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Alexander Drilon, Chief of the Early Drug Development Service (left), leads a group of experts dedicated to making advances in targeted therapies. Read about their life-changing work on page 38.

A MESSAGE FROM THE CHAIRMAN AND THE PRESIDENT

For more than 135 years, people facing cancer have counted on Memorial Sloan Kettering.

Their fierce determination to regain their health never dimmed during the COVID-19 pandemic. Just as unwavering was MSK's commitment to care for them with compassion and to advance the understanding and treatment of cancer.

We are proud to report the strides MSK has made over the past year, including contributions to fighting COVID-19 that helped set the standard for cancer care during the pandemic. We also want to share important progress in ensuring that MSK is more inclusive and more effective at reducing the cancer burden that is borne disproportionately by communities of color.

Today, patient activity and research are nearly back to pre-pandemic levels at MSK, thanks to the tireless dedication of our staff. We are proud of what the entire MSK community has accomplished during a deeply challenging year. And we look forward with great optimism to our singular mission to helping people with cancer, in every way we can.

Helping More People, In More Ways

In early 2020, our ability to care for people on an outpatient basis took another major step when the David H. Koch Center for Cancer Care at Memorial Sloan Kettering Cancer Center opened up for full patient care. This 26-story center joins our pioneering network of outpatient facilities and is now home to our Hematologic Malignancy, Thoracic Oncology, and Head and Neck Cancer programs. This center is the latest milestone in our decades-long effort to transform cancer care to make it less stressful, with fewer side effects. and closer to our patients' homes and work,

which we know improves the quality of life and outcomes for the people we care for.

The challenges of 2020 also demanded immediate and nimble responses to best care for our patients. In March, when MSK went to its highest level of alert under the leadership of Ned Groves, Cynthia McCollum, and others, 150,000 people were undergoing active treatment in our care. To provide robust COVID-19 testing capability, MSK developed one of the first COVID-19 diagnostic tests in New York City under the leadership of Esther Babady, Mini Kamboj, Deborah Korenstein, Melissa Pessin, and many others.

MSK also leveraged its digital and technology capabilities. Almost overnight, MSK made the promise of telemedicine a reality. Telemedicine visits — where an MSK clinician connects with a patient by computer or smartphone — jumped from 500 a week to almost 20,000 a week, more than 50 percent of all visits. Clinical trials under the leadership of Deputy Physician-in-Chief Paul Sabbatini also used telemedicine visits to keep vital clinical trials running, when many other hospitals stopped theirs.

MSK also immediately responded to a sharp increase in the number of cancer patients who were in need. Beginning in March, the number of MSK patients who used the MSK FOOD Pantry program, which helps cancer patients who are food insecure, increased threefold. This program,

under the leadership of Francesca Gany, Julia Ramirez, and Luke Paolantonio, expanded to deliver the equivalent of 90,000 meals to some 600 food-insecure cancer patients, including people being treated at hospitals outside MSK.

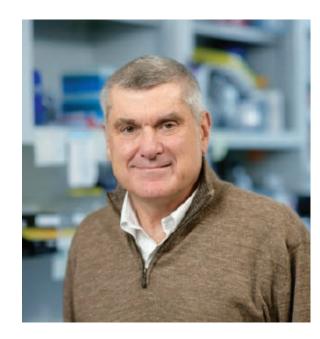
That is just one of the contributions MSK made to the fight against COVID-19 that extended far beyond our institution. MSK took in cancer patients from nearby hospitals, freeing up desperately needed capacity to treat people with COVID-19. And MSK faculty generated more than 230 COVID-19 related publications in 2020, ranging from practice-changing guidelines to identifying promising drug candidates and uncovering new details about the structure and function of the virus. (Learn more about MSK's response to COVID-19 on page 10.)

Clinical and Research Advances

MSK's singular focus on cancer produced important advances in 2020, including for some of the deadliest cancers.

You may have heard about the encouraging decline recently in deaths from lung cancer. These efforts will be aided by important new research from teams led by MSK's Alexander Drilon, Chief of the Early Drug Development Service, and medical oncologist Bob Li and others. Their clinical trials of targeted therapies aimed at genetic mutations in lung and other cancers have led to important advances in new drug approvals from the US Food and Drug Administration. (Learn more on page 38.)

MSK researchers also made important discoveries last year about leptomeningeal metastasis, when cancer spreads to the membranes lining the



CRAIG B. THOMPSON President and Chief Executive Officer



SCOTT M. STUART Chair, Boards of Trustees and **Governing Trustees**

Annual Report 2020







LISA M. DEANGELIS

Physician-in-Chief and
Chief Medical Officer



JOAN MASSAGUÉ
Director, Sloan
Kettering Institute



DOUGLAS A. WARNER III
Honorary Chair,
Boards of Trustees and
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brain and spinal cord. This particularly difficult condition is increasingly common as people live longer with cancer. Teams led by neuro-oncologist Adrienne Boire and Dana Pe'er, Chair of Computational and Systems Biology at the Sloan Kettering Institute, found insights into how cancer cells reprogram themselves to acquire the iron needed to survive, offering new avenues for research and treatment. (Read more on page 34.)

Despite the many challenges of the pandemic, MSK continued its preeminence in all forms of research over the past year, with 48 faculty members ranked among the most highly cited researchers in the world by the Institute for Scientific Information.

Among many highlights, a team led by SKI structural biologist Nikola Pavletich published a study that shed light on how a key step in DNA repair could lead to cancer when defective. And SKI immunologist Ming Li's group discovered how manipulating an important player in inflammation and the wound-healing process could reduce tumors in mice. He calls this new approach "cancer environment immunotherapy."

Central to all of these efforts is our vital educational effort. MSK has more than 3,000 scientific and clinical trainees, and the work they do is crucial to discoveries in our labs and clinical trials, to patient care, and to carrying out the MSK mission. Trainees will form the next generation of the cancer community's leaders, physicians, and scientists, and so it was crucial that our

educational leaders and their teams quickly pivoted to virtual or hybrid versions of summer internships, training programs, and seminar series to sustain MSK's educational mission during the height of the pandemic.

Equality, Diversity & Inclusion

The pandemic highlighted the devastating consequences of disparities in healthcare, which are also long-standing in cancer care. The social justice movements of 2020 also sparked a long overdue effort to address issues of inequality and discrimination in our society, including at MSK.

To ensure MSK makes real and enduring progress, we undertook several important steps this past year, including the appointment of MSK surgeon Carol Brown as the first Chief Health Equity Officer. Among many initiatives, her office will expand existing MSK efforts that are already bearing fruit to include more diverse patients in MSK clinical studies and also improve access to care at MSK, particularly for cancers that disproportionately harm underserved communities.

These efforts have been supported by the creation of the Nicholls-Biondi Chair for Health Equity, through a generous gift from Jamie Nicholls, an executive of the MSK Boards of Trustees and Governing Trustees, and her husband, Fran Biondi. (Learn more about Dr. Brown and the Office of Health Equity on page 44.)

MSK also established the Equality, Diversity & Inclusion Council, chaired by Chief Diversity

Officer Tomya Watt. The Council's purpose is to address issues of discrimination, build a more inclusive culture at MSK, and recruit and train a more diverse staff across the institution.

(Learn more about these efforts on page 50.)

Recognition and Honors

During the pandemic, MSK continued to demonstrate the excellence it is known for. MSK was once again ranked one of the top two cancer hospitals in the country, as it has been every year since *U.S. News & World Report* began its rankings 31 years ago. Three MSK subspecialties were recognized as national leaders for the first time: diabetes and endocrinology, pulmonary and lung surgery, and nephrology.

One of the most important contributors to that excellence is MSK's unparalleled nursing staff — which seems particularly fitting during the International Year of the Nurse. In late 2020, under the leadership of Elizabeth McCormick, MSK nurses were recertified with Magnet® designation, the highest distinction in nursing, after undergoing a rigorous examination process.

Many individual members of the MSK community also received prestigious recognitions. Scott Keeney and Christopher Lima were elected to the National Academy of Sciences; Michel Sadelain received the 49th Fondation ARC Léopold Griffuel Award for Translational and Clinical Research; Vinod Balachandran, Lydia Finley, and Andrea Schietinger were named winners of the 2020 Pershing Square Sohn Prize for Young Investigators; and Linde Miles, Sahana

Rao, and Mohita Tagore were named inaugural recipients of the 2020 Marie-Josée Kravis Women in Science (WiSE) fellowship grants, among many other recognitions of MSK faculty, staff, and trainees.

Continued Support

In 2020, more than ever, we are deeply grateful to those whose generous philanthropic support sustains MSK's mission to provide hope and improve outcomes. This year that support included the MSK Employee Relief Fund, which was created to support MSK colleagues experiencing financial hardship during the COVID-19 pandemic and distributed more than \$14 million to over 3,000 MSK employees and their families.

We are also thankful to the foundations and corporations and individuals who support MSK every year, including those who participate in Kids Walk for MSK Kids, Fred's Team, and Cycle for Survival — which is celebrating its 15th year and has raised more than \$275 million for rare cancer research.

As this report went to press, the medical world marked the 50th anniversary of what is sometimes called "the war on cancer," when legislation greatly increased funding for cancer research. Over the last half century, MSK has led enormous advances and is charting a course for the future of cancer care.

With your continued support, we look forward to pursuing our mission to help people live happier, healthier lives. Because MSK has always been here. And we always will be.

Cracy S. Thompson

CRAIG B. THOMPSONPresident and
Chief Executive Officer

SCOTT M. STUART
Chair, Boards of Trustees and
Governing Trustees

Strength

When a crisis struck, the MSK community rose up with unwavering focus on what mattered most: exceptional cancer care, research, and education.



As the global pandemic took hold of the world, the year 2020 presented the most formidable challenges in the more-than-135-year history of Memorial Sloan Kettering.

By March, New York had declared a state of emergency, And yet. MSK teams continued to care for our 150,000 patients. Scientists found ways to maintain critical research, and educators across the institution continued their mission. "Cancer doesn't stop," says MSK President and CEO Craig B. Thompson. Through ingenuity, technology, and total dedication, neither did the people of MSK.

Here is just part of that incredible story.

Scan here for an interactive experience and to meet some of our frontline heroes.







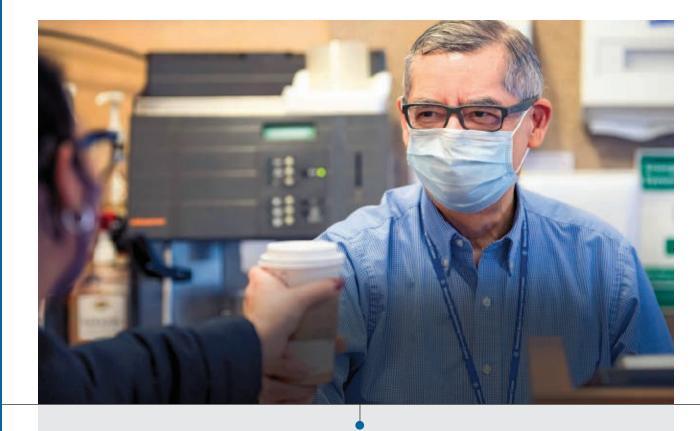


- MSK moved quickly with a plan of action. On February 5, the Hospital Incident Command System (HICS) issued the first of what would become 76 emergency communications by the end of the year to protect patients and staff from COVID-19 infection. "We didn't have all the answers, but we wanted to make sure we were communicating what we did know, as soon as we knew it," says HICS Incident Commander Cynthia McCollum (left). "Facing this challenge together made us an even stronger organization."
- MSK developed and deployed one of New York City's first US Food and Drug Administrationauthorized COVID-19 tests. The day after it was deployed, MSK had its first positive case. "I remember running down the stairs to the laboratory and just taking in that, 'Okay, this is happening," says Esther Babady, Section Head for MSK's Clinical Microbiology Laboratory and a leader in developing the test.



- Infectious disease expert Monika Shah (above) recalls testing at MSK ramped up quickly to protect patients and staff. "We went from manually ordering COVID-19 tests to a self-scheduling system scaled up for thousands of our employees."
- MSK mounted a rapid response to the state of emergency declared by Governor Andrew Cuomo on March 7. "That's when things became real for our team," says Marcia Levine, Vice President, Perioperative & Inpatient Nursing Services. "We began meeting twice daily to determine how to provide essential surgeries while converting 20 operating rooms into intensive care unit beds for COVID-19 patients."
- Many patients were afraid to come to the hospital amid the pandemic. In just six days, medical oncologist and HICS member Diane Reidy-Lagunes helped adapt an existing remote monitoring system so patients could report

- COVID-19 symptoms via telemedicine. "This allowed us to stay connected to our patients while keeping them safe in their own homes," she says.
- A monumental effort by MSK's tech team made it possible for many of MSK's staff — 21.000 **strong – to work remotely.** New systems were built from scratch. Atefeh Riazi, Chief Information Officer, says, "It was an incredible adjustment. The 'future' happened overnight."
- Volunteers, too, stepped up to the plate. About 90 members of the Volunteer Resources Department fanned out across all MSK patient care locations, doing temperature checks at entrances, assisting with personal protective equipment (PPE), and, later, helping in MSK's vaccine clinic. Volunteers in the Patient and Caregiver Support Program continued to offer peer support, guidance, and insight, and even MSK's Caring Canines continued virtual visits with pediatric patients.



APRIL

- Weeks of working 24-7 left frontline workers exhausted. Ricardo Santos (above), MSK gift shop associate, recalls, "One day a nurse stopped by for coffee. He seemed stressed. I asked how he was, and he replied, 'very worried.' I reassured him and said, 'most importantly, you're serving others.' His expression changed immediately. He thanked me and went on his way."
- Members of MSK's Patient and Family **Advisory Council for Quality (PFACQ)** and the Scarlett Fund at Memorial Sloan Kettering, which raises funds and awareness for pediatric cancer research, teamed up to **keep spirits lifted.** The groups organized a card drive (right) for children and adults that sent encouraging messages to all employees and patients fighting cancer in the midst of the pandemic.

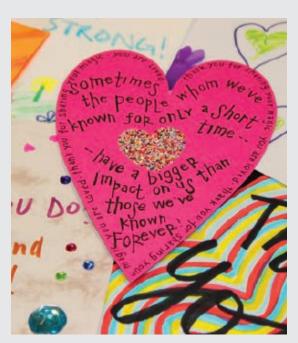


Photo: Courtesy of Emily McCormack



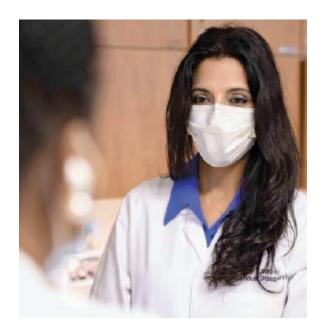
Tommie, MSK Kids patient

MAY

- The MSK Kids team published a study about COVID-19 in children in JAMA Oncology. Researchers found that if children with cancer developed COVID-19, their symptoms were usually mild. "Our findings enabled us to push forward with all cancer-directed therapies and surgeries, ensuring that no child's outcome would be compromised because of the pandemic," says Andrew Kung, Chair of the Department of Pediatrics at MSK Kids.
- When the live show for the important annual fundraiser Comedy vs. Cancer was canceled, organizers virtually staged **Saturday Night on Broadway.** Theater stars Mandy Gonzalez and Nick Kroll hosted the live Zoom performance on May 16, featuring Steve Martin, Jon Hamm, Ellie Kemper, and more. The event raised \$400,000 for MSK research.
- May 21 marked the return of in-person care for Advanced Practice Providers (APPs) at MSK Monmouth. "We had been taking must-see patients but quickly realized the need to pivot back to regular on-site care," says Cheryl Barnes, APP manager at MSK Monmouth.
- COVID-19 did not stop the next generation of scientists. At a virtual graduation ceremony, Michael Overholtzer, Dean of the Gerstner Sloan Kettering Graduate School of Biomedical Sciences, told graduates, "You wound up teaching us through your research, dedication, and passion." Graduates also chatted with honorary degree recipient and Nobel Laureate James Allison in a private Zoom session after commencement.

JUNE

- Publishing an important study in Nature Medicine, Chief Medical Epidemiologist Mini Kamboj (right) found that taking chemotherapy did not worsen COVID-19 illness. The study reassured patients that they should continue their treatment, even if they got sick with COVID-19.
- MSK continued innovating to offer world-class cancer care. By late June, two out of every three outpatient appointments were telehealth visits via computer or smartphone. A survey of our radiation patients published in the Journal of the National Comprehensive Cancer Network found no significant differences in patients' understanding of and confidence in their treatment.



AUGUST

• Telemedicine became a successful tool for clinical trials. "Our goal was to have people come to see us only when they were actually receiving treatment and do checkups through telemedicine," explains medical oncologist Nitya Raj (right). The process was so convenient that telemedicine will remain a part of future MSK trials, even after the end of the pandemic.



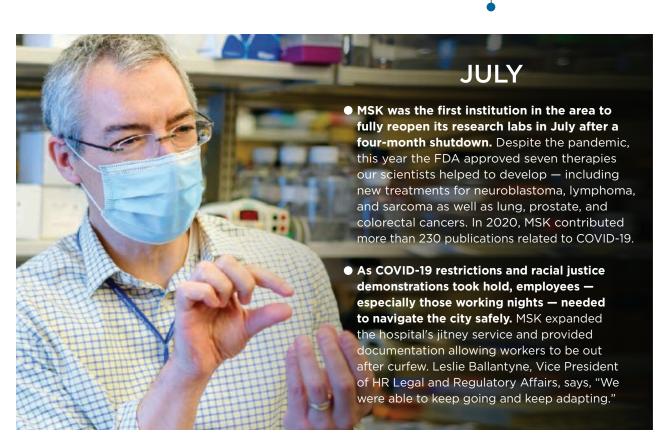






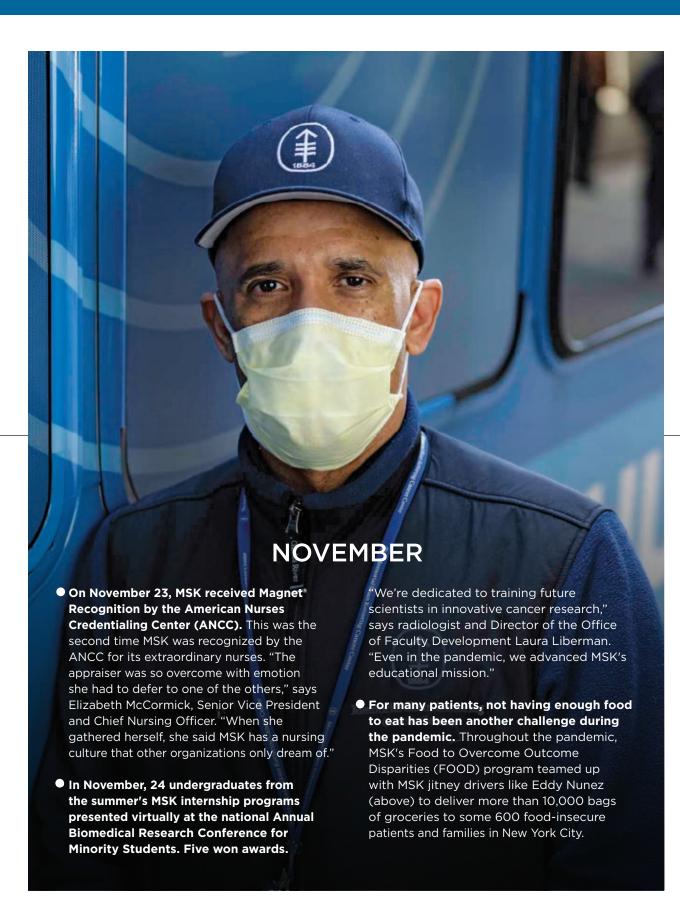
Photo: Courtesy of "Team MSK Kids on the Move"

SEPTEMBER

"It was six, eight, nine months of working seven days a week because we needed to for the patients," says Matthew Matasar, Medical Director of MSK Bergen and a medical oncologist. "And that's exactly what we signed up for. There's a real energy that comes from being called to duty in the midst of a historic crisis."

OCTOBER

• Despite the cancellation of the 2020 TCS New York City Marathon, members of the Fred's Team community rallied together online on October 29 for a 25th anniversary celebration. Runners like "Team MSK Kids on the Move" (left) took to the streets to run their own marathons. Since 1995, Fred's Team has raised nearly \$90 million for research at MSK.





DECEMBER

- MSK's extraordinary donors made the 2020 #GivingTuesday digital campaign the most successful yet: More than 2,500 people contributed approximately \$500,000, with gifts ranging from \$50 to \$25,000. That built on the \$76,000 that MSK's donor community raised on May 5 for #GivingTuesdayNow, a worldwide emergency campaign in response to the COVID-19 pandemic.
- At last, new hope emerged. In the middle of December, healthcare heroes at MSK rolled up their sleeves to get their first dose of the COVID-19 vaccine. In the first month, more than 10,000 MSK employees were vaccinated. "This is our chance to set an example and protect our community," says Chris Choudhry, Director of Environmental Services (above with nurse Brianna Zappi). "Let's do this together."



FROM THE FRONT LINES

Memorial Sloan Kettering staff, patients, and donors stepped up in extraordinary ways during the COVID-19 pandemic.

Meet just some of these heroes.



PAUL CORTELLESI

Senior system architect, Digital, Informatics & Technology Solutions (DigITs)

As a firefighter and EMT in his New Jersey hometown, Paul Cortellesi doesn't flinch when times get tough. So, when COVID-19 started to ramp up, he leapt into action and immediately volunteered to join the front lines at MSK. Mr. Cortellesi, a senior system architect in MSK's DigITs group, was one of hundreds of clinical and nonclinical employees redeployed to assist with COVID-19-related operations. In March, he became a coordinator for MSK's emergency response team to manage MSK's supply of PPE. "There was no standard," Mr. Cortellesi says. "We made it up as we went, based on best practices and the equipment we had." Mr. Cortellesi also spent his days troubleshooting technology and logistics to keep the ship sailing. During the height of

the first wave, Mr. Cortellesi worked 41 consecutive days — even on weekends and Easter — and slept at a hotel within walking distance of MSK. He credits his "enormous support network" for lifting him up during these challenges. Family and friends sent him cards and care packages at the hotel, and his wife came up with an ingenious way of reducing the strain of the N95 mask on his ears: She sewed buttons to his surgical cap that the mask could hook onto. Over the summer, Mr. Cortellesi thanked his fellow staffers by hosting socially distant get-togethers at his family farm. Mr. Cortellesi says he will never forget his service during the pandemic. "When I say it was my favorite three months of my career, I definitely mean it."



care of their own." Still, she worried about



MSK'S DONOR COMMUNITY

The MSK donor community swiftly united to meet the institution's unprecedented needs during the COVID-19 pandemic. More than 3,000 donors — including MSK staff, MSK Board members, and people around the world — contributed \$6.3 million to the COVID-19 Fund, designating gifts toward greatest needs, research and innovation, or employee relief.

Recognizing the pandemic's challenges on the home front, MSK allocated a total of \$14 million of philanthropic funds, drawing from both the COVID-19 Fund and other donations, to assist employees, including donations earmarked for greatest needs. More than 3,000 employees received grants to help pay for rent, childcare, groceries, and more.

Donors' generosity also extended to in-kind donations of PPE, food, and other much-needed goods for frontline workers.

They even wrote more than 2,000 thank you messages to MSK's healthcare heroes, which were posted all over the hospital and shared by email to provide encouragement.

As global demand for PPE and critical supplies accelerated, traditional supply chains could not scale up fast enough. Prices for some items rose to nearly ten to 14 times their standard cost, and MSK required a higher number to keep patients and staff safe. In April 2020, for example, MSK used 32,000 procedure masks a day — up from the usual 8,500. "MSK was able to procure everything we needed to provide the best cancer care because of our supply chain experts and the generosity of our amazing donor community," says Lisa Lieberman, Senior Director of Supply Chain and Sustaining Care Services Operations at MSK.

Debbie Parmet-Sondock (left), MSK volunteer, and Donna Sbriglia, Senior Project Manager, Construction, help sort donations of PPE.



who cares for patients before, during, and after surgery, stepped out of her regular role in March and into new territory caring for critically ill COVID-19 patients. "I knew I had the knowledge and skill to care for patients who were so gravely ill," she recalls. "But I was also afraid of the unknown." Four days before her deployment, her husband and children moved in with her parents. "I didn't know how else to keep them safe," she says. After four months of caring for COVID-19 patients in the ICU, Ms. Farrat returned to perioperative nursing in July. Telemedicine was keeping clinics as well as surgeries running smoothly.

It was a new tool for sharing critical information with families. "My role had to change from meeting patients' families and updating them in person to calling and texting them," she says. "Even though families were not able to be present on the day of surgery, they felt cared for. And that is one of the many ways that the care at MSK is exceptional." For her tireless efforts, Ms. Farrat received the 2020 The Finest Hour award, a national achievement that recognizes nurses who have gone above and beyond in providing care during the COVID-19 pandemic. "She brought the human touch to each nurse and patient," says her colleague Evangelina SantaTeresa.

LAURA MENOCAL PhD student in the lab of Andrea Schietinger In March, the Laboratory Emergency Task that were necessary," Ms. Menocal says. Her Force was created to make sure research selfless efforts meant her colleagues could could continue despite the pandemic. For avoid COVID-19 exposure. Today, the labs many, like Laura Menocal, the work was are up and running again thanks in part to personal. Her cousin, a doctor in Mexico, Ms. Menocal's work. "It was very smooth died of COVID-19. Ms. Menocal helped MSK picking up my work again," she says. "I'm scientists stay on track. "Once or twice a very excited about what's ahead in cancer week, I came into the lab alone and stayed research because we are making so many for an hour or two to take care of things important discoveries," she adds.

HEL AND LEAH and MSK patients The COVID-19 pandemic was raging in April sisters know, Rachel's diagnosis would uncover lifesaving information for her older sister, too. When Leah decided to have genetic testing at when 38-year-old Rachel Zitofsky (left) got the news: She had stage II breast cancer. With the added stress of facing cancer during MSK, she learned that she, too, had a BRCA2 mutation. Despite concerns about being in the a pandemic, Rachel was grateful she could hospital during the pandemic, she chose to build a care team close to her home at have preventive surgeries at MSK. "No matter Memorial Sloan Kettering Commack, led how long this pandemic lasts, I'd rather be by breast surgeon Lisa Sclafani. here to watch my kids grow up," she says. When telemedicine visits and genetic testing through MSK's Clinical Genetics Service As Rachel and Leah were recovering, Leah learned that tests on the tissue removed during revealed a BRCA2 mutation, dramatically increasing her risk of a second breast cancer her preventive surgery showed early-stage and of developing ovarian cancer, Rachel breast cancer, or ductal carcinoma in situ. had both breasts, ovaries, and fallopian tubes "If I would have waited, that cancer could have removed. "Dr. Sclafani told me we'd get grown, and I could have needed chemo and through this together and she'd support me radiation. It could have been so much worse," all the way," Rachel recalls. Leah says. "But I saw what my sister went Rachel's sister, Leah Blanton, traveled through — her cancer saved my life." from Florida to be by her side. Little did the Photo: Courtesy of Rachel Zitofsky and Leah Blanton

DISCOVERY

Through ingenuity and sheer dedication to saving lives, MSK researchers are making strides to address some of the most pressing challenges in cancer science.





TO SOLVE STUBBORN CANCER MYSTERIES, RESEARCHERS GROW TUMORS FROM SCRATCH

"Your cancer has spread." It is a phrase said too many times, and one that no patient wants to hear. Beyond a cancer diagnosis itself, learning that the cancer has spread, or metastasized, can feel like a death sentence. And indeed, the situation is grave.

Metastasis is responsible for more than 90 percent of cancer deaths. Once a cancer has metastasized, it is much harder to cure. That's not only because more parts of the body are harmed by cancer's relentless expansion but also because of the particularly aggressive tendencies of metastatic cancer cells themselves.

"Metastatic cancer cells are a completely different entity from the tumor that they started off in," says Karuna Ganesh, a Josie Robertson Investigator at Memorial Sloan Kettering who both treats patients and has her own research lab in the Sloan Kettering Institute. "They're more equipped to survive the stress of living in a new environment, and that makes them very difficult to get rid of."

Finding out what distinguishes metastatic cancer cells from regular tumor cells is Dr. Ganesh's lab's main focus, and they've already gained some important insights.

"Genetically, these cells are exactly the same," Dr. Ganesh says. "They have the same mutations, the same alterations, that were in the primary tumor."

In her lab, physician-scientist Karuna Ganesh (left and above) studies how cancer cells change when they metastasize.

But what distinguishes metastatic cells from primary tumor cells is a heightened ability to change their behavior by turning on and off different genes.

Scientists call this plasticity.

Plasticity allows metastatic cancer cells to adapt and survive outside the breast or the lung or the colon — wherever they originated. Plasticity also allows metastatic cancer cells to evade destruction by even our best treatment weapons.

Yet plasticity is difficult to study with conventional approaches. That's why, to tackle this important problem, Dr. Ganesh and her MSK colleagues have turned to an innovative technology called organoids.

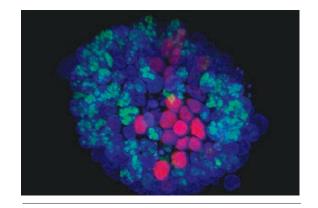
Disease in a Dish

As their name suggests, organoids are tiny balls of cells that resemble organs in their structure and function. MSK scientists can create organoids from patient tumor samples and use them to study the process of metastasis under more realistic conditions. The technology is transforming the way researchers at MSK study cancer, providing information that conducting experiments in lab mice never could.

Working with MSK colorectal surgeons, Dr. Ganesh and her team have been able to generate colon cancer organoids from cells obtained from patients undergoing surgery for their cancer. They can then grow these organoids in the lab and watch how they change over time.

One thing they've learned this past year, and published in the journal *Nature Cancer*, is that not all the cells in a metastatic tumor sample are equally capable of growing into an organoid. Those that can are called metastasis stem cells.

They have some unique properties. Most notably, they produce a protein called L1CAM.



This colorectal cancer organoid shows dividing tumor cells (in green) and non-dividing tumor cells (in pink). Image: Courtesy of Ahmed Mahmoud, Ganesh lab

This sticky molecule is a normal part of the tissue repair process that is turned on in response to injury. In the colon, that injury may be colitis, an inflammatory condition of the bowel. Activating L1CAM in tissue stem cells is part of the way that the colon repairs itself. Stem cells making L1CAM can separate from their neighbors, migrate into the gap of a wound, and then start to fill it in with new cells.

But it turns out that L1CAM is also crucial for metastasis. Cells that cannot make L1CAM cannot effectively spread to new sites in the body.

More and more, scientists are learning that metastasis relies on the same pathways that normal body tissues use to repair themselves. In other words, instead of growing new tissue to repair a damaged organ, the metastasis stem cells help to regrow the tumor in another part of the body where they have taken up residence.

"We now understand metastasis as the regeneration of the wrong tissue — the tumor — in the wrong place — distant vital organs," says Joan Massagué, Director of the Sloan Kettering Institute, whose lab has made some of the fundamental discoveries in this area and helped to galvanize the research paradigm. Under his leadership, SKI continues to be at the forefront of this research.



"We now understand metastasis as the regeneration of the wrong tissue — the tumor — in the wrong place distant vital organs."

- Joan Massagué, Director, Sloan Kettering Institute



Physician-scientist Viviane Tabar's lab uses organoid technology — tiny balls of cells from a patient's tumor — to identify a possible culprit in the brain cancer glioblastoma.

Viewing metastasis as regeneration gone wrong opens up potential treatment approaches. In Dr. Ganesh's lab, for example, they are currently looking for drugs that might block L1CAM and thereby rob cancer cells of their ability to metastasize.

Hunting Down Cancer Stem Cells in the Brain

Stem cell plasticity is also believed to be at the root of a difficult-to-treat brain cancer called glioblastoma. Up until recently, scientists hadn't been able to determine these cells' identity and had few leads to search for them. That changed this past year when a multicenter team led by scientists at MSK published a study in *Stem Cell Reports* that identified a promising suspect: radial glia cells. Radial glia cells play a key role in building fetal brains — newly birthed neurons travel along them like train tracks to reach their home — but have not before been linked to cancer.

"The look and behavior of radial glia cells in the developing brain and the tumor stem cells that we have identified are so similar to each other," says physician-scientist Viviane Tabar, Chair of MSK's Department of Neurosurgery, who led the research. "We can't say with certainty that radial glia cells are the same as tumor stem cells, but they are now very high on the candidate list."

Once again, organoid technology was crucial to making the discovery. Rong Wang, a research associate in Dr. Tabar's lab, was using tumor tissue that had been removed from patients to grow organoids. She noticed that some cells in the organoids had very long tails and divided in an unusual synchronized dance, much like radial glia.

Further analysis confirmed that these unusual cells also were present in dozens of tumor tissues taken from patients.

"Radial glia cells previously were not thought to persist in adulthood," Dr. Tabar explains. "If glioblastoma tumors arise from them, that may mean that humans retain some fetal radial glia cells in our brains as adults. The other possibility is that the genetic and epigenetic changes in the cancer turn some of the brain cells back into cells that look very much like radial glia cells."

Now that Dr. Tabar's team has a lead suspect, they can begin collecting more evidence and can hopefully solve the mystery of this brain cancer. •



DETERMINED TO DEFEAT CANCER'S SPREAD

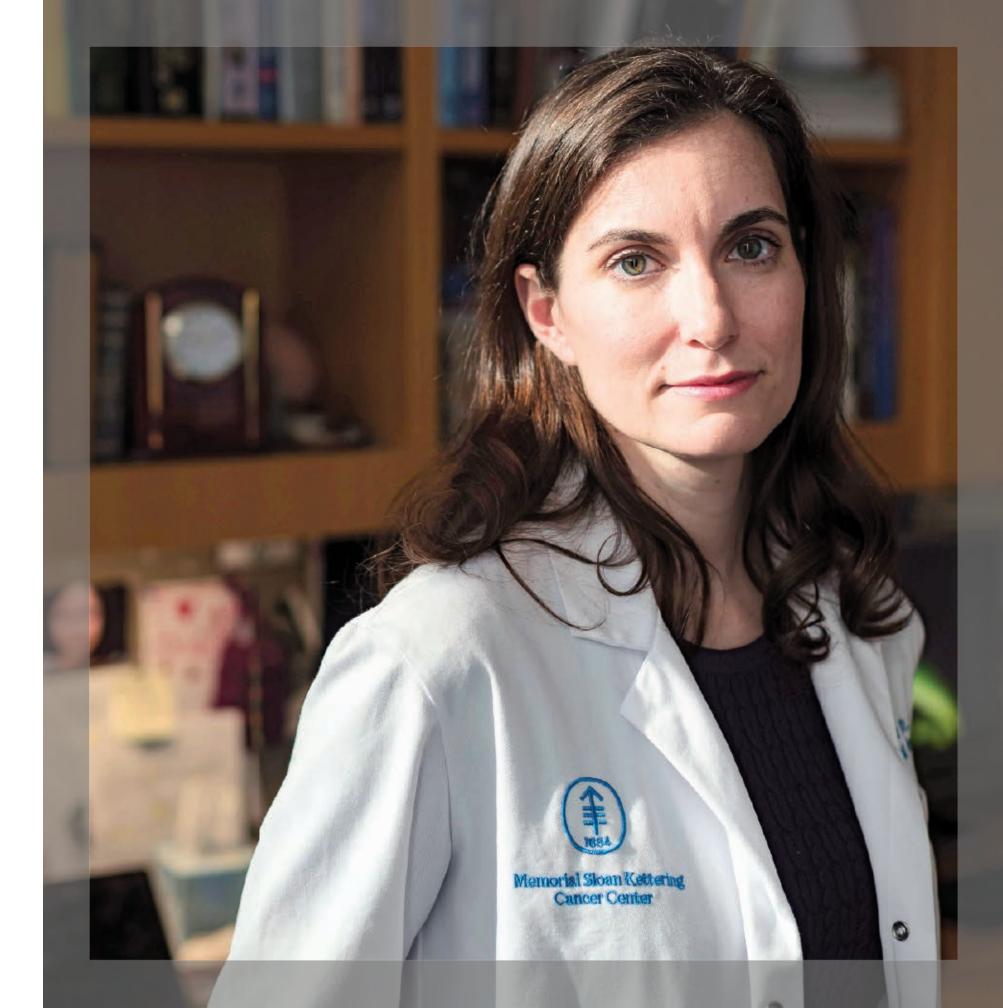
Neuro-oncologist Adrienne Boire was at a loss for words. Her patient was upset and couldn't understand how her breast cancer — seemingly under control — had spread to her spinal fluid. Now the woman could no longer walk, had terrible headaches, and had lost bowel and bladder control. She was suffering the devastating effects of a form of metastatic cancer called leptomeningeal metastasis (LM).

"She had a lot of questions for me about why this was happening and why there weren't better treatments, and I didn't have any good answers for her," Dr. Boire recalls. "She said, 'I really wish someone would figure this out,' and all I could think was, 'Me too."

With that difficult conversation still very much on her mind, Dr. Boire crossed the street from Memorial Hospital to Zuckerman Research Center, where she was a research fellow in the laboratory of Sloan Kettering Institute Director Joan Massagué. "I pushed the revolving door into Zuckerman and suddenly realized, 'This woman is telling me what I should be doing with my life."

Dr. Boire turned around, went straight back to the woman's hospital room, and sat with her, taking notes. "We came up with a list of questions together and then I went right to the lab and got to work," she says. The year was 2014. Sadly, the woman died, but her memory lives on through Dr. Boire's determination to solve LM, an increasingly urgent clinical problem. With cancer patients living longer because of better treatments, it means there is more time for the disease to spread to the spinal fluid and wreak havoc.

An unforgettable encounter with a patient inspired neuro-oncologist Adrienne Boire (above and right) to devote her scientific career to conquering a form of metastatic cancer.



Annual Report 2020

"[The patient] had a lot of questions for me about why this was happening and why there weren't better treatments, and I didn't have any good answers for her. I suddenly realized, 'This woman is telling me what I should be doing with my life."

Adrienne Boire, Neuro-Oncologist

Six years later, Dr. Boire's resolve to crack the mystery of this daunting complication has already produced critical insights and raised hopes for an effective treatment. The discoveries resulted from MSK's unparalleled combination of clinical and laboratory expertise.

Hardy Cancer Cells

These key findings relate to something that has long puzzled researchers: how LM cells manage to survive in spinal fluid after spreading there. The brain and spinal cord are largely sealed off from the rest of the body by a tight barrier and the space is devoid of nutrients to support cell growth.

In 2017, Dr. Boire and colleagues in the Massagué lab studied human LM cells in mice. They found that a protein called C3 opens the membrane between the blood and spinal fluid and allows growth factors and nutrients from the blood to enter and sustain the cancer cells.

This discovery, however, did not fully explain how LM cells survived in the mostly barren environment. Immune cells also invade the spinal fluid and vastly outnumber the cancer cells, competing for the same nutrients. Yet some of the cancer cells persevere. The question was: How? The only way to find this secret power would be to study the activity of the individual cancer cells in exquisite detail.

To conduct this kind of deep analysis, Dr. Boire — who now leads her own lab — collaborated with SKI computational biologist Dana Pe'er, a world-renowned expert in single-cell analysis. Dr. Pe'er is Scientific Director of the Alan and Sandra Gerry Metastasis and Tumor Ecosystems Center, which was established in 2017 and provides critical funding for metastasis research.

Dr. Pe'er oversees the Single Cell Research Initiative, also supported by the Gerrys' philanthropy, which uses new technologies to study cancer one cell at a time. This enables researchers to look at RNA rather than DNA within individual cells to determine which genes are expressed, or "turned on."

"I knew Dana could help me cast a very wide net so we could understand at a really granular level how these cancer cells live in the spinal fluid," Dr. Boire says.

The researchers conducted a test called single-cell RNA sequencing on fluid samples taken from five patients who had developed LM that had spread from breast or lung tumors. This revealed many differences in RNA activity among the cancer cells — even within the same sample. But all the cancer cells shared one critical feature: They reprogramed themselves to produce a protein called lipocalin-2. This protein binds to iron, which LM cells need to survive.

"Normally, only immune cells can turn on the set of genes to make the lipocalin-2 protein," Dr. Pe'er says. "The cancer cells not only access this genetic program but hypercharge it to work a thousand times more efficiently than in the immune cells."

Breaking the Cancer Cells' Grip on Iron

The increased lipocalin-2 levels enable the cancer cells to monopolize the iron, foiling the immune response that would normally destroy them. It's like creating a much stronger magnet to pick up more paper clips.

"It shows the very powerful force of evolution in driving these diverse cancers to adapt to the harsh environment by using the one trick that seems to work," Dr. Pe'er explains.

The researchers reported this finding in the journal *Science* in July 2020.

Identifying the key role played by lipocalin-2 led the researchers to their next question: What if you could cut off access to iron? In mouse models for the disease, they showed that delivering chemical compounds called iron chelators directly into the spinal fluid deprived the cancer cells of their lifeline and slowed their growth. The chelators bind to the iron so less is available to all the cells, taking away the cancer cells' survival advantage.

"It reminds me of when kids are fighting over a toy and the parent says, 'That's it — I'm taking it away. Nobody gets it,'" Dr. Boire says. The researchers are now working to bring this therapy to a clinical trial. It could be the first effective treatment for a condition that has long vexed researchers and clinicians alike.

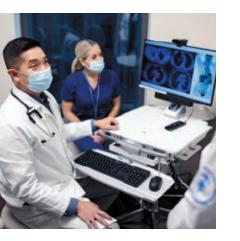
Dr. Boire says her lab work helps her stay motivated rather than despondent after seeing patients endure such a difficult condition. This incentive is what drove her back to speak with her patient that day in 2014.

"The security guards probably thought I forgot something," she says, "but it's more like I remembered something — what I should be doing here." •



Computational biologist Dana Pe'er (above) used her expertise in single-cell analysis to help Dr. Boire study metastatic cancer cells individually, offering a deeper understanding of their activity and how they adapt to new environments.





NEW TARGETED THERAPIES TRANSFORM LIVES

"We've seen sick patients who were practically knocking on death's door," says Alexander Drilon, Chief of Memorial Sloan Kettering's Early Drug Development (EDD) Service. "Targeted therapy then achieved a Lazarus effect — their cancer-related symptoms dramatically improved, and they went back to living their lives the way they did prior to their cancer diagnosis."

In just the past three years, the US Food and Drug Administration has approved three drugs developed by the EDD and Dr. Drilon's team, working with pharmaceutical companies. In May 2020, selpercatinib (Retevmo™) was approved to treat lung and thyroid cancers driven by RET fusions or mutations. In August 2019, entrectinib (Rozlytrek™) was approved for lung cancer driven by ROS1 fusions and all cancers driven by NTRK fusions. In November 2018, larotrectinib (Vitrakvi®) was approved for adult and pediatric tumors driven by NTRK fusions. All of these drugs are targeted therapies, which block the cancer-causing genes and directly attack tumors while mostly sparing healthy cells.

Doctors in the EDD Service specialize in developing new therapies for cancers, including those with specific gene changes. "Immunotherapy can work extremely well for some cancers," Dr. Drilon says, adding that his patients often ask if these drugs are an option. "But for cancers caused by a mutation or fusion, targeted therapy can work much better." Unlike therapies that activate the immune system to fight the cancer, targeted therapy drugs like selpercatinib, entrectinib, and larotrectinib turn off the signals that tell cancer cells to grow and divide.

Chief of the Early Drug Development Service Alexander Drilon (left and above with clinical trials nurse Lauren Kaplanis) says targeted therapies can help some patients achieve a "Lazarus effect" — dramatic improvement when they've run out of other options.



"I don't think I'd still be here today without it," says patient and advocate Melissa Crouse about a targeted drug she received in a clinical trial at MSK.

A Second Chance for a Born Teacher

Florida grandmother and retired middle school music teacher Melissa Crouse is one of the patients whose life was turned around by Dr. Drilon's work.

When Melissa met Dr. Drilon for the first time in April 2017, she'd been living with lung cancer for 12 years and had been through five other clinical trials. "None of them worked well, but together they kept me alive," she says. "Then I learned about the trial at MSK."

That June, Melissa received her first dose of selpercatinib, taken as a pill. By September, a scan showed her tumors were shrinking. The extreme fatigue she felt in the beginning subsided. She has had no evidence of disease since April 2020. She continues to take the pill every day and is amazed to feel so well.

"Selpercatinib was my sixth clinical trial," says 66-year-old Melissa. "I don't think I'd still be here today without it."

"Melissa's experience was remarkable," says Lauren Kaplanis, a clinical trials nurse who works with Dr. Drilon. "And it was repeated in many of the nearly 100 people we've treated with this drug so far."

"We've known about the link between *RET* fusions and lung cancer since 2011, but prior to the start of the selpercatinib trial in 2017, there

were no drugs that were designed to optimally target only the RET protein," Dr. Drilon says. Other drugs were less effective and caused a lot more side effects.

The New Frontier

RET fusions or mutations are one of many gene changes targeted by a new class of more powerful drugs. The genes affected by these changes sound like an alphabet soup — EGFR, ALK, ROSI, NTRK — but in this exciting era of molecular testing and personalized medicine, they've become common lingo for patients. Melissa even started a group called the "RET Renegades" for others with RET fusions or mutations. Changes in RET and hundreds of other cancer-causing genes can be detected with MSK-IMPACTTM, a diagnostic test developed at MSK.

Dr. Drilon is not the only specialist at MSK focused on targeted therapies for lung cancer. In September 2020, physician-scientists Piro Lito and Bob Li reported dramatic results in the New England Journal of Medicine from the first-ever clinical study of a drug that targets a common mutation in a gene called KRAS. KRAS mutations are found in about one quarter of lung cancers, and until recently they were considered to be "undruggable" mutations because of the shape of the KRAS protein.

In January 2021, Dr. Li reported at the World Conference on Lung Cancer Presidential Symposium that in the registrational phase II trial, 100 of 126 patients whose cancer was caused by a *KRAS* mutation called *KRAS-G12C* had their tumors either shrink or stop growing. Of those, 46 patients' tumors shrank substantially, and half of them were still responding to the drug ten months later. Nine people had to stop taking the drug because of side effects. Based on these results, the FDA designated sotorasib a Breakthrough Therapy.

"Sotorasib is the first among a growing number of emerging therapeutics aiming to directly target *KRAS*-mutant cancers," says Dr. Lito, who is a member of the Thoracic Oncology Service and the Human Oncology and Pathogenesis Program.

"Sotorasib is not a cure, but this study is the first to crack *KRAS* in a clinically meaningful way," adds Dr. Li, a member of the EDD and Thoracic Oncology Services. Dr. Li and Dr. Lito are continuing to study sotorasib in clinical trials.

Expanding Access Beyond Clinical Trials

Philanthropy has provided critical support for the investigators in the EDD Service. The Fiona and Stanley Druckenmiller Center for Lung Cancer Research at MSK provided funding for Dr. Drilon's research with *RET* gene changes, among other important work, as well as Dr. Li's research.

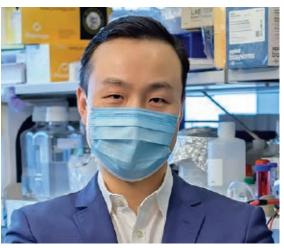
"Through the EDD Service, we are able to offer select patients outcomes with targeted therapy that they may never attain with other standard therapies. I have patients who have taken these drugs for years and are still doing well," Dr. Drilon says. "When these drugs are approved by regulatory agencies around the world, more people can access these new treatments." Other pathbreaking work in the EDD Service has also received support from Mike Repole and his Nonna's Garden Foundation.

For Dr. Drilon and his team, there is no greater motivation. Their work has made a difference not only for his own patients and those being treated by the EDD Service — it's changing therapies for cancer patients everywhere.

Melissa is now an activist and patient advocate, even starring in an Emmy Award-winning documentary about lung cancer called *Melissa's Story*.

A self-described type A personality, she had left her teaching job when she started the selpercatinib trial. She says, "If I had known then what I know now, I wouldn't have retired." •

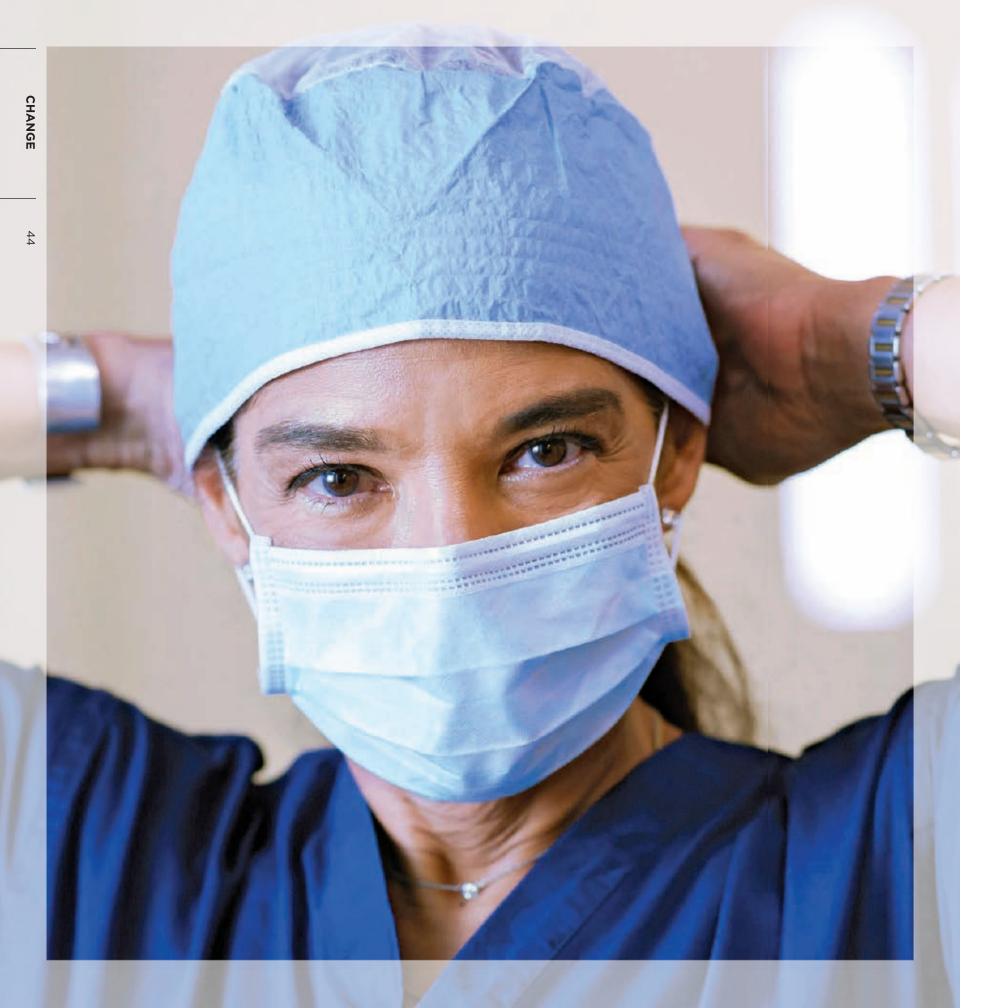




Critical work led by thoracic oncologists Piro Lito (top) and Bob Li (above) means a mutation found in one quarter of lung cancers is no longer considered "undruggable," bringing hope to patients in need.

MSK is committed to breaking down barriers and creating a more diverse and inclusive community for all.







CLOSING THE GAP: MAKING HEALTHCARE AVAILABLE TO ALL

Carol Brown Leads a New Commitment to Reducing Cancer Disparities

For gynecologic cancer surgeon Carol Brown, a commitment to equity in healthcare was forged during her time as a medical student at Columbia University in the 1980s. In addition to being President of the Black and Latino Student Association and the first recipient of the Malcolm X Scholarship, Dr. Brown spent many rotations at Harlem Hospital where she witnessed firsthand the benefit of providing cutting-edge care to those who needed it most but had the least access.

"I was part of an all-Black team of exceptional physicians in the ICU treating a man in his 50s with an experimental medicine for his rare heart arrhythmia. It felt like we spent 18 hours a day at this one patient's bedside fighting to keep his heart beating in a normal rhythm — fighting to keep him alive," she says. "The quality of care he received saved his life."

Dr. Brown says that experience and many others have convinced her that long-standing disparities in healthcare access and outcomes can be overcome. "With the right science and the right social support and the right tools," she explains, "you can change people's lives, including people who for too long have not gotten the care they deserve."

During her more than 25 years at Memorial Sloan Kettering, Dr. Brown has become a national leader in the effort to eliminate disparities in healthcare — particularly cancer care — based on race, ethnicity, or socioeconomic status.

A deep commitment to equity in healthcare has been a hallmark of the distinguished career of gynecologic surgeon Carol Brown (above and left).

In 2020, MSK made a major commitment to this issue by appointing Dr. Brown as MSK's first Chief Health Equity Officer. "MSK is the leading cancer center in the world in terms of high-quality care and lifesaving research," she says. "Our vision for the Office of Health Equity is to make sure MSK is also a leader in helping all people with cancer achieve the best possible outcome regardless of their race, ethnicity, gender identity, sexual orientation, physical ability, the language they speak, or their socioeconomic status."

Cancer Disparities and a 'Game Changer'

Despite some recent gains, long-standing disparities in cancer threaten the lives of far too many people. Dr. Brown says 2020 was a "game changer" and believes this tumultuous year "raised a new consciousness around the country and at MSK."

First, COVID-19 revealed that health disparities — especially those based on race — could determine who lives and who dies, says Dr. Brown. Then, she says, "The deaths of people of color at the hands of law enforcement rocked

our institution and our staff." The result at MSK, says Dr. Brown, was that "the institution listened. This year the commitment to diversity, inclusion, and health equity has risen to a whole new level."

She is also encouraged by the reaction of the larger MSK community, such as the endowment in December 2020 of the Nicholls-Biondi Chair for Health Equity at MSK by Jamie Nicholls and her husband Fran Biondi. Dr. Brown says, "The generous gift by Ms. Nicholls and Mr. Biondi inspires me and so many others at MSK who have worked to reduce and eliminate cancer disparities. It shows us that the goals of health equity we're working towards can really happen."

Family Ties

For Dr. Brown, the seeds of purpose were planted in her childhood. Dr. Brown was born and raised in Los Angeles where her father, Charles E. Brown, was one of the city's first African American surgeons. When she was a young girl, Dr. Brown recalls that "he would talk a lot about the issues of healthcare access for Black people in South Central Los Angeles, so I learned about it at the dinner table."



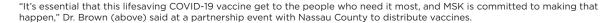




Photo: Courtesy of NBCUniversal

SHINING A SPOTLIGHT ON PROSTATE CANCER DISPARITIES

One key to reducing cancer disparities is to raise awareness about them. And that is precisely what beloved TV news anchor Al Roker decided to do when he was diagnosed with prostate cancer.

On NBC's *Today* show, Al revealed his cancer diagnosis along with his surgeon, Memorial Sloan Kettering's Vincent Laudone, Chief of Surgery at the Josie Robertson Surgery Center.

In February 2021, Al joined Dr. Brown for a video chat, and she thanked him for going public about his diagnosis. She said, "Prostate cancer involves rectal exams and blood tests, and that's difficult." She continued, "You stepping forward really helps those of us who have Black men that we love say to them, 'OK, Al did it. Now you can too."

Al told Dr. Brown that's one of his key messages because "men, especially Black men, who see going to the doctor as some sort of weakness, need to realize it's really not."

Al praised the exceptional care he got at MSK. Dr. Brown responded, "We want to advocate so that all people who are at higher risk for different types of cancer can get access to high-quality care at centers like MSK and cancer centers that are part of our public heath hospital system."

Al noted the grim reality that not all patients are as fortunate as he is. "If we don't all have access to good healthcare," he said, "people are going to die. I think it's as simple as that."



The Grim Reality of Cancer Disparities

PROSTATE CANCER

Black men are 50 percent more likely to develop it and twice as likely to die of it

BREAST CANCER

Black and white women are diagnosed at the same rate, but Black women have a 40 percent higher death rate

ENDOMETRIAL CANCER

Black women have a 20 percent lower five-year survival rate than white women

Source: American Cancer Society

Her father also set a powerful example of how to create solutions: In the late 1960s and early 70s, he helped found the Charles R. Drew Postgraduate Medical School and Martin Luther King, Jr. General Hospital in South Central Los Angeles. She came to understand that her father's efforts "showed that you could affect positive change and work with health systems and big universities to really solve problems for people despite the effects of racism on the healthcare delivery system."

More Access, Outreach, and Insight

In her medical career, Dr. Brown has turned those life lessons into action. She explains that cancer inequities exist for many different reasons: "It may be about access to care or it may be about access to screening." In other cases, she says, "cancer disparities may be the result of tumor biology that affect different populations of people in different ways."

Dr. Brown plans to attack cancer disparities on all these fronts — and more. She will expand the existing Cancer Health Equity Research Program (CHERP) to include additional hospitals that provide cancer care for underserved patients in their local communities. Dr. Brown explains that "CHERP partners with dedicated community oncologists to bring MSK clinical trials to their patients in Queens and Brooklyn who otherwise may not have access to cutting-edge therapy."

For example, hundreds of underserved patients have benefited from MSK IMPACT™, a test that analyzes more than 500 genes to find tumor mutations that are vulnerable to particular drugs. It helps identify patients eligible for clinical trials or therapies they would not otherwise have access to.

She also wants to help people avoid cancer in the first place as well as provide MSK care to less-advantaged people when they are newly diagnosed. One of her efforts focuses on endometrial cancer. "The incidence and mortality for this kind of cancer has been rising rapidly over the last four to five years," says Dr. Brown, "and the difference in outcome for Black women is actually getting worse compared to white women in the United States."

To help, Dr. Brown is leading efforts to educate Black women about their risk of endometrial cancer and the importance of getting evaluated for its most common symptom: abnormal bleeding. She explains that "one hypothesis about the lower cure rates experienced by women of color is because Black women tend to get more aggressive types of endometrial cancer." Dr. Brown says, "We want to make sure the women most at risk for this disease have knowledge about their risk and access to treatments and research at MSK that really make a difference, including immunotherapy and targeted therapy."

The Road Ahead

After decades of working to reduce cancer disparities, Dr. Brown knows better than anyone how many challenges lie ahead. Too often, she says, "MSK has been perceived as a place that's hard to get into — that it's not accessible." She wants MSK "to become known as a place that's welcoming to people from every walk of life and that reaches out to help underserved communities that suffer disproportionately from cancer."

To achieve that goal, she will draw on the same determination and compassion that helped save a desperately ill man so many years ago — and has helped forge a career devoted to helping everyone receive the care and respect they deserve. •





PERSONAL PERSPECTIVES

ON EQUALITY, DIVERSITY, AND INCLUSION AT MSK

The seismic events of 2020 sparked honest, sometimes uncomfortable conversations at Memorial Sloan Kettering about race and equality. With this renewed focus, we are committed to creating a more diverse staff to improve opportunities and to reflect the communities we serve. Every patient must feel welcomed, understood, and well cared for when they come to MSK.

People who are helping to lead these changes in many areas across MSK shared their perspectives.

TOMYA WATT VICE PRESIDENT OF TALENT ACQUISITION & MOBILITY CHIEF DIVERSITY OFFICER

"In order for our patients — all patients — to feel welcomed and supported, our workforce has to feel welcomed and supported. In 2020, leadership, including the Board, recognized there was much for them to learn and hear from our employees. They took the time to listen to issues in ways that maybe they hadn't listened in the past. I think there's been a dramatic shift in the organization's attention and energy on issues of equality, diversity, and inclusion. We are focused on increasing representation in our patients; however, we also have to look at our workforce and work to close those gaps, as well.

My primary focus is our workforce — attracting and retaining employees. For example, during the 2008 recession, when so many people were unemployed, it was a best practice to add education requirements like a college degree to reach top talent. We found, however, that this created an artificial barrier, which ended up eliminating many people who could have made a meaningful contribution to MSK. Over time, we started removing the requirement. And in the summer of 2020, we made the commitment to remove educational requirements from all jobs unless required for a license or certification.

Additionally, we have to provide our existing employees with the best opportunities to develop their careers here at MSK and break down barriers to employment by attracting talent not necessarily from the places we've drawn from in the past.

However, I want to be clear that if we only focus on diversity, it can be perceived as a quota-driven solution. Instead, we have to focus on inclusion. In focusing on inclusion, we will use different tools and solutions — in other words, equity — to make sure that all employees feel respected, supported, and welcomed.

We established the MSK Equality, Diversity & Inclusion (ED&I) Council and the Governance Group. We have provided and will continue to provide workshops and learning programs to set the foundation and give us a common language. But it's much less about programs and more about the individual. How do I come to work every day and value my colleagues, whether they are the same as or different from me? Ultimately, equality, diversity, and inclusion is everyone's responsibility.

Together, we all play an important role in fulfilling our commitments to equality, diversity, and inclusion and holding each other and MSK accountable for creating a sense of inclusion."

"It's much less about programs and more about the individual. How do I come to work every day and value my colleagues, whether they are the same as or different from me? Ultimately, equality, diversity, and inclusion is everyone's responsibility."

> Tomya Watt, Vice President of Talent Acquisition & Mobility and Chief Diversity Officer



YAIHARA FORTIS SANTIAGO ASSOCIATE DIRECTOR, OFFICE OF POSTDOCTORAL AFFAIRS & TRAINEE DIVERSITY INITIATIVES, SLOAN KETTERING INSTITUTE

"Change requires recognizing your own unconscious bias. For instance, in the sciences, when we are considering people for a position as a student or researcher, we tend to put weight on things that are subjective, like the prestige of the institutions where they studied.

But when two candidates have similar qualifications, giving the edge to an Ivy League education might be shortsighted. To come up with innovative ways to solve questions about cancer and biology, we need a diversity of ideas, backgrounds, and opinions at the table. We need to hear ideas from people who are sometimes marginalized or come from communities different than the majority of researchers.

We also need to recognize some of the unique contributions of faculty from underrepresented populations. Most of them are committed to opening the doors for the generation coming after them. They sacrifice their time and energy to mentor them and take on projects to help diversity. But that comes at a cost. While they are spending time and effort on those initiatives, their white peers are moving up the ladder because all they have to do is focus on their science. We need to better recognize their contributions and reward them.

Overall, I am hopeful about what's happening at MSK — many people seem to be unlearning old ways of thinking, particularly after the social justice movements in the summer of 2020. People are raising their hands and saying, 'How can I do better?' And people's reactions are constructive instead of defensive."





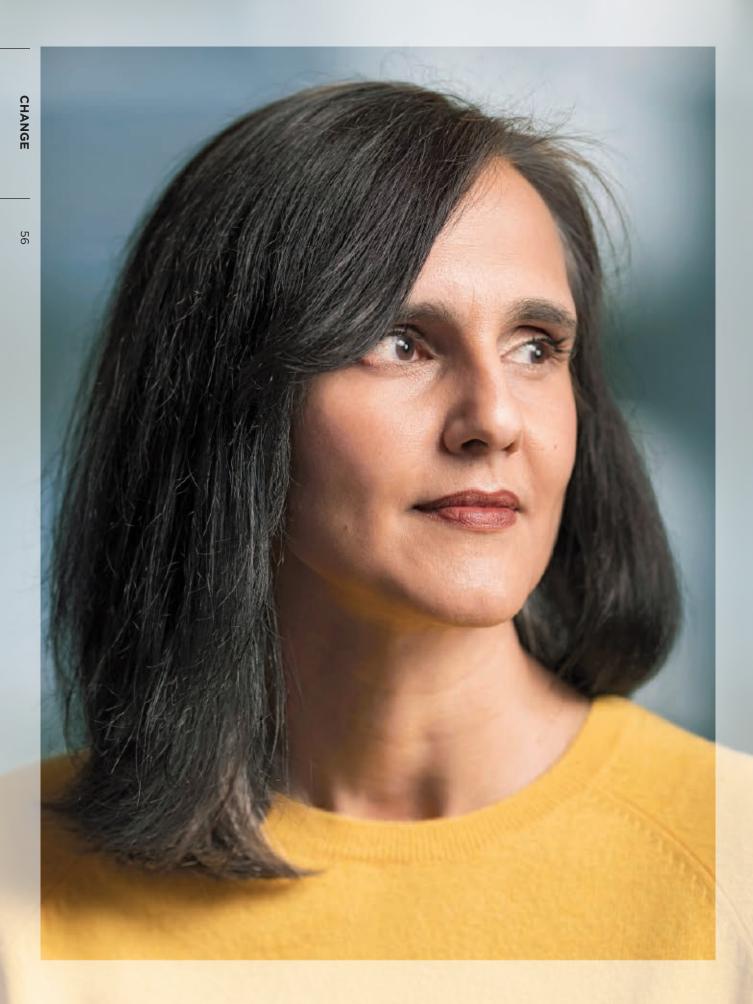
MELODY SMITH HEMATOLOGIC ONCOLOGIST

"I'm of Afro-Caribbean heritage and I grew up in the South, in a town that's still in large part divided by railroad tracks. For as long as I can remember, issues of race have always been present. I think that 2020 was one of the first times in my life where it seemed as though others have been really interested in these topics and in understanding some of the issues that still remain in this country.

I'm a physician-scientist whose work focuses on adult bone marrow transplant and cellular therapy, like CAR T cell therapy. Some of the main issues in my field are addressing access to care for people from diverse and underrepresented populations and finding strategies to make these treatments more affordable for a broader demographic of patients.

Medically, we've made a lot of advances in the last ten years to help people from underrepresented backgrounds who may not have many matches on donor lists for a bone marrow transplant. But unfortunately, many people from these backgrounds may not have access to insurance that will cover the cost of these lifesaving therapies. That's one of many factors that fuel the disparity in cancer outcomes between white patients and those who are Black, Latinx, and other people of color.

I'm hopeful about change. But I also know that it requires persistence and can take time. One of my cousins on my mother's side is one of the Greensboro Four, whose sit-in at a Woolworth's lunch counter on February 1, 1960, helped lead to the movement that integrated restaurants and businesses. Their sit-in marked its 60th anniversary in 2020. So much has changed in the years since, both in the country and at MSK. But there's still a lot of progress that needs to be made."



USHMA NEILL VICE PRESIDENT, SCIENTIFIC EDUCATION & TRAINING

"After the events in the summer of 2020, and the heightened consciousness about racial issues, it's gratifying to see how many colleagues have raised their hands to help diversify the people who walk in our hallways, on every level. Just as important is creating a culture where people from all backgrounds feel included and valued.

In my field, one priority is making sure we attract more trainees from diverse backgrounds. MSK has over 3,000 scientific and clinical trainees, and the work they do is crucial to discoveries in our labs and clinical trials, to patient care, and to carrying out the MSK mission. Trainees are the backbone and will form the next generation of MSK.

We've broadened our recruitment efforts to include a more diverse mix of schools over the last few years and revisited the way we evaluate candidates. And we're not waiting until people apply to MSK's graduate programs. We are actively seeking participants from underrepresented backgrounds in our high school and college training programs. We also send our trainees as science ambassadors into New York City classrooms. We live in the most diverse area in the world — we should reflect that."

"We live in the most diverse area in the world we should reflect that."

- Ushma Neill, Vice President, Scientific Education & Training

KREG KOFORD SENIOR VICE PRESIDENT OF SUPPLY CHAIN AND SUSTAINING CARE SERVICES

"As a healthcare provider, MSK purchases a tremendous amount of individual supplies, and it's easy to go with the big, established companies. But over the last several years, MSK has made it a focus to attract a diverse group of suppliers, including companies owned by women, minorities, veterans, LGBTQ vendors, and other groups. And that commitment intensified in 2020. We are eager to continue this focus in 2021 and beyond.

MSK feels our suppliers should reflect our employees and patients. MSK also knows that when we have diverse, local suppliers we help strengthen the economic health of the communities we live in. So, we are reaching out to partner with local companies to help them develop the capacity to become our suppliers.

Mentoring companies can have real benefits in terms of innovation. For example, when COVID-19 first hit, we found that some local, diverse suppliers were able to transition quickly to producing PPE. These companies are often very nimble, and helping them become healthcare suppliers is good for us, for them, and for the communities we live in."





CORNELIUS TAABAZUING RESEARCH FELLOW, SLOAN KETTERING INSTITUTE

Also pictured on page 43

"As a research fellow, I'm in the transition phase between the postdoctoral and faculty stage. At each stage, as a diverse person, you see less and less people who look like you. The solutions are not simple. But I think MSK is making a focused and intentional effort to recruit and improve diversity so people who are currently underrepresented feel comfortable and feel their cultures and worldviews are accepted and respected.

People need to see people like themselves succeed — it should be normal, not exceptional.

That feeling of being accepted and safe can't be only at work. It has to extend to the rest of life too. That's a larger systemic issue where MSK can also play a role. I was pulled over on my college campus a few times and searched for drugs and then let go when nothing was found. Statistically, people of color are likely to have more interactions with police than their white counterparts — many of which are negative experiences. Feeling safe and

respected outside of work is vital to feeling that way inside work too.

It's important to have institutions like MSK publicly say, 'Look, this is what we believe in, this is our stance,' and support politicians and laws that try to make our country more inclusive. Taking a stance like that is a risk — do you risk losing philanthropic support that doesn't agree with your views? But if institutions like MSK, Columbia, Harvard, NYU, and others really want to make a difference, they need to work together and change government policies that permit racism. This will help the institutions and society overall.

At an individual level, I suggest people take ownership. Think of diversity as your own problem. 'How can I solve it?' Everybody at MSK is incredibly smart. Use those incredible minds to think of creative solutions and then project forward and say, 'What do we want it to be like ten, 15 years from now?'"

MONIKA SHAH INFECTIOUS DISEASE PHYSICIAN CHAIR, GRADUATE MEDICAL EDUCATION COMMITTEE

"In my field, we are working on two big buckets. One is our workforce and making sure it's diverse and that people who work at MSK feel valued and heard. The second is not only making sure that we care for a wide diversity of patients but also that we have the cultural sensitivity and competency to understand where our patients are coming from.

That's really important in caring for people. And it's not necessarily intuitive. We all have our own worldview based on our experiences, and it sometimes requires active thinking to truly understand someone who may be very different from us.

We know we can improve our sensitivity and understanding of other people through training. And we are expanding our training in these issues. Nearly 50 percent of our physicians were trained here at MSK, so taking active steps to make our trainees more diverse and more culturally aware will definitely be reflected in our future faculty."





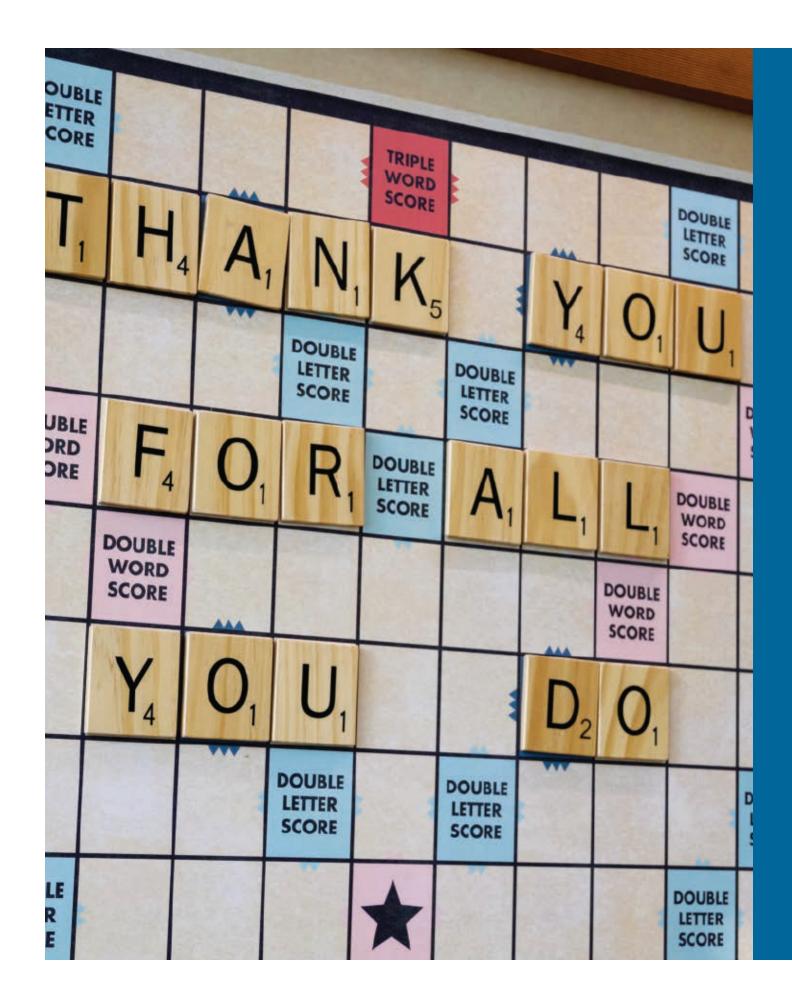
JORGE CAPOTE VICE PRESIDENT, PATIENT RELATIONS HOSPITAL ADMINISTRATION

"I have the privilege of working directly with patients and their caregivers as an advocate. I also oversee our information desk, interpretation services, and patient recreation offerings to ensure that we are meeting the needs of our patient community. I learn from every patient encounter and summarize for leadership when we fall short on expectations. It's a two-way street: What we do and how we do it is just as important for our patients as it is for our staff. The most important aspect is that we don't lose our sense of humanity.

As our patient population becomes more diverse, our employee base should reflect that, too. As a leader of color, I am proof. We're making sure our staff mirrors the diverse patient populations coming to Memorial Sloan Kettering. I'm fortunate to have been appointed as a member of the ED&I Council, which helps our leaders understand the issues and behaviors that drive equality, diversity, and inclusion.

We're making a dedicated effort to educate employees on building better relationships. For example, MSK recently passed a policy formally denouncing racism and other uncivil behaviors. We're also using a new module to properly train employees on equality, diversity, and inclusion. This is a game changer. Not realizing what behaviors we've condoned in the past was part of the problem.

We have challenges, sure, but we're on a better path now. We're on a path of awareness. Greater transparency and frank conversations are paramount to fixing the issues together. It's not going to happen overnight, but if you look at the speed of implementation from the institution — at the height of a pandemic, no less — there's a very strong commitment from senior leadership. To me, that is very reassuring."



Review.

MSK Giving

Donors to Memorial Sloan Kettering

Boards of Trustees and Governing Trustees

Leadership

Statistical Profile

Financial Summary

The Society of Memorial Sloan Kettering

A Scrabble message (left) in the Charles Hallac Patient Recreation Center helped keep MSK's healthcare heroes' spirits lifted.



Patient Care and Greatest Needs

Patient care is at the heart of MSK's mission, and the donor community helped our doctors and nurses seamlessly adapt to the pandemic. Unrestricted gifts allow MSK to swiftly address high priorities and embrace opportunities as they arise. In 2020, philanthropy supported:

- Food and financial assistance for patients in need
- Greater access to care through telemedicine
- Recognition and research opportunities for nurses
- PPE and other critical supplies

Research

Philanthropy is essential to early-stage research and clinical trials, which lead to new drugs and better outcomes for people with cancer. In 2020, MSK donors helped make possible:

- FDA approvals of life-changing treatments
- 230 COVID-19-related research papers
- The launch of MSK's Office of Health Equity
- A new framework for understanding metastasis

Education

MSK is committed to growing the next generation of talented and diverse leaders in oncology research and care. This year, philanthropy helped us expand access to our training programs by launching:

- The Diversity Clinical Scientist Fellowships for Academic Careers in Cancer Research
- The Maximizing Excellence in Research, Innovation, and Technology Initiative
- New programs and fellowships for women in science

HOW MSK DONORS Met the Months Month

Facing unprecedented challenges, our community reimagined how to support one another and our institution, such as moving meetings and events online, and we are grateful for the exceptional commitment and generosity of so many. Thank you to everyone who came together to drive progress and bring hope to people with cancer and their families worldwide.

In 2020, MSK received nearly 715,000 donations from 507,000 individuals, families, foundations, and companies who contributed a total of

\$309,547,924

to advance cancer care, research, and education.

Scan here to learn more and to donate.



MORE THAN 5 MORE THAN 65,000 donors increased their giving.

121,866 donors made their first online donation.

90,000
donors made two or more donations.

+0

1,329
Facebook and Instagram fundraisers for MSK.

More than 2,000 donors submitted heartfelt "Words of Encouragement" to MSK's healthcare heroes, which were displayed at Memorial Hospital and online.



people told us that MSK was in their estate plans.

3,000-plus donors, including almost 750 MSK staff and 41 Board members, contributed

\$6.3 million

to the MSK COVID-19 Fund to support our patients and staff.

Annual Report 2020

DONORS TO MSK

GIFTS OF \$100,000 AND ABOVE

\$10,000,000-\$19,999,999

Stanley F. and Fiona Druckenmiller

\$5,000,000-\$9,999,999

Aligning Science Across Parkinson's (with The Michael J. Fox Foundation for Parkinson's Research) Debra and Leon Black Initiative Crimson Lion/Lavine Family Foundation Marie-Josée and Henry Kravis Donald and Catherine Marron Charitable Trust Jamie Nicholls and Fran Biondi The Thompson Family Foundation Estate of Emil J. Vaccari

\$2,500,000-\$4,999,999

The JPB Foundation Stand Up To Cancer The Starr Foundation Trust of Stanford Zeisel

\$1,000,000-\$2,499,999

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Foundations

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\$500,000-\$999,999 The Rita Allen Foundation

Anonymous

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⁺ ex officio

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STATISTICAL PROFILE

MEMORIAL SLOAN KETTERING CANCER CENTER

	2016	2017	2018	2019	2020
PATIENT CARE					
Patient Admissions: Adults	21,708	21,953	22,792	24,175	21,517
Patient Admissions: Children	1,370	1,553	1,451	1,422	1,305
Total Admissions	23,078	23,506	24,243	25,597	22,822
Total Patient Days	160,072	161,661	171,798	173,702	160,922
Average Patient Stay (days)	6.9	6.9	7.1	6.8	7.1
Bed Occupancy Rate (1)	92.5%	94.3%	95.2%	96.2%	85.9%
Outpatient MD Visits: Manhattan	512,142	526,006	541,146	562,224	505,224
Outpatient MD Visits: Regional Network	153,451	196,232	235,400	276,849	276,700
Total Outpatient Visits	665,593	772,238	776,546	839,073	781,924
Screenings (2)	23,497	31,683	38,738	45,263	45,549
Surgical Cases	23,066	25,330	27,919	27,379	23,967
New Radiation Oncology Patients Starting Treatment: Manhattan	4,831	5,283	4.434	5,538	4,173
New Radiation Oncology Patients Starting Treatment: Regional Network	3,399	4,510	5,203	6,616	6,666
Diagnostic and Interventional Radiology Procedures	498,372	543,322	575,383	631,174	591,450
Clinical Investigation Protocols (3)	1,072	1,133	1,139	1,159	1,254

	2016	2017	2018	2019	2020
STAFF					
Sloan Kettering Institute Members	131	133	130	133	137
Hospital Attending Staff	1,091	1,148	1,228	1,358	1,417
Advanced Practice Providers	605	623	702	836	885
Registered Nurses	2,259	3,098	3,398	3,874	3,933
Administrative and Support Staff	11,638	12,325	13,137	14,333	14,774
Total Staff (1)	15,697	17,301	18,569	20,559	21,105
Volunteers	943	1,019	960	770	432
EDUCATION					
Residents and Clinical Fellows: Positions	468	468	476	475	460
Residents and Clinical Fellows: Annual Total	1,734	1,749	1,714	1,690	1,619
Research Fellows	344	346	325	346	277
Research Scholars	92	120	133	171	150
Research Associates	112	115	117	132	153
Graduate Research Assistants	43	37	34	39	28
PhD Candidates	292	278	266	277	282
MD/PhD Candidates	26	24	22	20	21
Registrants in CME Programs	4,724	6,098	7,246	7,921	6,582
Medical Observers	563	511	569	596	31
Medical Students	569	577	524	477	246
Nursing Students	351	355	512	595	507
Social Work Students	8	7	6	7	C
Radiation Oncology Technology Students	12	12	15	19	19
Physical Therapy Students	5	6	8	6	4
Occupational Therapy Students	2	2	2	2	3
Laboratory Medicine Students	20	13	15	12	20

Annual Report 2020

⁽¹⁾ Based on adjusted bed count

⁽²⁾ Data from 2016 represent individual screening visits; 2017-2020 data represent screening procedures. Data from 2019 have been revised.

⁽³⁾ Excludes studies closed to accrual

⁽¹⁾ In 2020, 41 staff members held appointments in both the Institute and the Hospital.

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Annual Report 2020

FINANCIAL SUMMARY

MEMORIAL SLOAN KETTERING CANCER CENTER

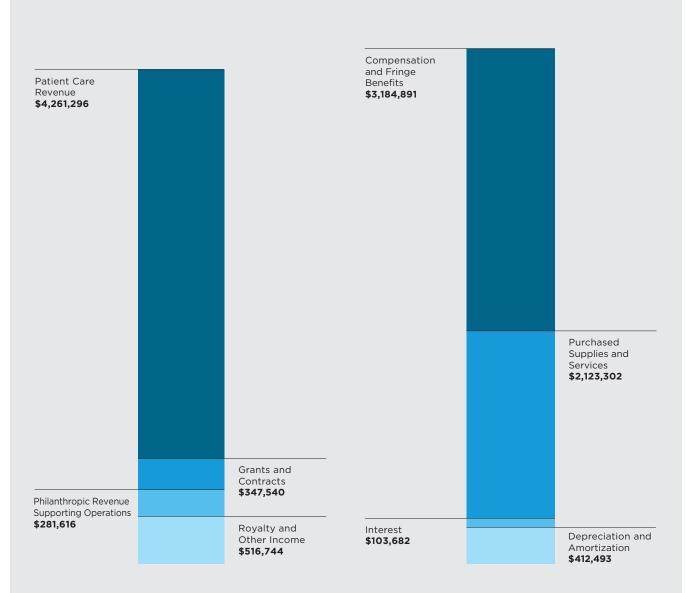
2020 TOTAL OPERATING REVENUES

(Dollars in Thousands)

\$5,407,196

2020 TOTAL OPERATING EXPENSES (Dollars in Thousands)

\$5,824,368



	2016	2017	2018	2019	2020
OPERATING REVENUES (in thousands)					
Patient Care Revenue	\$3,068,587	\$3,536,976	\$3,973,778	\$4,560,174	\$4,261,296
Grants and Contracts	257,893	296,493	334,536	368,743	347,540
Philanthropic Revenue Supporting					
Operations	248,095	278,643	290,927	268,525	281,616
Royalty and Other Income	242,934	159,458	159,140	123,489	357,654
Investment Earnings Supporting					
Operations	136,979	137,750	151,473	162,445	159,090
Total Operating Revenues	\$3,954,488	\$4,409,320	\$4,909,854	\$5,483,376	\$5,407,196
OPERATING EXPENSES					
Compensation and Fringe Benefits	\$2,131,070	\$2,335,132	\$2,587,336	\$2,892,770	\$3,184,891
Purchased Supplies and Services	1,320,893	1,501,935	1,756,174	2,026,254	2,123,302
Depreciation and Amortization	263,964	287,145	300,239	329,774	412,493
Interest	48,724	45,343	47,045	40,099	103,682
Total Operating Expenses	\$3,764,651	\$4,169,555	\$4,690,794	\$5,288,897	\$5,824,368
(LOSS) INCOME FROM OPERATIONS	\$189,837	\$239,765	\$219,060	\$194,479	\$(417,172)
PHILANTHROPIC REVENUE	\$317,270	\$318,386	\$383,341	\$254,401	\$263,572
CAPITAL SPENDING	\$634,134	\$737,965	\$700,827	\$628,148	\$264,706
BALANCE SHEET SUMMARY					
Assets	\$9,891,492	\$10,636,012	\$10,623,567	\$11,621,453	\$13,315,250
Liabilities	4,160,515	4,530,909	4,196,154	4,646,113	5,246,709
Net Assets	5,730,977	6,105,103	6,427,413	6,975,340	8,068,541

Annual Report 2020

Society OF MEMORIAL SLOAN KETTERING

"I am grateful to the members of The Society and our network of supporters who have bolstered our mission during these challenging times. Our legacy of support for MSK endures, bringing hope and real progress to those with cancer."

- Kate Allen, President, The Society of MSK

The Society Campaign: A Philanthropic Tradition

Since 1946, The Society of Memorial Sloan Kettering has provided seed funding to critical research projects — ensuring that MSK patients have access to life-changing cancer care. The Society's generous giving has been essential to MSK's ability to thrive without limits and help people with cancer worldwide.

The 2020-2021 Society Campaign honors that legacy and celebrates The Society's leadership role, serving as a force for progress at MSK. Recent highlights of an enormously successful philanthropic partnership include supporting the work of world-renowned dermatologist Allan Halpern, who was part of an MSK cohort that included medical oncologist Jedd Wolchok, the Lloyd J. Old/Virginia and Daniel K. Ludwig Chair for Clinical Investigation, and Nobel Prize-winning immunologist James Allison. The team developed and tested the first modern immunotherapies (drugs that stimulate or suppress the immune

system to help the body fight disease) to treat patients with late-stage melanoma.

Supporting standard-setting patient care is the cornerstone of The Society's mission. The Society stepped forward to meet an essential human need by supporting the expansion of MSK's Food to Overcome Outcome Disparities (FOOD) Program, led by internist Francesca Gany, a recognized expert in disparities that affect human health. The Society, by thoughtfully supporting FOOD pantry expansion to MSK's regional sites, helped provide a reliable, no-cost resource that patients can turn to for a critical need. People receive groceries tailored to provide optimal nutrition based on their cancer diagnoses.

The Society is also committed to helping MSK address challenges to health equity in cancer. The Society funded the Cancer Health Equity Research Program (CHERP), a landmark initiative led by surgeon and Chief Health Equity Officer Carol Brown, to address healthcare disparities that particularly affect the Black community.

In her research, Dr. Brown has found a clear association between high-volume cancer care at local hospitals and poorer outcomes for underserved people. Through CHERP, MSK now partners with community hospitals to support life-changing clinical trials at their own sites.

Championing Research and Recognizing Achievements

The Society Prize is awarded at the annual MSK Academic Convocation to a researcher, doctor, or team leader who has made a positive and lasting impact in the fight against pediatric cancer. The 2020 recipients of The Society of Memorial Sloan Kettering Prize were immunologist Carl June and MSK's own physician-scientist Michel Sadelain. Dr. June is the Director of the Center for Cellular Immunotherapies and a professor in the Department of Pathology and Laboratory Medicine at the Perelman School of Medicine at the University of Pennsylvania. He is a pioneer in the development of CAR T cell therapy, especially

for pediatric patients with leukemia. Dr. Sadelain is the Stephen and Barbara Friedman Chair and Director of the Center for Cell Engineering at MSK. Dr. Sadelain runs a lab at the Sloan Kettering Institute, which studies the mechanisms governing transgene expression, stem cell engineering, and genetic strategies to enhance immunity against cancer.

The Society Scholars Prize honors postdocs who are performing at the highest level while also managing family obligations and adjusting to being new parents. This merit-based prize is awarded annually to postdoctoral researchers who submit a brief application and personal statement. They are reviewed by a selection panel made up of MSK faculty who are parents, with final approval from The Society's President, in consultation with its Executive Committee. The prize provides a cash award for up to four years and is open to postdocs at MSK who have a dependent child under 4 years old. This year, The Society Scholars Prize was awarded to a total of 20 postdocs. •



By supporting MSK's Food to Overcome Outcome Disparities Program, The Society of MSK helps ensure people with cancer have access to no-cost, nutritious groceries. Pictured: Community Outreach & Health Access supervisor Luke Paolantonio

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Allied Printing Services

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