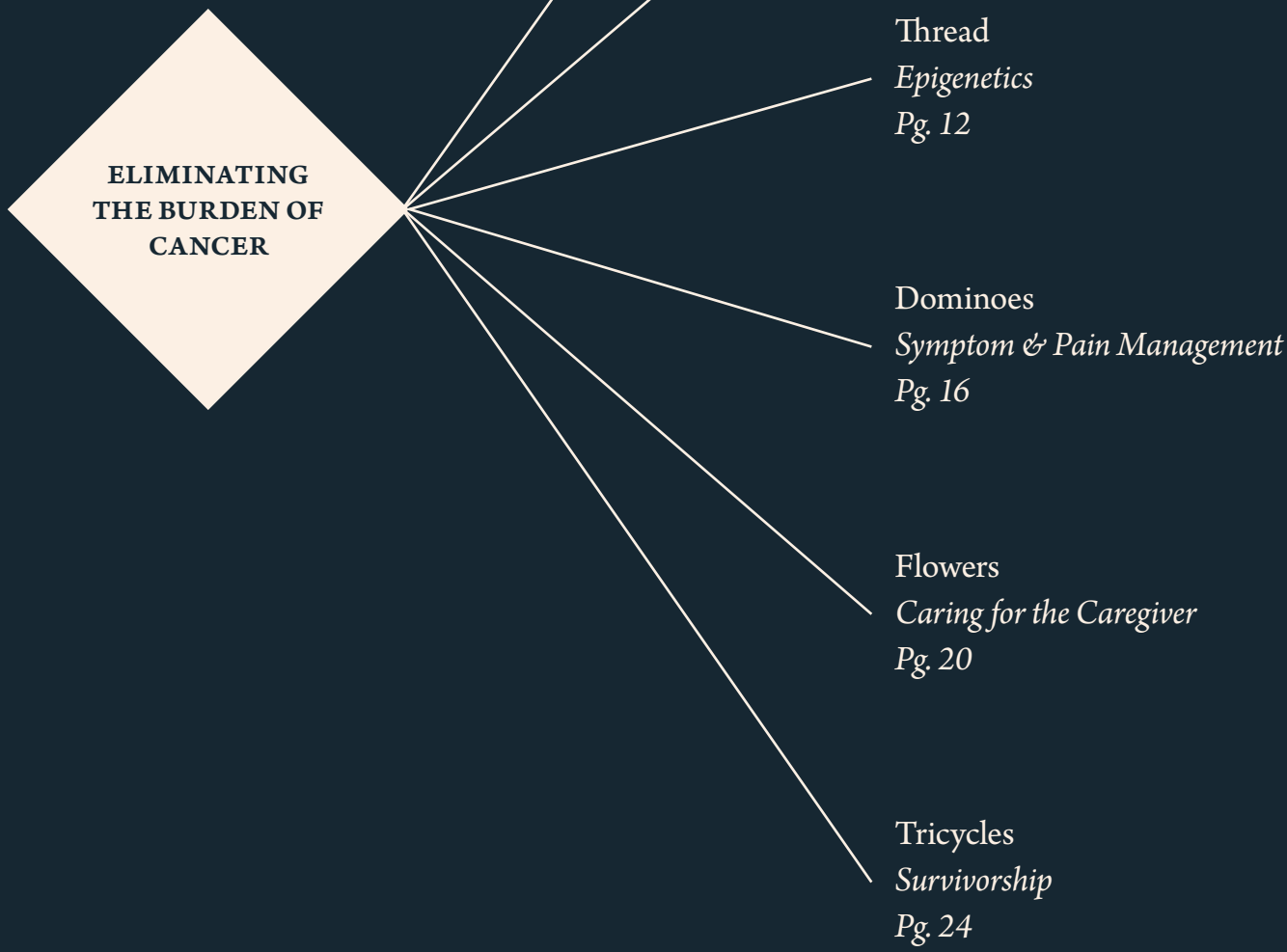
What do

Thumbprints Matchmaking Thread Dominoes Flowers & Tricycles

have in common?

NYU Cancer Institute 2010/2011 Report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…While seemingly different, all six have one thing in common. They all reflect unique discoveries that will help eliminate the burden of cancer.

◇ ***NYU Cancer Institute*** is a clinical incubator that extends beyond the traditional walls of an academic medical center to capitalize on its synergistic relationship with the diverse cultural and socioeconomic landscape of New York City. All of the images in this report reflect the spirit of these connections that are at the heart of our organization. In the following pages, you will see examples of how the NYU Cancer Institute is making steady progress toward eliminating the burden of cancer, and how the notions of thumbprints, matchmaking, thread, dominoes, flowers and tricycles are playing a significant role.

WHAT DIFFERENTIATES US

Matrix

Our structure as the Cancer Institute at NYU Langone Medical Center, with ties to the larger University, enhances collaborations and leverages access to critical new technologies. NYU School of Medicine's Curriculum for the 21st Century (C21) features an innovative new oncology curriculum.

Pursuit

Our team fosters a unique relationship between treating physicians and laboratory scientists, driving the pursuit of methods to neutralize the biological pathways that underlie the origins of human cancer. These efforts are leading to novel ways to prevent and treat this class of diseases.

Focus

Our clinical research focus has encouraged 20% of our patients to participate in therapeutic clinical trials (national average = 4% participation), providing patients with access to the best available therapies while defining better options to improve outcomes.

Access

Our affiliation with the New York City Health and Hospitals Corporation's Bellevue Hospital Center and Woodhull Medical and Mental Health Center affords distinctive opportunities to learn and care for extraordinarily diverse groups of patients with cancer.

Heart

Our thoughtful approach to balancing the needs of our patients, our community and our staff remains at the heart of what we do: we care.

Collaboration

Our culture of collaboration is reinforced throughout the Cancer Institute and translates into a true willingness of our teams to partner and conceive of new methods to prevent and treat cancer.

Diversity

Our location in the heart of New York City offers us access to a one-of-a-kind urban laboratory with a unique global patient population. It helps us to understand variations of cancers within certain populations and allows the Cancer Institute to define and eradicate barriers to care for patients in our community.

Recognition

Our reputation as an NCI-designated Cancer Center, and recognition as one of the top 25 academic medical centers for cancer in the country and one of the top three in New York, according to *U.S. News & World Report*'s "2011–2012 Best Hospitals," reflect our commitment to excellence.

Join us for six stories of discovery


YOUR MOUTH IS HOME TO A THRIVING COMMUNITY OF MICROBIAL LIFE.
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MAPPING THE HUMAN MICROBIOME IS A MAJOR CHALLENGE BUT ALSO AN OPPORTUNITY TO IMPROVE MEDICINE'S APPROACHES
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YOUR MOUTH IS HOME TO A THRIVING
COMMUNITY OF MICROBIAL LIFE
MICROBIOME

THUMBPRINTS

Microbiome

90% of you is a unique community of bacteria.

Trillions of bacteria live in our bodies, outnumbering our own cells by 10:1. These largely unexplored microbes are particularly robust in our mouth, esophagus, stomach and intestines. Now biomedical scientists at the NYU Cancer Institute are discovering that bacteria, collectively known as the microbiome, may play a pivotal role in developing certain cancers and in the development of new treatments and preventive measures. One key objective is to figure out if humans share a core microbiome profile, and if changes in the microbial "population" trigger changes in our health. Eventually, the microbiome profile of each person — as unique to an individual as their thumbprints — could reveal a great deal of information about how we can fight disease and achieve health. Because of this promising new direction, the National Institutes of Health (NIH) established the Human Microbiome Project, which has been awarding research grants for selected projects that examine the microbiome-disease connection. Zhiheng Pei, MD, PhD, associate professor of pathology and medicine, leads one of the select few teams chosen in the United States to conduct demonstration projects on behalf of the Human Microbiome Project.

◇ ***Linking changes in the microbiome to esophageal cancer***

A significant game changer occurred with the development of high-throughput sequencing that led to the discovery of many new types of bacteria never before recognized. Dr. Pei and his colleagues have collected and sequenced bacteria from the esophagus in both healthy elderly males and those suffering from gastroesophageal reflux disease (GERD). They found that the mix of bacteria was, indeed, different in the diseased esophagus. "The progression in Barrett's esophagus is a multi-decade process characterized by genomic instability and accumulation of molecular alterations in cells, but the driving force behind the genetic changes is unknown," says Dr. Pei. What is known is that patients with Barrett's esophagus have a 30-to-60-fold excess risk of developing esophageal adenocarcinoma (EA)

Microorganisms outnumber cells in the human body

Ten

relative to the risk of the general population. Despite the decline in the incidence and mortality rates of cancers in recent years, the rate of EA has increased by more than 600% in just the past three to four decades. In essence, Dr. Pei is investigating the theory that chronic exposure to an abnormal microbiome in the esophagus is carcinogenic. Through the NIH Human Microbiome Project grant, Dr. Pei is using a specialized DNA sequencing technique that he designed to catalogue thousands of bacterial strains in a larger sample of patients.

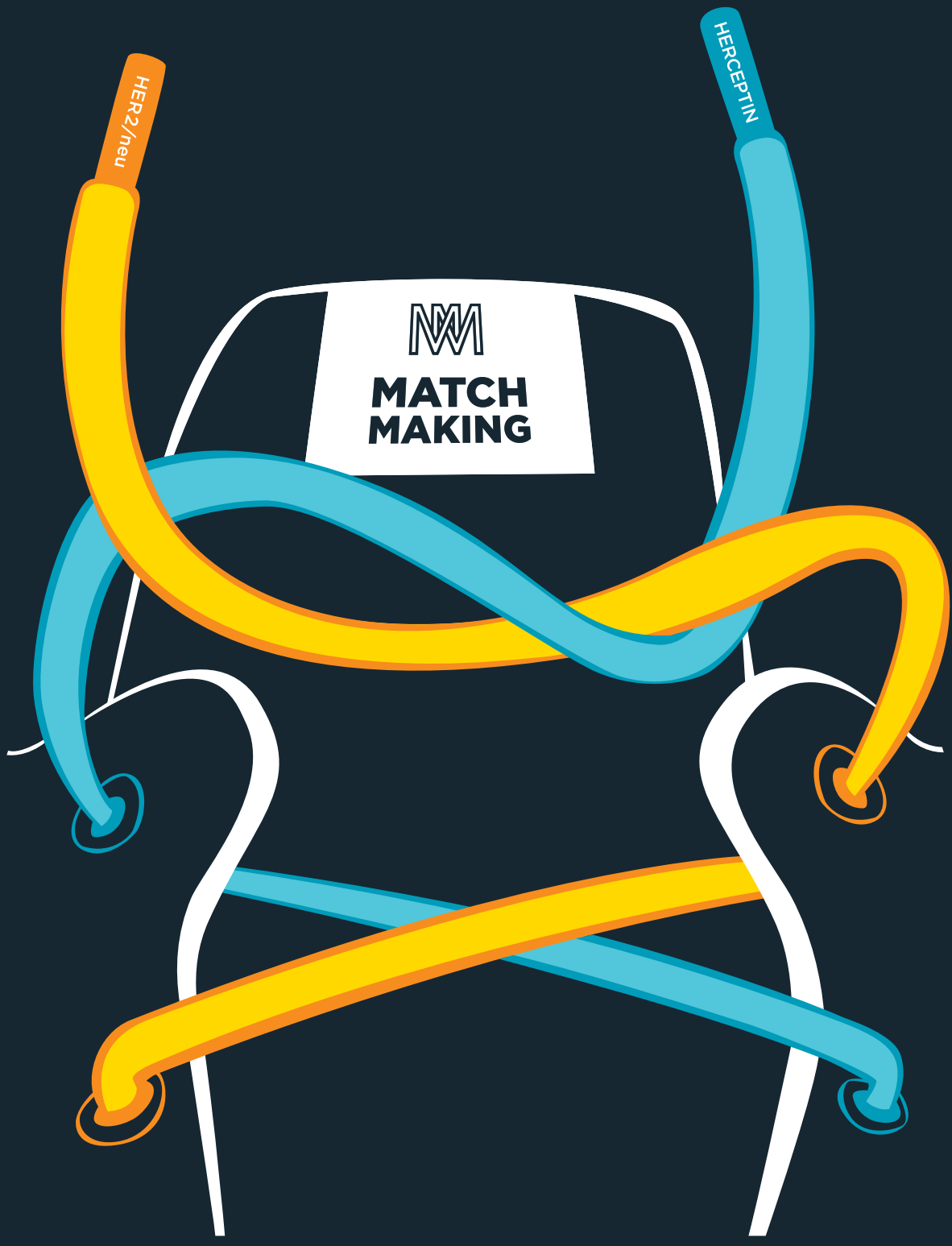
◇ ***Linking the microbiome to other diseases*** Other faculty members have been conducting innovative research as well. Martin J. Blaser, MD, the Frederick H. King Professor of Internal Medicine, and chair, Department of Medicine, and professor of microbiology, has received recognition for his pioneering work, which has deepened our understanding of the connections between *Helicobacter pylori* (*H. pylori*), cancer and other human diseases. Of particular note is his view that *H. pylori* is sometimes helpful (probably early in life) and sometimes harmful (probably late in life). Building on his early success, Dr. Blaser continues to receive support for his creative approaches to research, including a study funded by the Human Microbiome Project to assess whether changes in the skin microbiome may contribute to psoriasis, an inflammatory skin disease.

◇ ***Linking the microbiome to oral cancer*** In another project funded by the National Cancer Institute, Dr. Pei and Richard B. Hayes, DDS, PhD, director of the Division of Epidemiology at NYU School of Medicine and associate director of population sciences at NYU Cancer Institute, are looking into the potential connection between the microbiome and cancers of the mouth and upper gastrointestinal and respiratory tracts. They are examining oral samples that were collected before some of the

One.

patients developed cancer. In comparing the pre-cancer bacterial profiles with the post-cancer profiles, they are seeking to identify a possible association between the changes in the microbiome and the development of disease. "We're trying to find cause and effect. Why do some smokers get cancer and others do not?" asked Dr. Hayes. "It may be because some people may have enough of the bacteria in their microbiome population that activate the carcinogens that lead to disease." With this potential new paradigm, the thinking is shifting dramatically. "Historically it was thought that a single pathogen caused a single disease. But if changes in the microbiome community are responsible, new avenues of discovery and new treatments are possible," says Dr. Pei.

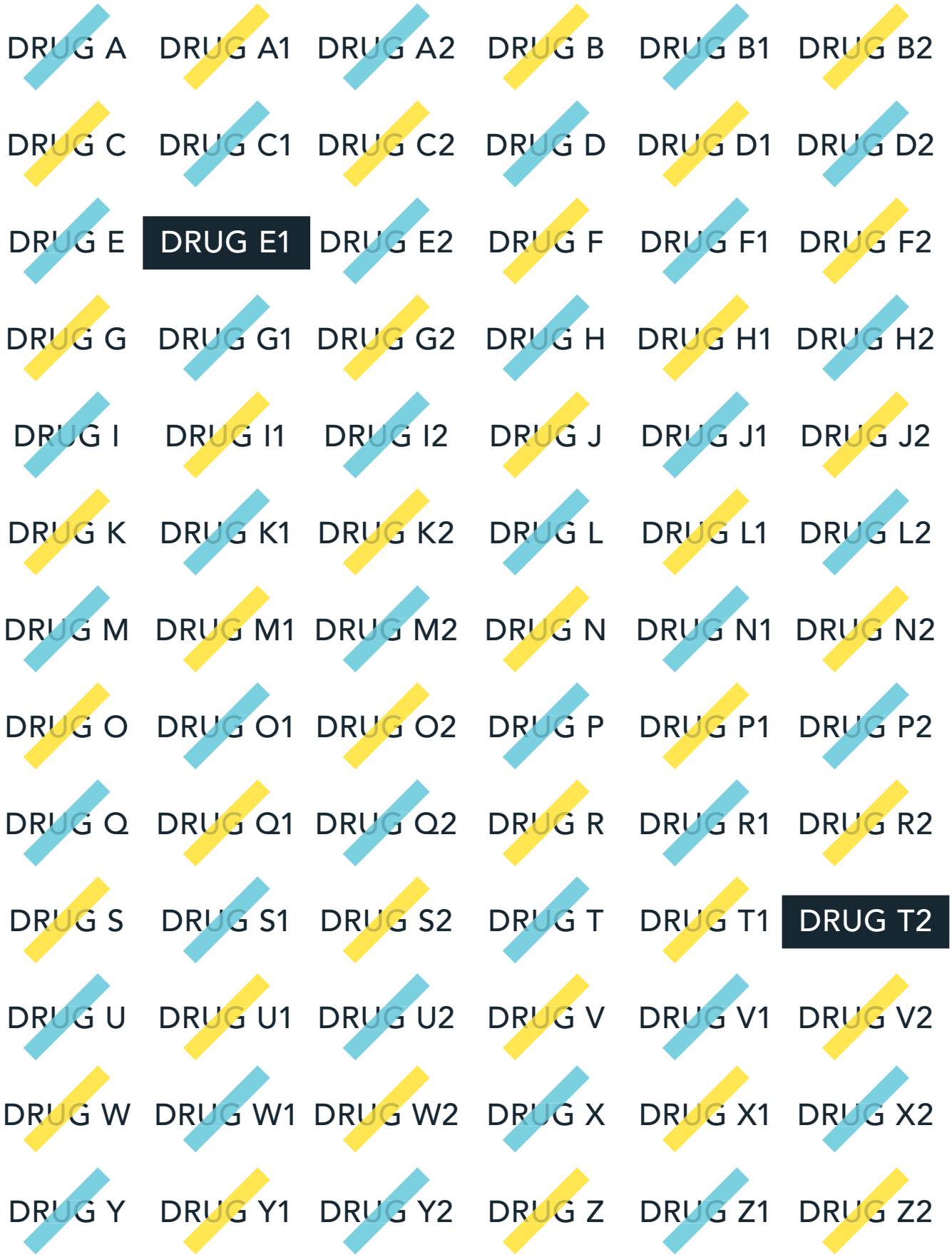
◇ ***New treatment options*** The study of the microbiome in the esophagus could yield patient outcome-associated biomarkers to assess risk, which could guide testing frequency. And if it's shown that changes in the microbiome trigger certain cancers, doctors could add probiotic, or beneficial bacteria, to the microbiome population, which could help restore a healthy microbial balance and weaken the effects of the destructive bacteria. Treatments may also include a combination of antibiotics, probiotic bacteria, or prebiotics, foods such as dietary fiber that stimulate the growth of beneficial bacteria in the intestine. In the case of oral cancers, adds Dr. Hayes, "We may find that a powerful mouthwash may ultimately be able to wipe out bad bacteria and restore a proper balance that will help patients avoid disease."


HER2/neu
HERCEPTIN
MATCH
MAKING

MATCHMAKING
Chemical Biology

Finding the perfect chemistry for science and life.

It takes on average 10 to 15 years or more, and lots of failures and missteps, to bring a single drug to market, as many cancer patients and their physicians wait anxiously for effective or better treatments. Just sifting through the myriad of data to establish a clear starting point in the drug development process for cancers with complex, multigenic etiologies is a major challenge. But now a new high-speed, searchable chemical biology network, in development at the NYU Cancer Institute, could streamline this process significantly by quickly finding matches between complex genetic or protein-based molecular signatures of cancers and the millions of bioactive, small-molecule drug compounds. This chemical network project, headed by Timothy J. Cardozo, MD, PhD, assistant professor of pharmacology, is the first of its kind, seeking to link molecular signatures of disease to molecular treatments, and vice versa. According to Dr. Cardozo, "Drugs largely have to bind to proteins expressed by genes in order to work. It sounds simple, but finding matches has until now been incredibly complex, costly and time-consuming." The system will be a web-based interface, modeled on public search engines like Yahoo! and Google. "Personalized medicine investigators will have a tool that links target molecular signatures, in the form of lists of genes or proteins, emerging from small, well-characterized studies of patient groups to an extensive library of drug compounds," explains Dr. Cardozo. The system not only makes a match, but also provides scores against all other protein signatures. Medicinal and chemical biologists and toxicologists will also be able to directly associate chemical structures with protein signatures to assess the viability and toxicity of potential drugs well before human trials begin. This knowledge avoids the time in development and in trials when promising drug candidates are found to cause debilitating side effects. "All the technologies are available and in place to immediately deploy this work," Dr. Cardozo says. "We're building an easily usable, public website that will not require a steep learning curve for busy biomedical researchers. This is designed as a self-service tool for the community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On the left:

A new high-speed searchable chemical biology network, modeled after search engines like Yahoo! and Google, will help scientists match specific medicines to specific patients as never before.

of scientists." The system, which is expected to be up and running by the end of 2012, will take advantage of computational and systems biology and a growing library of data generated by the National Institutes of Health (NIH) Molecular Libraries Program. The first part of the database includes all potential drug binding sites, or 'pockets' in the human proteome, using computational modeling and structural analysis techniques. The second step uses computational molecular docking to cross-reference these drug-binding pockets with the NIH's PubChem database, the comprehensive repository of more than 30 million small-molecule compounds built and managed by the National Center for Biotechnology Information.

◇ ***Streamlining the drug development process*** "The need for this kind of searchable system is critical," Dr. Cardozo says, noting that the FDA recently launched a "Critical Path" initiative to improve the speed and efficiency of the drug development process in order to bring effective new treatments to patients more quickly and at lower costs. This will be especially meaningful for patients with "orphan" or rare diseases, who may not have as many treatment options, and are often prescribed drugs that may not represent their specific treatment needs. To realize the benefits of personalized medicine, the key is to identify the genetic profiles of patients — frequently highly complex genetic data now available because of breakthroughs resulting from the Human Genome Project — that correlate with optimal therapeutic responses. "Essentially, the chemical biology network would process one of these profiles, and a list of biologically matched drug-like chemical compounds would instantly be retrieved," says Dr. Cardozo. "Lead drug compounds in early-stage development — quickly targeted to specific disease-related proteins — could emerge from this process, resulting in fewer failures as well as shorter times to validation in clinical trials on more specific patient populations, with more clearly recognizable end points," explains Dr. Cardozo.

◇ ***Realizing the promise of personalized medicine*** Such a tool should also have a profound impact on drug approval. Already we know that the clinical trials of drugs matched to a single gene or protein biomarker, such as the HER2/neu biomarker matched to Herceptin®, proceed more rapidly, and succeed more often, at a greatly reduced cost. As researchers identify more sophisticated genomic markers, the needs of smaller groups of patients with specific mutations found in common cancers can be addressed more quickly in small, targeted clinical trials. "This would include patients with metastatic melanoma, for example, who until recently have had limited treatment options," says Dr. Cardozo. "Personalized medicine investigators who identify a subpopulation up front could utilize the knowledge directly for drug discovery and by extension for designing an appropriate personalized or targeted clinical trial. The potential result could be more and faster approvals for drugs at lower cost and risk," he says.


thread

THREAD
Epigenetics

Your life is written on a thread, which can be unraveled and read.

Ten or 15 years ago, most biomedical scientists didn't know about epigenetics: the study of changes in gene expression caused by the surrounding network of proteins that is associated with the DNA helix, rather than modifications in the DNA sequence itself. But all that is changing dramatically as the NYU Cancer Institute builds a body of knowledge that is leading to innovative treatments for cancer. Until recently, scientists have appreciated that genes and environmental factors worked in parallel to influence a person's biological makeup, including a predisposition to certain diseases. Now scientists are recognizing the interplay between environment and inheritance in much greater detail. Not only are genes influenced by the environment, they actually receive instructions on where and when to act. And thanks to high-throughput technologies we have begun to read these instructions, which activate or deactivate genes in response to changing conditions. The instructions are not encoded in the DNA sequence (genome), but in other molecular structures associated with the chromosomes (epigenome). The National Institutes of Health, which considers epigenetics "a new frontier of science," has been investing $190 million to accelerate research, because it's now widely accepted that the origins of health and susceptibility to disease are, in part, the result of epigenetic regulation of the genetic blueprint. Cancer scientists, in particular, are on the front lines of this new frontier, learning to manipulate epigenetic marks that turn off some genes (tumor suppressors, or the brakes for cancer) and jump-start others (oncogenes, or the accelerators of cancer). Several leading researchers at the NYU Cancer Institute are helping to define this important field of study, focusing on how epigenetic code is regulated by environmental factors that trigger certain cancers, as well as the development of innovative agents that alter epigenetic regulation, which could lead to less toxic cancer treatments than those currently available.

◇ ***Understanding epigenetic mechanisms*** Danny Reinberg, PhD, professor of biochemistry and a Howard Hughes Medical Institute investigator, has been studying epigenetic mechanisms, that is, the regulation of gene expression

through alterations in chromatin, and how the chromatin structure can be inherited from cell to cell. Chromatin is composed of DNA molecules, which are wound like thread around a spool on protein complexes containing histones. This winding process is necessary to fit the DNA into the nucleus of the cell, Dr. Reinberg explains. When chromatin is unwound and opened, cells can use the genetic information in the DNA; when chromatin is compacted and closed, the information is virtually inaccessible, although it is still replicated and transmitted to the next generation, when cells divide. "We have spent a great deal of time learning how the state of these spools is determined," says Dr. Reinberg. "A signal for one set of proteins makes the spools wrap DNA tight and keep it inaccessible. Another set of proteins spools with the opposite effect — making them loosen their hold on the DNA," he explains. Now, Dr. Reinberg says, "we have identified the set of enzymes and chromatin-binding proteins responsible for regulating the chromatin structure." These enzymes and binding proteins form the cell's toolkit for epigenetic regulation — opening and closing chromatin or modifying the chromatin structure to help control when and where genes are expressed. "Our research has shown that when epigenetic regulatory events occur aberrantly, the proteins that regulate these events can become drivers of disease. Inhibiting these targets with novel agents promises to be a powerful avenue to develop important treatments serving unmet medical need," he says.

◇ ***Environmental factors*** Max Costa, PhD, a professor and chair of the Department of Environmental Medicine, and director of the Nelson Institute of Environmental Medicine, is looking into the environmental causes of diseases by investigating which pollutants, genes, epigenetic programs, and cell signaling pathways influence the processes of disease

development. Diet and exposure to environmental chemicals, among other factors, throughout all stages of human development, can cause epigenetic changes that may turn on or turn off certain genes. His work is building on the mounting evidence that a growing list of environmental carcinogens, such as nickel, induces changes in epigenetic programs. Nickel is a component of air pollution caused by the burning of oil. The greater the pollution, the greater the exposure to nickel particulates, and the higher the incidence of lung cancer.

On the left:

Gene-expression profiling and the spectrum of genes turn on or off under different disease-specific contexts. The genetic signaling in the cell flows through primary, secondary and tertiary signaling hubs, with varying degrees of importance in cancer development.

One study focuses on the collected lymphocytes from nickel refinery workers and individuals in China who have had a very high ambient exposure to nickel. "We're finding that the workers exposed to nickel have dramatic changes in their epigenetic profiles," says Dr. Costa, "which is helping us understand changes in gene expression following occupational or environmental exposure to nickel." Dr. Costa believes that nickel inactivates a tumor suppressor gene, which normally stops rampant cell growth and can lead to lung and nasal cancers. "Understanding the nature of metal-induced epigenetic effects will shed light on changes during carcinogenesis, leading not only to early detection but also to prevention strategies and biomarker development," says Dr. Costa. "Ninety-five percent of lung cancer is fatal because it's not caught early enough. If we have the tools to catch it early, we can save lives."

◇ ***Agents of change*** Doctors at the NYU Cancer Institute are in the process of developing novel epigenetic treatments for various hematologic malignancies, including lymphomas that occur in adults and leukemias in children. Investigators have determined that aberrant histone acetylation and DNA methylation are frequently observed in human cancer, contributing to tumor progression and correlating with drug resistance. Work in the laboratory of William L. Carroll, MD, the Julie and Edward J. Minskoff Professor of Pediatrics, professor of pathology and director of the NYU Cancer Institute, has shown that treating relapsed leukemia cells with histone deacetylase and DNA methyltransferase inhibitors can reprogram a refractory genetic signature and restore sensitivity to conventional chemotherapy. He and his colleagues have just initiated a nationwide study to treat children with relapsed acute lymphoblastic leukemia. These new drugs may be combined with traditional chemotherapy to create a more powerful and effective treatment, Dr. Carroll says — a synergistic approach to available treatments that can be applied to other cancers.


CHRONIC PAIN
FATIGUE
SLEEPLESSNESS
DEPRESSION
ANXIETY
WEIGHT LOSS

DOMINOES

Symptom & Pain Management

One symptom leads to another. Finding ways to ease the burden.

Brian L. Schmidt, DDS, MD, PhD, professor of oral and maxillofacial surgery and director of the Bluestone Center for Clinical Research at NYU's College of Dentistry, is all too familiar with the intensity of cancer pain. So are the nurses, social workers, nutritionists, psychologists and psychiatrists at the NYU Cancer Institute's multiple treatment centers. While these healthcare providers can tell countless stories of healing and relief, they also know about the pain that prevents patients from engaging in everyday activities. Unaddressed, this kind of pain, whether caused by disease or treatment, can disconnect people from who they are and lead to other problems, like sleep deprivation, anxiety and depression. "Like one domino knocking over another, one symptom can trigger others, sometimes in clusters, making them even more difficult to treat," says Frances Cartwright, PhD, RN, AOCN, senior director of nursing for oncology services and medicine. The opportunity lies in targeting interventions so that alleviating one symptom in a cluster will relieve multiple related symptoms at the same time. While many people mistakenly equate palliative care with hospice, today we know that the term palliative care refers to management of symptoms regardless of disease stage.

◇ ***Easing the burden*** "Cancer for many patients represents a loss of control, which is why we do everything we can to help, including listening and allowing them to share their burden. It also helps patients feel less alone in the process," explains Karen G. Langer, PhD, clinical associate professor of rehabilitation medicine, and manager, Supportive Services Program at the Cancer Institute's Clinical Cancer Center. "It's a full-time commitment," agrees Laura J. Tagliareni, PhD, staff psychologist at NYU Langone's Stephen D. Hassenfeld Children's Center for Cancer and Blood Disorders. "Our staff does whatever it takes to help ease the burden." For psychologists and social workers, this dedication isn't only about sensitive patient advocacy, it also includes support by providing individual or group counseling to deal with pain, depression, anger and anxiety at various stages of their treatment.

In addition to alleviating the burden of pain, our comprehensive programs for symptom management are designed to also support nationwide efforts to reduce morbidity, hospital stays, repeated admissions and insurance costs.

◇ ***Finding new treatments*** As these professionals focus daily on easing pain and suffering, "pain management medications haven't kept up with advances in cancer treatment," says Dr. Schmidt. "Today, doctors still rely on high doses of narcotics and nonsteroidal anti-inflammatory drugs. These analgesics yield limited relief and may have significant side effects." Dr. Schmidt believes that oral cancer is a logical place to start the search for new treatments. "Oral cancer is very painful, but the pain is at an accessible, primary site, so sampling the cancer microenvironment is relatively easy." During surgery to remove the oral cancer, Dr. Schmidt will place a probe into the tissue to test it for proteins and peptides that produce pain. He is also asking oral cancer patients to report on their pain levels in a study funded by the National Institutes of Health (NIH) through the Bluestone Center.

Dr. Schmidt later validates patient responses by identifying which of the sampled cancer molecules correlate with the patients' reported pain. "With a better understanding of cancer pain mechanisms coming out of the study, we hope to spur the development of new medications that can block those mechanisms," says Dr. Schmidt. He and others believe that with newer, targeted medications to reduce or eliminate cancer pain, other symptoms in the cluster, such as sleeplessness and depression, may also subside, helping to improve the patient's quality of life.

◇ ***Working collaboratively*** Meanwhile, a few blocks away, multidisciplinary teams within the Cancer Institute are reinforcing the importance of raising pain awareness among staff and forging new relationships to improve pain and symptom management. In fact, Dr. Cartwright and her NYU College of Nursing colleague, Marilyn Hammer, PhD, DC, RN, are collaborating with Dr. Schmidt on building a symptom management program and finding better ways to manage symptoms through the Cancer Institute's evolving care model. Buoyed by these close relationships, the NYU College of Dentistry is now sharing a $1.25 million NIH grant for cancer pain research with the Boston Biomedical Research Institute. "NYU has always worked on many fronts — bringing clinical, educational and research disciplines together — to develop the most coordinated approach to pain and symptom management. That's why I'm here. NYU's collaborative environment is inspiring," says Dr. Schmidt.

◇ ***Treating symptoms proactively*** With this collaborative environment, the Cancer Institute is achieving promising results — thanks to the dedication of its interdisciplinary teams, which not only include clinical staff but also massage therapists, acupuncturists and yoga instructors. "Patients at the Clinical Cancer Center are reporting benefits from our integrative approach," reports James P. Fraiman, MD, clinical assistant professor of psychiatry and director of psychosocial services at the center. "Patients who receive massage therapy while receiving chemotherapy have described reductions in pain, nausea and anxiety. Cancer survivors also say that attending yoga classes has improved their sense of well-being," he adds. Joan S. Scagliola, MSN, RN, director of outpatient oncology operations, is "committed to continuing to expand the integrative health services available to patients" and build upon the services already available throughout the Medical Center. At the Stephen D. Hassenfeld Children's Center, patient support and symptom management may involve child life specialists, dietitians, recreation and music therapists, and a full-time teacher to help young patients keep up with school. The Center even boasts a "fairy" with purple wings — in reality a yoga and meditation teacher who guides young patients and their families in the Family Wellness Room. These programs are funded by generous support from the Making Headway Foundation, the Hassenfeld Committee, and the Chillin' with Adam: The Adam Gaynes Foundation Inc. "As a translational cancer institute we do all we can to understand the physical, psychological, social and spiritual aspects of care and how we can use this information to target symptom distress," says Dr. Cartwright. "This is integral to our mission of providing personalized care."


GET
WELL
SOON

FLOWERS

Caring for the Caregiver

Taking care of you, so that you can take care of your loved ones.

Survival rates for many cancers have improved, but survivors often still need varying degrees of care, even following successful treatments. That means the helpful family member or friend becomes a primary caregiver, a critical supportive role during and after therapy is completed. With this key responsibility, caregivers can have a profound impact on the survivor's quality of life, helping the survivor avoid complications and even reduce the length of hospital stays. "But caregivers can be thrust into the role unexpectedly, taking on responsibilities for which they may not feel prepared," says Victoria H. Raveis, PhD, a research professor in the Department of Cariology and Comprehensive Care, and director of NYU College of Dentistry's newly established Psychosocial Research Unit on Health, Aging and the Community. "They may experience a range of emotions, including anxiety, anger and sadness, even as they try to care for their loved one," she says.

◇ ***Tailoring programs and services*** Ultimately, Dr. Raveis says caregiving can cause caregivers a great deal of stress, often resulting in sleep disorders, poor eating and the neglect of their own health and personal problems. Understanding the impact of cancer on the family is still evolving, says Dr. Raveis. "Limited research has been focused on family caregiving during cancer survivorship, and little attention has been directed toward tailoring programs and services that address posttreatment informal care, particularly for those growing populations experiencing the greatest cancer burden—minorities and the elderly," she explains. Recognizing these challenges, the NYU Cancer Institute continually looks for ways to support caregivers. Dr. Raveis is currently involved in two major research projects focusing on the issue. One initiative, called "Enhancing Family Caregivers' Strengths and Skills in Managing Older Cancer Patients' Symptoms," deals with supporting family caregivers who are addressing the needs of older cancer survivors. Dr. Raveis and her team are not only investigating the practical issues of adapting to the cancer diagnosis and survivorship, they are also developing evidence-based, family-centered, psychoeducational and health interventions, targeting diverse and medically underserved

On the right:

Caregivers may experience a range of emotions, including love, anger and hope, even as they try to care for their loved one.

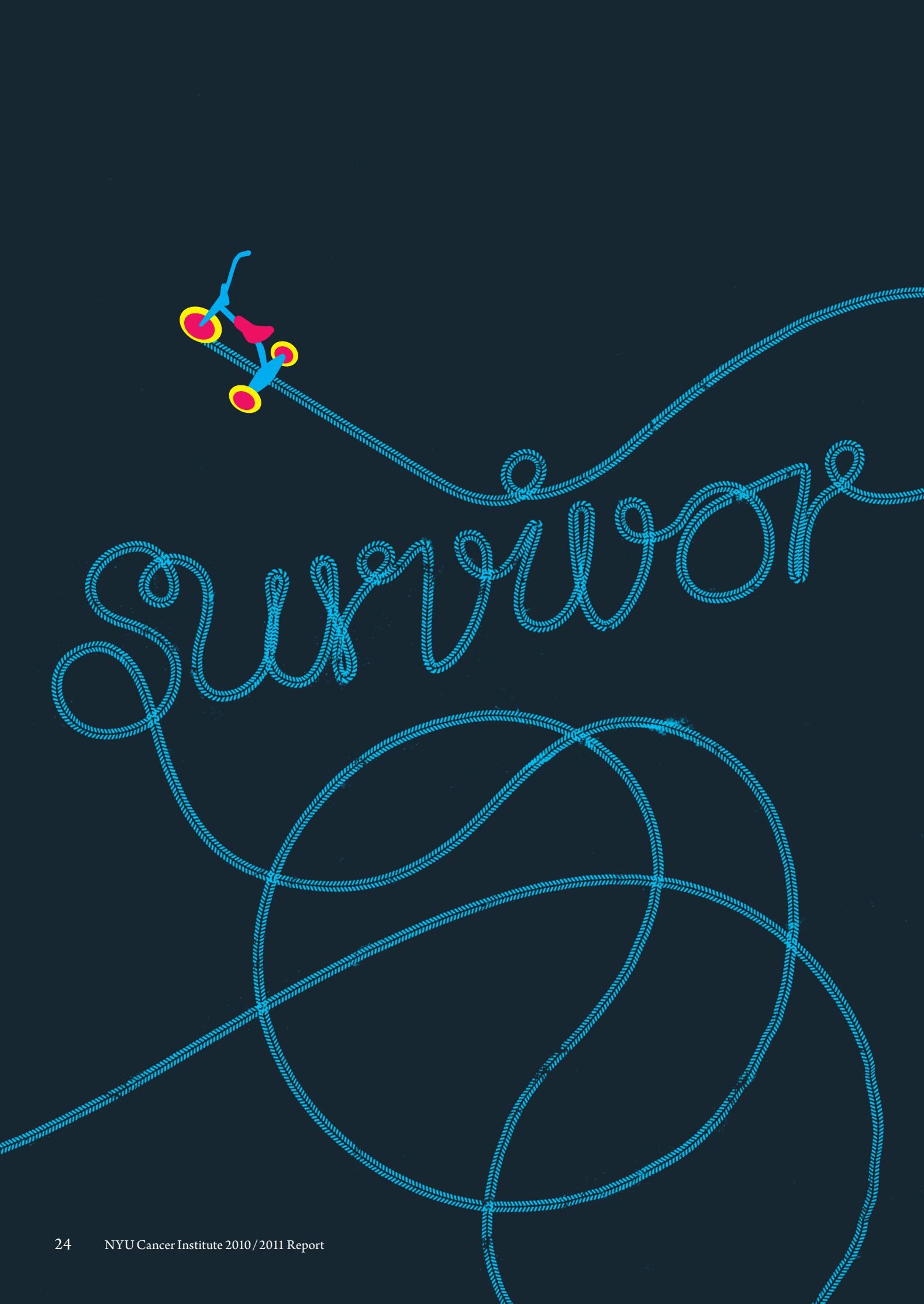
communities. "Through NYU Langone's outpatient programs, affiliates and community-based partners, there is easy access to diverse groups who intensely experience the burden of cancer. NYU also offers an interdisciplinary research and care team model for clinical and community-based survivorship studies," says Dr. Raveis.

◇ ***Providing skills and health literacy*** The first phase of the program focused on identifying and helping 220 low-income families, located throughout New York City, who seek care in community health centers. Final follow-up assessments with participants are being completed. In the second phase, with support from the National Institutes of Health's National Cancer Institute (NCI), Dr. Raveis and her team are working with caregivers recruited from naturally occurring retirement communities (NORCs) — communities and neighborhoods around New York where large numbers of people have stayed into their senior years. Both phases of the program are designed to provide problem-solving skills and improved health literacy for caregivers who are trying to manage symptoms and care needs. The sessions are designed to strengthen skills in the environment by helping caregivers understand and use expert health information, how to access available supportive resources and plan needs more effectively. "Once the patient is home and contact with medical providers is limited, the problem-solving and communication skills of family members are tested," says Dr. Raveis. "By delivering educational and supportive interventions through existing community centers, we hope to help caregivers improve the quality of life and quality of care for survivors and themselves. Following these interventions, we will analyze results, and if successful, will use the program as a model for others." The study is expected to be completed in 2012.

◇ ***Working through cultural differences and family dynamics*** Beyond the basics, other factors can exacerbate the caregiver's difficulties. "In some cultures, for example, patients are expected to endure chronic pain," says Dr. Raveis. "But if we can address cultural differences and symptom management sensitively, quality of life may improve significantly." Helping caregivers work through the dynamics of family relationships in a posttreatment environment can also help improve care and reduce stress. When adult children take care of elderly parents, for example, issues about personal control and dependency, role reversal and fears of mortality can arise. "The emotional trauma of cancer in a family heightens existing tensions, impacting every aspect of family relationships and causing everyone to feel especially vulnerable," says Dr. Raveis. Since the program addresses all of these issues, initial survey results indicate that caregivers are very satisfied with the program.

◇ ***Changing the role of senior centers*** Another groundbreaking program Dr. Raveis is leading, "An Academic and Community Partnership to Transform Senior Centers to Wellness Centers," explores the idea of making senior centers more relevant to the influx of aging baby boomers, who are racing toward their senior years. The goal is to promote healthy aging and to reposition senior centers as centers of wellness. The program is a collaboration between the Council of Senior Centers and Services of New York City, Inc. "Working in conjunction with Mayor Bloomberg's 'Age-Friendly NYC: Enhancing Our City's Livability for Older New Yorkers,' we are trying to position the city's senior centers to become centers of wellness, incorporating state-of-the-science public health and medical research on healthy aging and wellness in their programming," says Dr. Raveis. "By understanding the needs and identifying barriers in these populations, we hope to develop appropriate community-based interventions that sustain health and enhance quality of life."


Love
Anger
Stress
Hope
Depression


survivor

TRICYCLES
Survivorship

When the patient becomes the doctor.

Laura Hogan, MD, was only three years old in 1981 when she was diagnosed with acute lymphocytic leukemia (ALL). Today, more than 30 years later, she's a pediatric oncologist treating children with the disease she had — and she's a research scientist spending countless hours studying its effects on survivors and looking for new treatments. "I was too young to understand just how sick I was when I was diagnosed," she says, "but I remember missing school, going to the hospital on holidays, and dealing with the nausea, fevers and hair loss that came with the treatment. I also clearly remember feeling different, because other children weren't going through this."

◇ ***Improving success rates*** Success rates at the time weren't so good, either. Before the 1970s, fewer than 15% of children survived ALL. With the successful introduction of chemotherapy drugs, however, survival rates began to climb, especially as physicians learned to use multiple chemotherapy drugs in effective new combinations. Better supportive care helped too. Despite all the challenges, Dr. Hogan was able to regain her childhood. She did well in school and got involved in sports. And, she says, it didn't take long for her to decide to become a pediatric oncologist, to help other children like her. "I had great relationships with the doctors and nurses who were treating me, who cared for me. I think that really influenced my decision, and I never really changed my mind as I grew up," Dr. Hogan explains. "I enjoy my work, it's tremendously rewarding," she adds, "but it's always difficult to see kids who are sick and to speak with their parents, who are so scared. It helps when I tell them I've been through the same thing. It gives them some hope. And now, as the mother of two young children, I can relate to the experience in a totally new way." But Dr. Hogan doesn't just care for children who face the same type of leukemia she once had. As a St. Baldrick's Fellow, she's also part of the team in the laboratory of William L. Carroll, MD, studying the causes of ALL relapse and the mechanism that makes relapse different from the original disease. Dr. Carroll, the

Julie and Edward J. Minskoff Professor of Pediatrics, professor of pathology and director of the NYU Cancer Institute, is one of the leading authorities on ALL and the founding chair of the Children's Oncology Group (COG) Committee on ALL. COG, sponsored by the National Cancer Institute (NCI), is the world's largest children's cancer research collaborative. While childhood leukemia today has an overall survival rate of 80%, chemotherapy is simply not as effective the second time around in the 20% of patients who have relapses. "Dr. Carroll's lab has found that certain genes appear to trigger the relapse, making them potential targets for new therapies, which is very promising," Dr. Hogan says.

◇ ***Helping survivors face risks*** If that's not enough, she also works on assessing the long-term effects of cancer treatment to help patients achieve long-term health. In 2008, in fact, she helped create a long-term follow-up clinic at NYU Langone's Stephen D. Hassenfeld Children's Center for Cancer and Blood Disorders, aimed at helping survivors of childhood cancer, and their families, understand and prepare for the additional health risks they face, which may include secondary cancers, osteoporosis and other diseases due to the lingering effects of chemotherapy or radiation. Concerns for children recently treated also include such effects on the brain and behavior as cognitive delays, attention and learning disorders, anxiety and poor school performance. No one told Dr. Hogan about residual effects when she was treated because, in the early 1980s, you were lucky just to survive, she says. And many of the long-term risks of childhood cancer treatment weren't known. A study funded by the NCI, the Childhood Cancer Survivor Study, determined that most adults who experienced childhood cancer do not receive recommended long-term monitoring.

◇ ***Receiving long-term monitoring*** Many simply are unaware that they should, and primary care physicians are often not familiar with the special needs of these patients. "Since the kids who develop ALL are so young, with so many years ahead of them, it's important for survivors to see doctors who understand the phenomenon and know what the risks are, so they can be screened and treated properly," says Dr. Hogan, who now divides her time between her continued research collaboration with NYU Cancer Institute and SUNY Stonybrook Cancer Center. At Hassenfeld, patients are eligible for the long-term follow-up clinic two years after cancer treatment ends, when they receive a comprehensive historical and physical analysis, as well as nutritional, psychological and physical fitness counseling, even into adulthood. "With appropriate, ongoing monitoring and our centralized approach, childhood cancer survivors can do extremely well," says Dr. Hogan, just as she has. Thirty years after her remission, Dr. Hogan admits to having a unique perspective that informs her work. And sometimes a patient will even say, "Look at Dr. Hogan. I'm going to grow up and be like her."

SURVIVAL RATE OF CHILDREN WITH ACUTE LYMPHOCYTIC LEUKEMIA BEFORE 1970 VERSUS 2010

Less than 15% survive more than five years before 1970

survive five years or more in 2010

A MESSAGE FROM THE DIRECTOR

William L. Carroll, MD

In the study and treatment of cancer, the key elements are human compassion and scientific rigor—the compassion to heal sick people, to help our patients and their families overcome a difficult disease, and the determination and discipline to develop powerful new tools to do the job. Both are at the core of who we are at the NYU Cancer Institute.

Every member of this organization takes on a personal mission to eliminate the burden of cancer in whatever way they can, and I'm proud of the remarkable dedication and care they bring to the challenge, especially today, as we realize significant progress in our understanding of cancer based on years of hard scientific inquiry.

With these inspiring professionals as our foundation, we've created a cancer institute that is making great strides in translating what's being learned in the lab to deliver the most effective cancer treatments available. To accelerate our progress even further, we continue to look for ways to optimize our multidisciplinary programs. In 2010, we completed a reorganization that establishes five primary areas of investigation, which are instrumental in translating discovery into clinical practice. These areas include:

— Cancer Targets and Novel Therapeutics — taking promising medicines from laboratory concepts through Phase I development and eventual approval for clinical use.

— Community and Environment — reaching out to the diverse communities of New York to make sure we understand the people we serve and the impact of their environment on health in order to implement cancer prevention strategies.

— Integrative Health — combining traditional medicine, behavioral science and new integrative therapies, such as massage, acupuncture and natural therapy, to ease the burden of disease on patients and caregivers.

— Molecular Oncology/Cancer Genomics — analyzing, in unprecedented ways, the features of the host and tumor, to create a unique "fingerprint" of every tumor and patient, in order to target the most promising treatment options.

— Immune- and Stem-Cell-Based Therapies — harnessing the immune system with therapeutics that strengthen the body's resistance to disease, including new vaccines and cell-directed therapies that direct a patient's own cells to attack tumors.

◇ ***Turning off the cancer switch*** With the extraordinary advances in biomedical science, we know that cancer is a much more personal disease than we once thought — in many ways like a breathing organism with a genetic code all its own. Breast cancer, for example, is probably dozens, if not hundreds, of different diseases, with thousands of mutations. While these numbers sound disheartening, our growing knowledge about the complexity of disease energizes us, because we're now able to profile each tumor and understand the mechanisms that create it, which is helping us find ways to turn off the cancer "switch." In fact, I believe that after achieving some progress over the decades, biomedical science is in the process of taking a big step forward. And the Cancer Institute, in particular, is playing a key role.

After years of investigation, the pieces are coming together. Unleashing the potential of the epigenome is a great example, as you see in the pages of this report. Our progress in breaking the epigenetic code, which activates or deactivates genes in ways we never understood before, is nothing short of extraordinary. With this knowledge we are establishing a new framework for understanding, preventing and treating cancer, as well as how to promote wellness more effectively. Combined with advances in chemical biology, we're now able to match existing and emerging drug compounds to specific tumors in ways that were considered impossible previously. To put it metaphorically, we're not just cutting off the branches and leaves of this disease, we're trying to pull out the roots.

◇ ***360-degree perspective*** With basic scientists who are clinicians and clinicians who are scientists, the Cancer Institute has a 360-degree perspective on the process of discovering and developing new cancer treatments to help our patients and cancer patients everywhere. Given the complexities of our work, however, we understand that no single person or lab at the Institute can have all the answers. So we emphasize a culture of teamwork to meet the challenge, with cancer researchers and physicians coming together to share ideas and solve problems with scientists in the fields of chemical biology, dentistry, nursing, environmental science and many other disciplines.

As part of an extraordinary university, we also have access to a range of resources and talent beyond the scope of the Medical Center. As a result, we can tap into the latest developments in everything from healthcare economics and law, to organic chemistry, to computational mathematics and computer science, to the role of the arts in patient recovery. And as a leader in a national effort, we work cooperatively with many other major cancer research centers across the country, sharing what we've learned and working in tandem to move the science and treatment of cancer forward, for the betterment of all human beings. These are just some of the reasons why the NYU Cancer Institute is a highly versatile institution where great things are happening, and I couldn't be more enthusiastic about our future and our contribution to research and the most promising new treatments.

The other reason for my enthusiasm, which I mentioned at the beginning of this letter — are the professionals and staff of this Institute, who obsessively care about easing the burden of cancer for our patients, their families and the communities around us. To this extraordinary team of colleagues and our tireless community of supporters, I want to express my deepest thanks for their passion and extraordinary commitment to education, research and patient care.

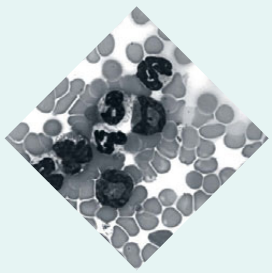
William L. Carroll, MD
Julie and Edward J. Minskoff Professor of Pediatrics;
Professor of Pathology,
NYU Langone Medical Center
Director, NYU Cancer Institute

Our mission is
origins of human
that knowledg
the personal and
of cancer in ou
the nation ar

to discover the
cancer and to use
ge to eradicate
l societal burden
ur community,
nd the world.

RESEARCH HIGHLIGHTS

The momentum continues as our investigators strive "to discover the origins of human cancer and to use that knowledge to eradicate the personal and societal burden of cancer in our community, the nation and the world." Here's a glimpse into just a few of their accomplishments:

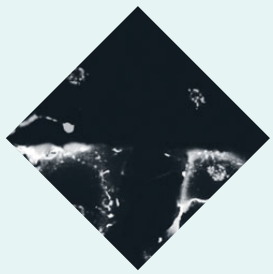


◇ ***Pathways*** **Iannis Aifantis, PhD, and his laboratory team** discovered that the Notch pathway, known to be a trigger in T cell leukemia, can "switch sides" and be a tumor suppressor in another type of leukemia, called chronic myelomonocytic leukemia. These findings suggest that reactivation of the Notch pathway can suppress some leukemias.

Nature: May 12, 2011

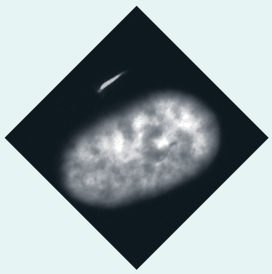
◇ ***Matrix*** The **laboratory team of Nina Bhardwaj, MD, PhD,** found that melanoma cells secrete MMP-2 (matrix metalloproteinase-2), which is part of a group of enzymes that break down proteins. These enzymes alter the function of key sentinels in the immune system known as dendritic cells. Their work has also prompted a collaboration with industry to evaluate the effect of MMP-2 inhibitors on melanoma in preclinical and clinical studies.

Cancer Cell: March 8, 2011



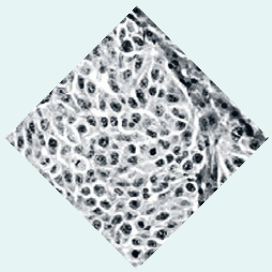
◇ ***Catalysts*** N-Ras and H-Ras are important oncogenes—genes that have the potential to cause cancer. Working with the immunophilin FKBP12, researchers from the **laboratory team of Mark R. Philips, MD,** found that modifications to H-Ras may provide a novel therapeutic target to inhibit Ras-dependent tumor development.

Molecular Cell: January 21, 2011



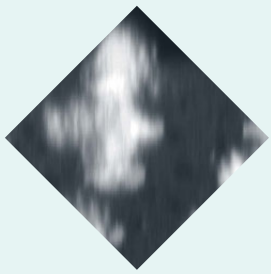
◇ ***Orchestration*** Cilia, microscopic hairlike projections on the surfaces of some cells, act as antennae to orchestrate key signaling pathways. Defects in primary cilia can play a role in several genetic diseases, including those that may underlie cancer. New work by **Brian D. Dynlacht, PhD, and his laboratory team** provided clues toward understanding the molecular mechanisms involved in primary cilia assembly.

Cell: June 10, 2011



◇ ***Cooperation*** **Eva Hernando-Monge, PhD, and the Interdisciplinary Melanoma Cooperative Group** identified the role specific microRNAs (miRNAs) play in causing cancer cells to invade tissue and at the same time shut down an individual's ability to fight abnormal cells. These findings may lead to the targeting of specific miRNAs as a therapeutic approach.

Cancer Cell: July 11, 2011

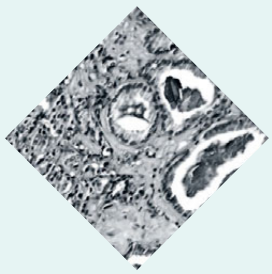


◇ ***Mediators*** T cells mediated from transplanted bone marrow can attack leukemic cells as well as the host. **Michael L. Dustin, PhD**, the Muriel G. and George W. Singer Professor of Molecular Immunology, **and his laboratory team** discovered that inhibiting the enzyme protein kinase C-theta augments the activity of regulatory T cells that can selectively suppress the attack on the host and may thus be a useful therapy in combination with bone marrow transplantation for treatment of leukemia.

Science: April 16, 2010

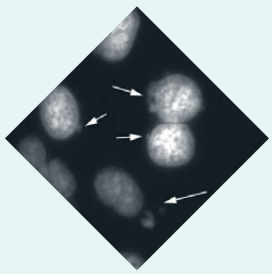
◇ ***Combinations*** Locally advanced breast cancer is a late stage and difficult to treat form of the disease that is responsible for the majority of worldwide breast cancer cases and deaths. **A group led by Silvia C. Formenti, MD**, the Sandra and Edward H. Meyer Professor of Radiation Oncology, reported an economically feasible therapeutic approach that simultaneously combines radiation therapy and chemotherapy.

Breast Cancer Research and Treatment: December 2010



◇ ***Robots*** **Danil V. Makarov, MD, MHS, and collaborators** examined the change in number of radical prostatectomies (RP) before 2001 versus after 2005 when use of surgical robots had become more common. They found that an increase in robot acquisition was associated with increases in the number of RPs at the regional and hospital levels.

Medical Care: April 2011



◇ ***Maintenance*** Genetic instability can cause tumors when the gain or loss of genes blocks the checkpoints that maintain a normal set of chromosomes. Building upon recent work from the Dynlacht laboratory, **Michele Pagano, MD**, the May Ellen and Gerald Jay Ritter Professor of Oncology, **and his laboratory team** identified and characterized a gene (cyclin F) that can manage and limit elements that ultimately impact the development and growth of tumors and maintain genetic stability.

Nature: July 1, 2010

THE CANCER INSTITUTE AT NYU LANGONE MEDICAL CENTER

Select Medical Center environments include:

1 ◇ ***Main Campus*** Tisch Hospital, including the Rita J. and Stanley H. Kaplan Stem Cell/Bone Marrow Transplant Center

NYU School of Medicine

Rusk Institute of Rehabilitation Medicine

Charles C. Harris Skin and Cancer Pavilion

Sackler Institute of Graduate Biomedical Sciences

Cancer Research Center at Joan and Joel Smilow Research Center

The Helen L. and Martin S. Kimmel Center for Stem Cell Biology at the Skirball Institute of Biomolecular Medicine

2 Department of Environmental Medicine: Division of Biostatistics

3 Hospital for Joint Diseases

4 NYU Cancer Institute administrative offices

5 NYU Clinical Cancer Center

6 The Stephen D. Hassenfeld Children's Center for Cancer and Blood Disorders

7 Women's Screening Center (opening 2012)

8 Future site of molecular oncology/cancer genomics laboratory

9 Joel E. Smilow Comprehensive Prostate Cancer Center

10 Clinical and Translational Science Institute Administration and Training Center

11 Bellevue Hospital Center

12 United States Department of Veterans Affairs VA New York Harbor Healthcare System

13 New York University College of Dentistry David B. Kriser Dental Center

14 Nelson Institute of Environmental Medicine

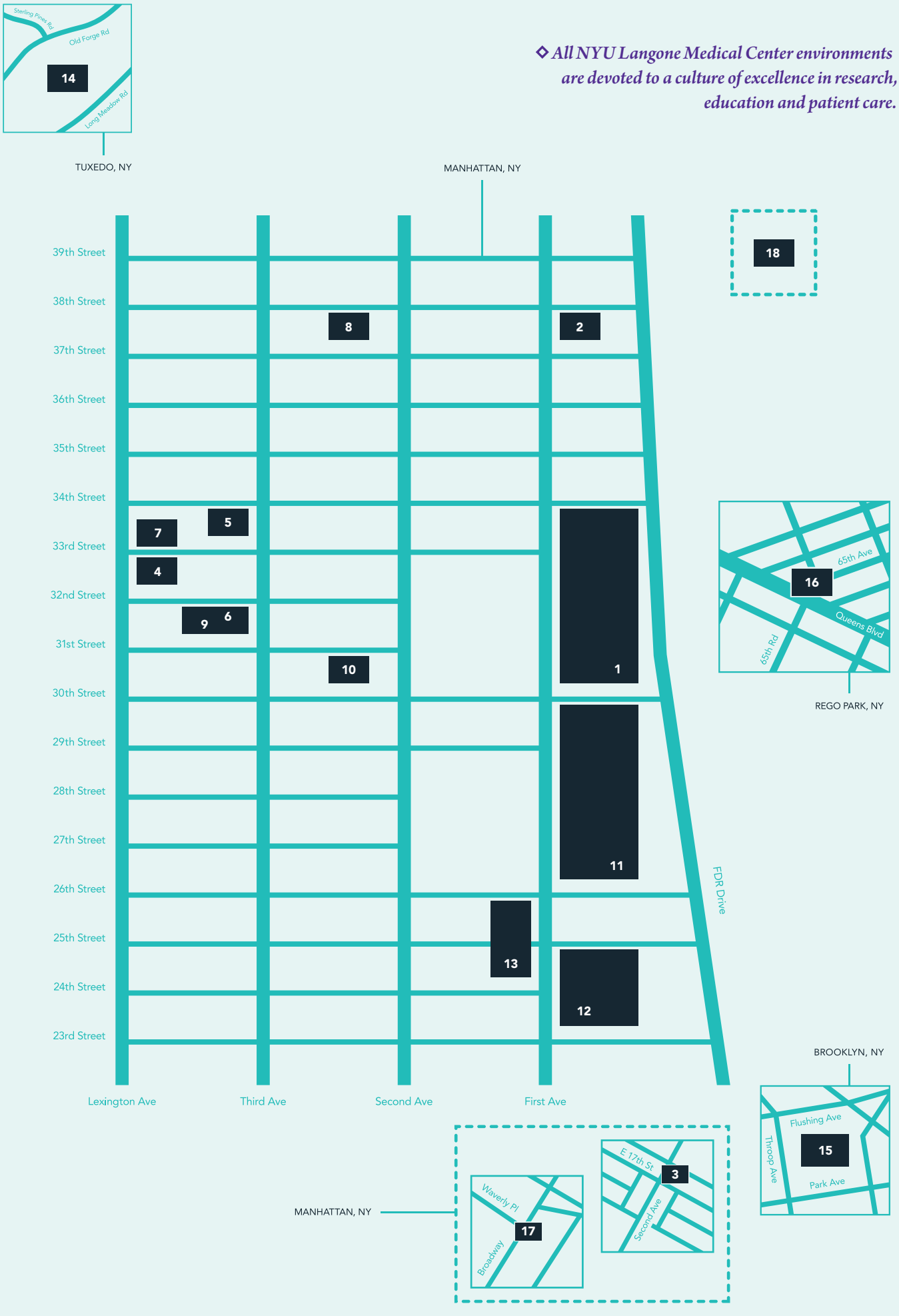
15 Woodhull Medical and Mental Health Center

16 NYU Langone at Columbus Medical, Rego Park, NY

17 New York University College of Nursing

18 Future collaborations

◇ *All NYU Langone Medical Center environments are devoted to a culture of excellence in research, education and patient care.*



PHILANTHROPY

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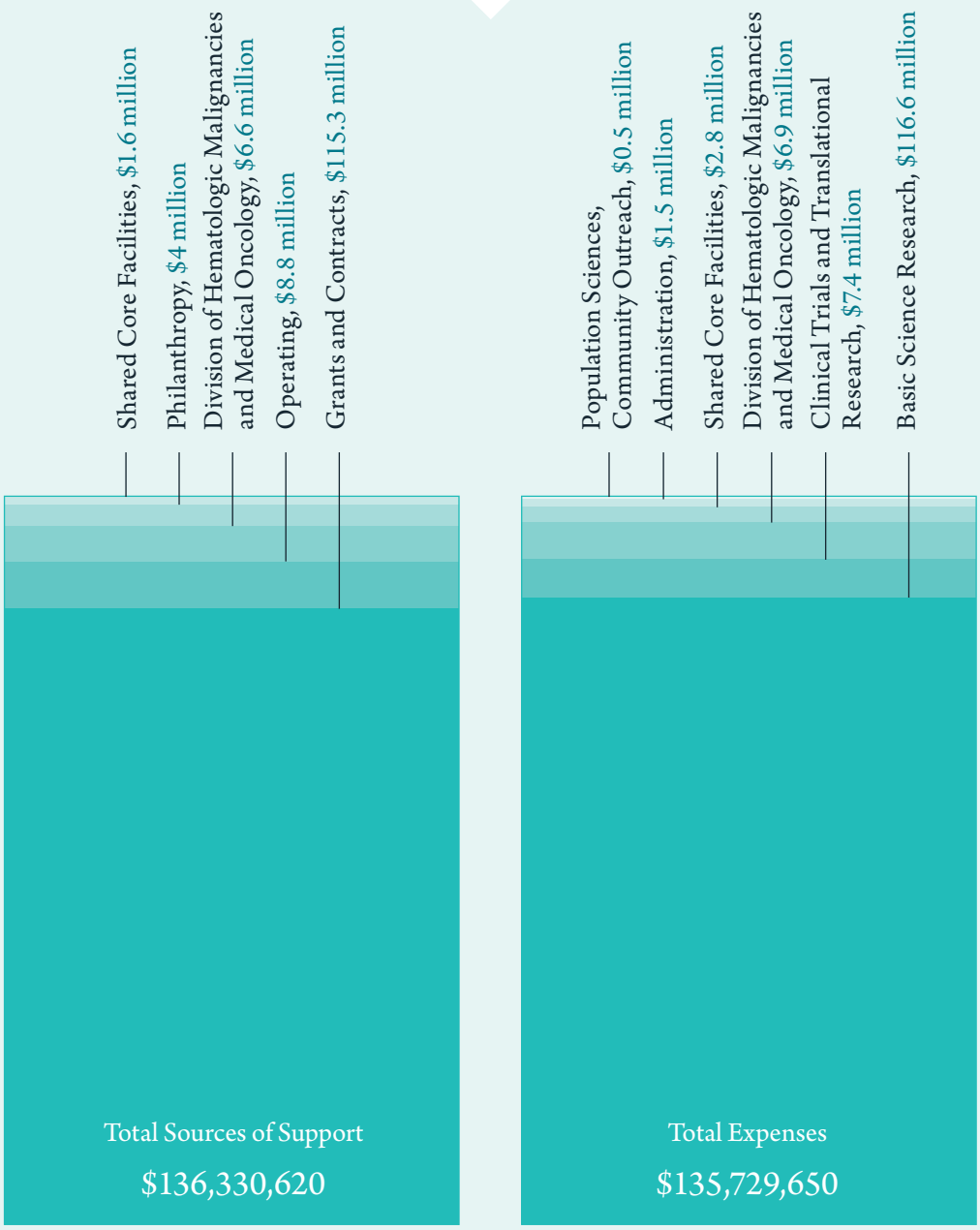

*The Cancer Institute sets the scientific, clinical and educational agenda for oncology across the NYU Langone Medical Center. Resources and institutional support are allocated to various departments and institutes to fund cancer-focused basic and clinical research initiatives, faculty recruitment, programs in various disease areas, the Division of Hematologic Malignancies and Medical Oncology and new technologies.

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NYU Cancer Institute Facts & Figures

155,000+
patient visits in FY2010 (total among our major sites).

151,170 sq. ft.
of dedicated space, a 400% increase since 2002.

$112.6
million in research funding inclusive of $24 million from the National Cancer Institute.

227
investigators working on cancer initiatives.

150+
oncology clinical trials available.

20%
patient participation in clinical trials, compared to 4% national average.

5,000
community members, patients and healthcare professionals benefit from our Community Outreach and Education programs.

Important Phone Numbers

- ***212.731.5000*** New Patient Physician Referral Line
- ***212.263.6485*** Clinical Trials Information
- ***212.731.5002*** Mammography and/or Related Procedures
- ***212.731.5198*** Lucille Roberts Wellness Boutique managed by Underneath It All
- ***212.731.5452*** Lynne Cohen Foundation and Caring Together Project for Women with Increased Risk for Cancer/ Clinical Cancer Center
- ***212.263.3198*** Lynne Cohen Foundation and Caring Together Project for Women with Increased Risk for Cancer/ Bellevue Hospital Center
- ***212.263.8400*** Stephen D. Hassenfeld Children's Center for Cancer and Blood Disorders
- ***212.731.5345*** 100 Women in Hedge Funds National Ovarian Cancer Early Detection Program
- ***212.731.5480*** NYU Clinical Cancer Center Support Group Information Line
- ***212.263.6342*** Community Outreach Programs & Speakers Bureau
- ***212.404.3555*** Media Inquiries
- ***212.404.3640*** Office of Development
- ***212.263.3276*** NYUCI Office of the Director

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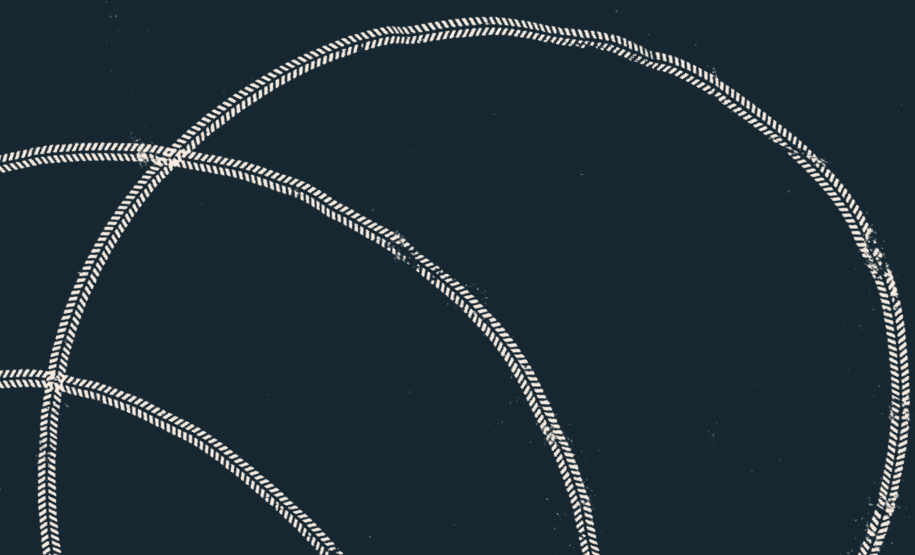

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