

Leading the Way to Cancer Cures

REPORT TO THE NATION ON BLOOD CANCER

2019



LEUKEMIA &
LYMPHOMA
SOCIETY®



**BEATING
CANCER
IS IN
OUR BLOOD.**

Myrrah was just six years old when she was diagnosed with acute lymphoblastic leukemia (ALL), the most common form of childhood leukemia. Today, she is cancer free, thriving in school and enjoying her childhood.

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Letter from the President & CEO



I believe that cancer can be cured, and I believe that we can achieve this in our lifetime. I can make that statement confidently because as the president and CEO of The Leukemia & Lymphoma Society (LLS), I see the extraordinary progress we are making in fighting blood cancers and, importantly, how this work is helping patients with other cancers and diseases.

Our mission begins with the word cure: Cure leukemia, lymphoma, Hodgkin's disease and myeloma and improve the quality of life for patients and their families. We're here to save lives and change the landscape of cancer care. We're here for patients.

LLS released the inaugural edition of the *Report to the Nation on Blood Cancer: Leading the Way to Cancer Cures* in 2017 to educate and engage the public in the fight against blood cancers – leukemia, lymphoma and myeloma – which are the third leading cause of cancer deaths among Americans. That same year the U.S. Food and Drug Administration (FDA) approved an unprecedented 18 treatment options for patients who urgently needed them. What's more, LLS played a role in virtually all of these advancements.

As the largest nonprofit dedicated to creating a world without blood cancers, we've invested more than \$1.2 billion in groundbreaking research since 1949, pioneering many of today's most innovative approaches. The scientific discoveries we continue to fund have expanded our understanding of how cancer works. It is these scientific insights that have led to lifesaving discoveries.



WE HAVE INVESTED MORE THAN
\$1.2 billion
IN RESEARCH SINCE OUR INCEPTION
70 YEARS AGO

Research supported by LLS has contributed to nearly every new blood cancer treatment and innovative approach in recent decades, including immunotherapy and precision medicine. Our track record in accelerating lifesaving treatments is unparalleled, and we champion the most pioneering research to fuel our attack against cancer. Our work not only is advancing breakthroughs for more than 1.3 million Americans living with or in remission from a blood cancer but, importantly, it is helping patients with other cancers and diseases.

In fact, many therapies initially approved for blood cancers are now being tested for other cancers, including breast, lung, pancreatic and prostate cancer. Further, innovations in immunotherapy and precision medicine that started in blood cancer research are now helping patients with other cancers.

This is an extremely exciting time in the field of cancer research. Recently, we witnessed a historic victory for cancer patients when a revolutionary immunotherapy was approved, ushering in a new era in the treatment of cancer. LLS invested \$40 million over 20 years to bring to market two CAR (chimeric antigen receptor) T-cell immunotherapies – now approved by the U.S. Food and Drug Administration – which are providing hope for patients who had no other options.

We are laser-focused on cures, and that means we're relentless in supporting patients and their families throughout their cancer experience to ensure they have access to care. With our robust education and support services, LLS is the leading nonprofit helping blood cancer patients before, during and after their diagnosis and treatment. When someone experiences the fear and uncertainty of a cancer diagnosis, we provide hope, guidance, education and support.

At the same time, our policy team in Washington, DC, is hard at work advocating on behalf of cancer patients, and pushing for legislation to protect patients and ensure they have access to affordable quality care. While some headway has been made to address increasing out-of-pocket costs

faced by cancer patients for their treatments and care, far more action is needed to address the financial toxicity that adds to the stress of a cancer diagnosis for patients and their families. LLS is uniquely positioned to facilitate collaboration among players in the healthcare ecosystem and to advocate for patients, and we are doing just that.



**LLS HELPED FUND
15 OF 18
TREATMENT APPROVALS
FOR PATIENTS
IN 2017**

changing belief. Curing cancer is in our blood. With your support, we are transforming this powerful belief into reality for more patients.

Louis J. DeGennaro, PhD
President and CEO
The Leukemia & Lymphoma Society

Our Impact

At LLS, our mission is to cure leukemia, lymphoma, Hodgkin's disease and myeloma, and improve the quality of life of patients and their families. Compared to any other blood cancer nonprofit, LLS is the largest funder of cutting-edge research and cures.

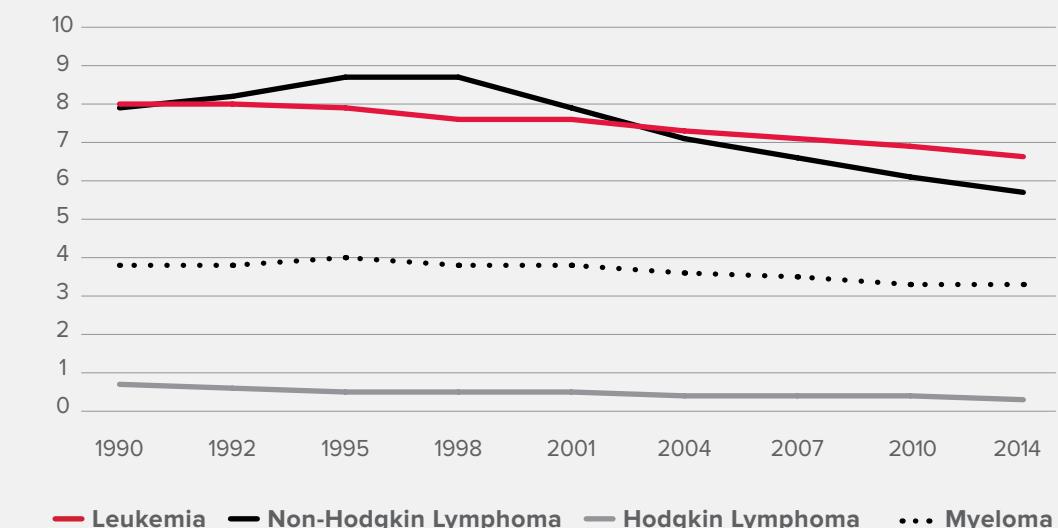


Catriona Jamieson, MD, PhD, University of California San Diego, is a researcher funded by LLS with expertise in myeloproliferative neoplasms and leukemia.

Though LLS is known for funding groundbreaking research to find better treatments and cures, we do so much more. We provide free information, education and support services for those who have been impacted by blood cancer. We fight for lifesaving policy changes at the state and federal level to help patients access quality, affordable, coordinated care. We are committed to working tirelessly toward our mission every single day, until we find a cure.

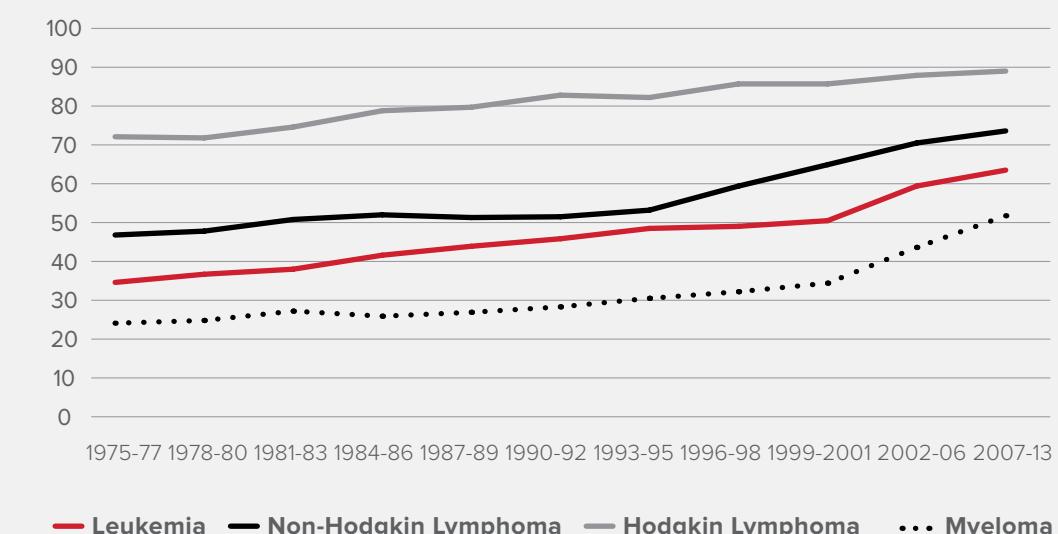
Our mission is to cure leukemia, lymphoma, Hodgkin's disease and myeloma, and improve the quality of life of patients and their families.

Deaths Per 100,000 People



We've seen an average decline of 22 percent in blood cancer death rates since the 1990s.

5-Year Relative Survival Rates (Percentage)



Since the 1960s, survival rates for many blood cancer patients have doubled, tripled or even quadrupled.

1 RESEARCH

Since 1949, LLS has supported remarkable scientists whose work has led to breakthrough advances in blood cancer treatments. To date, LLS has invested more than \$1.2 billion in cutting-edge research, funding nearly all of today's most promising advances, and bringing us closer to cures.



We have invested more than
\$1.2 Billion
in cancer research since 1949.

4,100

research projects
have been supported
since 1949.

250

research projects are
being supported at any
given time.

Currently funding research at nearly
100 medical institutions
across the globe.

\$55 Million

has been invested annually over the
past five years.

2 EDUCATION & SUPPORT

As the leading source of free information and support for blood cancer patients, caregivers and healthcare professionals, LLS helps patients navigate their cancer treatments and access quality and coordinated care.



Nearly
20,000

inquiries last year alone to LLS's Information Specialists who connect with patients and caregivers one-on-one and guide them to our wide array of support and education services.

More than
\$431 million
provided in co-pay financial assistance



supported more than
93,000
patients since inception.

More than
560
patients were guided through the clinical trial process by registered nurses from our Clinical Trial Support Center in 2018.

More than
600,000
educational booklets about specific diseases were distributed last year.

More than
1,300
connections were made in 2018 between patients and volunteers diagnosed with the same disease through LLS's *Patti Robinson Kaufmann First Connection Program*.

10,000

patients, caregivers and supporters are registered for LLS Community, our online social network that provides education and support.

More than
100
support groups facilitated in local communities and online led by nurses and social workers last year alone.



Our **Information Specialists** are master's level oncology social workers, nurses and health educators who provide blood cancer patients and caregivers free personalized information and support tailored to their specific diagnosis and needs. They speak in-depth with caregivers and patients—many of them newly diagnosed—about their disease, clinical trials, how to talk to their physician, and so much more. Services include financial and emotional support, and up-to-date disease and treatment information. Information Specialists refer patients to the Clinical Trial Support Center as appropriate, which helps patients find and enroll in clinical trials.

To reach an Information Specialist, call (800) 955-4572.

3

ADVOCACY

LLS works tirelessly not only to find cures but also to ensure patients can access the lifesaving treatments they need. Our Office of Public Policy is staffed by legislative and regulatory affairs experts and advocacy professionals who are dedicated to removing barriers to care.

More than **100,000** volunteer advocates mobilized across the U.S. acting as a powerful voice for cancer patients and survivors by influencing change at the state and federal level.

Advanced laws in **43** states and the District of Columbia, to ensure that cancer patients who take treatment in the form of a pill do not face higher out-of-pocket costs than patients taking an intravenous treatment.

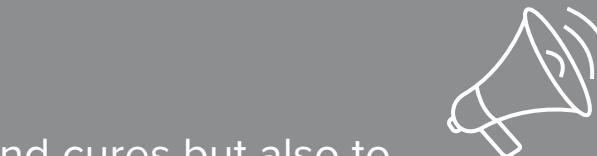
While legislators debated proposals that would roll back access to meaningful health insurance coverage, LLS advocated strongly at the state and federal level for guaranteed access to stable, quality, affordable coverage. LLS advocates took action by contacting federal and state policymakers:

More than
11,040 letters sent

More than
1,100 calls were made

Conducted
65+ in-person meetings

Advocates raised their voices to help pass The Childhood Cancer Survivorship, Treatment, Access, and Research (STAR) Act into a law – the most comprehensive federal childhood cancer legislation ever introduced.



VOLUNTEERS IMPACT OUR MISSION

Our volunteers are part of a diverse community of supporters who represent all walks of life and bring different experiences and passions to drive forward our mission. Beating cancer is in our blood, whether you are going through a diagnosis, caring for someone who has been impacted, or simply want to know a world without blood cancer. With countless ways to engage, from raising critical funds, to driving forward policies that benefit patients, to providing support to those impacted by cancer, our volunteers are truly making a difference.

Through fundraising and donations, our volunteers have helped us invest more than

\$1.2 billion

in blood cancer research since 1949.

They help raise the funds that enable us to support

250

research projects at any given time.

Nearly

8,000

volunteers across the nation provide direct support to patients and families in their communities. Last year alone, they helped facilitate more than 100 support groups in local communities and online.

More than
100,000 volunteer advocates are effecting change by advocating for policy changes at the state and federal level. Their efforts have helped increase federal research funds, speed the review and approval process of new therapies, and ensure patients are able to access lifesaving treatments.



Tens of thousands of volunteers dedicate their time and talent each year to make our signature fundraising campaigns a success! Volunteers join Team In Training, Light The Night, Pennies for Patients, Man & Woman of the Year, Students of the Year, and Leukemia Cup Regatta, raising awareness and critical funds to drive forward our mission.

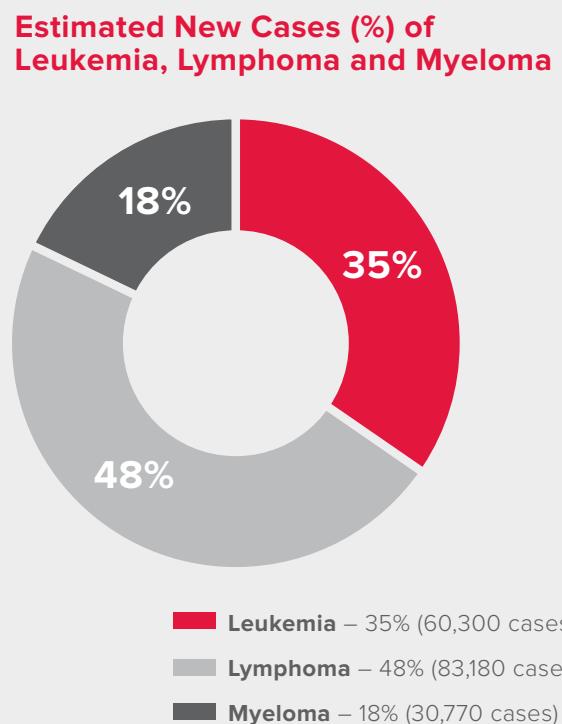
RESEARCH

EDUCATION & SUPPORT

ADVOCACY

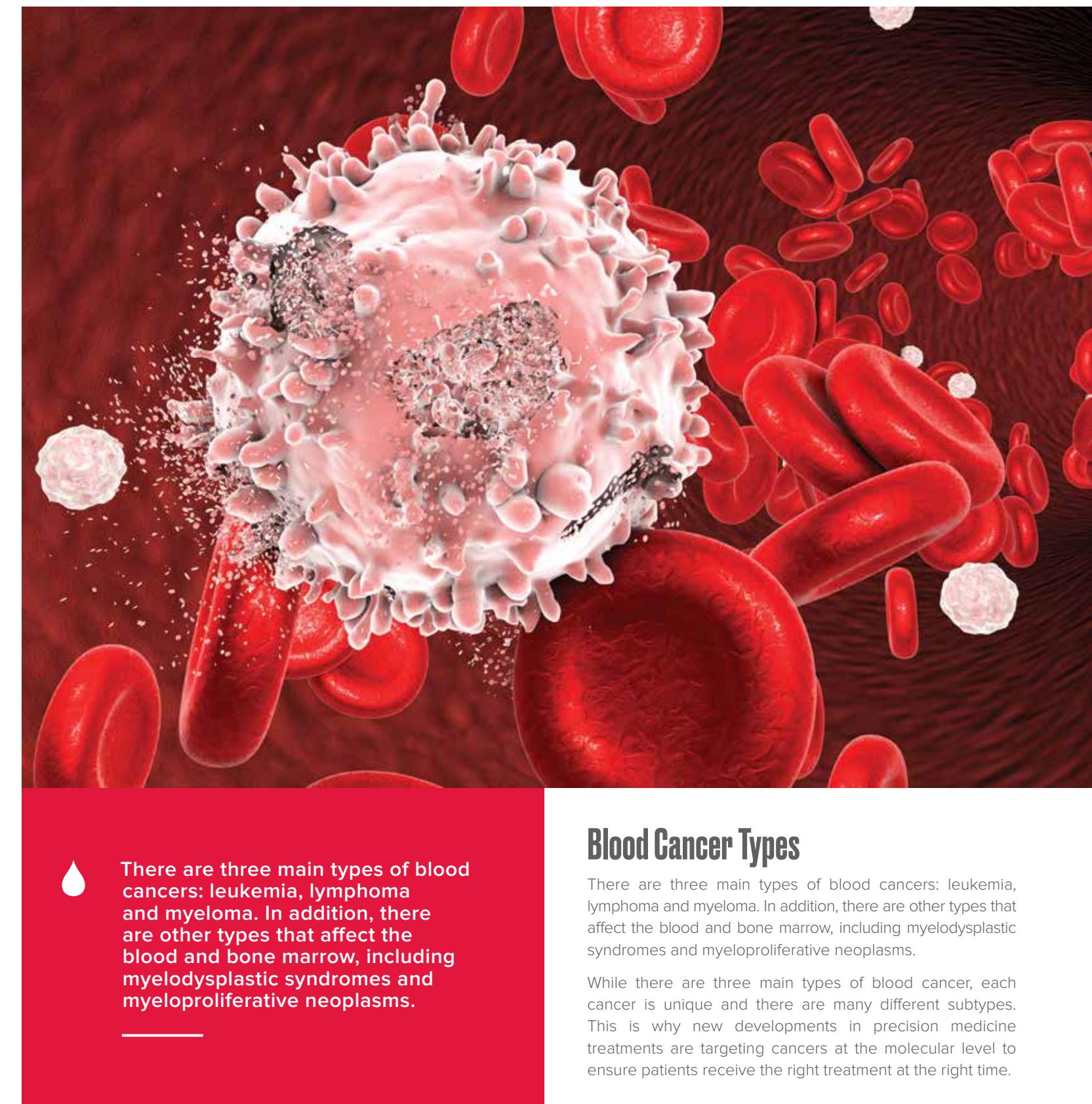
What Are Blood Cancers?

Approximately every three minutes, a person in the United States is diagnosed with a blood cancer. Every nine minutes, someone dies from it. An estimated 174,250 people in the U.S. will be diagnosed with leukemia, lymphoma or myeloma in 2018, and 58,100 people will die from these diseases.



New cases of these blood cancers are expected to account for 10 percent of the estimated 1.7 million new cancer cases diagnosed in the U.S. in 2018. Additionally, 1.3 million people in the U.S. are either living with, or are in remission from, leukemia, lymphoma or myeloma.

As the name suggests, blood cancers affect the production and function of blood cells; most of these cancers start in the bone marrow where blood cells are produced. In cancer, the normal blood cell development process is interrupted by uncontrolled growth of an abnormal type of blood cell. These abnormal cells prevent the body from performing many of its functions, such as strengthening the immune system and preventing serious bleeding.



There are three main types of blood cancers: leukemia, lymphoma and myeloma. In addition, there are other types that affect the blood and bone marrow, including myelodysplastic syndromes and myeloproliferative neoplasms.

Blood Cancer Types

There are three main types of blood cancers: leukemia, lymphoma and myeloma. In addition, there are other types that affect the blood and bone marrow, including myelodysplastic syndromes and myeloproliferative neoplasms.

While there are three main types of blood cancer, each cancer is unique and there are many different subtypes. This is why new developments in precision medicine treatments are targeting cancers at the molecular level to ensure patients receive the right treatment at the right time.

BLOOD CANCER TYPES:

Leukemia

Leukemia begins in a cell in the bone marrow. Once the marrow cell undergoes a leukemic change, the leukemia cells may grow and survive better than normal cells. Over time, the leukemia cells crowd out or suppress the development of normal cells. In 2018, more than 60,000 people will be diagnosed with leukemia, and there are an estimated 381,774 people living with, or in remission from, leukemia in the U.S.

Without a normal number of healthy blood cells, an individual can develop a variety of serious health conditions:

- **Anemia** is characterized by a low number of red cells in the blood, which can cause fatigue and shortness of breath.
- **Neutropenia** is characterized by a low number of white cells, which prevents the immune system from effectively guarding against infection due to a lack of neutrophils (a type of white cell).



It was six days before Dustin Riedesel's wedding date when he was diagnosed with a subtype of acute myeloid leukemia (AML) at the age of 31. He spent 33 days in the hospital followed by eight months of chemotherapy treatment. The treatment worked and he is now cancer free, married, an author of a book, and a volunteer with LLS.

BLOOD CANCER TYPES:

Leukemia

① Acute Lymphoblastic Leukemia (ALL)		② Acute Myeloid Leukemia (AML)	
Description	ALL is a cancer of the bone marrow and blood that affects the immune system.	Description	AML is a cancer of the bone marrow and blood that affects cells that are not fully developed. AML develops when the DNA of a developing stem cell in the bone marrow is damaged, which is called an "acquired mutation."
Prevalence/ New Cases/ Deaths	78,275 people are living with ALL. 5,960 new cases are expected to be diagnosed in 2018. 1,470 people are expected to die from ALL in 2018.	Prevalence/ New Cases/ Deaths	51,172 people are living with AML. 19,520 new cases of AML are expected to be diagnosed in 2018. 10,670 people are expected to die from AML in 2018.
Typical age at diagnosis	ALL is the most common cancer found in children and young adults under 20 years of age.	Typical age at diagnosis	AML generally affects adults age 60 years and older.
5-year survival rate	71.0% overall. 91.8% for children/adolescents younger than 15 years, and 94.0% for children younger than 5 years.	5-year survival rate	27.4% overall and 66.4% for children and adolescents under age 15.
Treatment	Chemotherapy. Stem cell transplantation. CAR T-cell immunotherapy. Tyrosine kinase inhibitors. Clinical trials. Immunotherapies.	Treatment	Chemotherapy. Stem cell transplantation. Clinical trials. Targeted therapies (FLT3, HDAC, IDH2 inhibitors).
Risk factors	For most people who have ALL, there are no obvious reasons why they develop the disease. Researchers have found that more developed countries and higher socioeconomic groups tend to have higher ALL rates, but they have not reached any firm conclusions, which suggests that many factors may be involved. Infants born with Down syndrome are at increased risk. People with certain genetic disorders, such as neurofibromatosis, Klinefelter syndrome, Fanconi anemia, Shwachman syndrome, Bloom syndrome and ataxia telangiectasia, are also at increased risk.	Risk factors	Repeated exposure to the chemical benzene has been identified as a potential risk factor. People with certain genetic disorders, such as Down syndrome, Familial Platelet Disorder, Fanconi anemia, Shwachman syndrome and Diamond-Blackfan syndrome, or who have had past chemotherapy or radiation treatments for other cancers, appear to be more likely to develop AML.

CONTINUES
→

BLOOD CANCER TYPES:

Leukemia

3 Chronic Lymphocytic Leukemia (CLL)		4 Chronic Myeloid Leukemia (CML)	
Description	CLL begins in the bone marrow and is the most common form of leukemia in adults. CLL does not completely interfere with the development of mature red cells, white cells and platelets. It can progress either slowly or quickly, depending on the form it takes. It is generally less severe than acute leukemia.	Description	CML develops when the DNA of a developing stem cell in the bone marrow is damaged. CML does not completely interfere with the development of mature red cells, white cells and platelets. CML is usually diagnosed in its chronic phase when treatment is very effective for patients, and is generally less severe than acute leukemia. People with CML have an abnormal chromosome called the Philadelphia (Ph) chromosome, which leads to the development of a cancer-causing gene (oncogene) called the BCR-ABL gene.
Prevalence/ New Cases/ Deaths	170,626 people are living with CLL. 20,940 new cases are expected for 2018. 4,510 people are expected to die from CLL in 2018.	Prevalence/ New Cases/ Deaths	47,583 people are living with CML. 8,430 new cases are expected for 2018. 1,090 people are expected to die from CML in 2018.
Typical age at diagnosis	CLL is more common in people who are 50 years or older.	Typical age at diagnosis	Most cases of CML occur in adults; incidence rates notably increase at age 60 years.
5-year survival rate	86.2% overall	5-year survival rate	68.0% overall. 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.
Treatment	Watch and wait. Single or combination drug therapy. Targeted therapies. Monoclonal antibody therapies. White blood cell growth factors. Radiation therapy. Splenectomy. Clinical trials.	Treatment	Tyrosine kinase inhibitors. Stem cell transplantation. Clinical trials. Chemotherapy. Novel therapies (targeting the T315I mutation).
Risk factors	There are no obvious reasons why people develop CLL. Experts have found that in a small number of cases, first-degree relatives (parents and siblings) of people with CLL are three to four times more likely to develop CLL than people who don't have first-degree relatives with the disease.	Risk factors	Two known risk factors are exposure to very high doses of radiation and high-dose radiation therapy (radiotherapy) used to treat other cancers such as lymphoma.

BLOOD CANCER TYPES:

Lymphoma

Lymphoma is the name for a group of blood cancers that develop in the lymphatic system, part of the body's immune system. In 2018, there will be approximately 83,180 newly diagnosed cases of lymphoma. An estimated 845,076

people are living with, or in remission from, lymphoma in the U.S. The two main types are Hodgkin lymphoma and non-Hodgkin lymphoma (see charts starting on next page).



When his daughter Gabriella was just 6 months old, Chuck Colletti was diagnosed with follicular lymphoma. While the initial treatment worked, his cancer returned in August 2017. He enrolled in a clinical trial for a revolutionary treatment called CAR T-cell immunotherapy, which LLS invested in for over two decades. It worked, and he is now cancer free.
(Photo: Healthcentral)

BLOOD CANCER TYPES:

Lymphoma

① Hodgkin Lymphoma (HL)	
Description	Hodgkin lymphoma, formerly known as Hodgkin's disease, is a cancer of the blood and bone marrow and one of the most curable forms of cancer. Hodgkin lymphoma starts when an abnormal change to a white cell (called a lymphocyte) causes it to become a lymphoma cell. Lymphoma cells grow and form masses, usually in the lymph nodes, located throughout the body in the lymphatic system.
Prevalence/ New Cases/ Deaths	191,423 people are living with HL. 8,500 new cases are expected for 2018. 1,050 people are expected to die from HL in 2018.
Typical age at diagnosis	Most common in young adults in their 20's and early 30's or in adults over age 65.
5-year survival rate	88.3% overall. For patients who were diagnosed under the age of 45, the survival rate is 94.0%.
Treatment	Chemotherapy. Combined modality therapy, which is when two or more types of treatment (e.g., radiation, chemotherapy) are used alternately or at the same time. Immunotherapy. Clinical trials. Stem cell transplantation.
Risk factors	There are no obvious reasons why people develop the disease. Patients who have a history of a blood test confirming mononucleosis have a three-fold increased risk of HL compared to the general population. People infected with human T-cell lymphocytotropic virus (HTLV) or human immunodeficiency virus (HIV) also have an increased risk of HL.

② Non-Hodgkin Lymphoma (NHL)	
Description	NHL is a type of cancer that affects the lymphatic system and generally develops in the lymph nodes and lymphatic tissues, but in some cases, NHL involves bone marrow and blood. NHL is not just a single disease – it is actually a diverse group of blood cancers that share a single characteristic in how they develop.
Prevalence/ New Cases/ Deaths	653,653 people are living with NHL. 74,680 new cases are expected for 2018. 19,910 people are expected to die from NHL in 2018.
Typical age at diagnosis	The incidence of NHL increases with age. The incidence rate at age 60-64 is 17 times greater than incidence the rate at age 20-24.
5-year survival rate	73.3% overall
Treatment	Chemotherapy. Radiation therapy. Monoclonal antibody. Stem cell transplantation. Clinical trials. Watch and wait.
Risk factors	For most people who have NHL, there are no obvious reasons why they develop the disease. Living or working in farming communities and exposure to herbicides and pesticides have been shown to increase the risk of developing NHL. Exposure to bacteria and viruses, especially those that suppress the immune system, has been shown to increase the risk of developing NHL.

① Diffuse Large B-Cell Lymphoma (DLBCL)	
AGGRESSIVE OR FAST GROWING NHL	
Description	DLBCL is the most common NHL subtype. It grows rapidly in the lymph nodes and frequently involves the spleen, liver, bone marrow or other organs. DLBCL development usually starts in lymph nodes in the neck or abdomen and is characterized by masses of large B cells (lymphocytes).
Incidence	27,650 new cases were estimated in 2016.
Typical age at diagnosis	It most commonly occurs in middle-aged and older persons. The median age of diagnosis is 65.
Overall Survival	Two-year relative survival ranged from 63% to 68% for DLBCL.
Treatment	Combination chemotherapy. CAR T-cell immunotherapy. Clinical trials.
Risk factors	People with B-cell-activating autoimmune diseases, hepatitis C virus, first-degree family history of NHL, and greater body mass index (BMI) as a young adult are at increased risk for developing DLBCL.

CONTINUES



BLOOD CANCER TYPES:

Non-Hodgkin Lymphoma

BLOOD CANCER TYPES:

Non-Hodgkin Lymphoma

③ Marginal Zone Lymphoma (MZL)		④ Mantle Cell Lymphoma (MCL)	
INDOLENT OR SLOW GROWING NHL		AGGRESSIVE OR FAST GROWING NHL	
Description	MZL includes several subtypes, each categorized by the type of tissue where the lymphoma forms: outside of the lymph nodes (extranodal or MALT), in the lymph nodes (nodal), and the spleen (splenic). It begins in B-lymphocytes in a part of the lymph tissue called the “marginal zone.” The disease tends to remain localized.	Description	Mantle cell lymphoma (MCL) is generally considered an aggressive type of B-cell non-Hodgkin lymphoma.
Incidence	7,460 new cases were estimated in 2016.	Incidence	3,320 new cases were estimated in 2016.
Typical age at diagnosis	Most people with MZL are 60-65 years old.	Typical age at diagnosis	MCL occurs more frequently in older adults—the average age at diagnosis is the mid-60's.
Overall Survival	Two-year relative survival ranged from 89% to 95% for MZL.	Overall Survival	Median overall survival is 6 years.
Treatment	Removal of the spleen. Single-agent chemotherapy. Combination chemotherapy. Immunotherapy with rituximab. Rituximab combined with chemotherapy. Clinical trials.	Treatment	Combination chemotherapy. Clinical trials.
Risk factors	People with systemic lupus erythematosus and Sjögren's syndrome, B-cell activating immune conditions, hepatitis C virus, peptic ulcers, asthma without other atopic diseases, and a first-degree relative with a hematological malignancy, are at increased risk for developing MZL.	Risk factors	MCL is more often diagnosed in males than in females.

BLOOD CANCER TYPES:

Multiple Myeloma

Myeloma is a cancer of plasma cells, which are a type of white blood cells (also called plasma B cells). Myeloma develops when a plasma cell is mutated. Healthy plasma cells are part of the immune system and make proteins called antibodies, which help fight infection. The most common form of the disease is called multiple myeloma because the malignant cells form tumors in multiple areas of the body.

Multiple Myeloma

Description	Multiple myeloma is the most common form of the disease, and it affects several different areas of the body.
Prevalence/ New Cases/ Deaths	118,273 people are living with multiple myeloma. 30,770 new cases are expected for 2018. 12,770 people are expected to die from multiple myeloma in 2018.
Typical age at diagnosis	Most people who develop myeloma are older than 50 years. Fewer cases occur in people younger than 40.
5-year survival rate	51.0% overall
Treatment	Single or combination drug therapy. Chemotherapy. Targeted therapies. Stem cell transplantation. Radiation therapy. Clinical trials.
Risk factors	Black Americans are nearly twice as likely to develop myeloma as white Americans. Men are at higher risk than women. People with a history of MGUS (monoclonal gammopathy of unknown significance) have increased risk. New research suggests that obese people have a higher incidence of myeloma.

Many new treatments were approved in the last few years and are likely to increase the overall survival rate for patients diagnosed with myeloma.

BLOOD CANCER TYPES:

Myelodysplastic Syndromes

Myelodysplastic Syndromes (MDS) are a group of diseases of the blood and bone marrow, with varying degrees of severity, treatment needs and life expectancy. MDS begin with a change to a normal stem cell in the marrow. These developing blood cells, called blast cells, die as they

approach maturity before they would normally be released into the blood. This results in a lower than normal number of circulating blood cells. Approximately 30 percent of patients diagnosed with MDS are at high risk of their disease converting to acute myeloid leukemia (AML).

Myelodysplastic Syndromes (MDS)

Description	MDS are a group of diseases of the blood and bone marrow. MDS develops when blood cell production in the bone marrow increases with more-than-the-normal number of developing blood cells (called "blast cells") filling the marrow.
New Cases	An estimated 14,275 new cases of MDS were diagnosed each year from 2010-2014.
Typical age at diagnosis	Occurs more often in people over 60 years old.
Treatment	Observation of blood cell counts. Transfusions and iron chelation therapy. Erythropoiesis-stimulating agents (ESAs)/growth factors. Managing infections. Drug therapy. Chemotherapy. Stem cell transplantation. Clinical trials.
Risk factors	Primary MDS – no obvious cause in most patients; repeated exposure to chemical benzene. Treatment-related MDS – previous treatment of chemotherapy and radiotherapy for other cancers.

BLOOD CANCER TYPES:

Myeloproliferative Neoplasms

Myeloproliferative neoplasms (MPNs) are types of blood cancers in which bone marrow cells proliferate abnormally and often genetic mutations are found.

Myeloproliferative Neoplasms (MPNs)

Types	There are three types of MPNs: Essential Thrombocythemia (ET), Myelofibrosis (MF) and Polycythemia Vera (PV).
Description	ET/MF/PV are rare cancers in which the bone marrow cells function abnormally.
New Cases	An estimated 9,204 new cases of MPNs were diagnosed each year from 2010-2014.
Typical age at diagnosis	MPNs are usually diagnosed in adult men and women. ET occasionally occurs in older children.
Survival rate	<i>Polycythemia Vera (PV):</i> Median survival for PV patients is 10.9 years. People with PV may have a shorter-than-normal life span, but with careful medical supervision and therapy, PV can usually be managed effectively for a long time. In some cases, however, PV may progress to myelofibrosis, acute myeloid leukemia or myelodysplastic syndrome. <i>Essential Thrombocythemia (ET):</i> On average, individuals with ET have a near-normal life expectancy if they are properly monitored and treated. Very rarely, ET can transform to a more aggressive blood disease. Patients are advised to discuss survival information with their doctors. <i>Myelofibrosis (MF):</i> Median survival for MF patients is approximately 15.4 years for low-risk patients, 6.5 years for INT (intermediate)-1 risk patients, 2.9 years for INT-2 risk patients and 1.3 years for high-risk patients. Some people, however, may survive for decades following a diagnosis. It is important to know that outcome data can show how groups of people with MF responded to treatment, but data cannot always determine how any one person will respond. For these reasons, patients are advised to discuss survival information with their doctors.
Treatment	Drug therapy. Chemotherapy. Plateletpheresis. Phlebotomy. Stem cell transplantation. Clinical trial.
Risk factors	For most people, there are no obvious reasons why they develop ET. About 90% of people with MF have a mutation in one of three genes – JAK2, CALR or MPL. Almost all people with PV have a mutation of the JAK2 gene.

Major Accomplishments in Blood Cancer Treatment and Survival: 1949 – Today

Since the founding of LLS (originally known as The Leukemia Society of America) in 1949, we have made enormous strides in our understanding and treatment of blood cancers.



LLS has played a major role in bringing groundbreaking treatments to blood cancer patients.

LLS has supported the development of some of the most effective and widely used therapies, from the early days of combination chemotherapies and bone marrow transplants more than 50 years ago, to immunotherapies and precision medicine today. Our support – funding both clinical and basic science – has led to groundbreaking clinical trials and breakthrough research on effective treatments for blood cancer patients.

LLS has played a major role in bringing groundbreaking treatments to blood cancer patients.

Through LLS's numerous research programs and work to improve patient access to better treatments, survival rates for many blood cancer patients have doubled, tripled and even quadrupled since 1960. LLS is especially proud that some of the therapies first approved for blood cancer patients are now helping patients with other types of cancers and serious diseases.

CML SPOTLIGHT

From Fatal Disease to Manageable Condition



Brian Druker, MD, Director of The Knight Cancer Institute at Oregon Health & Science University

Imatinib (Gleevec®) is a targeted therapy originally approved by the U.S. Food and Drug Administration (FDA) in 2001 for the treatment of chronic myeloid leukemia (CML), turning a once fatal diagnosis into a manageable condition for most patients.

Given its remarkable success, the drug also has been approved by the FDA to treat other cancers, including stomach and skin cancers. It is also approved to treat other blood cancers including Philadelphia Positive (Ph+) acute lymphoblastic leukemia (ALL) in children.

The journey to develop imatinib took more than a decade, led by the extraordinary efforts of Brian Druker, MD, who is now the Director of The Knight Cancer Institute at Oregon Health & Science University (OHSU). Druker found a way to “turn off” the enzymes that cause cancer.

This drug was the first to target a novel enzyme that appears in many types of cancer called the “kinase” enzyme. Today, more than 40 kinase inhibitors are approved to treat other cancers, including breast, lung, kidney and colon cancer.

Researchers around the country – and the world – were involved in different aspects of the research and development that led to the discovery of imatinib. Funding from LLS provided critical support at key progress points, including the discovery of a genetic abnormality by LLS-funded investigator Janet Rowley, MD, of the University of Chicago, as well as proof of concept work by Druker.

Clinical trials of the drug began in 1998 and the results were astonishing: 98 percent of patients with CML showed dramatic improvements. Today, the five-year survival rate for CML patients is 68 percent, and the survival rate in clinical trials is even higher. 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 rates.

Imatinib is also being tested in studies for patients with a type of colon cancer, neurofibromatosis and diabetes. Imatinib works by inhibiting a group of enzymes that serve many functions, including roles in cell growth and proliferation, as well as the autoimmune response in diseases such as diabetes.

A TIMELINE:

The Impact of LLS Funding Over Decades in the Fight Against Cancer

In 1964, the five-year survival rate for children with the most commonly diagnosed pediatric leukemia, ALL, was 3 percent. Today, it's approximately 90 percent.



1949

1950

1955

1955

1956

1965

1970s

1980

1985

1990

In 1949, Rudolph and Antoinette Roesler de Villiers, who lost their teenage son, **Robert**, to leukemia in 1944, established the first incarnation of what became The Leukemia & Lymphoma Society. The impact was felt right away and the 1950s and 1960s saw some major treatment advances that were revolutionary for the time.

George H. Hitchings, PhD, and Gertrude B. Elion, D.Sc., began collaborating in 1945 and developed the most widely used anti-leukemia drugs in 1950-1951. Both later served as medical and scientific advisors to LLS, and earned the 1988 Nobel Prize in Physiology and Medicine.

Photo: Wellcome Library, London

In 1955, **William Dameshek, MD**, became a medical and scientific advisor to LLS, organizing its grant review process. In 1946, he was a lead investigator of studies that led to the first anti-cancer chemotherapy.

Photo: PBS/Cancer: The Emperor of All Maladies

James Holland, MD, was among the first LLS grant recipients, receiving funding in 1955; he went on to become one of the first researchers to advance combination chemotherapy.

Photo: PBS/Cancer: The Emperor of All Maladies

E. Donnall Thomas, MD, conducted the first successful bone marrow transplant on a leukemia patient in 1956. Thomas was an LLS advisor in the 1960s, and was awarded the 1990 Nobel Prize in Physiology and Medicine.

Photo: Susie Fitzhugh

The first combination chemotherapy was developed for childhood leukemia patients by **Emil "Tom" Frei, MD** (background), and **Emil J. Freireich, MD**, under the leadership of **Gordon Zubrod, MD**, (foreground), Director of the National Cancer Institute's Clinical Center.

Photo: The Zubrod Family

The advent of the 1970s brought an early understanding of the genetics of cancer with the discovery of oncogenes. For his role in identifying oncogenes, **J. Michael Bishop, MD**, an advisor to LLS, later received the 1989 Nobel Prize in Physiology and Medicine. By the 1980s, researchers advanced this knowledge further.

Photo: PBS/Cancer: The Emperor of All Maladies

Riccardo Dalla-Favera, MD, and his LLS-funded research team studied the molecular pathway involved in immune B-cell activation and how those pathways became dysregulated in B-cell cancers. A few decades later, he led a team of LLS-funded researchers investigating the genetic origins of B-cell non-Hodgkin lymphoma.

Photo: PBS/Cancer: The Emperor of All Maladies

In 1985 and again in 1989, **Hagop Kantarjian, MD**, received LLS scholar awards to study new approaches to treating patients with chronic myeloid leukemia (CML). He later played a significant role in the development of the first targeted therapy to treat CML patients.

Photo: PBS/Cancer: The Emperor of All Maladies

By the 1990s, the discovery of genetic pathways was followed by the first FDA approvals for targeted blood cancer drugs. In 1990, LLS-funded researcher **Susan Rabinowe, MD**, and others, showed the protein CD20 is consistently present on B-cell chronic lymphocytic leukemia (CLL) cells.



"LLS is where it is today because it has groomed a remarkable generation of scientists and physician scientists who have led the extraordinary advances in treatment of hematologic malignancies."

GARY GILLILAND, MD, PHD, PRESIDENT OF FRED HUTCHISON COMPREHENSIVE CANCER CENTER

Forty years ago, the five-year survival rate for someone diagnosed with myeloma was 10 percent. Today, it's about 50 percent. Over the past decade, treatment options, many supported with LLS funding, have increased significantly, and the survival rates are expected to continue to increase.



1996

2001

2005

2012

2014



2016

2017

2018

Today

In 1996, LLS-funded investigator **Brian Druker, MD**, tested a *BCR-ABL*-blocking drug. This resulted in the first clinical trial, led by Druker and Charles Sawyers, MD, of *ST1-571*, later known as imatinib (Gleevec®) in 1998.

From 2001 to 2005, LLS-funded researchers David Maloney, MD, **Margaret Shipp, MD**, Felipe Samaniego, MD, and others showed rituximab (Rituxan®) improved the effectiveness of the standard chemotherapy regimen for diffuse large B-cell lymphoma patients.

Richard Stone, MD and James Griffin, MD, along with colleagues at Dana-Farber Cancer Institute, Memorial Sloan Kettering Cancer Center and other institutions, received funding from LLS that led to discovery of the role of FLT3 activation in AML biology. This pre-clinical work led to the approval of midostaurin in 2017, a significant advancement in AML treatment.

LLS-funded research continued to drive breakthroughs and advances, transforming cancer's grim past into a promising future. From 2010-2012, **John Byrd, MD**, and colleagues published Phase II trial results for ibrutinib in CLL and small lymphocytic lymphoma (SLL) patients, showing safety and lasting remissions.

New advances in immunotherapy include an approach called immune checkpoint inhibitors, that unleash the immune system by removing the "brakes." This approach is advanced by researchers, including LLS-funded investigators Margaret Shipp, MD, and **Steve Ansell, MD, PhD**.

In 2016, the FDA approved a new therapy, venetoclax (Venclexta®), for patients with a high-risk form of chronic lymphocytic leukemia. Since 2002, LLS continuously supported research by Jerry Adams, PhD, **Andrew Roberts, MBBS, PhD**, and colleagues to advance this therapy.

The FDA approved two types of CAR (chimeric antigen receptor) T-cell immunotherapy, a revolutionary approach to treating cancer. Over the past two decades, LLS provided \$40 million in funding for researchers to drive this therapy forward including **Stephan Grupp, MD, PhD**, who credits LLS with launching his career and played an instrumental role in this advancement, and Carl June, MD, who is credited with pioneering the treatment.

LLS supports emerging work to understand how mutations lead to blood cancer in order to help prevent it including the work of Benjamin Ebert, MD, PhD, and **Irene Ghobrial, MD**, who are studying how to prevent recurrence after treatment, as well as precursor diseases that lead to blood cancer.

Breakthrough advances in blood cancer research are now helping patients with other cancers and serious diseases. Today, LLS supports the work of **Selina Chen-Kiang, PhD**, discovered an innovative treatment approach that is helping both blood and breast cancer patients, and Ron Levy, MD, who developed a cancer vaccine being tested in lymphoma patients that shows potential utility in breast, colon and melanoma cancer.

Blood Cancer Research Leads the Way

Breakthrough advances in blood cancer research are now helping patients with other cancers and diseases. Cancer cells in the blood are more accessible than those in solid tumors, making it easier to study cancer-causing molecules, measure the effects of new therapies and make pivotal biologic discoveries applicable to other diseases.

LLS has invested more than \$1.2 billion in research to advance groundbreaking approaches and therapies in cancer treatment, including immunotherapy, genomics and personalized medicine, which are saving lives. Our focus on curing blood cancers has not changed, but our work is fueling significant scientific and medical breakthroughs across the cancer

landscape. In fact, many pivotal discoveries have originated from LLS-funded research, and these game changing insights and treatment approaches are now being tested in clinical trials with other cancers and diseases. That's why we can say proudly: **"Beating Cancer is in Our Blood."**

Revolutionary Approaches for Blood Cancer

are now being tested in clinical trials with other cancers and diseases including:

- BONE CANCER
- BRAIN CANCER
- BREAST CANCER
- DIABETES
- KIDNEY CANCER
- LIVER CANCER
- LUNG CANCER
- LUPUS NEPHRITIS
- MELANOMA
- MULTIPLE SCLEROSIS
- OVARIAN CANCER
- PANCREATIC CANCER

- PROSTATE CANCER
- STOMACH CANCER
- SKIN CANCER
- RHEUMATOID ARTHRITIS



Selina Chen-Kiang, PhD

A Targeted Treatment Works for Blood and Breast Cancer

Selina Chen-Kiang, PhD, Weill Cornell Medicine, discovered an innovative treatment approach that is helping both blood and breast cancer patients. While her work is focused on myeloma and lymphoma, Dr. Chen-Kiang's discovery that a targeted therapy was effective in blocking an enzyme responsible for the division and proliferation of cancer cells, helped lead the way to that therapy, palbociclib, receiving approval from the U.S. Food and Drug Administration (FDA) in 2015 for breast cancer. With LLS support, Dr. Chen-Kiang is leading a cutting-edge research team to test palbociclib's effectiveness in treating patients with mantle cell lymphoma (MCL).

"Studying blood cancer has many unique advantages over studying solid tumors. You can easily isolate cancer cells, and once you isolate the cancer cells, you have a better chance of treating the blood cancer. The Leukemia & Lymphoma Society recognized the potential of this type of approach, and to see the results in patients is really very gratifying."

— Selina Chen-Kiang, PhD



Benjamin Ebert, MD, PhD

Blood Cancer Mutation Discovery Informs Cardiovascular Disease Prevention

Benjamin Ebert, MD, PhD, Dana-Farber Cancer Institute, uncovered that mutations in blood cells of otherwise normal, healthy individuals are associated with a higher probability of developing blood cancers later in life. Dr. Ebert's research went even deeper: his lab was the first to demonstrate that these mutations are also associated with the development of cardiovascular disease. The discovery opens up the possibility of preventative medicine to identify people at risk of developing disease years before it occurs and ultimately, devise treatment strategies to mitigate the risk.



Ron Levy, MD

A Vaccine for Lymphoma Shows Promise for Breast, Colon and Melanoma Cancers

Ron Levy, MD, Stanford University, pioneered a treatment approach that uses the body's immune system to develop antibodies against invading tumor cells. His foundational work resulted in the FDA approval of the first monoclonal antibody to treat cancer, rituximab, in 1997, which is now used to treat many lymphomas and rheumatoid arthritis. Today, Dr. Levy is moving immunotherapy in a bold direction. With support from LLS's Therapy Acceleration Program (TAP), he is testing an experimental, immune-boosting vaccine among patients with lymphoma – an approach that also shows promise for breast, colon and melanoma cancers.

Accelerating Treatments Through Innovative Research

There has been tremendous momentum and excitement in blood cancer research over the past several years as breakthroughs in immunotherapy, genomics and personalized medicine have improved and saved the lives of patients.



Rayne Rouce, MD, Baylor College of Medicine and Texas Children's Cancer Center, is part of a team that works on cutting-edge research in immunotherapy, which focuses on using the body's immune system to attack cancer.

From the discovery of imatinib (Gleevec®), which has transformed chronic myeloid leukemia (CML) from a devastating disease to a chronic condition, to new monoclonal antibody treatments and immune checkpoint inhibitors, our growing understanding of the genetic underpinnings of blood cancer and the pace of drug discovery have been super-charged.

LLS supports the full spectrum of research from bench to bedside – that is, from basic, laboratory-based research to large-scale clinical trials – with the singular goal of accelerating treatments and cures for the more than 1.3 million people in the United States living with some form of blood cancer.



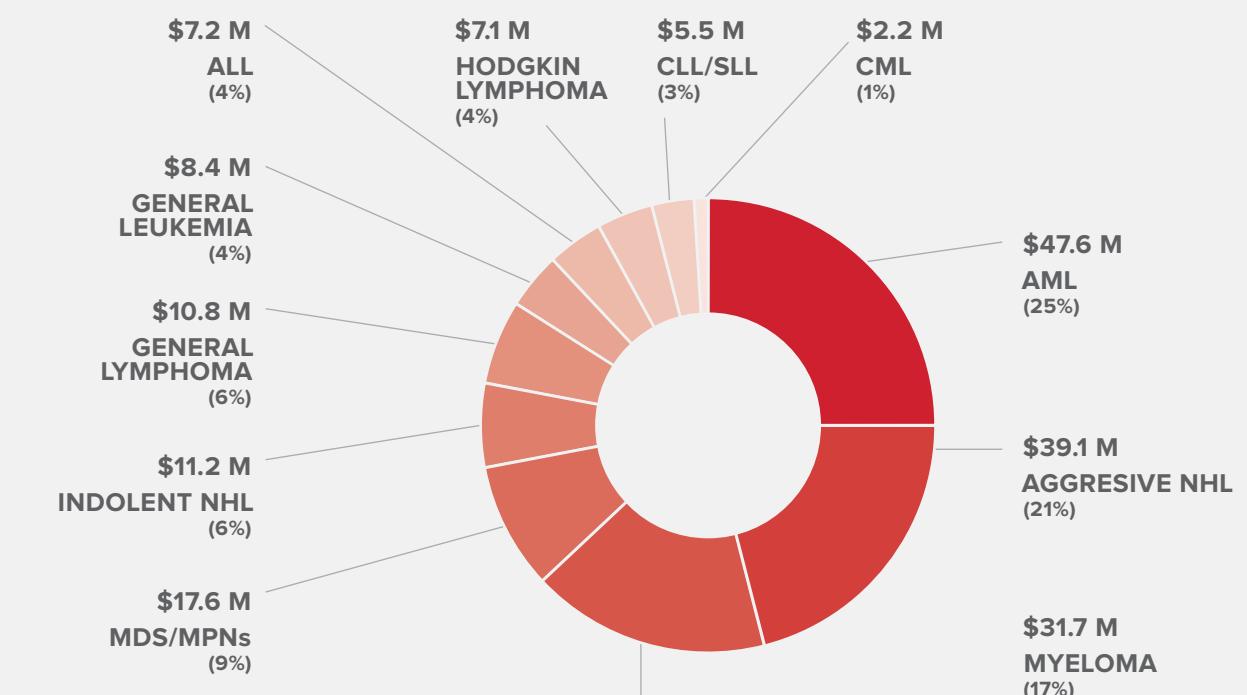
Our growing understanding of the genetic underpinnings of blood cancer and the pace of drug discovery have been super-charged.

LLS supports multiple research programs through specialized grants, collaborations and venture philanthropy. Our Career Development Program is designed to support promising investigators in their developing careers. Specialized Center of Research (SCOR) grants fund multinational, multidisciplinary teams of researchers who are engaged in collaborative efforts, while our Translational Research Program (TRP) brings promising research findings from the laboratory to clinical development. Our New Idea Awards fund innovative approaches that may fundamentally change the understanding, diagnosis and treatment of blood cancers and related pre-malignant conditions. Through our Therapy Acceleration Program® (TAP), we partner directly with academic institutions and biotechnology companies to help accelerate the development of promising therapies.

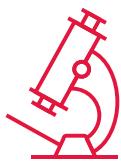

LLS supports the full spectrum of research from bench to bedside – that is, from basic, laboratory-based research to large-scale clinical trials.

OUR INVESTMENT: \$188 MILLION

THE AMOUNT LLS COMMITTED TO INVESTING IN RESEARCH IN 2018



Our Research Portfolio



Nearly
3,200 grants awarded since 1953

at more than
400 medical and academic institutions

1 INVESTS IN YOUNG SCIENTISTS

Career Development Program attracts and retains the highest quality young scientists, launching the careers of many of the most productive clinicians and researchers in cancer.

THIS INCLUDES:

3 Nobel Laureates	More than 15 members of the National Academy of Science	9 directors of comprehensive cancer centers	10 department chairs/section directors
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2 LEADS THE CHARGE TO BEAT AML

Beat AML Master Clinical Trial® is a groundbreaking, collaborative clinical trial for acute myeloid leukemia (AML), a deadly disease that until the past two years, had seen few improvements in treatments for more than 40 years.

More than 12 leading cancer centers participating across the country	More than 10 treatment study arms open across the country
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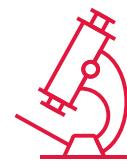
More than 400 patients enrolled in the trial	Patient's genetic analysis completed within 7 days
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3 TRANSLATES RESEARCH FROM BENCH TO BEDSIDE

Translational Research Program was developed in 1996 to provide early-stage support for clinically translatable research in blood cancers.

LLS has awarded more than 775 grants through this program	Contributing to the development of more than 20 blood cancer treatments since 2000
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Our Research Portfolio



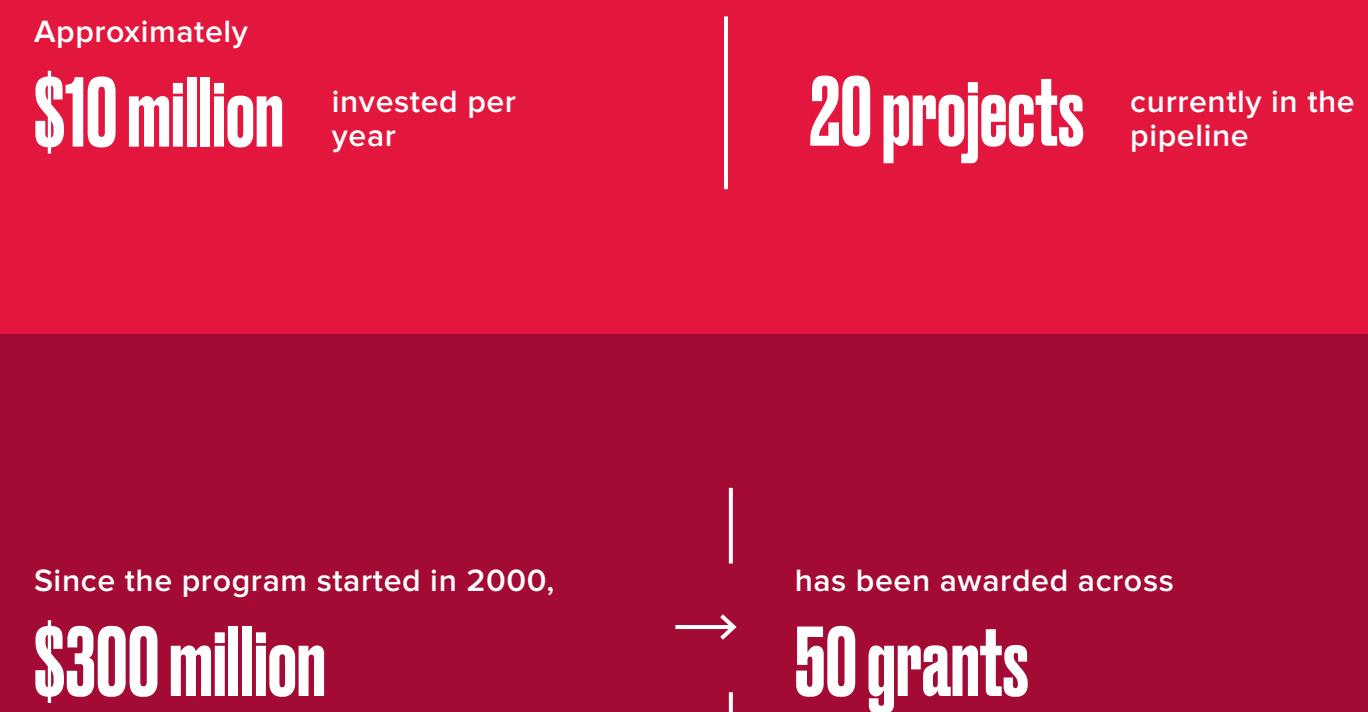
4 ACCELERATES THE DEVELOPMENT OF PROMISING THERAPIES

Therapy Acceleration Program® expedites getting treatments to patients by supporting promising projects and clinical trials through collaborations with biotechnology companies and academic institutions.



5 FOSTERS COLLABORATION ACROSS DISCIPLINES & INSTITUTIONS

Specialized Center of Research program brings together established investigators across different disciplines from one or several institutions to develop a research program over five years. These synergistic collaborations greatly advance research progress and clinical applications.



6 ENCOURAGES “OUT OF THE BOX” THINKING

New Idea Award supports innovative “out of the box” approaches that may fundamentally change the understanding, diagnosis and/or treatment of blood cancers, but may not be candidates for conventional LLS or government funding.



Our Priorities for Blood Cancer Cures

The following are some of our priority areas we've set for our agenda in the coming years.

1. Accelerating Care and Cures for Children

Forty percent of all pediatric cancers are blood cancers. And although survival rates have improved dramatically in recent decades, we believe that every young life lost to blood cancer is one too many. The Leukemia & Lymphoma Society (LLS) is committed to ensuring children and their families can access safer, more effective treatments, while helping these families cope with the financial, emotional and psychological impact of cancer.

Since childhood cancers are biologically distinct from adult cancers, the way children respond to treatment is unique as well. Dedicated pediatric research is needed to understand the molecular underpinnings of these diseases, identify appropriate dosages and evaluate the long-term impact of treatment. Since LLS was founded in 1949, the median five-year-survival rate for children with acute lymphoblastic leukemia (ALL), the most common type of cancer to impact children, has improved from 5 percent to approximately 90 percent. But there is still much more to do.

Although survival rates have improved dramatically for children with ALL, children with other types of blood cancers, such as acute myeloid leukemia (AML), still face a difficult prognosis. Further, the lifelong impact of childhood cancer treatment can include severe physical and cognitive impairments, secondary cancers, and a range of ailments that the medical community is only beginning to understand.

That's why LLS has committed to more than doubling our investment in pediatric research over the next five years. We are committed to investing \$20 million in pediatric cancer research over this time in programs spanning the spectrum



Austin was only 2 years old when he was diagnosed with acute lymphoblastic leukemia (ALL). After chemotherapy and a bone marrow transplant, the cancer came back for a third time. When he was five years old, his parents enrolled him in a clinical trial for a revolutionary treatment called CAR T-cell immunotherapy, which LLS invested in for over two decades. He is now cancer free.

from basic science to translational research and clinical trials. We have convened a team of leading pediatric physicians and scientists to investigate the feasibility of launching a multisite precision medicine clinical trial in pediatric leukemia. We've also set an ambitious goal of sequencing the genetic profiles of every child with leukemia in order to facilitate faster and more precise research into the unique molecular drivers and pathways of pediatric cancers. Our ultimate goal is to bring cures to children faster and deliver the promise of precision medicine to children with leukemia.

At the same time, we plan to expand the education and support we already provide to children with cancer and their families, including clinical trial enrollment, financial assistance and local support groups. Through our advocacy efforts, we will continue to advocate for cures and ensure these children are able to access lifesaving treatment.

2. Shaping the Future of Cancer Survivorship

We have made great strides in the treatment of cancer and there are millions of survivors living in the United States today. As this dramatic pace of progress in treatment breakthroughs continues, the number of survivors will grow exponentially. But many patients who are cured or achieved lasting remissions have expressed that once treatment has ended, it is difficult to transition to a new way of life, which often includes a number of lifelong physical, psychosocial and financial effects.

At LLS, our goal is to shape the future of blood cancer survivorship care and improve the quality of life of survivors as they transition from treatment to recovery. A multipronged approach is needed to give survivors the support they need.

As the leading source of free information and support, we offer many resources for survivors to help answer their questions and find the support they need. Our Information Specialists are master's level oncology social workers, nurses and health educators who work to provide blood cancer patients and caregivers free personalized information and support tailored to their specific diagnosis and needs.

We provide educational resources and programs focused on survivorship issues including booklets, workshops, webcasts and podcasts. Our support services for survivors include our online LLS community, as well as local support groups and peer-to-peer programs.

Through education and awareness, we also conduct outreach to oncology and primary care physicians to ensure they understand the long-term impact of cancer treatments so they are able to provide their patients with the best possible care.

At the same time, we also recognize the need to identify gaps and opportunities to enhance care and patient support. LLS is funding a study to assess survivorship resources and services provided to blood cancer patients who are treated at the 63 National Cancer Institute (NCI) designated cancer centers throughout the U.S. The purpose of this study is to determine how LLS can uniquely support survivors and help improve their quality of life.

LLS is also increasing our investment in research to understand and prevent secondary cancers and cancer recurrence. And as new therapies are developed, we are introducing long-term studies to identify and address long-term health implications and symptoms.

3. Taking Care of Caregivers

A cancer diagnosis impacts close friends and family, many of whom will take on the role of caregiving. Helping a loved one with cancer isn't always easy. Caregiving can feel overwhelming and may be a full-time, nonstop job. At LLS, we are focused on helping caregivers work on self-care while providing a wide range of resources, information and support they need to navigate the challenges of helping cancer patients.

Through our services, we want caregivers to know that they are not alone. Last year, 29 percent of all inquiries to LLS Information Specialists were from caregivers. Further, our online LLS Community includes more than 1,800 caregivers who connect, share their experiences and provide support to one another. Whether they join a live, weekly online chat moderated by an oncology social worker, participate in a LLS Family Support Group in their community or tune in to The Bloodline with LLS podcast, these caregivers can find the support that is right for them.

During Caregiver Awareness Month in November, LLS launched a series of new resources for caregivers including an educational teleweb, a video providing the perspective of other caregivers, and an opportunity for patients and survivors to thank their caregiver through a digital campaign.

LLS also recently began distributing "The Caregiver Workbook," a comprehensive tool for people who are



Instead of one treatment for all patients, we are developing ways to specifically target each patient's type of AML. After a 40 year drought in the approval of new therapies for this lethal disease, the past two years have seen progress with multiple new drug approvals and several more currently under FDA review. However, even with current treatments, only one in four AML patients survives five years after diagnosis.

Because of the urgent unmet medical need, LLS is taking a multi-pronged approach to find cures for AML. Currently, about one-fourth of our research budget is dedicated to AML. LLS invests in research focused on understanding the underlying causes of the disease to develop better therapies and save more lives.

LLS also leads a groundbreaking genetic study, a partnership between LLS and Oregon Health & Science University, to open up avenues of research previously unattainable. Under the leadership of Brian Druker, MD, The Knight Cancer Institute at Oregon Health & Science University (OHSU), researchers at 11 institutions have collected more than 900 AML patient samples, creating one of the largest sample sets available and shedding light on the diversity of AML types, the genetic mutations that drive them, and the precision medicine required to treat them.

With its Beat AML® Master Clinical Trial, LLS is changing how AML is treated and how clinical research is conducted. Through this groundbreaking clinical trial, LLS has convened pharmaceutical companies, researchers, medical centers, and the U.S. Food and Drug Administration to work collaboratively in order to drive this master clinical trial forward. LLS expects to enroll 1,000 patients, all of whom will be screened for genetic changes or mutations driving their disease, and treated with a therapy based on their genetic profile.

As our investment in research continues to lead the way for cures and survivorship, we are focused on making sure caregivers are equipped with the education and support they need to help improve the quality of life for themselves and their loved ones.

The goal is to develop a methodology to swiftly diagnose an individual patient's specific subtype and identify the most effective treatment in order to change the paradigm for how this deadly cancer is treated. LLS is uniquely qualified to lead this unprecedented clinical trial collaboration, which is a rare role for a nonprofit organization and a first for LLS. Beat AML demonstrates LLS's ability to convene the medical and research communities to think and act boldly in the quest for new and better treatments for blood cancer patients, and it supports our goal to accelerate the rate at which precisely targeted breakthrough therapies reach the patients who urgently need them.

After Eevie was born, she was diagnosed with a rare form of leukemia that affects 1 in 5 million newborns. Doctors gave her a 17 percent chance of surviving to age 2. She defied the odds and just celebrated her fifth birthday. Eevie's parents and primary caregivers, Brynne and Ryan, found support and resources through LLS.

caring for a loved one with blood cancer. The workbook covers a myriad of topics including communication, blood cancer diagnosis and treatment options, nutrition, as well as managing legal and financial issues. The goal is to provide caregivers with the tools to help care for their loved ones while caring for themselves.

As our investment in research continues to lead the way for cures and survivorship, we are focused on making sure caregivers are equipped with the education and support they need to help improve the quality of life for themselves and their loved ones.

4. Using Precision Medicine to Beat AML

LLS is leading efforts to focus the power of precision medicine to pioneer new paradigms in clinical research and in treatments for acute myeloid leukemia (AML), a deadly disease that is responsible for more than 10,600 deaths each year. Standard treatment has historically involved intensive chemotherapy, followed by a stem cell transplant once a patient is in remission. But this approach fails most patients, the majority of whom are adults 60 or older and cannot withstand the intensity and toxicity of treatment.



Josh was diagnosed with follicular lymphoma (FL) at the age of 49. He was treated with an array of different therapy regimens. However, he continued to relapse and the FL ended up transforming into diffuse large B-cell lymphoma (DLBCL). With the help of LLS's Clinical Trial Support Center and his oncologist, Josh enrolled in a clinical trial for CAR T-cell immunotherapy. Today, the 55-year-old avid surfer is cancer free.

With our ability to convene the landmark Beat AML Master Clinical Trial, combined with a significant investment in scientific research, as well as patient support and education, we are leading the way to accelerate new treatments and cures for this deadly disease.

5. Connecting Patients to Clinical Trials

One of LLS's most important roles in accelerating the development of new therapies is connecting cancer patients with clinical trials, which are the essential foundation for the advancement of scientific research and life-saving treatments. Despite the public's recognition of their value, many clinical trials are unable to achieve their goals because they cannot enroll enough patients. In fact, only about 8 percent of cancer patients actually enroll in clinical trials focused on finding cancer treatments. There are many reasons for the low clinical trial enrollment rate, including patients' misperceptions about

clinical trials, and financial and logistical concerns. Provider attitudes and beliefs about trials are also a factor; many providers do not feel comfortable discussing trials with their patients and view clinical trials only as an option of last resort.

LLS has increased its efforts to help patients enroll in clinical trials by expanding our Clinical Trial Support Center (CTSC) in which specially trained nurses help patients find and enroll in clinical trials based on highly detailed, individualized assessments. Working closely with our CTSC nurses and Information Specialists, patients are provided with the information and support they need, at no cost, to overcome barriers to enrolling in a trial including help with finances and lodging.

In fact, LLS's nurses engage in many interactions with each patient and often call clinical trial sites to help with trial enrollment. The result is that the majority of patients working with LLS's CTSC have enrolled in one or more clinical trials. LLS also collaborates with

the Leukemia & Lymphoma Society to provide support and resources to patients and caregivers.



When Kimberly's 35-year-old husband, Elijah, was diagnosed with multiple myeloma in 2005, shortly after retiring from the Oakland Raiders, they were stunned. He passed away in 2010, leaving two young boys behind. Since then, Kimberly has been working with LLS to raise awareness about myeloma and raise funds for groundbreaking research so other families do not experience what her family did.

Dana-Farber Cancer Institute on the Blood Cancer Research Program (BCRP), which is designed to provide access to clinical trials in communities where there are no major medical centers. Through its network of multiple sites across the nation, BCRP aims to accelerate the advancement and expansion of access to well-designed and innovative clinical trials for blood cancer patients treated at community sites. LLS is planning to further expand these efforts to accelerate the initiation and completion of innovative clinical trials, and to provide access to cutting-edge trials for patients who are treated at community health centers.

By increasing access to and enrollment in clinical trials, our goal is to provide patients the opportunity to receive the newest treatments and best care, while also helping to accelerate life-saving treatments to help patients in the future.

6. Increasing our Investment in Myeloma Cures

In the U.S., myeloma is the third most common type of blood cancer. While there have been many new therapies approved over the last decade and researchers are studying promising treatments, the disease remains incurable. Only half of patients diagnosed with myeloma will survive five years after diagnosis.

To address this urgent unmet medical need, LLS is taking a multi-pronged approach over the next five years to improve outcomes for patients, by investing in scientific research, as well as education and outreach efforts, to improve patient access to the most promising, cutting-edge treatments.

LLS is addressing the striking health disparities among African Americans with myeloma. In fact, African Americans have twice the incidence of myeloma as white Americans, and recent studies show they are significantly less likely to receive the newest treatments or combination therapies, and are more likely to experience treatment delays, including transplant delays.

Through the multifaceted program called *Myeloma Link: Connecting African American Communities to Information, Expert Care, and Support*, LLS is conducting extensive outreach to African Americans in targeted major cities throughout the country to help them navigate the treatment landscape more effectively and cope with the disease.

On the research front, LLS will significantly increase its current annual investment in myeloma research over the next few years, with a focus on resistance to therapy, understanding which patient should get which targeted therapy, immunotherapies and preventing progression of the disease. A major focus of this research investment is to develop targeted therapies that can be used alone or in combination with other newly approved drugs, as well as immunotherapies, that will harness the immune system to fight myeloma.

Through a renewed investment in cutting-edge research and patient education, our goal is to find cures and significantly improve the lives of those living with myeloma.

7. Driving Forward Immunotherapy

Since its beginnings, LLS has invested in the promising field of immunotherapy, which harnesses a patient's own



Emily, a 32-year-old mother of three young children, was diagnosed with non-Hodgkin lymphoma in August 2013. In July 2015, Emily became the third patient in the world enrolled in Kite Pharma's clinical trial for a lifesaving treatment called CAR T-cell immunotherapy that was made possible by LLS funding. Because of this treatment, she is cancer free today.

immune system to kill cancer cells. It remains a major focus of our research commitment today, as it is one of the most promising treatment approaches for cancer.

One groundbreaking approach is called chimeric antigen receptor (CAR) T-cell immunotherapy, which LLS has been investing in since the mid-1990s. We recently witnessed a historic victory for cancer patients when this revolutionary, innovative immunotherapy was approved, ushering in a new era in the treatment of cancer.

On August 30, 2017, tisagenlecleucel (Kymriah) was the first CAR T-cell immunotherapy approved by the FDA. It was approved for children and young adults age 25 and under who relapsed or were not responding to therapy for acute lymphoblastic leukemia (ALL). LLS funded much of the research advancing this therapy at the University of Pennsylvania for over two decades, and Novartis licensed that therapy in 2012.

The FDA approved axicabtagene ciloleucel (Yescarta) on October 18, 2017 for patients with relapsed or refractory diffuse large B-cell lymphoma (DLBCL) and other rare large B-cell lymphomas. The therapy was initially developed at the National Cancer Institute under the guidance of Steven Rosenberg, MD, and Terry Fry, MD, and was expanded by

“One groundbreaking approach is called chimeric antigen receptor (CAR) T-cell immunotherapy, which LLS has been investing in since the mid-1990s. We recently witnessed a historic victory for cancer patients when this revolutionary, innovative immunotherapy was approved, ushering in a new era in the treatment of cancer”

the biopharmaceutical company, Kite, a Gilead Company. LLS supported the clinical trial leading to the approval of Yescarta since 2015 through its Therapy Acceleration Program® (TAP).

LLS will continue to invest in the next generation of CAR T-cell immunotherapy, so that this innovative approach can be improved for blood cancers, and this research can lead to the ability to use it to treat other cancers and serious diseases. After decades of research in immune response to cancer, the field of immunotherapy, championed by LLS, has taken great leaps forward in recent years. But much work remains to be done.

LLS will continue to fund research to understand the profound complexity of the immune system and realize the full power of immunotherapy to cure patients with blood cancer. For example, while some therapies will induce cancer remission, relapse and potential toxicity from treatment remain threats that must be addressed. Methodologies are urgently needed to identify which immunotherapy would be most effective for an individual patient, as well as to explore the benefits of using immunotherapy in combination with other treatments. From monoclonal antibodies to vaccines, and other novel ways to target the immune system, the field is poised to expand dramatically with new curative approaches in the coming decades.

8. Advocating for Cures and Access to Care

While advances in blood cancer therapies are having a dramatic impact on the way patients are treated, critical challenges remain in the discovery, development and regulatory review of new therapies and in patients' ability to access care.

At LLS, we work tirelessly not only to find cures but also to ensure patients can access the lifesaving treatments they need. Based in Washington D.C., with regional teams throughout the country, our Office of Public Policy is staffed by legislative and regulatory affairs experts and advocacy professionals who are dedicated to removing barriers to care. We empower and equip blood cancer patients, survivors and their loved ones to influence change. Our mobilized nationwide network of 100,000 online grassroots advocates acts as a powerful voice for cancer patients and survivors by sharing their personal stories and testimony with policymakers.

LLS's Office of Public Policy has achieved groundbreaking results for patients at both the state and federal level. For example, LLS advocates raised their voices to make The Childhood Cancer Survivorship, Treatment, Access, and Research (STAR) Act a reality – the most comprehensive childhood cancer legislation ever introduced in Congress. The Childhood Cancer STAR Act, which was signed into law in June, boosts pediatric research efforts at the National Cancer Institute, unlocks new insights into childhood cancer through enhanced tracking and reporting, and improves the quality of life of childhood cancer survivors by actively tracking the late effects of their disease and treatments.

While there has been great progress in advancing cancer research, much work remains to ensure that federal healthcare rules continue to protect cancer patients and ensure that patients can access their treatments. To address these issues, LLS works to advance policies that accomplish the following goals:

✓ **Reduce Financial Burden Associated with Cancer Treatment.** As an organization that puts patients at the forefront, LLS is engaged in discussions with stakeholders across the cancer healthcare landscape – patient advocacy organizations, doctors, hospitals, policymakers, insurers, pharmacy benefit managers and drug makers – to find ways to lessen the burden for patients.

In May 2017, LLS put forward more than two dozen potential policy solutions and other recommendations aimed at reducing the cost of care across the healthcare system, from ideas for lowering the costs of prescription drugs to restructuring the payment models used to reimburse physicians. Some of those potential solutions include:

- Encouraging patients and doctors to have a frank dialogue about the costs and benefits of each treatment option;
- Adopting more innovative reimbursement models to reward higher value care;
- Promoting competition in the prescription drug marketplace in order to drive down drug prices.

For each of these areas, the LLS Office of Public Policy has identified short term and long term opportunities to make changes that will benefit cancer patients and make the cancer care system more sustainable.

✓ **Protect the Ability of Cancer Patients to Buy Meaningful Insurance Coverage.** Cancer patients need to have access to meaningful health insurance coverage. Their lives literally depend on it. To this end, LLS advances the following policy solutions to uphold our core principles for meaningful coverage:

- Guarantee Access – Newly diagnosed cancer patients must continue to have the right to purchase quality, affordable health insurance to help them access the care they need.
- Ensure Quality – Health plans must continue to meet minimum quality standards to protect patients from being locked out of necessary treatment due to bare bones coverage.



LLS advocate and non-Hodgkin lymphoma survivor Sam (pictured with his girlfriend Meg) went to the United States Capitol to testify at a Congressional briefing. As an advocate, he continues to tell the story of his diagnosis and his insurance plan's refusal to pay for his cancer care. His plan—technically a 'short term' insurance plan—was legally allowed to deny his care because they deemed his cancer a pre-existing condition.

- Promote Affordability – Premium assistance and cost-sharing limits that allow a cancer patient to use their coverage must be improved.
- Provide Stability – Policymakers must ensure stability in the health insurance marketplace so that patients have the peace of mind that they will have access to affordable, quality coverage.

✓ **Accelerate & Improve Drug Development.** LLS works with Congress, the U.S. Food and Drug Administration (FDA) and other federal agencies to promote new medical discoveries and speed the development of new treatments and cures.

✓ **Promote Public Research to Find New Diagnostics, Treatments & Cures for Blood Cancers.** LLS will continue to advocate for resources to drive research forward. Last year, advocates sent more than 2,400 letters asking Congress to increase funding for critical cancer research at the National Institutes of Health (NIH). Thanks to this

groundswell of support, Congress allocated \$3 billion in new research funding for the NIH, which will improve cancer patients' lives and bring us that much closer to cures.

Further, recognizing the importance of the Department of Defense's innovative cancer research program, LLS took the lead in asking Congress to make blood cancer research a priority within this program. Congress listened to our request, increasing funding for this cancer research program by \$20 million—a 33 percent increase from last year—while also restoring "blood cancers" as a priority research focus in 2018.

Our advocacy efforts are unapologetically patients first, and we will continue to advance policy at the state and federal level to drive forward cures and ensure patients have access to quality affordable care.

How the Public Can Help Fight Blood Cancer

As the world's largest nonprofit fighting blood cancer, we are leading the way to cancer cures and ensuring patients can access the lifesaving treatments they need. We have invested more than \$1.2 billion in research in our almost 70-year history, leading to breakthroughs in cancer treatment that are saving lives. But the fight against blood cancers cannot be won without the public's support.

Blood cancer patients, their families, friends and colleagues, along with individuals who have not been touched directly by cancer, are powerful allies in the fight, and their voices and actions carry tremendous influence. Yet, we often hear from the public that they are not sure how to get involved

and whether their individual involvement "counts." Our answer is an unequivocal "yes." Every voice, every action, every contribution is needed and valued. LLS encourages the public to join the fight in one or all of these ways:



1 VOLUNTEER TO IMPACT OUR MISSION

Our volunteers are part of a diverse community of supporters who represent all walks of life and bring different experiences and passions to drive forward our mission.

Beating cancer is in our blood, whether you are going through a diagnosis, caring for someone who has been impacted, or simply want to know a world without blood cancer. With countless ways to engage, from raising critical funds, to driving forward policies that benefit patients,

to providing support to those impacted by cancer, our volunteers are truly making a difference. [Join us to make an impact at www.lls.org/volunteer](http://www.lls.org/volunteer) or contact your local LLS Chapter.

2 RAISE YOUR VOICE IN THE FIGHT AGAINST BLOOD CANCER

LLS advocates for legislation at the state and federal levels, driving policies that accelerate new treatments and ensure patients have access to care, so that they can live longer, healthier lives.

To advance its policy goals, LLS encourages its volunteers, friends and other supporters to contact their elected representatives – in Congress and in state legislatures – to share with them the impact that blood cancers have on millions of Americans each year and to urge responsible policies that will address the serious burdens of these diseases.

You can join the more than 100,000 volunteer advocates who are a powerful voice for cancer patients and survivors, many of whom share their personal stories with their policymakers. Start raising your voice today by going to www.lls.org/advocate.

3

JOIN A CAMPAIGN TO RAISE FUNDS FOR A CURE

With LLS's signature fundraising campaigns, participants can run, hike, walk, sail, build teams and gain lifelong learning skills while raising funds to drive forward our mission to end blood cancers. Our signature campaigns include:

Light The Night

Light The Night is a series of fundraising campaigns benefiting LLS's mission. Friends, families and co-workers gather together to celebrate, honor or remember those touched by cancer. Walk participants carry illuminated lanterns – white in honor of survivors and the power of research, red in support of patients and finding cures, and gold in remembrance of those who have been lost. The campaign has raised nearly \$700 million since 1999.

Team In Training

Team In Training, which celebrated its 30th anniversary in 2018, is the largest charity endurance training program in the world. From marathons and epic hikes to challenging triathlons and spectacular bike rides, Team In Training takes fundraising teams on a journey that expands beyond crossing the finish line – creating lifelong memories and raising funds to cure cancer. Team In Training and LLS continue to innovate a platform for fundraisers to change lives, both theirs and those impacted by blood cancers. This industry leading endurance sport fundraising campaign continues to deliver a transformative experience that inspires and supports "teammates" through camaraderie, coaching and an engaging journey of personal discovery. Team In Training teammates complete in events that include running, walking, cycling, triathlons, and hiking, as well as new multi-day cycling and climbing experiences, such as summiting Mount Kilimanjaro or trekking to Everest Basecamp. The campaign has raised more than \$1.5 billion and trained more than 650,000 teammates since 1988.

Pennies for Patients

Pennies for Patients is a science-based philanthropy program where students gain the unique experience of helping thousands of people in their fight against blood cancers. We connect schools with local blood cancer patients, provide tangible life skills to participants, and allow students to see the impact they're making in the lives of others. More than 13 million students and 850,000 educators in 27,000 schools across the United States participate annually. The campaign has raised \$368 million since 1993.

Man & Woman of the Year

Man & Woman of the Year is a philanthropic competition among a group of motivated and dedicated individuals in communities across the United States who fundraise to drive forward LLS's mission to end blood cancers. Candidates form powerful fundraising teams and compete in honor of local children with blood cancer. The man and woman who have raised the most funds during the 10-week campaign are awarded the prestigious title of Man or Woman of the Year in their community. The man and woman who have raised the most across the entire U.S. are recognized as the national Man & Woman of the Year.

Students of the Year

Students of the Year, LLS's newest innovation in fundraising, is a seven-week campaign during which select high school students participate in a fundraising competition to drive forward LLS's mission of fighting blood cancers. The candidate team that raises the most money at the end of the competition earns the title Student(s) of the Year. The students raise money in honor of a young local patient hero who is currently battling or is in remission from a blood cancer, known as their Honored Hero. In addition to making a significant impact in the fight against blood cancer, students develop professional skills such as entrepreneurship, leadership, marketing and project management, ensuring they stand out among their peers when applying to college and/or competing for jobs.

Leukemia Cup Regatta

Leukemia Cup Regatta is a thrilling series of events that combines the joy of on-water sports with the important task of raising money to cure cancer. At events held at yacht clubs throughout the year across North America, skippers register their boats and recruit friends and colleagues to help crew and raise funds. Crew members seek donations from friends, family, co-workers and employers to sponsor their boat. More than \$66 million has been raised through the Leukemia Cup Regatta series for lifesaving research, education and support for blood cancer patients since its start more than 30 years ago.

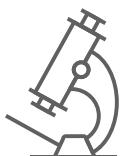
LLS Lifestyle

LLS Lifestyle, launched in October 2017, is a new way to fundraise for LLS. This new peer-to-peer fundraising platform enables LLS supporters to get creative and start their own movement to cure cancer. With LLS Lifestyle, every activity or passion is an opportunity to fundraise for LLS – from bake sales and birthday parties to spin class challenges and video game tournaments. The options are limitless! This year, LLS Lifestyle participants took their creativity to new heights. Campaigns have included a multi-day mountain bike ride across South Africa, birthday fundraisers and charitable wedding registries.

4

SUPPORT BLOOD CANCER CURES

LLS funds research based on the most urgent medical needs, provides education and support to patients, and advocates for policies that ensure affordable, coordinated care. Every dollar invested is used in a number of ways in the fight against blood cancers:



Funding research to advance cures and lifesaving treatments. LLS has been fighting blood cancers by advancing breakthrough research leading to treatments and cures for almost 70 years. Our work has helped millions impacted by cancer.



Helping patients and their families when they need it most. LLS is the leading source of free information and support for blood cancer patients, caregivers and healthcare professionals.



Advocating for policies that benefit patients. LLS advocates for policies to ensure blood cancer patients have access to affordable care and the most innovative therapies.

donate.lls.org



A three-time cancer survivor, Jessica overcame her first bout with non-Hodgkin lymphoma while studying at Princeton University. Today, she is cancer free and a motivational speaker inspiring others.



**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.