560	560	320	70
Missouri	1,240	1,480	610	160
Montana	230	280	100	*
Nebraska	410	460	180	50
Nevada	500	580	220	60
New Hampshire	280	370	130	*
New Jersey	1,990	2,370	990	280
New Mexico	360	410	170	*
New York	4,410	4,890	2,180	620
North Carolina	2,050	2,240	1,180	270
North Dakota	150	170	60	*
Ohio	2,060	2,880	1,160	320
Oklahoma	710	860	340	100
Oregon	650	1,010	350	110
Pennsylvania	2,930	3,430	1,270	400
Rhode Island	190	270	100	*
South Carolina	960	1,150	670	130
South Dakota	190	220	80	*
Tennessee	1,370	1,540	660	170
Texas	4,580	5,460	2,330	680
Utah	480	520	190	70
Vermont	120	170	60	*
Virginia	1,250	1,760	770	230
Washington	1,330	1,770	550	190
West Virginia	390	480	190	50
Wisconsin	1,350	1,410	570	160
Wyoming	100	120	*	*
United States	60,300	74,680	30,770	8,500

Table 18. Source: American Cancer Society.

*Estimate is fewer than 50 cases.

Estimates are rounded to the nearest 10. State estimates may not sum to US total due to rounding and/or exclusion of state.

(Note: The projected numbers of new cancer cases and deaths in 2018 should not be compared with previous years to track cancer trends because they are model-based and vary from year to year for reasons other than changes in cancer occurrence. Age-standardized incidence and death rates should be used to measure cancer trends.)

Estimated Deaths from Blood Cancers, by State, 2018

State	Leukemia	Non-Hodgkin Lymphoma	Myeloma	Hodgkin Lymphoma
Alabama	400	300	220	*
Alaska	*	*	*	*
Arizona	540	410	260	*
Arkansas	260	200	130	*
California	2,580	2,140	1,300	130
Colorado	340	250	170	*
Connecticut	290	220	140	*
Delaware	80	70	50	*
Dist. of Columbia	*	*	*	*
Florida	1,820	1,510	950	70
Georgia	620	530	400	*
Hawaii	90	100	60	*
Idaho	120	110	60	*
Illinois	980	790	480	*
Indiana	550	450	270	*
Iowa	250	250	140	*
Kansas	260	180	130	*
Kentucky	380	320	180	*
Louisiana	330	290	200	*
Maine	130	110	60	*
Maryland	420	340	270	*
Massachusetts	520	380	260	*
Michigan	840	750	450	*
Minnesota	460	380	230	*
Mississippi	230	170	140	*
Missouri	520	370	270	*
Montana	80	70	*	*
Nebraska	150	130	80	*
Nevada	210	150	90	*
New Hampshire	110	80	60	*
New Jersey	650	510	320	*
New Mexico	140	120	70	*
New York	1,460	1,200	760	60
North Carolina	760	610	470	*
North Dakota	60	50	*	*
Ohio	1,000	860	540	*
Oklahoma	350	270	150	*
Oregon	310	280	180	*
Pennsylvania	1,180	970	580	*
Rhode Island	90	60	*	*
South Carolina	400	300	260	*
South Dakota	80	50	*	*
Tennessee	540	460	300	*
Texas	1,660	1,330	820	90
Utah	170	130	90	*
Vermont	50	50	*	*
Virginia	550	490	340	*
Washington	520	450	250	*
West Virginia	200	150	100	*
Wisconsin	520	420	270	*
Wyoming	60	*	*	*
United States	24,370	19,910	12,770	1,050

Table 19. Source: American Cancer Society.

*Estimate is fewer than 50 cases.

Estimates are rounded to the nearest 10. State estimates may not sum to US total due to rounding and/or exclusion of state.

(Note: The projected numbers of new cancer cases and deaths in 2018 should not be compared with previous years to track cancer trends because they are model-based and vary from year to year for reasons other than changes in cancer occurrence. Age-standardized incidence and death rates should be used to measure cancer trends.)

Five-Year Incidence and Mortality Cases, by State

Five-Year Blood Cancer Incidence Cases, by State, 2010-2014

State	Leukemia	Non-Hodgkin Lymphoma	Myeloma	Hodgkin Lymphoma
Alabama	3,237	4,507	1,862	544
Alaska	360	528	155	60
Arizona	4,171	5,802	1,954	748
Arkansas	2,070	2,932	1,108	407
California	24,290	35,941	11,396	4,475
Colorado	3,598	4,582	1,570	666
Connecticut	3,197	4,402	1,485	623
Delaware	758	1,123	405	150
Dist. of Columbia	292	537	258	115
Florida	15,935	22,008	7,971	2,604
Georgia	6,521	8,652	3,947	1,208
Hawaii	939	1,468	468	121
Idaho	1,331	1,562	508	207
Illinois	9,238	13,450	4,384	1,826
Indiana	4,713	6,833	2,371	957
Iowa	2,940	4,019	1,266	479
Kansas	2,491	3,156	1,045	364
Kentucky	3,866	5,067	1,657	590
Louisiana	3,224	4,827	1,803	642
Maine	1,335	1,767	539	208
Maryland	3,958	5,557	2,217	817
Massachusetts	4,765	7,536	2,517	1,018
Michigan	7,884	11,570	3,852	1,433
Minnesota	5,017	6,596	1,941	793
Mississippi	1,987	2,748	1,220	373
Missouri	4,707	6,421	2,194	811
Montana	947	1,186	399	146
Nebraska	1,482	2,104	658	266
Nevada	1,803	2,240	650	257
New Hampshire	1,097	1,665	479	196
New Jersey	7,543	10,649	3,563	1,424
New Mexico	1,446	1,804	584	256
New York	17,636	23,712	8,950	3,287
North Carolina	7,134	9,376	4,073	1,279
North Dakota	618	822	248	119
Ohio	7,852	12,638	4,060	1,528
Oklahoma	2,870	3,826	1,234	511
Oregon	2,799	4,304	1,234	501
Pennsylvania	11,522	17,011	5,383	2,146
Rhode Island	867	1,363	370	186
South Carolina	3,497	4,444	2,185	630
South Dakota	719	950	317	105
Tennessee	4,938	6,499	2,311	872
Texas	16,734	21,837	8,382	3,169
Utah	1,718	2,212	704	345
Vermont	492	842	224	100
Virginia	4,652	7,453	2,662	1,013
Washington	5,497	7,653	2,299	911
West Virginia	1,637	2,219	717	251
Wisconsin	5,687	6,950	2,337	910
Wyoming	419	513	168	60
United States	225,540	316,095	110,585	41,250

Table 20. Source: Copeland G, Lake A, Firth, R, et al, eds. *Cancer in North America: 2010-2014, Volume Two: Registry-specific Cancer Incidence in the United States and Canada*. North American Association of Central Cancer Registries, Inc (NAACR). June 2017.

Five-Year Blood Cancer Mortality Cases, by State, 2010-2014

State	Leukemia	Non-Hodgkin Lymphoma	Myeloma	Hodgkin Lymphoma
Alabama	1,948	1,611	1,073	99
Alaska	168	136	89	^
Arizona	2,398	2,003	1,105	101
Arkansas	1,235	1,070	600	62
California	12,151	10,546	5,816	704
Colorado	1,538	1,271	748	72
Connecticut	1,450	1,216	682	57
Delaware	363	324	194	15
Dist. of Columbia	156	130	119	12
Florida	8,471	7,473	4,119	373
Georgia	2,815	2,426	1,721	172
Hawaii	427	445	216	21
Idaho	553	526	268	29
Illinois	4,937	4,134	2,333	192
Indiana	2,644	2,348	1,290	127
Iowa	1,371	1,286	669	61
Kansas	1,249	987	587	51
Kentucky	1,838	1,633	843	56
Louisiana	1,636	1,544	910	106
Maine	628	564	282	24
Maryland	2,014	1,682	1,195	108
Massachusetts	2,576	2,171	1,268	107
Michigan	4,045	3,890	2,104	206
Minnesota	2,237	1,993	1011	95
Mississippi	1,112	860	616	65
Missouri	2,555	2,068	1,242	106
Montana	380	348	215	17
Nebraska	736	646	355	32
Nevada	903	725	403	39
New Hampshire	510	421	236	28
New Jersey	3,259	2,832	1,607	153
New Mexico	682	578	338	35
New York	7,093	6,298	3,482	374
North Carolina	3,418	3,007	1,978	167
North Dakota	276	238	148	^
Ohio	4,807	4,498	2,512	236
Oklahoma	1,642	1,347	725	84
Oregon	1,510	1,480	811	83
Pennsylvania	5,804	5,273	2,761	253
Rhode Island	422	380	195	24
South Carolina	1,741	1,454	1086	78
South Dakota	409	299	174	^
Tennessee	2,616	2,252	1,337	138
Texas	7,813	6,553	3,780	457
Utah	717	607	360	30
Vermont	259	236	118	19
Virginia	2,621	2,395	1,521	138
Washington	2,418	2,236	1,190	111
West Virginia	903	794	430	38
Wisconsin	2,585	2,101	1,209	112
Wyoming	250	164	96	^
United States	116,289	101,499	58,167	5,696

Table 21. Source: Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Mortality - All COD, Aggregated With State, Total U.S. (1969-2014) <Katrina/Rita Population Adjustment>, National Cancer Institute, DCCPS, Surveillance Research Program, released December 2016. Underlying mortality data provided by NCHS (www.cdc.gov/nchs).

Underlying mortality data provided by NCHS (www.cdc.gov/nchs).

^Statistic not displayed due to fewer than 10 cases.

Five-Year Leukemia Incidence and Mortality Cases, by State

Five-Year Leukemia Incidence Cases, By State, 2010-2014

State	Leukemia	Acute Lymphocytic Leukemia	Chronic Lymphocytic Leukemia	Acute Myeloid Leukemia	Chronic Myeloid Leukemia
Alabama	3,237	308	1,011	1,031	391
Alaska	360	48	100	116	47
Arizona	4,171	530	1,072	1,451	501
Arkansas	2,070	193	720	645	259
California	24,290	3,744	7,432	7,607	2,939
Colorado	3,598	367	1,252	999	460
Connecticut	3,197	262	1,234	929	409
Delaware	758	75	265	213	99
Dist. of Columbia	292	39	78	83	34
Florida	15,935	1,567	4,988	5,296	2,117
Georgia	6,521	670	2,258	1,971	888
Hawaii	939	105	240	363	129
Idaho	1,331	134	529	333	182
Illinois	9,238	1,021	2,747	3,190	1,223
Indiana	4,713	476	1,433	1,655	660
Iowa	2,940	239	1,167	848	376
Kansas	2,491	218	916	718	328
Kentucky	3,866	287	1,444	1,186	553
Louisiana	3,224	303	1,099	985	493
Maine	1,335	102	549	402	162
Maryland	3,958	392	1,271	1,301	484
Massachusetts	4,765	473	1,580	1,503	600
Michigan	7,884	788	2,735	2,509	1,056
Minnesota	5,017	425	2,073	1,300	641
Mississippi	1,987	192	648	636	279
Missouri	4,707	418	1,473	1,527	602
Montana	947	63	414	250	120
Nebraska	1,482	145	526	469	188
Nevada	1,803	220	587	541	184
New Hampshire	1,097	89	446	296	130
New Jersey	7,543	715	2,908	2,136	907
New Mexico	1,446	171	506	404	192
New York	17,636	1,515	7,123	4,910	2,207
North Carolina	7,134	701	2,540	2,117	1,019
North Dakota	618	47	280	164	73
Ohio	7,852	824	2,277	2,580	975
Oklahoma	2,870	283	986	861	357
Oregon	2,799	293	989	918	294
Pennsylvania	11,522	1,016	4,150	3,632	1,445
Rhode Island	867	60	307	247	116
South Carolina	3,497	338	1,206	1,096	449
South Dakota	719	57	269	230	91
Tennessee	4,938	479	1,854	1,470	588
Texas	16,734	2,369	5,315	4,406	2,283
Utah	1,718	246	598	479	201
Vermont	492	48	185	157	63
Virginia	4,652	520	1,344	1,555	603
Washington	5,497	566	2,151	1,581	674
West Virginia	1,637	125	582	521	222
Wisconsin	5,687	432	2,260	1,561	829
Wyoming	419	40	162	122	50
United States	225,540	23,900	76,899	69,014	29,088

Table 22. Source: Copeland G, Lake A, Firth, R, et al, eds. *Cancer in North America: 2010-2014, Volume Two: Registry-specific Cancer Incidence in the United States and Canada.* North American Association of Central Cancer Registries, Inc (NAACR). June 2017.

Five-Year Leukemia Mortality Cases, By State, 2010-2014

State	Leukemia	Acute Lymphocytic Leukemia	Chronic Lymphocytic Leukemia	Acute Myeloid Leukemia	Chronic Myeloid Leukemia
Alabama	1,948	88	328	707	78
Alaska	168	^	30	80	^
Arizona	2,398	191	437	992	110
Arkansas	1,235	40	219	436	55
California	12,151	1,185	2,190	5,269	578
Colorado	1,538	118	309	652	76
Connecticut	1,450	73	315	614	71
Delaware	363	16	84	144	17
Dist. of Columbia	156	14	38	56	^
Florida	8,471	532	1,562	3,367	406
Georgia	2,815	167	467	1004	134
Hawaii	427	21	35	215	21
Idaho	553	33	121	219	28
Illinois	4,937	244	961	1,914	202
Indiana	2,644	126	524	1,146	116
Iowa	1,371	86	330	619	69
Kansas	1,249	50	283	492	57
Kentucky	1,838	99	390	732	84
Louisiana	1,636	74	255	565	95
Maine	628	24	138	284	27
Maryland	2,014	85	378	767	97
Massachusetts	2,576	138	551	1,080	90
Michigan	4,045	209	858	1,651	167
Minnesota	2,237	116	537	993	102
Mississippi	1,112	61	172	362	41
Missouri	2,555	145	542	1,068	118
Montana	380	23	81	146	17
Nebraska	736	34	181	319	25
Nevada	903	75	124	378	34
New Hampshire	510	23	135	196	17
New Jersey	3,259	169	642	1,280	115
New Mexico	682	53	136	287	20
New York	7,093	423	1,416	3,171	274
North Carolina	3,418	164	738	1,448	177
North Dakota	276	15	68	122	10
Ohio	4,807	251	969	2,064	226
Oklahoma	1,642	96	325	593	80
Oregon	1,510	84	328	669	72
Pennsylvania	5,804	312	1,203	2,306	228
Rhode Island	422	16	92	184	15
South Carolina	1,741	90	302	771	83
South Dakota	409	22	95	172	12
Tennessee	2,616	137	563	1,099	137
Texas	7,813	687	1,300	3,067	407
Utah	717	55	152	264	36
Vermont	259	11	66	126	13
Virginia	2,621	130	521	1,023	118
Washington	2,418	177	559	1,219	101
West Virginia	903	37	224	330	34
Wisconsin	2,585	132	535	1,116	104
Wyoming	250	15	53	100	11
United States	116,289	7,175	22,862	47,878	5,221

Table 23. Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Mortality - All COD, Aggregated With State, Total U.S. (1969-2014) <Katrina/Rita Population Adjustment>, National Cancer Institute, DCCPS, Surveillance Research Program, released December 2016. Underlying mortality data provided by NCHS (www.cdc.gov/nchs).

^Statistic not displayed because fewer than 10 cases were reported.

Notes and Definitions

The data within *Facts 2017-2018* reflect the most recent statistics from The National Cancer Institute's *Surveillance, Epidemiology and End Results (SEER) Program, Cancer Statistics Review (CSR) 1975-2014*. The CSR reports cancer incidence, mortality, survival, prevalence and lifetime risk statistics. Incidence, prevalence and survival data were released online by SEER, www.seer.cancer.gov, on April 15, 2017. The next SEER Cancer Statistics Review is expected to be published online in the spring of 2018.

Incidence and mortality rates measure exactly what occurred, and cover the entire period through the most recent year reported, 2014. However, in order to calculate survival rates, the most current year of data are not considered, because not enough time has passed for it to be included.

The SEER Program's CSR presents statistics by age, sex, race and ethnicity. Statistics for these categories reflect a blend of biological and cultural factors. Additionally, data reported by race and ethnicity represent both the diversity and the mixed heritage of the US population.

Data by Hispanic ethnicity is not shown for statistics/years for which they are not available. The Hispanic ethnicity categorization is not mutually exclusive with race, so in instances where comparisons are made using ethnicity, the groupings Hispanic whites and non-Hispanic whites are used to enable meaningful comparisons.

Mortality data reflected in the 2017 referenced SEER report reflect data from the National Cancer for Health Statistics (NCHS) from 1969 to 2014, and were made available in 2017.

The SEER (18 region) data cover only about 27.8 percent of the US population. The data can be extrapolated for the entire US by multiplying by the population ratio, but these figures do not take into account differences in geography, race and ethnicity in various regions, or region-specific health risks.

Data on American Indians and Alaska Natives (AI/AN) should be interpreted with care because the data reflect statistics from Indian Health Service (IHS) Contract Health Service Delivery Area (CHSDA) counties only. Many AI/ANs do not reside in such counties, and other AI/AN individuals are not members of federally recognized tribes and cannot avail themselves of IHS services.

Limited data on myelodysplastic syndromes (MDS) and myeloproliferative neoplasms (MPNs) were included in the SEER statistics as separate entities beginning in 2007.

State level incidence rates presented in *Facts 2017-2018* are provided by the North American Association of Central Cancer Registries (NAACCR). NAACCR presents the most current 5-year incidence rate for the US and Canada in the annual publication, *Cancer in North America*.

The American Cancer Society (ACS) projected the number of estimated cancer cases for 2018 using a model based on incidence data from 49 states and the District of Columbia for the years from 1995 to 2013. That incidence data met the North American Association of Central Cancer Registries' (NAACCR) high-quality data standard for incidence. This method considers geographic variations in sociodemographic and lifestyle factors, medical settings, and cancer screening behaviors as predictors of incidence, and also accounts for expected delays in case reporting. The ACS projected the estimated number of US cancer deaths by fitting the number of cancer deaths from 1995 to 2014 to a statistical model that forecasts the number of deaths expected to occur in 2018. The estimated number of cancer deaths for each state is calculated similarly, using state-level data. For both US and state estimates, data on the number of deaths are obtained from the National Center for Health Statistics (NCHS) at the Centers for Disease Control and Prevention (CDC).

In instances where 2018 incidence count estimates are not available from the ACS, actual national incidence counts were obtained using the United States Cancer Statistics (USCS) public use database, which contains cancer incidence for the entire US for 2001 to 2014, sourced from the CDC's National Program for Cancer Registries (NPCR) and SEER. National incidence counts are presented as a yearly average of the 5 most recent years of US incidence available.

Definitions

Age-adjusted rate is an incidence or death rate that has been adjusted to reduce the bias of age in the makeup of the populations that are being compared, thereby providing a more reliable rate for comparison. Incidence or death rates can be adjusted for any demographic factor or any combination of factors, such as age (the most common), sex and race.

Incidence is the number of newly diagnosed cases either for a specific cancer, or for all cancers combined, during a specific time period. When expressed as a rate, it is the number of new cases per standard unit of population during the time period. Incidence rates can be calculated based on a number of factors, such as age, race or sex.

Prevalence is the estimated number of people alive on a certain date in a population who previously had a diagnosis of the disease. It includes new cases (incidence) and preexisting cases and is a function of both past incidence and survival. Prevalence may be calculated in a number of different ways, especially in looking at populations in which individuals have had more than one type of cancer. In some prevalence statistics, only the first diagnosed cancer counts. Thus, if a person is initially diagnosed with melanoma and later develops leukemia, his or her survival with leukemia may not be counted in leukemia prevalence statistics. Therefore, prevalence numbers reported may vary depending upon the method used to determine them. In this report, complete prevalence is reported as defined by SEER as "an estimate of the number of persons (or the proportion of population) alive on a specified date who had been diagnosed with the given cancer, no matter how long ago that diagnosis was." This publication is using the "39-year limited duration" prevalence figures, based on the "first invasive tumor for each cancer site diagnosed during the previous 39 years (1975-2013)," as per SEER Table 1.22. The specified date is January 1, 2014, for the prevalence estimates. The prevalence counts in *Facts 2017-2018* are adjusted for race, sex and age.

Relative survival rate is an estimate of the percentage of patients who would be expected to survive the effects of the cancer. This rate is calculated by adjusting the observed survival rate so that the effects of causes of death other than those related to the cancer in question are removed. The relative survival rate is a comparison of survival to that of a person who is free of the disease. ("Observed survival" is the actual percentage of patients still alive at some specified time after diagnosis of cancer. It considers deaths from all causes, cancer or otherwise.)

Remission is when signs of a disease disappear. This usually follows treatment. The words "complete" and "partial" are sometimes used to further define the term "remission." Complete remission means that all evidence of the disease is gone. Partial remission means that the disease is markedly improved by treatment, but residual evidence of the disease is present.

Observed-to-expected ratio (O/E) is the observed number of cancers in a population of cancer survivors divided by the number of cancers expected. The number of cancers expected is calculated using cancer rates from the general population and person-years-at-risk of the survivor population under study. The risk of developing subsequent cancers varies by the type of first cancer diagnosed, age at first diagnosis, environmental exposures, genetic factors, treatment and other factors.

Person-years-at-risk (PYAR) is counted from the date two months after the diagnosis of the first cancer (to exclude multiple primaries diagnosed at the same time) until the date of last known vital status or death, and allocated by age, sex, race and calendar year. All second and later (third, fourth, etc) cancer diagnoses are included.

Estimated absolute risk (EAR) is calculated by subtracting the expected number of cancer cases from the observed number, dividing by the PYAR and multiplying by 10,000. The EAR represents the number of excess cancers per 10,000 PYAR (for example, a population of 10,000 cancer survivors followed for 1 year or 1,000 cancer survivors followed for 10 years).

About The Leukemia & Lymphoma Society

The Leukemia & Lymphoma Society (LLS) exists to find cures and ensure access to the most appropriate treatments for blood cancer patients.

LLS funds research to advance more breakthrough therapies for blood cancer patients.

LLS is the voice for all blood cancer patients, and we help them navigate their cancer treatment, access quality care and find a clinical trial.

Despite progress, about a third of blood cancer patients still do not survive 5 years after their diagnosis.

Research

Over the past 69 years, LLS has invested more than $1.2 billion in research to advance therapies and save lives. We provide funding across the continuum, from basic research through clinical trials—from bench to bedside. LLS research grants have funded many of today's most promising advances, including targeted therapies and immunotherapies. Our funding supports the training of the next generation of first-rate cancer researchers.

Our **Research Grant programs** support scientific studies at academic centers throughout the world.

- *The Career Development Program (CDP)* provides stipends to investigators of exceptional promise in the early stages of their careers. CDP is stratified into two separately reviewed programs: basic or clinical research.
- *The Translational Research Program (TRP)* supports outstanding investigations likely to translate basic biomedical discoveries into safe and effective treatments. Awards are for an initial 3-year period. Renewals to support clinical trials are possible for an additional 2 years.
- *The Specialized Center of Research Program (SCOR)* encourages multidisciplinary academic investigations by teams of at least three research groups, regardless of their location.
- *The New Idea Award* seeks innovative approaches that can lead to significant improvements in clinical outcomes and changes to standards of care for blood cancer patients.
- *The Screen to Lead Program (SLP)* provides support for medicinal chemistry and/or drug target screening in blood cancers.

LLS creates partnerships with universities, biotechnology and pharmaceutical companies to get treatments to patients faster than ever–especially to patients with unmet medical needs.

Our ***Therapy Acceleration Program® (TAP)*** speeds the path of potentially better therapies into preclinical development and clinical trials. Working with academic investigators, medical centers, biotechnology and pharmaceutical companies, TAP is increasing the likelihood that breakthrough treatments will be available to patients sooner. Two TAP programs have led to FDA-approved therapies in 2017.

LLS has foundation partnerships with:

- The MPN Research Foundation, to fund innovative grants to better understand and treat the range of myeloproliferative neoplasms (MPN)
- The International Waldenström's Macroglobulinemia (WM) Foundation, to fund research to improve quality of life and to better understand and treat WM and other B-cell malignancies
- The Rising Tide Foundation for Clinical Cancer Research, to fund novel immunotherapy and prevention research linked to clinical trials for all blood cancers
- The Babich Family Foundation/RUNX1 Research Program, to fund translational research seeking to control familial platelet disorder (FPD) leading to acute myeloid leukemia (AML).

Visit www.LLS.org or email researchprograms@LLS.org for information about LLS research grant programs.

Public Policy

LLS recognizes that finding cures is not enough; we need to ensure that patients have access to the treatments they need to live longer, better, healthier lives. The LLS Office of Public Policy (OPP) is dedicated to removing barriers to care by advancing Federal and State public policy, and regulatory policy initiatives. OPP works with Congress and regulatory agencies to accelerate approval of innovative treatments for blood cancer patients. OPP works with a nationwide team of policy advocates to help drive public policies to ensure that patients have sustainable access to quality, affordable coordinated care.

The work of OPP helps to provide **access to better therapies, faster.** LLS is a strong voice in Washington, DC, and throughout the US, representing the healthcare and medical research interests of patients and families to policy makers at all levels of government. Our staff includes Federal and State Government & Regulatory Affairs, and Policy Advocates professionals. We collaborate with our passionate and extensive Policy Advocate Network of volunteers—many individuals whose lives have been touched by a blood cancer. Currently, we are working at the federal, state and community levels to ensure that patients have affordable health insurance coverage and to remove barriers to access. To join the LLS Advocates Network, visit www.LLS.org/advocacy.

Patient Education and Support Services

LLS is the leading source of free blood cancer information, education and support. To help ensure access to the latest treatments and survivorship care, and improve quality of life, staff and volunteers provide assistance and resources to patients, caregivers, and healthcare professionals nationally and in communities through our chapters across the US and Canada.

- **Accurate, up-to-date information.** Our Information Specialists are master's level oncology professionals who provide a one-to-one connection for patients, families and healthcare professionals. The staff members offer personalized guidance for coping with a blood cancer diagnosis, current disease information and referral to resources within LLS and beyond.

  Information Specialists can help conduct clinical-trial searches. When appropriate, personalized clinical-trial navigation by trained nurses is also available through our Clinical Trial Support Center (CTSC). Clinical Trial Specialists are registered nurses with expertise in blood cancers. They personally assist patients and caregivers throughout the entire clinical-trial process. For more information, contact an Information Specialist.

  Information Specialists can be contacted at (800) 955-4572, Monday through Friday, from 9 am to 9 pm Eastern Time, or by visiting www.LLS.org/InformationSpecialists.

- **Assistance with financial burdens.** Our *Co-Pay Assistance Program* has provided $394 million to date to help patients pay for co-payments and health insurance premiums. Eligibility for this program is based on fund availability for specific blood cancer diagnoses and financial need criteria. A current list of funds by blood cancer diagnosis is available at www.LLS.org/copay or at (877) 557-2672.

  Our *Susan Lang Pay-it-Forward Patient Travel Assistance* program provides financial assistance to patients diagnosed with a blood cancer who struggle to pay for treatment-related transportation and/or lodging costs. Qualified patients, who meet program eligibility criteria, receive an annual stipend to help cover these expenses. Patient assistance is based upon available funding. Visit www.LLS.org/travel or call (844) 565-2269.

- **Free information booklets.** Disease, treatment and support booklets in English, Spanish and several other languages are available through our Information Specialists and LLS chapters and can be downloaded and ordered at www.LLS.org/booklets.

- **Education programs.** LLS provides free education programs for patients, caregivers and healthcare professionals.

  Programs and videos for patients and caregivers feature experts who share the latest disease, treatment and research updates, including information about survivorship. These programs are available via telephone and web. Visit www.LLS.org/programs and www.LLS.org/EducationVideos.

  Our podcast, *The Bloodline with LLS*, features experts and patients who guide listeners in understanding diagnosis, treatment, and resources available to blood cancer patients. For more information and to subscribe, visit www.LLS.org/TheBloodline.

  LLS offers free continuing education programs online and in person for nurses, social workers, and physicians. Visit www.LLS.org/ProfessionalEd.

- **Connection with other blood cancer survivors.** LLS creates many opportunities for peer-to-peer support.

  Weekly online chats are moderated by a licensed social worker and can provide support and help cancer patients to reach out and share information. For more information, visit www.LLS.org/chat.

  The *Patti Robinson Kaufmann First Connection Program* gives patients and caregivers the opportunity to share experiences with someone who has "been through it," and obtain valuable information about the community resources available to support them. Visit www.LLS.org/FirstConnection.

  LLS Community is a one-stop virtual shop for chatting with other patients and staying up-to-date on the latest diagnosis and treatment news. Patients and caregivers can share their experiences with one another and get personalized support from trained LLS staff. To join, visit www.LLS.org/community.

  Support groups in communities throughout LLS chapters provide mutual support and offer the opportunity to discuss anxieties and concerns with others who share the same experiences. To find out if there is a support group near you, visit www.LLS.org/ChapterFind to contact your chapter.

- **Blood Cancer Conferences.** LLS Blood Cancer Conferences are free, in-person, educational events where blood cancer patients, caregivers and their families can learn more about the latest disease-specific breakthroughs, current treatments and survivorship information from local and national experts. Visit www.LLS.org/bcc for a list of these upcoming regional events.

Visit www.LLS.org for access to up-to-date disease, treatment and support information.

Citations and Acknowledgements

Citations

Cancer Facts & Figures 2018. Atlanta, GA: American Cancer Society; 2018.

Cancer Facts & Figures for African Americans 2016- 2018. Atlanta, GA: American Cancer Society; 2016.

Copeland G, Lake A, Firth R, et al, eds. *Cancer in North America: 2010-2014. Volume Two: Registry-specific Cancer Incidence in the United States and Canada*. Springfield, IL: North American Association of Central Cancer Registries, Inc; June 2017. https://20tqtx36s1la18rvn82wcmpn-wpengine.netdna-ssl.com/wp-content/uploads/2017/06/Cina2016.v2.incidence.pdf.

Haque R, Shi J, et al, eds. Medication adherence, molecular monitoring, and clinical outcomes in patients with chronic myelogenous leukemia in a large HMO. *Journal of the American Pharmacists Association*. 2017;57;303-310.

Howlader N, Noone, AM, Krapcho M, et al, eds. *SEER Cancer Statistics Review, 1975-2014*. Bethesda, MD: National Cancer Institute; 2017. Based on November 2016 SEER data submission, posted to the SEER web site, April 2017. http://seer.cancer.gov/csr/1975_2014/.

National Program of Cancer Registries and Surveillance, Epidemiology, and End Results SEER*Stat Database: NPCR and SEER Incidence – USCS 2001–2014 Public Use Research Database, United States Department of Health and Human Services, Centers for Disease Control and Prevention and National Cancer Institute. Released August 2017, based on the November 2016 submission. Accessed at www.cdc.gov/cancer/npcr/public-use.

Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Mortality - All COD, Aggregated With State, Total U.S. (1969-2014) <Katrina/Rita Population Adjustment>, National Cancer Institute, DCCPS, Surveillance Research Program, released December 2016. Underlying mortality data provided by NCHS (www.cdc.gov/nchs).

Surveillance, Epidemiology and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: NAACCR Incidence - CiNA+ in SEER*Stat 2010-2014, All Races, North American Association of Central Cancer Registries.

Benzene. Toxic Substances Portal. Agency for Toxic Substances & Disease Registry. https://www.atsdr.cdc.gov/PHS/PHS.asp?id=37&tid=14. Accessed March 12, 2018.

Zuelzer WW. Implications of long-term survival in acute stem cell leukemia of childhood treated with composite cyclic therapy. *Blood*. 1964;24:477-494.

Acknowledgements

Control and Population Sciences, National Cancer Institute, the North American Association of Central Cancer Registries and Rebecca Siegel, MPH, Director, Surveillance Information, American Cancer Society, for providing statistical assistance. Data compilation services were provided by Information Management Services, Inc.

This publication is designed to provide information in regard to the subject matter covered. It is distributed as a public service by The Leukemia & Lymphoma Society (LLS) with the understanding that LLS is not engaged in rendering medical or other professional services.

Notes

Notes

Notes

BEATING
CANCER
IS IN
OUR BLOOD.

The Leukemia & Lymphoma Society 3 International Drive, Suite 200, Rye Brook, NY 10573 914-949-5213

The mission of The Leukemia & Lymphoma Society (LLS) is to cure leukemia, lymphoma, Hodgkin's disease and myeloma, and improve the quality of life of patients and their families. Find out more at **www.LLS.org**.

PS80 5M 5/18