

Cycle for Survival is determined to beat rare cancers by powering groundbreaking research to help patients—many of whom have few or no options.

Every dollar launches and accelerates research led by Memorial Sloan Kettering Cancer Center (MSK) within six months of the events, empowering researchers to pursue the revolutionary ideas that lead to lifesaving breakthroughs.

**2016 was the biggest fundraising year yet. Raising \$30 million this year—and more than \$105 million during our first ten years—was only possible because of our dedicated community of riders, supporters, patients, researchers, and doctors.**

**Here's how that \$30 million is transforming the fight against rare cancers:**



### Equinox Innovation Initiative

Brain Cancer  
Cholangiocarcinoma  
Germ Cell Tumors  
Hematologic Malignancies  
Kidney Cancer  
Leukemia  
Liposarcoma  
Liver cancer  
Lymphoma  
Metastatic Tumors  
Neurofibromatosis  
Pancreatic Cancer  
Pediatric Cancer  
Pediatric Rhabdoid Sarcoma  
Precision Pathology  
Rhabdomyosarcoma

### Directed Support

Adrenocortical Carcinoma  
Bladder Cancer  
Brain Cancer  
Cholangiocarcinoma  
Clear Cell Ovarian Cancer  
Endometrial Cancer  
Esophageal Cancer  
Kidney Cancer  
Lymphoma  
Merkel Cell Carcinoma  
Melanoma  
Multiple Myeloma  
Myelodysplastic Syndrome  
Pancreatic Neuroendocrine Tumors  
Sarcoma\*  
Testicular Cancer  
Thyroid Cancer

\*Sarcoma research includes: Angiosarcoma, Ewing Sarcoma, GIST, Leiomyosarcoma, Liposarcoma, Osteosarcoma, Rhabdomyosarcoma

### Pediatric Research

Brain Cancer  
Ewing Sarcoma  
Germ Cell Tumors  
Lymphoma  
Neuroblastoma  
Osteosarcoma  
Retinoblastoma  
Rhabdomyosarcoma

## Funded Research

**MSK is on the frontline of the battle against rare cancers. We're proud to support the advancement of several comprehensive initiatives at MSK, which span across many critical areas of research.**

### »»» The Center for Hematologic Malignancies

Remarkable progress in understanding the genetic mutations driving tumor growth make this an ideal time to intensify focus on blood cancers. Cycle for Survival will strengthen and advance critical research in this area, which will have a major impact on patients worldwide.

The Center for Hematologic Malignancies, led by **Dr. Ross Levine**, is a new effort to maximize MSK's expertise in leukemia, lymphoma, and myeloma—and change the paradigm for how these diseases are treated. Cycle for Survival will support clinical trials that evaluate two types of therapies, each targeted to more than one genetic mutation in a tumor. Cycle for Survival funding will also allow Dr. Levine's team to screen the DNA of all leukemia patients enrolled in clinical trials at MSK, which will inform new therapies for patients everywhere.

## »» Sarcoma Research

Sarcoma affects people of all ages, and there are very few treatments that work long-term. Because sarcomas are a number of rare cancers, each presents unique challenges, and requires specialized therapy and expertise. Cycle for Survival funding continues to uncover the best new methods for tackling every type of sarcoma.

The Sarcoma Medical Oncology Service, led by **Dr. William Tap**, seeks to ensure that all patients with sarcoma can benefit from the many new and exciting clinical trials available. Cycle for Survival funding will open several clinical trials, which will include the application of a novel cell cycle inhibitor in liposarcoma (with the goal of irreversibly arresting cancer cell growth), and a new trial for GIST patients. In the Jennifer Goodman Linn Laboratory of New Drug Development in Sarcoma and Rare Cancers, researchers will explore the sarcoma tumor microenvironment for clues to both prevent and halt sarcoma growth and metastasis. Cycle for Survival support continues to foster groundbreaking research that is extending the lives of sarcoma patients, and providing new hope for everyone impacted by this complex disease.

## »» The David M. Rubenstein Center for Pancreatic Cancer Research

Pancreatic cancer remains largely incurable. Patients urgently need effective treatments to fight back. Cycle for Survival is accelerating progress against this aggressive disease by promoting bold, multidisciplinary research.

The mission of the David M. Rubenstein Center for Pancreatic Cancer Research, led by **Dr. Steven Leach**, is to fundamentally change what it means to be diagnosed with pancreatic cancer. Thanks to Cycle for Survival, Dr. Leach is now launching the first-ever clinical trial aimed at the prevention of benign pancreatic cysts progressing to cancer. Funding will also support a study to measure a patient's resistance to chemotherapy with a simple blood test, called a liquid biopsy. And, in the laboratory, Dr. Leach's team is studying DNA changes in pancreatic cancer cells.

## »» The Marie-Josée and Henry R. Kravis Center for Molecular Oncology

Identifying the genetic mutations responsible for cancer is the key to more effective therapies and better outcomes overall. Cycle for Survival's investment gets us closer to reaching the CMO's goal to sequence every patient's tumor, and to then share these important findings with the global oncology community.

The Marie-Josée and Henry R. Kravis Center for Molecular Oncology (CMO), directed by **Dr. David Solit**, has sequenced more than 10,000 patient tumors in the past two years—cementing its role as the world's largest genomic profiling program. With support from Cycle for Survival, the CMO has identified new drug targets in people with rare cancers, and hastened their enrollment in clinical trials. New funding will be directed to genetic profiling using liquid biopsy—a simple but revolutionary blood test that is less risky than a traditional tumor biopsy. Cycle for Survival is also bolstering an important effort to pool genomic data on rare cancers with other major research centers worldwide.

## »»» Functional Genomics Initiative

In order to target and kill malignant cells, scientists need to figure out why a healthy cell becomes cancerous in the first place. Cycle for Survival supports the Functional Genomics Initiative, which performs in-depth genetic analysis that informs powerful new cancer treatments.

The Functional Genomics Initiative (FGI) brings together clinicians and scientists from diverse fields to test novel theories, which spring from the vast output of genetic information MSK's Center for Molecular Oncology produces. Under the direction of **Dr. John Petrini**, the FGI's objective is to gain a better understanding of the cascade of events that turn a healthy cell into a cancerous one. Funds from Cycle for Survival will seed new research ideas gleaned from CMO data. For example, FGI investigators are studying the functional consequences of mutations commonly found in pediatric cancers; this work will help target vulnerabilities in cancer cells to develop more effective treatments for patients.

## »»» Head and Neck Immunology Research

Immunotherapy is a game-changing approach to cancer treatment, and MSK is a recognized powerhouse in this field. Cycle for Survival will help researchers unlock the power of the immune system for patients fighting cancers of the head and neck.

Immunotherapy seeks to treat cancer by inciting and empowering the immune system to attack cancer—often with dramatic results. Yet much more still needs to be done for those with rare cancers of the head and neck. **Dr. Richard Wong**, in collaboration with **Dr. Jedd Wolchok**, will use Cycle for Survival funding to enable early-career immunologists to focus on developing new head and neck therapies. And, in a critical effort to prevent rare cancers, Cycle for Survival support will also help expand MSK's HPV-vaccine research program.

## »»» The Human Oncology and Pathogenesis Program

To make a meaningful impact on cancer treatment, it is vital to connect discoveries made in the laboratory with those made in the clinic—quickly. Cycle for Survival supports HOPP, an effort to turn scientific breakthroughs into real progress for patients across many cancer types.

The Human Oncology and Pathogenesis Program (HOPP) is an exceptional collective of physician-scientists from different specialties and backgrounds. The cross-pollination of expertise facilitates bold ideas, which then leads to advances in drug development. Led by **Dr. Charles Sawyers**, HOPP is using Cycle for Survival resources to seed innovative research that might otherwise not get off the ground. For example, Cycle for Survival is funding the development of a new treatment to inhibit a cancer-causing protein, and new drug-combinations for patients who urgently need effective therapies.

## »»» Ovarian Cancer Research

Called “the silent killer,” ovarian cancer is hard to diagnose, and even harder to treat. Cycle for Survival is supporting research to identify the genetic roots of this disease, as well as the development of better treatments—bringing hope to women where very little existed before.

Cycle for Survival will advance a number of high impact studies led by **Dr. Dennis Chi**, including one examining how molecular differences within and among metastasized tumors may influence surgical outcomes. Another trial is testing the efficacy of surgery when it is combined with heated chemotherapy (delivered directly into the abdomen), in reducing toxicity and increasing surgical success. In a third project, Cycle for Survival is supporting research that explores the impact of chemotherapy on the tumor microenvironment in women with high-grade ovarian cancer. These efforts seek to provide much needed improvements in ovarian cancer treatment.

## Equinox Innovation Initiative in Rare Cancers

The Equinox Innovation Initiative—named in honor of Cycle for Survival’s founding partner and worldwide corporate leader in the battle to beat rare cancers—fuels cutting-edge research that embodies the innovative spirit of Equinox.

These trailblazing projects and esteemed grants, issued annually to MSK physicians and scientists through a highly competitive process, represent the most promising ideas in cancer research and treatment.

### Advanced Germ Cell Tumors

**Dr. Darren Feldman** is researching why some germ cell tumors overcome standard chemotherapy. After validating his previously identified link between chemotherapy resistance and the alteration of a particular gene, he will determine whether the gene is detectable through liquid biopsy—a simple but powerful tool to evaluate and predict treatment response.

### Brain Cancer

**Dr. Robert Benezra’s** lab has proven that a family of proteins—known to drive the formation and growth of glioblastoma—fuels the growth of brain cancer stem cells and their offspring. Efforts to understand the biological role of these proteins and inhibit their activity with a new class of compounds will enable researchers to test new treatments.

### Brain Cancer

For people battling these aggressive and virulent tumors, the Neuro-Oncology Research Translation in Humans program will rapidly connect molecular discoveries made in the laboratory with clinical application. Run by **Dr. Ingo Mellingerhoff**, the team is initiating a series of projects designed to expand treatment options for brain cancer.

### Central Nervous System Lymphoma

Using disease models and DNA sequencing of samples from a promising ongoing trial studying ibrutinib—a drug that blocks a protein fueling CNS lymphoma—**Dr. Christian Grommes** is characterizing mechanisms of response and resistance. Next, his team will evaluate whether combining ibrutinib with other drugs boosts efficacy.

### Cholangiocarcinoma

Using high-tech imaging, **Dr. Amber Simpson’s** team is leading an effort to further define bile duct cancer. Anchored by MSK’s reservoir of DNA sequencing data, this study will obtain and analyze information that holds the key for conquering this malignancy.

### Glioma and Liposarcoma

A cell entering the cell cycle and proliferating is fundamental to the growth of cancer—the cdk4 gene regulates this behavior. Integrating full genome sequencing, clinical samples, and molecular and cellular approaches, **Dr. Andrew Koff’s** lab is examining how signaling pathways fuel liposarcoma and glioma—to determine who might benefit from cdk4 inhibitors, alone or with other drugs.

### Hematologic Oncology

**Dr. Marcel van den Brink** is maximizing the full potential of MSK’s high-speed cell analyzer: state-of-the-art technology capable of measuring up to 50 characteristics of a single cell. Designed to advance scientists’ study of the immune system, data generated from the machinery will fuel the discovery of new treatments.

### Kidney Cancer

**Dr. Emily Cheng** is designing models of a highly metastatic form of kidney cancer caused by a poorly understood genetic mutation. Focusing on the molecular mechanisms causing this abnormality, she will test the effect of an inhibitor—seeking insights into why these tumors develop and how to beat them.

## Leukemia

The focus of **Dr. Michael Kharas'** lab is on identifying the factors that impact cell changes in leukemia and other blood cancers. The lab's work includes studying RNA regulators that have the potential to alter cell behavior.

## Leukemia and Lymphoma

To help patients overcome their body's rejection of a bone marrow transplant, **Dr. Kitai Kim** is investigating a highly promising—and potentially curative—option that involves replacing the chromosome of embryonic stem cells.

## Metastatic Tumors

**Dr. Daniel Heller's** lab has created uniquely formulated “nanomedicines” that are guided directly to metastatic tumors throughout the body. They are making targeted drug-carrier nanoparticles to increase drug doses that reach tumors and reduce side effects. They are also developing special sensors to detect disease even before symptoms arise.

## Neurofibromatosis

**Dr. Luis Parada** is establishing new ways to develop laboratory cultures modeling the growth of these inherited nerve disorders. His goal is to extend this research to patients—opening the door to potential therapies.

## Pancreatic Solid Pseudopapillary Neoplasms

Through comprehensive analysis of protein levels and DNA genomic sequencing of this pancreatic cancer subtype, **Dr. Maurizio Scaltriti** aims to uncover molecular vulnerabilities researchers can explore with targeted therapies.

## Pediatric Cancer

To develop the next generation of therapies for our youngest patients, **Dr. Andrew Kung**, Chair of MSK's Department of Pediatrics, is focused on whole genome sequencing—a process that reveals a child's full DNA code. This in-depth analysis will allow researchers to identify vulnerabilities to target for safely and effectively destroying cancer.

## Pediatric Cancer

By studying the levels of circulating tumor DNA found in the blood and urine, **Dr. Dana Tsui** is establishing non-invasive means to genetically profile children with high-risk cancer. This effort will create a powerful approach to guide treatment strategies and assess disease response.

## Pediatric Brain Cancer

**Dr. Alexandra Joyner's** lab is studying the cellular changes and signaling networks driving medulloblastoma, the most common malignant brain tumor in children. By synchronizing lab-based models with clinical efforts, they aim to identify new targets for the development of therapies designed to improve outcomes and quality of life.

## Pediatric Rhabdoid Sarcoma

**Dr. Alex Kentsis** is leveraging recent discoveries in his lab regarding the molecular mechanisms of rhabdoid sarcoma. Focusing on specific DNA repair requirements, his team is investigating how to therapeutically target irregular DNA repair—potentially leading to clinical trials.

## Precision Pathology

At the heart of MSK's specimen-based research program is our new Precision Pathology Biobanking Center. Led by **Dr. Michael Roehrl**, the team is creating a premier repository of patient samples. They will design and implement basic, translational, and clinical studies. This includes “basket trials”—highly personalized therapies targeting the genetic mutation causing a person's cancer.

## Rhabdomyosarcoma

**Dr. Mary Baylies** is studying the behavior of this aggressive soft tissue sarcoma as it begins to spread—to better understand how the transformed cells invade and integrate into adjacent tissues. This knowledge will lay the groundwork for screens of new drugs that halt tumor development and metastasis.

## Select Projects Supported by 2016 Donations

The funds raised in 2016 were also allocated for new and ongoing research efforts that focus on specific types of rare cancers and how to defeat them.

### Brain Cancer

Guided by unique molecular abnormalities found in a patient's tumor, **Dr. Lisa DeAngelis** is applying precision medicine to diagnose and treat malignant brain tumors.

### Cholangiocarcinoma

Using MSK-created genomic technologies, **Drs. Scott Lowe** and **Maeve Lowery** are identifying new drug targets for this aggressive bile duct cancer. They aim to advance promising clinical trials to stop cancer growth via the genetic mutations found in a patient's tumor.

### Cholangiocarcinoma, Gallbladder, and Liver Cancer

**Dr. Ghassan Abou-Alfa** is leading research into the addition of a targeted therapy and/or immunotherapy, based on a patient's genetic profile, that will help overcome resistance to classic treatments like chemotherapy in bile duct, gallbladder, and liver cancers.

### Clear Cell Ovarian Carcinoma

**Dr. Jason Konner** is leading a multi-institutional effort to generate a comprehensive genetic and immunologic profile of this gynecologic cancer. By determining the markers that signal a patient's response to therapies, his goal is to gain new insight into the underlying biology of the disease, and use this information to guide new treatments.

### Esophageal and Stomach Cancer

Using cutting-edge molecular imaging and liquid biopsy technologies, **Dr. Yelena Janjigian** is designing non-invasive ways to diagnose these forms of cancer and to assess a patient's response to treatment.

### Lymphoma

By uncovering how and why immunotherapy works for patients with Hodgkin lymphoma, **Dr. Craig Moskowitz** is finding ways to enhance its efficacy even more—and extend this powerful treatment option to benefit all forms of lymphoma.

### Melanoma

For patients with metastatic melanoma, **Dr. Michael Postow** is determining the immunologic effects of adding radiation therapy to an immunotherapy combination, ipilimumab and nivolumab.

### Pancreatic Neuroendocrine Tumors

Using laboratory models, **Dr. Diane Reidy-Lagunes** and her team are evaluating innovative imaging and targeted-therapy approaches—ultimately leading to a better, more personalized way of managing these difficult-to-treat tumors.

### Thyroid Cancer

**Drs. Alan Ho** and **Eric Sherman** are developing a series of molecularly targeted clinical trials for people with anaplastic thyroid cancer, a devastating disease for which there are no effective therapies.

### Ewing Sarcoma

**Dr. William Tap** is testing MSK-developed drugs that attack cancerous cells with extreme precision. He seeks to impair their function and deliver more-effective, less-toxic results to patients.

## Neuroblastoma

To help children, adolescents, and young adults fighting this highly malignant disease, **Dr. Brian Kushner** and colleagues are using their powerful, newly developed therapies in clinical trials to mobilize the immune system to attack and destroy cancer cells.

## Pediatric Brain Cancer

In laboratory models of the brain tumor known as ependymoma, **Drs. Yasmin Khakoo** and **David Lyden** are collaborating to identify molecular markers that signal tumor progression. Their goal is to use non-invasive techniques to identify and treat recurrences in children earlier—ultimately increasing survival.

## Pediatric Leukemia

For children with leukemia, **Dr. Neerav Shukla** is evaluating the use of very broad molecular profiling known as whole genome sequencing—an approach that may reveal treatment options for patients.

## Retinoblastoma

For children with this form of eye cancer, **Drs. David Abramson** and **Ira Dunkel** are perfecting a technique they pioneered called ophthalmic artery chemosurgery. Their approach is not only life-saving, but also preserves patients' eyesight.

## Rhabdomyosarcoma

Using sophisticated genomic methods, **Drs. Cristina Antonescu** and **Leonard Wexler** are seeking to refine the molecular sub-classification and prognostic markers for this type of sarcoma.

## The December Challenge: Funding the Purchase of a Transformative Technology

Building on the momentum of last season, this past December the community came together once again to raise \$1.2 million to purchase a new **Liquid Biopsy System**—a transformative technology that's minimally invasive for patients, provides a more complete picture of cancer in the body, and will improve cancer detection and monitoring.

To honor the teams and individual Extreme riders who met the Challenge by raising \$1,000 per-bike by the end of December, their names are now on display in the Memorial Sloan Kettering lab that houses the Liquid Biopsy System.

